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COVID-19 Pandemic: Mental health, life habit changes and social phenomena

Edited by
Daria Smirnova, Konstantinos N. Fountoulakis, Xenia Gonda and Pedro Morgado

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COVID-19 Pandemic: Mental health, life habit changes and social phenomena

Topic editors

Daria Smirnova — Samara State Medical University, Russia
Konstantinos N. Fountoulakis — Aristotle University of Thessaloniki, Greece
Xenia Gonda — Semmelweis University, Hungary
Pedro Morgado — University of Minho, Portugal

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Wulf Rössler,
Charité Universitätsmedizin
Berlin, Germany

*CORRESPONDENCE
Pedro Morgado
pedromorgado@med.uminho.pt

†These authors have contributed equally to this work and share senior authorship

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Editorial: COVID-19 pandemic: Mental health, life habit changes and social phenomena

Pedro Morgado[1,2]*, Xenia Gonda[3,4], Daria Smirnova[5†] and Konstantinos N. Fountoulakis[6†]

[1]Life and Health Sciences Research Institute (ICVS), School of Health Sciences, University of Minho, Braga, Portugal, [2]ICVS-3Bs PT Government Associate Laboratory, Braga/Guimarães, Portugal, [3]Department of Psychiatry and Psychotherapy, Semmelweis University, Budapest, Hungary, [4]NAP-2-SE New Antidepressant Target Research Group, Hungarian Brain Research Program, Semmelweis University, Budapest, Hungary, [5]International Centre for Education and Research in Neuropsychiatry, Samara State Medical University, Samara, Russia, [6]Third Department of Psychiatry, School of Medicine, Faculty of Health Sciences, Aristotle University of Thessaloniki, Thessaloniki, Greece

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Editorial on the Research Topic
COVID-19 pandemic: Mental health, life habit changes and social phenomena

The SARS-CoV-2 virus brought dramatic changes into daily life, subjecting society to the new and unforeseen era. The COVID-19 pandemic introduced challenges to governments, healthcare systems (including mental healthcare services), clinicians, and researchers worldwide, including management of healthcare sector investigations and international multicenter projects (1–5).

The COMET study was one of the largest quasi-epidemiological projects in the field of psychiatry which evaluated the impact of COVID-19 pandemic and its related lockdown conditions on the mental health of the 40 countries' population and was supported by the World Psychiatric Association. Study findings proved that pandemic was not just a threat to physical health but also presented severe stresses that broadly impacted the mental health and social lifestyles of people (6–9) (Panfil et al.). Its negative influence on the mental health of different vulnerable population groups has been described since the early beginning of the pandemic in 2020 (10–17).

This Research Topic was intended to describe the impact of COVID-19 pandemic on the population's mental health, life habits, daily beliefs, and social behaviors, as well as to discuss the urgent needs to face this evolving environment in the future. The 69 papers comprising this Research Topic, accepted from authors representing several countries and continents, examine the consequences of pandemic-associated factors investigated from multiple angles and points of view, and providing a really manifolded and

detailed insight, not only broadening our understanding of the pandemic-related situation, the consequences of the lockdown conditions and similar crises, but also widening our knowledge in social, clinical psychiatry, and epidemiology of mental disorders.

COVID-19 has increased economic uncertainty, and not only negatively affected mental health, but also severely limited access to health services, which produced a cumulative burden in broad populations. The impact was differential and seemed to influence more significantly women (Batista et al.; Vrublevska et al.; Xie et al.; Alhazmi et al.; Bonzini et al.; Zhang et al.; Chutiyami et al.; Pisanu et al.; Eleftheriou et al.; Biswas et al.), younger people (Panfil et al.; Batista et al.; Chutiyami et al.; Pisanu et al.; Liu et al.), city inhabitants (Meyer et al.), and those persons who had experienced mental health problems in the past (Panfil et al.; Vrublevska et al.; Jang et al.; Ali et al.). Several studies identified depression (Meyer et al.; Jang et al.; Kim et al.) (18), anxiety (Vrublevska et al.; Alhazmi et al.; Folayan et al.; Fu et al.) (19), stress/distress (Krajewska-Kułak et al.; AlRasheed et al.) (19), burnout phenomenon (Chen, Bai, et al.) (20), post-traumatic stress disorder signs (Chutiyami et al.; De Pasquale et al.) (21), sleep disturbances (Folayan et al.; AlRasheed et al.), obsessive-compulsive symptoms (18, 22), and internet/mobile phone addiction (Jiang et al.; Moniri et al.) as the most common problems in the area of mental health observed in the general population.

The mental health of patients diagnosed with COVID-19 was also impacted by factors related to the pathophysiology of the SARS-CoV-2 infection and by various stressors multiplied during the quarantine period, and after release from quarantine. Anxiety and/or mood disturbances with psychomotor retardation as well as symptoms of impaired consciousness, memory, and insight were frequent and may be considered neuropsychiatric manifestations of COVID-19 (Sorokin et al.). Patients diagnosed with SARS-CoV-2 reported concerns about recovery and complications, stress related to social isolation measures, issues associated with the treatment environment, limited information about COVID-19 and infodemic, financial difficulties, stigma, discrimination, increased violence and conflicts within a family (Park et al.; Li et al.). Besides epidemiological findings, some of the presented papers describe background mechanisms which may also help to identify the targets for prevention and intervention in similar crisis situations.

During the pandemic, healthcare professionals were subject to extreme demands which pose significant short- and long-term effects on their mental health. Studies from several countries demonstrated the broad impact of the current pandemic on healthcare workers' mental health. A meta-review found that anxiety, depression, and stress/post-traumatic stress disorder were the most reported COVID-19 pandemic-related mental health conditions affecting healthcare workers (Chutiyami et al.). Other problems such as insomnia, burnout, fear, obsessive-compulsive disorder, somatization symptoms, phobia, cognitive failures, substance abuse, and suicidal thoughts were also reported (Chutiyami et al.; Mehri et al.). Those working in high-risk settings presented poorer mental health outcomes (Zhang et al.) (20).

Fortunately, not all that experience of stressful events related to the COVID-19 pandemic showed adverse consequences of it. In this vein, coping is defined as cognitive and behavioral efforts to deal with the demands of particular stressful situations minimizing their potential negative impacts. Physical exercises (Zhu et al.), yoga (Upadhyay et al.), and self-care activities (Gavurova et al.) within the daily routine were found beneficial. The most used coping or adjustment mechanisms were the avoidance-oriented coping with stress, emotion-oriented coping, and task-oriented coping (Twardowska-Staszek et al.). Interestingly, suppression has been shown as an adaptive response to the worry associated with uncertainty, at least, in the short-term context (Khatibi et al.). Among healthcare workers, the most-reported coping strategies include individual/group psychological support, family/relative support, training/orientation, and the adequacy of personal protective equipment (Chutiyami et al.).

The impact of the pandemic on society was significant but the ability to build effective responses was even more surprising. In a few months, a new and effective vaccine was developed and administered to millions worldwide significantly reducing the burden of the disease. Several diagnostic and therapeutic interventions were also developed both for COVID-19 symptoms and sequels as well as for its mental health consequences (Lee et al.; Asanjarani et al.; Hoseinzadeh et al.; Guelmami et al.; Schröder et al.).

As the knowledge of the virus increased and the correct information spread, the adaptation to stress also improved (23). In the early phases of the pandemic, public adherence to public health measures was high (Law et al.) but the spread of rumors, fake news, and misinformation was a challenge to governments, health authorities, and scientific institutions (Chen, Rong et al.) (24). Vaccination was particularly affected by misinformation. However, receiving information concerning COVID-19 vaccination from healthcare workers and scientific experts was associated with greater vaccination acceptance and decreased stress concerning COVID-19 vaccination (Zheng et al.; Vasileva et al.; Maciaszek et al.). Indeed, those who got the vaccine presented lower levels of depressive symptoms during the second wave of the infection outbreak (Zheng et al.; Benedetti et al.).

COVID-19 pandemic represents a public health emergency that exposed the dire consequences of inequality, affecting more negatively those who were more vulnerable before and at the beginning of the pandemic. Thus,

economic support played a relevant role in the reduction of the negative impact of the pandemic contributing to alleviating symptoms of depression and anxiety (Yao et al.).

Humanity has learned a lot from this (perhaps, not so much) unexpected experience. The time is now to identify how we can be more resilient to future challenges. Current challenging times request us to rethink and to act.

Author contributions

PM wrote the first draft. All authors wrote and approved the final manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Covid-19, Lockdown and Self-Isolation: Evaluation of Deliberate Self-Harm Admissions

Callum Shields[1], Jack Bernard[1], Omer Idris Mirza[1], David Reeves[2], Adrian Wells[3] and Anthony Heagerty[4]*

[1] Manchester University Foundation Trust, Manchester, United Kingdom, [2] Division of Population Health, Health Services Research and Primary Care, Manchester, United Kingdom, [3] School of Psychological Science, Section of Clinical and Health Psychology University of Manchester Rawnsley Building, Manchester, United Kingdom, [4] Division of Cardiovascular Sciences, Faculty of Biology, Medicine and Health, University of Manchester Core Technology Facility, Manchester, United Kingdom

Background: COVID 19 is still presenting a clear and dynamic global threat. The United Kingdom remains one of the hardest hit countries from the pandemic. In January 2021 parliament announced that the UK will be entering a full national lockdown. This paper explores what effect lockdown measures had on rates of deliberate self-harm presentations to one NHS trust in Manchester UK.

Methods: This paper compared the number of cases of deliberate self-harm which presented to the emergency department of Manchester Royal Infirmary for March-May in 2018, 2019 and 2020. This was achieved by utilising coding from emergency department data and reviewing hospital records surrounding each case.

Results: 2018 recorded a total of 101 admissions as a result of DSH with all causes admissions of 8,514 making the proportions of admissions due to self-harm 1.19%. In 2019, 9,038 patients were admitted, of these, 130 (1.44%) were identified as DSH. In 2020 the total number of admissions fell to 5,676 with 118 admitted due to self-harm, representing 2.08% of admissions. The absolute number of admissions remained stable however the proportion of admissions due to self-harm was significantly higher in 2020 ($p < 0.001$). Other significant findings include a higher proportion of male admissions compared to females in 2020 (58.5%) and a decrease in the normal of cases relating to paracetamol overdose in 2020.

Discussion: The findings demonstrated by this study do not indicate that lockdown is an absolute risk for DSH behaviours however it does illustrate the stable nature of these cases despite and dramatic decline in all cause admissions. The rate of increase of deliberate self-harm accelerated significantly between March and May in 2020. Steps must be taken to avoid a similar situation following the 2021 lockdown and beyond – focus on improving access to certain virtual services may help to achieve this goal.

Keywords: COVID-19, self harm, lockdown, mental health, stress, deliberate self harm, suicide

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Yuka Kotozaki,
Iwate Medical University, Japan

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Jitendra Rohilla,
All India Institute of Medical Sciences, Rishikesh, India
Kristiana Siste,
University of Indonesia, Indonesia
Carlo Antonio Bertelloni,
University of Pisa, Italy

****Correspondence:***
Callum Shields
callum.shields@mft.nhs.uk

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BACKGROUND

COVID 19, the disease caused by the novel variant of the Sars-Cov-2 virus is still presenting a clear and dynamic global threat. Despite the glimmers of hope offered by the roll out of several vaccines, the virus is still sweeping through many international communities (1).

During the first wave of the pandemic in spring 2020 the UK Government enforced the first nation-wide lockdown to help combat the spread of the virus. This led to severe social restrictions, prohibiting mixing between households and a blanket closure of almost all hospitality and leisure industries. These measures remained in force from March-May after which gradual relaxation of the rules occurred (2). Moving forward to 2021, the United Kingdom (UK) remains one of the hardest hit countries from the pandemic and figures show a peak incidence of over 60,000 daily cases in January. Additionally, a near 25,000 hospital admissions due to the virus occurred in the first week of 2021, when coupled with the usual winter pressures exerted on the NHS, there was growing concern that our healthcare system would exceed breaking point (3). It is for this reason Parliament announced on the 4th of January that the UK will be entering a full national lockdown akin to the measures enforced during the first peak of the pandemic in spring 2020 (4). These restrictions are to be in place until at least April and although a provisional date of June 21st has been established for a return to normal, future lockdown periods remain a real possibility (5). This is evidenced by the emergence of multiple variant strains of COVID-19, the possibility of vaccine resistance and the need to accommodate normal winter pressures (6). With the prospect of further periods of strict health protection laws on the horizon, it is prudent to reflect on the original 2020 lockdown to examine what effects it had on the mental health of the population. Indeed, many papers have examined the impact these restrictions had on mental health of the population generally (7–11). Less have commented on how this impact has translated into severe manifestations such as suicidal behaviours and deliberate self-harm (DSH).

Historically, it has been documented that extreme social phenomena such as pandemics increase the burden on mental health. During the Spanish flu pandemic, the literature reports that one repercussion stemming from this is higher than normal levels of suicidal behaviours (12). Many papers have attempted to postulate the underlying aetiology behind these spikes in morbidity. Accounts from the time comment on the culpability of an acute influenza induced delirium or psychosis (13). Whereas, more contemporary papers state that societal factors such as loss employment or curbs on social freedoms are more likely responsible (12, 14). Furthermore, a recent study published in the Lancet highlighted the potential effects of a long-COVID syndrome on psychiatric disorders at 6 months post infection. This paper reported a statistically significant hazards ratio of 1.47 in the development of mood disorders amongst COVID patients compared to those with seasonal influenza (15). Given these links, this paper examines the effects of the initial lockdown period in the UK and the number of DSH admissions. This was done with reference to the World Health Organisation definition of self-harm:

> "an act with non-fatal outcome, in which an individual deliberately initiates a non-habitual behaviour that, without intervention from others, will cause self-harm, or deliberately ingests a substance in excess of the prescribed or generally recognised therapeutic dosage, and which is aimed at realising changes which the subject desired via the actual or expected physical consequences" (16).

Primary Aim

To determine what, if any, effect lockdown measures had on the number of deliberate self-harm admissions.

Methods

We compared the number of admissions from the Emergency Department of Manchester University Foundation Trust (Manchester Royal Infirmary) from March 1st to May 31st 2018, 2019, and 2020 and identified patients with a diagnosis of self-harm. This study period was chosen to reflect the most stringent lockdown restrictions present in the UK, specifically referencing the prohibition of social mixing between households hence representing the greatest degree of isolation (2).

Many papers have utilised survey methods to establish a general deteriorative trend in mental health during the pandemic (7–11). This study therefore focused specifically on cases which required admission to hospital for further treatment. This criterion was chosen to allow the data to embody severe cases of DSH over the study period. This was to allow reflection on the metric of self-harm behaviours of a degree severe enough to warrant admission.

We used local emergency departmental coding data to identify all cases coded as DSH for the study periods, as well as all cause presentations for the same period.

Inclusion criteria for the study were as follows:

1. Age over 16, this study focused solely on attendances to the adult emergency department.
2. Attendance coded as "Overdose and poisoning," "Self-harm" or "Major trauma" on the emergency department admission sheet.
3. Attendances that were of a degree/severity to warrant admission into the hospital.
4. Reference to deliberate intent of self-harm contained within the emergency department admission summary sheet. This was achieved by examining the "nurse triage" or "clinician's comments" section of the summary sheet and identifying which patients had acted with the intent to cause harm to themselves. This filtered out presentations for accidental injuries or overdoses, for example when an individual had mistakenly taken too many paracetamol tablets.

From this dataset we then used hospital EPR systems to extract key facets of each presentation – length of stay, mode of self-harm, intensive care involvement, death – to compare each year. The mode of self-harm contained several categories defined below:

1. Major trauma – Involved serious injuries from self-inflicted traumas most commonly jumping from heights or stabbings.
2. Self-mutilation – Injuries of a lesser severity than major trauma such as superficial incisions or wounds.
3. Household products – Involving ingestion of items found within the house such a bleach.
4. Alcohol – Cases which involved alcohol.
5. Recreational drugs – Cases which involved the use of drugs such as cannabis/cocaine.
6. Medication – Cases involving prescription medication such as anti-depressants, analgesia or any other pharmaceutical drug. The cases which referenced paracetamol were also included within this category.
7. Paracetamol – Cases specifically referencing the use of paracetamol.

Each case reported in the results represented a unique admission. Some cases did contain more than one mechanism of injury e.g., self-inflicted wound and paracetamol overdose. This provides explanation for the mismatch between the total number of cases and the overall counts for the underlying mechanism.

Statistical Analysis

Analysis focused principally on comparing numbers and rates of DSH admissions between years (2018, 2019, and 2020) and calendar months (March, April, May), and in relationship to patient characteristics. The admissions data was in the form of counts and with the exception of age the factors of interest were categorical, for which statistical inference was undertaken using Pearson Chi^2 analysis; to test for age differences we used one-way analysis of variance.

To examine if the characteristics of admitted patients differed between years, we pooled the data across the 3 months of observations within each year prior to analysis. When testing for differences in admission numbers and rates between years, to minimise multiple testing we first conducted an overall test for equality across years within months and only if that was rejected went on to test each month separately. An alpha value for statistical significance of 5% was used throughout.

RESULTS

Patient Demographics

The total number of admissions for DSH across the 3 years were 101, 130 and 118 for 2018, 2019, and 2020, respectively. These cases were then stratified for age, sex, ethnicity and marital status to discern any meaningful demographic differences across the study periods. The results are summarised in **Table 1**.

The groups were well-matched in terms of marital status and ethnic category with even distribution across the 3 years. A Pearson Chi^2 test comparing the percentage single (vs. any other marital status) between the 3 years was not statistically significant (Chi^2 3.16, df = 2, $p = 0.206$), nor was a comparison of the percentage of British or Irish ethnicity, vs. any other (Chi^2 2.39, df = 2, $p = 0.302$). However, mean age differed between the years (F = 3.65, df = 2:346, $p = 0.027$) with the 2020 group being somewhat older, as did the ratio of male to female admissions (Chi^2 9.89, df = 2, $p = 0.007$), with an increase in male representation in 2020.

TABLE 1 | Demographic differences across study years by age, sex, marital status and ethnic category for DSH admission cohort.

Year	2018	2019	2020	Mean
Age (average)	34.4	36.0	39.4	36.6
Sex *N*(%)				
Male	39 (38.6)	56 (43.1)	69 (58.5)	54.7 (46.7)
Female	62 (61.4)	74 (56.9)	49 (41.5)	61.7 (53.3)
Marital status *N*(%)				
Single	82 (81.2)	93 (71.5)	92 (78.0)	89 (76.9)
Married	6 (5.9)	11 (8.5)	10 (8.5)	9 (7.6)
Divorced	2 (2.0)	6 (4.6)	2 (1.7)	3.3 (2.8)
Widowed	2 (2.0)	3 (2.3)	0 (0.0)	1.7 (1.4)
Not stated	9 (8.9)	17 (13.1)	14 (11.8)	13.3 (11.3)
Ethnic category *N*(%)				
British	77 (76.2)	88 (67.7)	90 (76.3)	85 (73.4)
Irish	1 (1.0)	2 (1.5)	0 (0.0)	1 (0.8)
African	3 (3.0)	2 (1.5)	1 (0.8)	2 (1.8)
Caribbean	2 (2.0)	1 (0.8)	1 (0.8)	1.3 (1.2)
Chinese	0 (0.0)	1 (0.8)	3 (2.5)	1.3(1.1)
Indian	0 (0.0)	2 (1.5)	0 (0.0)	0.7 (0.5)
Pakistani	2 (2.0)	7 (5.4)	4 (3.4)	4.3 (3.6)
Mixed ethnicity	0 (0.0)	4 (3.1)	1 (0.8)	1.7 (1.3)
Any other ethnic background	8 (7.9)	13 (10.0)	10 (8.5)	10.3 (8.8)
Not stated	8 (7.9)	10 (7.7)	8 (6.8)	8.7 (7.5)

DSH Admissions March 1st – May 31st 2018

A total of 101 admissions as a result of DSH with all causes admissions of 8,514. This makes the proportions of admissions due to self-harm 1.19% with a monthly distribution of 0.84% (March), 1.18% (April) and 1.52% (May) – see **Figure 1** for full comparison. The average age in this group was 34.4 years and the average length of admission was 2.6 days. There were no deaths within this cohort however 14 (13.9%) of cases resulted in ITU/HDU input. In terms of coding, 15 (14.9%) were classified as major trauma, 18 (17.8%) as self-mutilation, 3 (3.0%) involved household items, 21 (20.8%) referenced alcohol involvement whilst 8 (7.9%) involved recreational substances. Medication was involved in 81 (80.2%) cases with 46 (45.5%) of these relating to paracetamol overdoses – see **Figure 2** for comparison of mechanisms of harm by year.

DSH Admissions March 1st – May 31st 2019

In 2019, a total of 9,038 patients were admitted via the emergency department, 130 were identified as being due to self-harm thus equating to 1.44% of admissions. Broken down by month to 1.27% (March), 1.38% (April) and 1.68% (May) – **Figure 1**. In this cohort the average age was 36 years, and the average

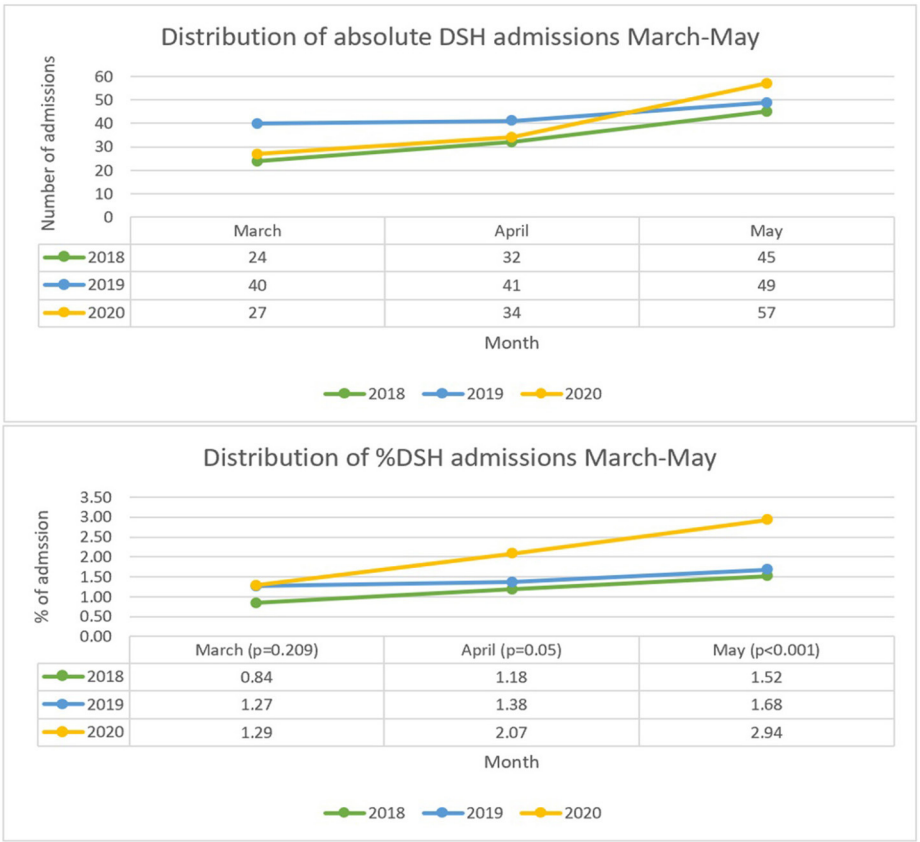

FIGURE 1 | Graphs comparing absolute and proportion of DSH by month and year.

length of hospital admission was 5.4 days. There were 2 (1.5%) deaths within this group and 12 (9.2%) had ITU/HDU involvement. Major trauma was cited in 14 (10.8%) of cases, 19 (14.6%) as self-mutilation, 5 (3.9%) involved household products. Alcohol was implicated in 32 (24.6%) of cases and recreational drugs in 8 (6.2%). A total of 77 (59.2%) cases involved medication overdoses with 63 (48.5%) involving paracetamol – **Figure 2**.

DSH Admissions March 1st – May 31st 2020

During lockdown in 2020 the total number of admissions fell to 5,676 a 33% decrease from 2018 and 37% decrease from 2019. The number diagnosed with self-harm was 118 representing 2.08% of all cause admissions – 1.29% (March), 2.07 (April), 2.94 (May) – **Figure 1**. The average age was 39.5 years and length of stay was 3.3 days. One (0.9%) death resulted from the self-harm in this year and 6 (5.1%) required escalation to HDU/ITU care. During 2020, major trauma accounted for 17 (14.4%) cases, 18 (15.3%) from self-mutilation and 3 (2.5%) from household items. Alcohol was involved in 29 (24.6%) of cases and 11 (9.3%) featured recreational drugs. Medication overdose was cited in 84 (71.2%) cases with 36 (30.5%) related to paracetamol overdoses – **Figure 2**.

Comparison of Years

Absolute Numbers of DSH Admissions

Numbers of DSH admissions in the months of March, April and May did not differ significantly between years (overall Chi^2 7.51, df = 6, $p = 0.277$). By contrast, total admissions for all causes differed between years, both overall and within each month separately (overall Chi^2 882.1, df = 6, $p < 0.001$; March Chi^2 219.4, df = 2, $p < 0.001$; April Chi^2 408.8, df = 2, $p < 0.001$; May Chi^2 254.0, df = 2, $p < 0.001$). The main contributing factors were the large reductions in all-cause admissions in April and May 2020 compared to 2019.

Proportions of DSH Admissions

Analysed as proportions of all emergency department admissions, rates of admissions for DSH differed between years (overall Chi^2 22.9, df = 6, $p < 0.001$). Under month-specific analysis, rates for March did not differ between years (Chi^2 3.14, df = 2, $p = 0.209$); but did differ for April (Chi^2 5.86, df = 2, $p = 0.05$), and May (Chi^2 13.9, df = 2, $p < 0.001$), largely driven by increased rates in April and May 2020 of 50 and 75%, respectively, compared to 2019.

Events Involved in DSH Admissions

Comparison of the rates at which each type of event was involved in DSH admissions found a significant difference

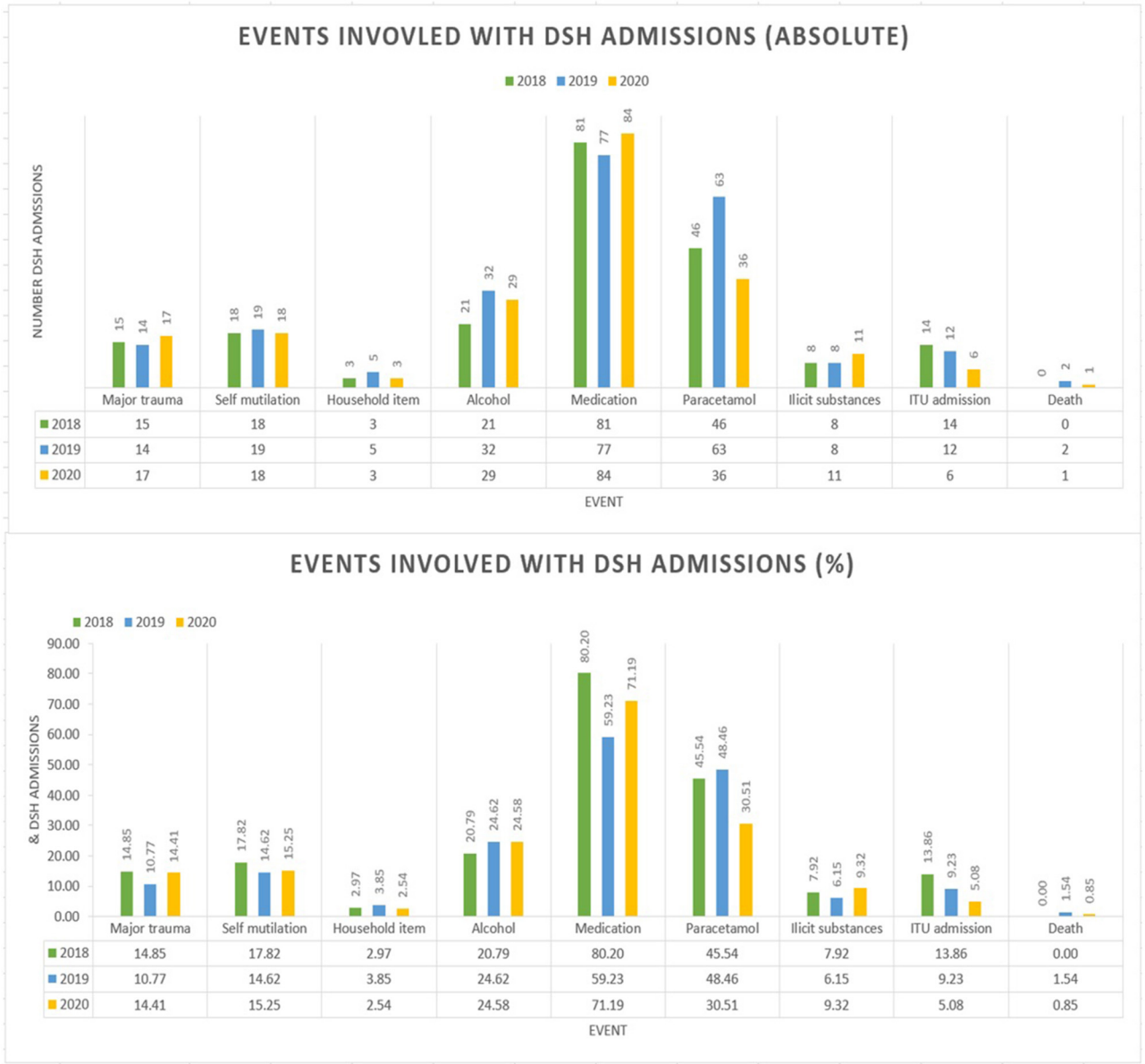

FIGURE 2 | Graphs showing events involved with DSH admissions by year.

between years for medication (Chi^2 12.04, df = 2, $p = 0.002$) and paracetamol (Chi^2 9.14, df = 2, $p = 0.01$) related event. It is notable that compared to 2019, the rate of medication overdose increased while paracetamol overdose decreased, despite the latter representing a major component of the former.

DISCUSSION

The number of admissions for DSH remained relatively steady across the study years. This indicates that, for the study cohort, the absolute risk of DSH did not change considerably during the lockdown period compared with previous years. One interesting facet to this finding however is the steadfastness of DSH admissions despite a radical decline in all cause admissions. As mentioned above, 2020 saw a respective drop of 33 and 37% in all cause admissions compared to 2018 and 2019. This has led to a statistically significant increase in the proportion of admissions due to DSH in 2020 compared to previous years. The large fall in overall medical admissions was a feature observed by many hospitals during the lockdown period and from a patient perspective may be attributed to fear of catching Covid-19 and a desire by many not to "bother" the NHS during a time of crisis (17). Furthermore, hospitals may have employed more stringent admission criteria than usual due to the potential bed crisis that loomed shortly after the first lockdown began. Nonetheless, even with this significant reduction in all cause

admissions, the number of DSH admissions proved unmalleable. This resistance may go some way in exemplifying the underlying aetiology of DSH behaviours. One of the driving factors behind an individual's desire to self-harm emanates from a help seeking mechanism. Indeed, a review by Edmondson et al. discerned that 87% of questionnaire studies linked self-harm practice as a way of expressing emotional pain to others (18). So, acknowledgement of the harm by a third party is an integral part of the underlying disease process for some individuals and hence explains the continued impulse to attend the emergency department. One of the main factors allaying people's desire to attend hospital during the pandemic is due to anxiety around catching Coronavirus. It is well-documented that individuals displaying suicidal behaviours, such as DSH, are more likely to participate in self-destructive patterns and have a lower regard for self-worth (19, 20). This unrelenting internal view directly opposes the COVID catching anxiety experienced by other patients, thereby helping them to overcome this barrier to attendance. Both reasons help to explain why the denominator of all causes admissions has reduced whilst the numerator for DSH admissions has remained stable.

A similar study conducted in Birmingham UK demonstrated an absolute increase in the presentations of deliberate self-harm to the emergency department. This study noted a rise in the percentage of these presentations from 1.98% to 3.69% ($p < 0.001$) when comparing 2019 to 2020 (21). These results may suggest a substantive negative impact of lockdown on mental health. However, this percentage increase only translates to an extra 10 cases overall which, as the authors state, could be attributed to normal year on year variation rather than directly because of lockdown. Additionally, data from Oxford and Derby conversely showed a 37% decline in the mean weekly number of self-harm presentations in 2020 compared to 2019. This equated to an average reduction of 18 cases per week during the lockdown period (22). Given that during this period the UK remained in a nationally standardised lockdown protocol it is unlikely that either local restrictions or fear of COVID itself account for these geographical differences. A possible explanation for this discord could be related to the regional variance of social factors such as economic instability. Financial security is a commonly cited variable linked with mental health, especially during a pandemic era (23). A report from the Office of National Statistics (ONS) highlighted the disparity of furloughed employees by geographical region. With Birmingham totalling 416,900, followed by 407,900 in Manchester, 103,000 in Oxford 37,500 for Derby (24). In addition to furlough there is also large regional variation in unemployment during the first half of 2020, again with the West Midlands (Birmingham) most severely affected at a rate of 4.6%. This compares to 3.7% in the North West (Manchester), 3.3% in the South West (Oxford) and 4.5% in the East Midlands (Derby) (25). This variation in the levels of financial uncertainty experienced by individuals due to lockdown may go some way in explaining the difference in mental resilience noted between locations within the UK.

On an international level a study from Japan which also centred around suicidal behaviours found that during the final quarter of 2020, suicide rates increased significantly compared with the same quarter in the previous 4 years. The maximal effect was demonstrated in October where there was an increase of 0.4 per 100,000 in the rate of suicide (26). One difficulty in applying data from global platforms is the inherent differences in the management of the pandemic by each nation. Length/extent of lockdown restrictions, prevalence and mortality of COVID and economic factors will all contribute strongly to the mental resilience of citizens (23, 27). Therefore, it is difficult to generalise findings from one country to the global stage. When viewed collectively the literature remains inconsistent on the effect lockdown may have on suicidal behaviours within the UK, thus further research from multiple national centres to explore this question is justified.

Several other studies have utilised survey methods to investigate suicidal ideation and mental health more generally and have established more consistent trends. A UK study conducted in April 2020, which surveyed 17,452 individuals, showed an 18.9% increase in reports of psychological distress compared with the previous years (7). A survey from Spain found that COVID had a severe psychological impact on 30.4% of participants (8). These findings are echoed at a global level with articles from other countries such as Italy, China and Korea displaying similar worrying trends (9–11). These studies bolster the notion that subjective mental health has been negatively affected by the pandemic. What remains unclear is whether lockdown is the paramount contributing factor of these observations or if they translate into the increased manifestation of extreme behaviours such as DSH and suicide.

Perhaps the most concerning statistic discerned from our data is the rate of growth of presentations from March to May 2020 (111% increase in the raw number of admissions and a 128% increase in proportion of admissions). Conferring evidence to suggest that, as the length of lockdown increases, the burden upon mental health also sharply increases. This is particularly relevant now, during the formative stages of the new lockdown and acts as a warning of the potential psychological toll which may materialise in the coming months. It is therefore imperative that measures to combat this possible scenario are employed. One study from Italy postulated the role of increased access to teletherapy as a mechanism to empower individuals to alter their outlook on stressful situations thus partially alleviating their sense of anxiety (28). Indeed, some NHS trusts have already begun to champion this style of consultation and by raising awareness and increasing the availability of this service may help to remedy the effects of lockdown (29). Moreover, a study from Finland demonstrated that coping mechanisms which emanated from close personal relationships proved to be the most significant strategy to maintain psychological well-being during the COVID crisis (30). Therefore, by increasing access and education relating to virtual communication platforms, which allow family units to stay connected, may prove beneficial.

From a demographic perspective this study highlighted a statistically significant increase in the ratio of DSH cases which were male in 2020. This finding is contrary to not only historical data about DSH prior to the pandemic but also from studies conducted during COVID times. It is widely accepted that females are at an increased risk of DSH. A study from The Lancet referenced a 2.9% difference in the prevalence of DSH between sexes in 2014 ($p = 0.0002$) (31). This trend is further evidenced by the Adult Psychiatry Morbidity Survey conducted

by NHS digital which found that 10% of women reported a severe common mental disorder compared with only 6% of men (32). This gender discrepancy has been further widened by the events stemming from COVID 19. A UK longitudinal study showed that the deterioration in psychological distress score was 6.9 percentage points higher in women than men in 2020 (33). Indeed, a UCL study expressly reports an increased tendency to self-harm amongst the female population during the initial lockdown period (34). This paper finds no overt reason why males in Manchester have demonstrated a higher risk of DSH behaviours compared to other populations. From March-April 2020, Manchester was subject to the same restrictions as other parts of the country and Government reports indicate both men and women were equally affected by the economic burden of COVID (35). Whilst this may represent a spurious occurrence, the significance emanating from the *p*-value warrants further investigation into possible factors which may be influencing this result. Although the average age did show a statistically significant increase in 2020, each cohort remained within the same general age bracket and therefore this finding was not deemed to be of clinical significance.

The number of observed overdoses involving paracetamol significantly decreased from 45.55%/48.46% of DSH admissions in 2018/2019, respectively to 30.51% in 2020. A possible underlying explanation for this finding stems from the accessibility of paracetamol in the second quarter of 2020. The UK Government's decision to enforce a lockdown in March 2020 sparked widespread fear within the general population. This fear was translated into a fierce survival instinct leading to the stockpiling of many products by individuals within society. Paracetamol was one such commodity and this resulted in sporadic shortages of the drug across many areas of the UK (36). Furthermore, the ability to gain access to paracetamol was further hampered by the closure of many high street shops consequentially coupled with the long queues originating from essential shops which remained open (37). Both factors listed above hindered the access to paracetamol and may have tempered the impulsivity associated with many cases of substance overdose.

There are some important limitations to this study. It is difficult to assess whether the increasing proportion of deliberate self-harm was due to imposed lockdown measures or from the direct effects of the virus. Many people have suffered unexpected bereavement or have themselves become deconditioned as a result of COVID infection. These factors are also likely to influence the mental resilience of the population and may contribute towards the observed increase outlined in this paper. Additionally, this may have perpetuated the observed trend in the rate of growth of admissions beyond the relaxation of lockdown in 2020 and represents a vital area of study for other papers. The data was gathered from one NHS trust in Manchester, a large metropolitan city known to struggle with higher-than-average rates of COVID 19 infection. It is therefore difficult to generalise our findings to the entire UK population. Further studies examining similar data from other regions would be useful in determining the scale of the problem identified in this study. Finally, due to the retrospective nature of this study, there is potential for bias, especially around case selection. Some may have been missed due to error in coding which may affect results.

CONCLUSION

While it is undoubtably true that, from a public health perspective, control of the virus must be given paramount concern, it cannot be said that resources should not be devoted to mitigating the negative ramifications of these strategies. Our study has demonstrated a relative stability in the number of DSH admissions across the 3 years, despite a radical decline in all cause admissions in 2020. Moreover, this paper has found an accelerating trend of DSH admissions with increasing time under lockdown. This confers an unmet need for psychological support in the general population during these unprecedented circumstances and highlighted the need for prompt action to curtail the psychological harm which may ensue from future. Possible interventions which will help achieve this goal centre around increasing awareness and education around technologies which help to provide access to therapies and maintain vital support networks.

ETHICS STATEMENT

This paper represents a service level audit involving usual care. In view of this review and approval by a research ethics committee was not required according to institutional or national guidelines. This was validated by an online tool provided by NHS Health Research Authority (38).

AUTHOR CONTRIBUTIONS

CS: lead author, data collection, study design, and article write up. AH and AW: contribution to writing and interpretation of data. DR: statistical analysis. OM and JB: data collection. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The Psychometric Properties of the Stress and Anxiety to Viral Epidemics-6 Items: A Test in the U.S. General Population

Sangha Lee[1], *Jihoon Lee*[2], *Soyoung Yoo*[3], *Sooyeon Suh*[4]*, *Seockhoon Chung*[2]* and *Sherman A. Lee*[5]

[1] Department of Psychiatry, Ajou University Medical Center, Ajou University School of Medicine, Suwon, South Korea, [2] Department of Psychiatry, Asan Medical Center, University of Ulsan College of Medicine, Seoul, South Korea, [3] Department of Convergence Medicine, University of Ulsan College of Medicine, Seoul, South Korea, [4] Department of Psychology, Sungshin Women's University, Seoul, South Korea, [5] Department of Psychology, Christopher Newport University, Newport News, VA, United States

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***Correspondence:**
Sooyeon Suh
alysuh@sungshin.ac.kr
Seockhoon Chung
schung@amc.seoul.kr

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Objectives: Many individuals around the world are suffering from psychological distress due to the COVID-19 outbreak. The aim of this study is to explore the validity and reliability of the English version of Stress and Anxiety to Viral Epidemics-6 (SAVE-6), which measures the anxiety response of the general population to the viral epidemic.

Methods: A cross-sectional web-based study with self-reporting measures was conducted. A total of 314 United States residents were recruited via online platform in exchange for payment. The participants were asked to an anonymous questionnaire, collecting information on demographics, psychiatric history, SAVE-6, Patient Health Questionnaire-4 (PHQ-4), and the Coronavirus Anxiety Scale.

Results: The result from confirmatory factor analysis (CFA) demonstrated that a single-factor model [$\chi^2_{(9)} = 11.53$, $p = 0.24$] yielded excellent fit for all of indices [χ^2/df ratio = 1.28; CFI = 1.00; TLI = 1.00; SRMR = 0.02; RMSEA = 0.03 (0.00, 0.07; 90% CI)] and yielded strong internal consistency reliability (Cronbach's $\alpha = 0.88$). The results from multigroup CFAs showed that there were no gender differences [$\Delta\chi^2_{(6)} = 3.20$, $p = 0.78$, ns] and no race differences [$\Delta\chi^2_{(6)} = 3.60$, $p = 0.73$, ns] between the models, along with excellent model fits.

Conclusions: The results of this study support the reliability and validity of SAVE-6 with strong psychometric properties for the English version of the U.S. population.

Keywords: COVID-19, stress, anxiety, scale, psychometry

INTRODUCTION

A novel coronavirus disease 2019 (COVID-19) is a new infectious disease that occurred in Wuhan City, Hubei Province, China in December 2019. After the first outbreak, the COVID-19 has rapidly spread to neighboring countries, and in March of the following year, the World Health Organization (WHO) declared a pandemic, the highest level of warning of transmission, meaning the stage of a global pandemic. According to the World Health Organization, globally,

as of September 9, 2021, there have been 221,648,869 confirmed cases of COVID-19, including 4,582,338 deaths, affecting 212 countries and territories. Especially in the United States of America, 41,300,407 confirmed cases of COVID-19 with 670,458 deaths have been reported [1].

The spread of COVID-19 has posed a great threat across social systems such as healthcare, public security, and the economy. Such rapid social change has had a profound effect individual mental health. The public has been exposed to constant fear and anxiety due to daily corona-related news (1). The fear of COVID-19 appears to be due to uncertainty about how much the current epidemic will deteriorate (2). According to a survey of Americans (3), 62% of respondents were more worried about COVID-19 than seasonal flu.

In addition, the public has experienced social isolation due to social distancing, working from home, and school closure, which can lead to various psychological problems such as personal stress, anxiety, depression, fear, anger, loneliness, frustration (4). Previous research has shown that people in quarantine suffered various psychological issues such as stress, fear, and depression (5). From the pandemics in the past, we have learned that there were more people affected by mental health than those affected by infections (6) and that mental health effects may be more lasting than the epidemic itself (7).

In response to these psychological crises brought about by COVID-19, researchers have developed measures to assess stress, anxiety, and fear specific to the pandemic. For example, Taylor et al. (8) developed a 36-item COVID Stress Scales (CSS) to measure a series of fears related to COVID-19. It demonstrated good validity and reliability in five factors, but the sample was limited to the US and Canadian populations and some items are believed to reflect sociocultural contexts (e.g., xenophobia toward Asians, insufficient supply in grocery stores). Another measure called the Fear of COVID-19 Scale (FCV-19S), proposed by Ahorsu et al., was designed to assess an individual's fear of COVID-19 with only seven items (9). Although FCV-19S is shorter (10), it contains items that focus primarily on physical reactions and appears to be limited to COVID-19 (e.g. "My hands become clammy when I think about coronavirus-19," "My heart races or palpitations when I think about getting coronavirus-19").

We originally developed Stress and Anxiety to Viral Epidemics-9 items (SAVE-9) scale, a nine-item scale to assess stress and anxiety of healthcare workers in response to the viral epidemic (11). It has the advantage of being a compact psychological scale that can be used in many various pandemic situations, and it was validated in various languages including Russian (12), Italian (13), Japanese (14), Turkish (15), and German (16). In a previous study, the SAVE-9 scale was divided into two factors; factor I- anxiety about viral epidemics (namely, SAVE-6), and factor II-work-related stress associated with viral epidemics. Although SAVE-9 is a well-established scale for measuring stress associated with viral epidemics, it is necessary to check the validity of the six-item item targeting the general public as it is for a specific occupational group. This scale is expected to be useful not only in the stress caused by COVID-19 but also in other pandemic situations that may occur in the future. We explored whether the SAVE-6 is useful for evaluating the anxiety related to the viral epidemic among the general population in Korea (17), and we found that it is a valid and reliable scale that may be used in the general population in Korea, Lebanon (18), and special population in Korea including cancer patients (19) and medical students (20). In this study, we aimed to assess the reliability and convergent validity of the English version of the SAVE-6 scale among the U.S. population.

[1] Available online at: https://covid19.who.int/ (accessed September 9, 2021).

TABLE 1 | Sample characteristics.

Characteristics	Statistics
Gender	
Male	150 (47.8%)
Female	164 (52.2%)
Race	
White	247 (78.7%)
Black	28 (8.9%)
Asian	20 (6.4%)
Hispanic	16 (5.1%)
Other	3 (1.0%)
COVID-19 diagnosis	
Yes	106 (33.8%)
No	208 (66.2%)
Knowledge of someone who died of COVID-19	
Yes	193 (61.5%)
No	121 (38.5%)
Plans on getting vaccinated for COVID-19	
Yes	247 (78.7%)
No	67 (21.3%)
Age	*M* = 39.53; *SD* = 11.46 (19–65)
Symptoms ratings	
Depression	*M* = 2.94; *SD* = 1.82 (0–6)
Generalized anxiety	*M* = 2.92; *SD* = 1.76 (0–6)
Suicidal ideation	*M* = 1.35; *SD* = 1.33 (0–4)
Substance use	*M* = 1.60; *SD* = 1.42 (0–4)
Coronaphobia	*M* = 7.87; *SD* = 5.91 (0–19)
Viral anxiety	*M* = 12.36; *SD* = 5.73 (0–24)

MATERIALS AND METHODS

Participants and Procedure

The data was collected via the online survey on December 11, 2020, from 314 adults residing in the United States, were used in this IRB approved study. The participants were recruited via Amazon MTurk in exchange for payment ($0.25) and were eligible if they provided consent and furnished complete information. Most of the participants (*Mage* = 39.53) were white (78.8%), female (52.2%), never diagnosed with COVID-19 (66.2%), knew someone who died of COVID-19 (61.5%), and plan on getting vaccinated for COVID-19 (78.8%) when they become available (see **Table 1**).

Measures

To get composite scores, item ratings within a measure were combined together. Higher composite scores imply that a condition is more prevalent.

Basic Information

Participants were asked to report their age, gender, race, COVID-19 diagnosis, whether or not they knew someone who died of COVID-19, and whether or not they plan on getting vaccinated for COVID-19 when they are available.

Psychological Distress and Substance Use

Clinical depression and generalized anxiety were rated using the Patient Health Questionnaire-4 (PHQ-4) (21). Participants rated each items how frequently, within the past 2 weeks (0 = not at all to 3 = nearly every day), they experienced symptoms of depression (e.g., "feeling down, depressed, or hopeless.") with two items ($\alpha = 0.78$) and generalized anxiety (e.g., "feeling nervous, anxious, or on edge.") ($\alpha = 0.74$). Passive suicidal ideation was measured with the single item, "I wished I was already dead so I did not have to deal with the coronavirus." While substance use coping was measured with the single item, "I used alcohol or other drugs to help me get through the fear and/or anxiety caused by the coronavirus." Participants indicated how frequently, within the past 2 weeks (0 = not at all to 4 = nearly every day), they experienced suicidal thoughts and used alcohol or drugs to cope with coronavirus related fear and anxiety.

Coronaphobia

Clinical symptoms of anxiety that are tied to coronavirus related thoughts or information were measured using the Coronavirus Anxiety Scale (CAS) (22). Participants indicated how frequently, within the past 2 weeks (0 = not at all to 4 = nearly every day), they experienced symptoms of coronaphobia (e.g., "I felt dizzy, lightheaded, or faint, when I read or listened to news about the coronavirus.") with five items ($\alpha = 0.93$).

Viral Anxiety

General anxiety responses to the viral pandemic were measured using the Stress and Anxiety to Viral Epidemics-6 (SAVE-6) (17). Participants indicated their level of agreement (0 = never to 4 = always) with pandemic-related anxiety questions (e.g., "Are you afraid the virus outbreak will continue indefinitely?") using six items ($\alpha = 0.88$). See **Table 2** for item properties.

Statistical Approach

A series of statistical analyses were used to examine the psychometric properties of the SAVE-6, a measure of viral anxiety. SAVE-6 total score differences in gender (men vs. women), race (whites vs. non-whites), COVID-19 diagnosis (yes vs. no), knowledge of someone who died of COVID-19 (yes vs. no), and plans on getting vaccinated for COVID-19 (yes vs. no), were examined using independent samples *t*-tests. SAVE-6 total score correlations with age and distress-related constructs (e.g., suicidal ideation) were examined using Pearson's product-moment correlations. Factor analysis was performed in two steps. In the first step, exploratory factor analysis (EFA) was conducted to determine using principal component analysis with Oblimin rotation to determine loadings of items and their dimensions. In the second step, a bootstrap (2,000 samples) maximum likelihood confirmatory factor analysis (CFA) was modeled on the six items of the SAVE-6 to examine the instrument's factorial validity for a unidimensional structure. Multigroup CFAs were run to determine if the SAVE-6 is measuring viral anxiety in the same way for men and women, as well as whites and non-whites. Satisfactory model fit for a CFA model was defined by a chi-square/df value < 2, a standardized root-mean-square residual (SRMR) value ≤ 0.05, root-mean-square-error of approximation (RMSEA) value ≤ 0.10, and comparative fit index (CFI) and Tucker Lewis Index (TLI) values ≥ 0.90 (23, 24). Measurement invariance was defined by both adequate model fit statistics and a non-significant value ($p \geq 0.05$) on a chi-square difference test. All of the statistical analyses were calculated using SPSS version 26.0, except for the confirmatory factor analyses (CFA), which were run using AMOS version 25.0.

TABLE 2 | Results of exploratory factor analysis (EFA) of the SAVE-6 using principal component analysis with Oblimin rotation ($n = 314$).

Item	Factor 1
SAVE-6 item 2	0.795
SAVE-6 item 4	0.780
SAVE-6 item 3	0.743
SAVE-6 item 1	0.737
SAVE-6 item 5	0.717
SAVE-6 item 6	0.714
Eigenvalue	3.797
% of Variance	63.283
Cumulative variance	63.283

RESULTS

Descriptive Statistics, Group Comparisons, and Correlations

The descriptive statistics reveal that the majority of the sample were highly distressed during the COVID-19 pandemic. Specifically, 62.4% experienced clinical levels of depression (≥3) [Kroenke et al. (21)], 64.0% experienced clinical levels of generalized anxiety (≥3) (21), 51.6% experienced coronaphobia (≥9) (22), and 38.9% experienced high viral anxiety (≥15) (17). In addition, 58.6% had suicidal ideation and 65.3% coped with their fear and anxiety over the coronavirus using drugs or alcohol. Most of the participants plan on getting vaccinated for COVID-19 in the future (78.7%) and knew someone who died of COVID-19 (61.5%).

Viral anxiety was significantly greater among those with a COVID-19 diagnosis [$t_{(260.04)} = 7.34$, $p < 0.001$], those who knew someone who died of COVID-19 [$t_{(312)} = 9.35$, $p < 0.001$], and those who plan on getting the vaccine for COVID-19 [$t_{(94.81)} = 4.78$, $p < 0.001$]. Demographically, viral anxiety was slightly associated with age ($r = 0.12$), but not gender [$t_{(312)} = 0.23$, $p = 0.82$, ns] and race [$t_{(91.23)} = 0.04$, $p = 0.97$, ns]. In terms of distress-related constructs, viral anxiety was strongly associated with substance use coping ($r = 0.61$) and suicidal ideation

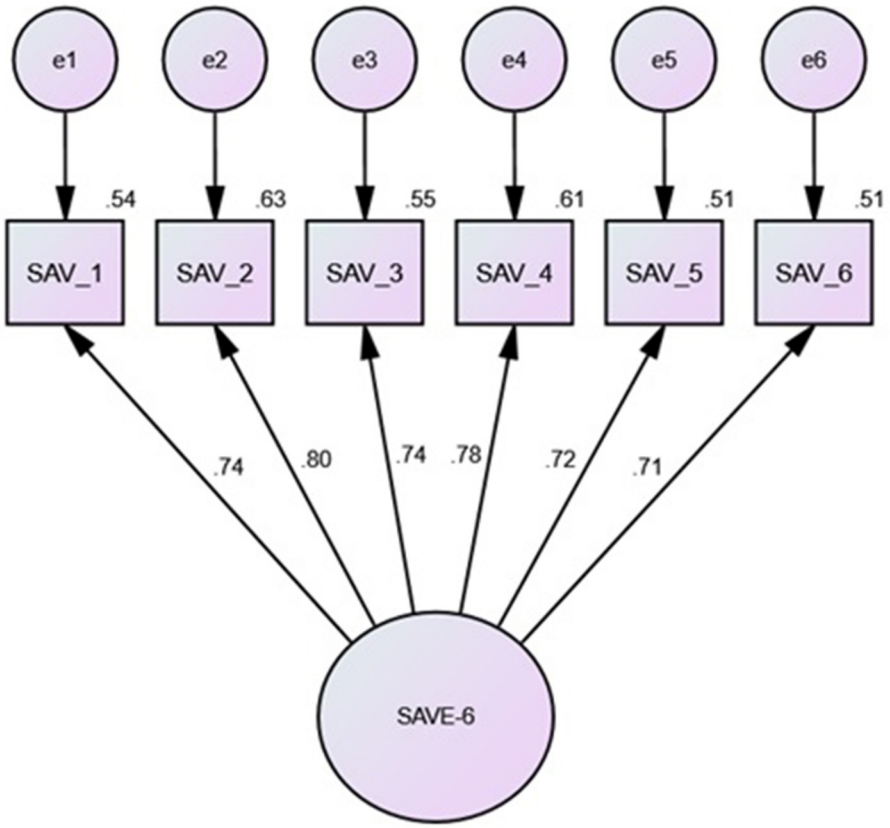

FIGURE 1 | Confirmatory Factor Analysis. Note. Model based on bootstrap Maximum Likelihood (ML) estimations (2000 samples). All of the standardized coefficients are significant at the .05 level. SAV_1 = continuation fear; SAV_2 = health fear; SAV_3 = infection worry; SAV_4 = physical sensitivities; SAV_5 = avoidance worry; SAV_6 = transmission worry.

TABLE 3 | Item properties of the SAVE-6.

Items	Response scale					Descriptive		Item metrics		
	0	1	2	3	4	M	SD	ITC	R^2	CID
1 Are you afraid the virus outbreak will continue indefinitely?	8.6%	15.9%	35.4%	25.8%	14.3%	2.21	1.14	0.69	0.48	0.86
2 Are you afraid your health will worsen because of the virus?	11.8%	19.7%	31.2%	29.3%	8.0%	2.02	1.13	0.74	0.55	0.86
3 Are you worried that you might get infected?	8.6%	18.8%	36.9%	20.7%	15.0%	2.15	1.15	0.69	0.50	0.86
4 Are you more sensitive toward minor physical symptoms than usual?	13.7%	20.7%	25.2%	27.4%	13.1%	2.05	1.25	0.72	0.53	0.86
5 Are you worried that others might avoid you even after the infection risk has been minimized?	21.0%	19.4%	24.5%	25.2%	9.9%	1.83	1.29	0.67	0.46	0.87
6 Do you worry your family or friends may become infected because of you?	14.6%	15.9%	29.9%	24.8%	14.6%	2.09	1.26	0.67	0.45	0.87

Cronbach's Alpha is 0.88 for total SAVE-6 measure; # Item Number; 0, never; 1, rarely; 2, sometimes; 3, often; 4, always; M, Mean; SD, Standard Deviation; ITC, Corrected Item-Total Correlation; R^2, Squared Multiple Correlation; CID, Cronbach's Alpha if item is deleted.

($r = 0.59$). As expected, and in support of the SAVE-6's construct validity, viral anxiety was shown to be associated with COVID-19 related experiences (i.e., COVID-19 diagnosis, knowledge of someone who died of the disease, and plans to get vaccinated) and distress-related constructs (e.g., suicidal ideation).

Initial Exploratory Factor Analysis

Table 2 and **Figure 1** show the results of exploratory factor analysis of the SAVE-6 using principal component analysis with Oblimin rotation ($n = 314$). The analysis revealed one factors with an Eigenvalue > 1, explaining 63.3% of total variance. All included variables loaded highly on the factor.

Confirmatory Factor Analyses

The SAVE-6 items were found to be acceptable for factor analysis after a preliminary examination of the data (25). Specifically, the data did not exhibit issues pertaining to sample size, missing data, non-normality, multicollinearity, or singularity. The correlation matrices were also shown to be factorable (Bartlett's test of sphericity $= p < 0.001$; Kaiser-Meyer-Olkin test $= 0.90$).

A CFA was used to see if the SAVE-6's six anxiety components could be combined into a unidimensional construct. The results demonstrated that a single-factor model [$\chi^2_{(9)} = 11.53$, $p = 0.24$] yielded excellent fit for all of indices [χ^2/df ratio = 1.28; CFI = 1.00; TLI = 1.00; SRMR = 0.02; RMSEA = 0.03 (0.00, 0.07; 90% CI)] and yielded strong internal consistency reliability (Cronbach's $\alpha = 0.88$). Thus, these results support the factorial validity of the SAVE-6 measure (**Table 3**).

Then, multiple sets of CFAs were run to check if SAVE-6's viral anxiety structure is measured in the same way on the demographic variables of gender (male vs. female) and race (white vs. non-white). The results show that there is no gender difference, which is evidenced by an excellent fit of the model. [$\chi^2_{(18)} = 23.10$, $p = 0.19$] for all of the indices [χ^2/df ratio = 1.28; CFI = 0.99; TLI = 0.99; SRMR = 0.03; RMSEA = 0.03 (0.00, 0.06; 90% CI)] and a non-significant increase in χ^2 value [$\Delta\chi^2_{(6)} = 3.20$, $p = 0.78$, ns] between the models. The results also demonstrated no race differences, which were evidenced by excellent model fit [$\chi^2_{(18)} = 25.87$, $p = 0.10$] for all of the indices [χ^2/df ratio = 1.44; CFI = 0.99; TLI = 0.98; SRMR = 0.02; RMSEA = 0.04 (0.00, 0.07; 90% CI)] and a non-significant increase in χ^2 value [$\Delta\chi^2_{(6)} = 3.60$, $p = 0.73$, ns] between the models. Thus, these results demonstrate measurement invariance by showing that the SAVE-6 measures viral anxiety the same way across gender and race groups.

Evidence Based on Relations to Other Variables

The SAVE-6 scale score was significantly correlated with PHQ-4 anxiety subscale ($r = 0.67$, $p < 0.001$), PHQ-4 depression subscale ($r = 0.64$, $p < 0.001$), or CAS scale ($r = 0.74$, $p < 0.001$).

DISCUSSION

The aim of the current study was to assess the psychometric properties of SAVE-6, a newly developed scale designed to evaluate the anxiety level associated to COVID-19 pandemic. The psychometric properties of the SAVE-6 were assessed in a representative sample of 314 adults who were between 19 and 65 years of age in the USA. The current study confirmed and extended previous reports of reliability and validity (17).

The result indicated that the internal consistency of SAVE-6 (Cronbach Alpha=.88) is excellent and adequate for CFA (Bartlett's test of sphericity = $p < 0.001$; Kaiser-Meyer-Olkin test = 0.90). The SAVE-6 score significantly correlated with depression and GAD scores, as well as another anxiety scale specific to COVID-19 (CAS), indicating good convergent validity. Previous studies have reported that people who have been diagnosed with COVID-19 or who knew someone who died of COVID-19 were more likely to meet the anxiety and depression criteria (26). Corona-related structures and viral anxiety in this study appeared to be higher in those with corona-related experiences, which seems to be consistent with these existing studies. Perceived stress associated with the coronavirus is a strong predictor of higher dysfunction and can predict symptoms of depression and anxiety disorders. In addition, we were able to confirm measurement invariance in all groups using multiple-group CFA. As shown in the results, gender and race did not seem to affect the response pattern of SAVE-6. Therefore, it can be concluded that the SAVE-6 is a reliable measure that assesses psychological issues associated with a viral epidemic across cultures.

The SAVE-6 is a rating scale which can measure the anxiety response specifically to the viral epidemic. It includes items asking anxiety symptoms such as "Are you afraid the virus outbreak will continue indefinitely?," "Are you afraid your health will worsen because of the virus?," or "Are you worried that you might get infected?" We believe the anxiety symptoms measured with this scale might be viral anxiety and not anxiety stemming from other factors. Although several measures have recently been published for COVID-19-related fears and anxiety, SAVE-6 differs from other measures in several ways. The COVID-19 Stress Scale developed by Taylor et al. include social contexts such as socioeconomic consequences of COVID, xenophobia, and compulsive checking (8). Other rating scales have been proposed to assess the symptoms of anxiety and associated physiological arousal (the Coronavirus Anxiety Scale) (22), nervousness, muscle tensions, or behaviors of avoidance (the COVID-19 Anxiety Questionnaire) (27), or avoidance, checking, and worried behaviors (the COVID-19 Anxiety Syndrome Scale) (28). Even other scales such as FCV-19S (9) or Coronavirus Pandemic Anxiety Scale (CPAS-11) (29) are similar to SAVE-6 in that it is evaluating the primary fear/anxiety of coronavirus, SAVE-6 differs in that it responds not only to the COVID-19 but also to other virus pandemics. With the possibility of another unpredictable pandemic that may occur in the future, we believe the scale will have additional utility in the future. We have explored the validity of the SAVE-6 among the general population in Korea (17), and it has reported that the scale has reliable psychometric properties. The SAVE-6 has been validated in other languages (18). In particular, the English version of SAVE-6 is expected to be highly utilized in a number of English-speaking countries.

This study has some limitations. First, all data was collected via online self-report surveys, which may have potential bias or errors. Further research involving various methods of assessment, such as face-to-face interviews or focus group interviews may enrich the analysis. Second, at the time of our survey, other measures were being reviewed and yet to be published, so the concurrent validity with them could not be confirmed. If the concurrent validity with the aforementioned scales can be reviewed later, it will help to increase the validity of SAVE-6. Third, some demographic characteristics such as education level, employment status, medications, history of psychiatric illness, and income level were not available. Since they were not included in covariates, some possible confounding factors may remain. Despite the limitation, the results of this study support the reliability and validity of SAVE-6 with strong psychometric properties for the English version of the U.S. population.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Institutional Review Board of Christopher Newport University. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

SC, SS, and SAL: conceptualization and writing—review and editing. SAL: methodology, formal analysis, data curation, and visualization. JL, SY, and SL investigation. SAL and SL: writing—original draft preparation. SS: supervision. SC: project administration and funding acquisition. All authors have read and agreed to the published version of the manuscript.

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Sleep Quality and Mental Health of Medical Students in Greece During the COVID-19 Pandemic

Anna Eleftheriou[1†], Aikaterini Rokou[1†], Aikaterini Arvaniti[2], Evangelia Nena[3] and Paschalis Steiropoulos[4]*

[1] Medical School, Democritus University of Thrace, Alexandroupolis, Greece, [2] Department of Psychiatry, Medical School, Democritus University of Thrace, Alexandroupolis, Greece, [3] Laboratory of Social Medicine, Medical School, Democritus University of Thrace, Alexandroupolis, Greece, [4] Department of Pulmonology, Medical School, Democritus University of Thrace, Alexandroupolis, Greece

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***Correspondence:**
Paschalis Steiropoulos
steiropoulos@yahoo.com

[†] These authors have contributed equally to this work and share first authorship

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Background-Aim: Medical students have been greatly affected by the COVID-19 pandemic due to their educational program, which comprises theoretical knowledge and also clinical duties, making them vulnerable to viral exposures and possibly affecting their everyday life. The aim of this study was to explore changes in sleep and mental health parameters among medical students in Greece during the second year of the pandemic.

Methods: This cross-sectional study comprised students of all medical schools in Greece (n = 7), using an anonymous online survey. Participants completed the following questionnaires: Pittsburgh Sleep Quality Index (PSQI), Athens Insomnia Scale (AIS), Fatigue Severity Scale (FSS), General Anxiety Disorder-7 (GAD-7), Patient Health Questionnaire-9 (PHQ-9). Statistical analysis was conducted with the use of SPSS v.26 (IBM SPSS, Armonk NY, USA).

Results: Out of the 562 received responses, 559 met the inclusion criteria. The largest proportion of the respondents came from 4th-year (27.8%) and the majority of the sample were females (69.8%). Only 5.9% of the participants reported having been infected by SARS-COV-2. Most of the respondents experienced insomnia (65.9%, mean AIS score: 7.59 ± 4.24), poor sleep quality (52.4%, mean PSQI score: 6.6 ± 3.25) and increased fatigue (48.5%, mean 35.82 ± 11.74). Moderate to severe symptoms of anxiety (mean 9.04 ± 5.66) and depression (mean 9.36 ± 6.15) were noted. Suicidal ideation was found in 16.7% of the sample, while use of sleeping pills in the previous month was reported by 8.8% (n = 47). Further analysis revealed independent associations between sleep and mental health parameters. Higher AIS score was associated with greater FSS score; higher PSQI scores with higher GAD-7 and PHQ-9 scores. Additionally, female students were found to be significantly more affected than males by the COVID-19 pandemic, displaying higher levels of insomnia, sleep disturbances, anxiety and depression. In addition, those with a history of COVID-19 infection or in close proximity with a positive case reported significantly more significant post-traumatic symptoms in IES-COVID-19 questionnaire.

Conclusions: In the aftermath of the COVID-19 pandemic, prevalence of sleep and mental health disorders among Greek medical students is significant, highlighting the need for better surveillance of students' wellbeing and subsequent counseling, with special focus on female students and other affected groups.

Keywords: COVID-19, medical students, sleep quality, mental health, pandemic

INTRODUCTION

The ongoing COVID-19 pandemic, which was officially declared by the World Health Organization on March 11, 2020, has caused significant changes in multiple aspects of everyday life (1, 2). Government agencies around the world have responded to this unprecedented situation by implementing measures like mandatory mask use, social distancing, travel ban and curfew, retail stores closure, contact tracing, virus detection tests and quarantine (3–5). Since the first months of the implementation of those measures, a significant impact has been described on the mental health and sleep quality of the general population (6, 7).

It was previously reported that the prolonged confinement, in combination with the growing health concerns, have resulted in a reduction in the duration and the quality of sleep of the general population. These findings were, also, positively associated with depressive symptoms (8). Similar findings were reported in Greece, with symptoms of depression and being at higher levels in certain groups, such as the younger in age (9).

A special sub-group of the population, which has been greatly affected by the above-mentioned measures, are university students. One of the first measures applied was the suspension of the operation in all educational institutions, followed by the implementation of e-learning. Also, for medical students, the clinical practice and laboratory exercise of their curriculum were paused, leading to great changes in the educational process and consequently, in their daily life (10, 11).

The new major health risk, the strict preventive measures, and the radical changes in the lifestyle of medical students are reflected on the quality of their sleep and on their mental state, as described previously (12–15). Specifically, medical students, who were concerned about the effects of COVID-19 on education and work, reported higher rates of poor sleep quality (12). Additionally, according to studies conducted during the first months of the pandemic, they presented increased rates of depression and severe anxiety, fear of stigmatization due to association with the hospital environment and anxiety of meeting the demands of the new educational reality. These findings were more likely to be more common among the female population (13–15).

However, studies conducted during the second pandemic wave, when an outburst of COVID-19 cases was reported worldwide are scarce. During that time, even stricter preventive measures were enforced, since vaccinations had not been authorized. Simultaneously, on-line education was applied for the Autumn-Winter semester of the Academic Year 2020–2021, and only medical students of the final year were allowed to resume their clinical practice. The above-mentioned developments in the course of the pandemic have caused alterations in everyday life and probably could be associated with different findings in sleep and mental health of students.

The aim of the present study was to evaluate the impact of the situation that arose during the second year of COVID-19 pandemic, on the quality of sleep and mental health i.e., anxiety and depression, of medical students in Greece.

MATERIALS AND METHODS

Protocol and Registration

In order to enroll to the study, participants had to confirm their consent in the electronic page of the questionnaire, after being informed of the goals and the procedure of the study. Anonymity was also ensured. Prior to the initiation of the study, ethical approval was acquired (Prot. Nr. 4/22-04-2021).

Participants

This study targeted undergraduate medical students, who completed an anonymous web-based questionnaire. The inclusion criteria were (i) currently attending one of the seven Medical Schools in Greece (ii) over 95% completion of survey questions. Answers from students pending graduation were also accepted.

Study Design

This cross-sectional study was conducted between the 22nd of April and 31st of May 2021. During this time, members of our research team shared a post twice in several Facebook groups of students studying in the seven Medical Schools and Departments of the country, namely Aristotle University of Thessaloniki (AUTH), Democritus University of Thrace (DUTH), National and Kapodistrian University of Athens (NKUA), University of Crete (UoC), University of Ioannina (UoI), University of Patras (UPatras), and University of Thessaly (UTH). This Facebook post contained an introductory text, in which the purpose of the study was stated alongside the intention to ensure the anonymity of the participants and invited group members to participate in the study voluntarily. The post, also, provided the link to the online questionnaire, after students confirmed their consent.

Measures

General Information

The initial part included questions about name of the attending University and year of studies, demographics, history of infection and hospitalization due to COVID-19.

Sleep Questionnaires

The Greek versions of the following validated questionnaires were included in the survey: Pittsburgh Sleep Quality Index (PSQI) (16), Athens Insomnia Scale (AIS) (17) and Fatigue Severity Scale (FSS) (18).

PSQI is a widely used self-administered questionnaire, which assesses subjectively the sleep quality of the participant over the course of the last month. PSQI measures sleep disturbances through 7 dimensions: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. It contains 19 questions and cut-off is 5. Additional sleep disturbances can be mentioned in the relevant open-end question. Total scores range from 0 to 21 with higher scores indicating increasingly poor sleep quality (16).

AIS is a self-administered psychometric questionnaire, which assesses sleep difficulty and particularly insomnia. It contains 8 items; questions are rated on a Likert scale from 0 to 3 and total scores $\geq$6 indicate insomnia. Higher scores suggest severe symptoms of insomnia (17).

FSS is a self-administered questionnaire, which assesses fatigue. It contains 9 items and each one of them is scored on a 7-point Likert scale ranging from 1 to 7 (completely disagree to completely agree). Cut-off is 36 and higher scores indicate greater severity, frequency and impact of fatigue on daily life (18).

Mental Health Questionnaires (Symptoms of Anxiety, Depression and PTSD After COVID-19 Infection)

The participants answered the validated Greek versions of three psychometric questionnaires: General Anxiety Disorder-7 (GAD-7) (19), Patient Health Questionnaire-9 (PHQ-9) (19, 20). They also answered the Impact of Event Scale Questionnaire adapted for COVID-19 (IES-COVID19) (21, 22). Only those who had personally been infected or those who had a positive case in their familial or amical environment completed the latter.

GAD-7 is a self-administered questionnaire that assesses the severity of anxiety symptoms. It contains 7 items which are scored based on a 4-point Likert scale from 0 to 3, with higher scores indicating more severe anxiety symptoms. Cut points of 5, 10, 15 correspond to mild, moderate and severe anxiety symptoms, respectively. Scores of 10 or greater suggest a potentially clinical condition (19).

PHQ-9 is a self-administered questionnaire, which assesses depression symptoms over the course of the past 2 weeks and may be used as a tool for diagnosing clinical depression. It contains 9 items which are scored based on a 4-point Likert scale from 0 to 3, with higher scores indicating more severe depression symptoms. Cut points of 5, 10, 15, 20 correspond to mild, moderate, moderately severe and severe depression symptoms, respectively. Scores of 10 or greater suggest a potentially clinical condition (19, 20).

IES-COVID19 is a 15-item self-administered questionnaire, which is designed to assess subjective distress during the past 7 days over experiencing a COVID-19 infection either personally or of the immediate environment. Every item is rated on a 4-point scale (0: not at all, 1: seldom, 3: sometimes and 5: often). Higher scores indicate a higher psychological impact of the COVID-19 infection (21, 22). The IES-COVID 19 could be used in a preventive manner by screening individuals at high risk for developing PTSD.

TABLE 1 | General characteristics of the participants.

	Number (N)	Percentage (%)
Participants (valid answers)	559	
Sex (M/F)	164/389	
Medical university		
AUTH	79	14.2
DUTH	117	21
NKUA	107	19.2
UoC	95	17
UoI	45	8.1
UPatras	66	11.8
UTH	49	8.8
Academic year		
1st	71	12.7
2nd	71	12.7
3rd	78	14
4th	155	27.8
5th	81	14.5
6th	80	14.3
Pending graduation	22	3.9
COVID-19 infection		
No infection	328	58.7
Only personally infected	16	2.9
Infection only in members of the close environment	198	35.2
Infection both personally and in the close environment	17	3

AUTH, Aristotle University of Thessaloniki (Thessaloniki, Greece); DUTH, Democritus University of Thrace (Alexandroupolis, Greece); NKUA, National and Kapodistrian University of Athens (Athens, Greece); UoC, University of Crete (Heraklion, Greece); UoI, University of Ioannina (Ioannina, Greece); UPatras, University of Patras (Patras, Greece); UTH, University of Thessaly (Larissa, Greece).

Statistical Analysis

Statistical analysis was conducted with the use of SPSS v.26 (IBM SPSS, Armonk NY, USA). Normality of distribution was checked with Kolmogorov-Smirnov test and appropriate analyses were applied. Descriptive and analytic statistics were used. Statistical significance was set at $p < 0.05$ level.

RESULTS

General Characteristics

In total, 562 answers were received, out of which, 559 were eligible for analysis (completion rate 99.46%). **Table 1** displays the characteristics of the participants. As seen, all Universities were represented, with variable participation rates. The majority were females, with a larger participation coming from students of the 4th year. Thirty-three (5.9%) respondents have been infected by SARS-COV-2 and 215 (38.4%) reported at least one positive case of COVID-19 in their approximate environment.

TABLE 2 | Reported sleep disturbances (open-end answers only).

Sleep disturbances	Number of participants
Stress–Anxiety*	30
Negative thoughts–overthinking	13
Use of technology	5
Palpitations	5
Tension	5
Fear	3
Loneliness	3
Headaches	2
Anger	2
Melancholy–sadness	2
Panic attack	1
Sleep paralysis	1

*About possible COVID-19 infection, increased workload, examinations.

COVID-19 Pandemic, Sleep Quality and Sleep Characteristics

The second part of the survey assessed the sleep quality of the participants spanning over a period of 1 week −1 month before its completion. Most of the respondents ($n = 368$, 66%) experienced insomnia, according to their AIS score (mean 7.59 ± 4.24), with females being significantly more affected (mean AIS female score: 7.88 ± 4.2, mean AIS male score: 6.88 ± 4.4, $p = 0.012$).

More than half of participants ($n = 293$, 52.4%) evaluated their sleep as being of poor quality, according to PSQI score. Sleep disturbances were reported by almost all participants (499/559 participants), including fragmented sleep, snoring, difficulty in breathing and nightmares. Additional sleep disturbances, as mentioned in the relevant open-end question, were anxiety, stress, and loneliness as demonstrated in more detail in **Table 2**. Interestingly, 8.8% ($n = 47$) of university students stated that they have used sleep- promoting medication during the past month. Almost half of the participants reported increased levels of fatigue ($n = 270$, 48.5%, mean: 35.82 ± 11.74).

Comparisons between students of different academic years revealed statistically significant variations in the duration of their sleep (i.e., third PSQI component). Specifically, students of the 6th year reported significantly shorter sleep duration ($p = 0.003$).

COVID-19 Pandemic and Mental Distress

The third part of the survey addressed the effects of the COVID-19 pandemic on different aspects of mental health. The majority of participants ($n = 377$, 67.6%) reported moderate to severe symptoms of anxiety (mean 9.04 ± 5.66). More specifically, 28.4% reported moderate symptoms, 23.1% moderately severe symptoms and 16.2% severe symptoms.

Similar results regarding depression symptoms were found (mean score: 9.36 ± 6.15), with 22.6% having moderate depression symptoms, 13.9% moderately severe depression symptoms, and 7.2% severe depression symptoms. Mild depression symptoms were reported in 30.6% of the respondents. Notably, a non-neglectable percentage ($n = 92$, 16.7%) of the participants, regardless of gender ($p = 0.579$), reported being affected by recurrent suicidal thoughts (several days: 9.8%, More than half of the days: 3.3%, nearly every day: 3.6%). Comparison analysis between COVID-19 infection status and depression levels (as indicated by PHQ-9) showed that students who had both themselves and their immediate environment infected, experienced symptoms in a more severe way (not infected: 9.03 ± 6.3 vs. only immediate environment infected: 9.89 ± 5.54, infected both themselves and their immediate environment: 12.29 ± 8.89; $p = 0.022$).

Comparison between genders revealed that females were experiencing significantly more severe symptoms in all mental health measures scores (GAD-7 mean score females: 9.4 ± 5.66, males: 8.16 ± 5.64, $p = 0.02$, PHQ-9 mean score females: 9.95 ± 6.16, males: 7.93 ± 5.98, $p = 0.001$, IES-COVID19 mean score females: 25.50 ± 13.53, males: 20.69 ± 12.21, $p = 0.018$).

Additionally, female students infected by COVID-19 or in close proximity with a positive case of the disease, reported significantly more frequently bad dreams ($p = 0.025$), and persistent negative thoughts or images ($p = 0.031$, $p = 0.048$, respectively) according to IES-COVID19 scores.

Correlations Between Sleep and Mental Parameters

As a next step, a correlation analysis between sleep and mental health parameters was conducted, revealing numerous independent associations among them as shown in **Table 3**. There was a statistically significant correlation between all scales. Higher levels of insomnia (according to the AIS score) were associated with greater severity and frequency of fatigue (as described by the FSS score); poor quality of sleep (resulting from PSQI) was associated with higher levels of anxiety and depression symptoms (as indicated by the GAD-7 and PHQ-9 scores).

DISCUSSION

Our study captures the alterations in sleep quality and mental health of medical students in Greece during the second year of the COVID-19 pandemic. Overall, regarding sleep parameters, the respondents reported impaired sleep quality due to multiple sleep disturbances and decreased sleep duration; this was more obvious among 6th year medical students. Higher levels of insomnia, especially in females and increased fatigue in daily life were also reported. These alterations in sleep parameters were correlated with moderate to severe deterioration of mental health. Respondents presented also moderate to severe symptoms of anxiety and depression, to the point that a significant proportion admitted recurrent suicidal thoughts.

So far, contradictory findings are available in the literature regarding alterations in students' sleep schedule and sleep quality and the majority refers to the first year of the COVID-19 pandemic until the end of December 2020. A recent study conducted in 7 countries showed a prevalence of poor sleep among students worldwide and deficient sleep duration in more than one out of four students (23). These findings are in

TABLE 3 | Correlations between sleep and mental parameters.

		AIS score	FSS score	PSQI score	GAD-7 score	PHQ-9 score
AIS Score	Pearson correlation coefficient (r)	1	0.496	0.684	0.556	0.633
	p		<0.001	<0.001	<0.001	<0.001
FSS score	Pearson correlation coefficient (r)	0.496	1	0.426	0.506	0.609
	p	<0.001		<0.001	<0.001	<0.001
PSQI score	Pearson correlation coefficient (r)	0.684	0.42	1	0.487	0.566
	p	<0.001	<0.001		<0.001	<0.001
GAD-7 score	Pearson correlation coefficient (r)	0.556	0.506	0.487	1	0.704
	p	<0.001	<0.001	<0.001		0.000
PHQ-9 score	Pearson correlation coefficient (r)	0.633	0.609	0.566	0.704	1
	p	<0.001	<0.001	<0.001	<0.001	

AIS, Athens Insomnia Scale; FSS, Fatigue Severity Scale; PSQI, Pittsburgh Sleep Quality Index; GAD-7, General Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9.

accordance with other studies that describe reduced night sleep duration and sleep efficiency due to sleep disturbances (24–26). Analogous conclusions have been drawn specifically for medical students and have been linked to disturbed daytime function (27). Notably, the senior medical students experienced significantly more intensely these alterations (12). However, in other studies insignificant changes in sleep quality (28) and an overall improvement in daily performance have been reported (29). Increased daytime napping though seems to offset sleep latency, thus total sleep duration remained unaffected (24). Increased total sleep time has also been mentioned, compared to the pre-pandemic period, especially among 6th year medical students (29). In our study, however, this specific population group reported the lowest sleep duration compared to students from other academic years. This can be possibly attributed to the resumption of their clinical practice and the clinical responsibilities during the pandemic, which may be linked with fear and anxiety, as previously shown (30).

Besides sleep schedule, during the COVID-19 health crisis, the mental health of students has been significantly affected. In our study 67.6 and 43.7% of the sample reported moderate to severe symptoms of anxiety and depression respectively. According to a recent systematic review by Batra et al. (31) performed in 15 countries, anxiety and depression levels reached 39.4 and 31.2% among university students, respectively. This study was conducted almost 1 year before our study, and thus during this period the psychological distress and depression have accumulated, possibly explaining the difference in our results (31). Interestingly, in two of the studies included in this systematic review almost one out of three and two out of three students, respectively, had suicidal ideation, which is surprisingly high compared to our results (32, 33). In our study, 16.7% of the respondents suffered from recurrent suicidal thoughts, which is in accordance with previous findings (34, 35). Furthermore, during the pandemic period, a rise in depression has been noted, with its severity and prevalence varying between different studies (12, 36–38). Additionally, the prevalence of PTSD symptoms, in those studies, was similarly elevated (31), with a higher degree of anxiety being attributed to increased concern about the impact of the COVID-19 pandemic (39) and the presence of a confirmed COVID-19 case in the proximal familial and friendly environment (40). This is also the case among medical students (36, 41), who experienced analogous levels of stress and anxiety symptoms (36, 37). According to our findings, infection in the immediate environment is associated with depression in a more severe way and PTSD symptoms, mainly in females.

Published literature associating gender and mental health is inconclusive, for example in the study by Xie et al. (12), males reported depressive symptoms more frequently, whereas Liu et al. found no statistically significant difference between gender with regards to anxiety and depression (37). However, Batra et al. (31) in their systematic review found that female students experienced higher levels of anxiety and stress. These results are consistent with our study. An interesting finding was that females having experienced COVID-19 either personally or in their proximal environment were significantly more affected than their male counterparts. A possible explanation could be that women in general, are more likely to report experiencing higher levels of anxiety (42) and that they are more affected by traumatic events (31).

Another finding in our study was the positive and independent correlation between insomnia, fatigue, dysfunctional sleep, depressive and anxiety symptoms. Previous studies confirm the association between sleep abnormalities and deteriorated mental health in students during the COVID-19 health crisis (26, 36). This comes as no surprise, since similar correlations have already been established, even before the pandemic. In a cross-sectional study of 95 medical students in Saudi Arabia stress, anxiety and depression were strongly linked with poor sleep (43). It was also reported that inadequate sleep duration and consequently fatigue may affect mental health to such a degree, that recurrent suicidal thoughts and even suicidal attempts may occur more frequently (44). Additionally, it has been demonstrated, both in the general population and specifically in medical students, that insomnia can be predictive of depression and anxiety (45, 46).

In a large study of the general population in Greece, Switzerland, Austria, Germany, France and Brazil, conducted during the first wave of the pandemic, total sleep time decreased and sleep quality in general improved in participants from

Greece, compared to other countries (47). At the same time, insomnia affected 37.6% in a sample of the Greek population, which was significantly increased compared to the pre-pandemic period (48). As far as mental health is concerned, levels of anxiety and depression were notably elevated during the first COVID-19 wave. Fountoulakis et al. reported a significant increase in anxiety symptoms in over 45% and depressive symptoms in almost 40% of the participating Greek citizens (49). According to Patsali et al. major depression in the general population reached 12.43% (50). Focusing on Greek students, during the first pandemic wave, they experienced overall lower sleep quality despite an increase in their sleep duration (33). Our findings suggest an even higher prevalence of insomnia in our selected population (medical students) compared to the general population, affecting 65.9% of the participants. Kaparounaki et al. noted anxiety in 73%, depression in 60.9% and suicidal ideation in 20.2% in a Greek university sample (33). Meanwhile in a study conducted in the University of Patras by Sazakli et al., anxiety symptoms during COVID-19 pandemic decreased to 35.8% and depressive symptoms increased to 51.2% (51). Interestingly, in our study, anxiety levels were significantly higher and reached 67.6%. This also the case with our reported levels of depression, where overall 74.3% of the participants experienced it to some degree and 43.7% admitted having moderate to severe symptoms.

Our study certainly has limitations. Firstly, participation rate was relatively low; however, it is representative of the experiences of medical students since respondents came from all Greek Medical Schools. Additionally, examined parameters were assessed with the use of self-administered questionnaires in an on-line survey. On the other hand, we have used a large number of diagnostic tools, validated for the Greek population, and already used in several studies and thus are ensuring standardized results. In addition, this is, to the best of our knowledge, the first study to assess the impact of COVID-19 pandemic on sleep parameters of medical students in Greece, in association with a large series of sleep and mental health parameters.

CONCLUSIONS

In the aftermath of the COVID-19 pandemic, Greek medical students experienced, in a greater degree, sleep and mental health disorders such as insomnia, fatigue, poor sleep quality, anxiety, post-traumatic stress and depression. Thus, the need for better surveillance of students' wellbeing and subsequent counseling is even more evident now. A special focus must be given to the most affected groups such as female students.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, upon request.

ETHICS STATEMENT

The study protocol, which involved human participants, was reviewed and approved by University General Hospital of Alexadroupolis Scientific Board. The patients/participants provided their informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AE, AR, and PS designed the study and wrote the manuscript. AA and EN contributed to the interpretation of the results and provided critical feedback. All authors contributed to the article and approved the submitted version.

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Suppression May Improve Adaptation to Worry When Facing Uncertainty: Studying COVID-19 Pandemic

Ali Khatibi[1,2], Louise Sharpe[3], Mohsen Dehghani[4,5], Erfan Ghalibaf[6], Parham Hosseinchi[6], Mahdi Mazidi[7], Seyran Ranjbar[4,7], Zoha Deldar[8], Carlos Gevers-Montoro[9,10], Pouyan Alizadeh[11], Shaghayegh Alidoust[6], Arghavan Babaei[6], Fattaneh Telkabadi[6] and Tahereh Ghadiri[12,13,14]*

[1] Centre of Precision Rehabilitation for Spinal Pain, University of Birmingham, Birmingham, United Kingdom, [2] Centre for Human Brain Health, University of Birmingham, Birmingham, United Kingdom, [3] Faculty of Science, School of Psychology, University of Sydney, Sydney, NSW, Australia, [4] Department of Psychology, Shahid Beheshti University, Tehran, Iran, [5] Neuroepidemiology Unit, School of Population and Global Health, University of Melbourne, Melbourne, VIC, Australia, [6] Institute for Cognitive Science Studies, Tehran, Iran, [7] Centre for the Advancement of Research on Emotion, School of Psychological Science, The University of Western Australia, Perth, WA, Australia, [8] Department of Psychology, McGill University, Montreal, QC, Canada, [9] Department of Anatomy, Université du Québec à Trois-Rivières, Trois- Rivieres, QC, Canada, [10] Madrid College of Chiropractic—Real Centro Universitario María Cristina, Madrid, Spain, [11] Family Research Institute, Shahid Beheshti University, Tehran, Iran, [12] Department of Neuroscience and Cognition, Faculty of Advanced Medical Sciences, Tabriz University of Medical Sciences, Tabriz, Iran, [13] Neurosciences Research Centre, Tabriz of Medical Sciences, Tabriz, Iran, [14] Shefa Neuroscience Research Centre, Khatam Alanbia Hospital, Tehran, Iran

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Daria Smirnova, Samara State Medical University, Russia

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***Correspondence:**
Ali Khatibi
ali.khatibi@gmail.com

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The COVID-19 pandemic has been associated with increased uncertainty, fear and worry in everyone's life. The effect of changes in daily life has been studied widely, but we do not know how emotion-regulation strategies influence adaptation to a new situation to help them overcome worry in the face of uncertainty. Here, 1,064 self-selected Farsi speaking participants completed an online battery of questionnaires that measured fear of virus and illness, worry, intolerance of uncertainty, and emotion regulation (two subscales: reappraisal, suppression). We also documented the number of daily COVID-19 cases and deaths due to COVID-19 on the day in which participants completed the questionnaire. Our findings suggest a correlation between contamination fear and the number of daily-confirmed cases ($r = 0.11$), and the number of reported deaths due to COVID-19 ($r = 0.09$). Worry mediated the relationship between intolerance of uncertainty and fear of virus and illness ($b = 0.16$, $0.1141 < CI < 0.2113$). In addition, suppression moderated the relationship between intolerance of uncertainty and worry ($p < 0.01$). Our results suggest that suppression (at least in the short term) can be an adaptive response to the worry associated with uncertainty. Suppression can reduce worry, which in turn can decrease fear of contamination and improve adaptation to social distancing requirements. Although, the observed correlations were significant, but considering the sample size, they are not strong, and they should be interpreted cautiously.

Keywords: pandemic, intolerance of uncertainty, emotion regulation, suppression, COVID-19

INTRODUCTION

Pandemics, particularly those associated with a novel virus, affect both the mental and physical well-being of people over time (1). Given that the virus was not previously known, information from different sources was vague and unclear, and sometimes conflictual. The lack of clear and accurate information about the virus led to ambiguity about how to manage it, for both governments and individuals. As information about the virus came to light, it seemed clear that COVID-19 had a longer incubation period compared to other coronaviruses (up to 14 days) and that people were contagious prior to experiencing any symptoms. In addition, it became clear early that some people were unaffected by the virus (i.e., asymptomatic), but tested positive for COVID-19 and could transmit the virus. COVID-19 proved to be highly contagious, which led to increases in cases becoming exponential once community spread began. These characteristics heighten ambiguity making assessments of risk difficult, particularly as risk changed very rapidly in specific regions during waves of community transmission.

As a result, many jurisdictions introduced various degrees of lockdown in order to limit the spread of COVID-19. These lockdowns, while generally associated with a gradual decline in cases that allowed jurisdictions to "flatten the curve," nevertheless led to the closure of businesses, schools and other non-essential services in many places. Around the world, many people had to quarantine, many lost their jobs or had to adapt to work from home, some while supporting children in their remote learning. These mitigation measures, while effective in reducing cases of COVID-19, came at considerable expense to the social and economic circumstances of individuals in the community. Moreover, even those regions that were able to quickly stem community spread initially (e.g., Singapore, New Zealand, and Australia) have experienced "second waves" of the virus, in some cases worse than the initial wave, which adds to the uncertainty that has characterised the pandemic internationally.

There is a voluminous literature on the impact of uncertainty on people's mental health, and in particular, on their anxiety symptoms (2). Research clearly suggests that intolerance of uncertainty is a key factor in the experience of worry and anxiety (3). Indeed, research shows that in the context of COVID-19, intolerance of uncertainty is unsurprisingly associated with greater fear of COVID-19 (4) and health anxiety (5) and less positivity in the face of the pandemic (6). Ouellet et al. (7) recently tested a new model relating to the role of intolerance of uncertainty in anxiety, more generally. They hypothesised that people who have high levels of intolerance of uncertainty are more likely to worry. In particular, they proposed that the relationship between intolerance of uncertainty and worry is mediated by cognitive avoidance and other emotion regulation difficulties.

Models of emotion regulation have posited two major strategies that are central to emotion regulation: suppression and reappraisal (8). Suppression is a strategy that is typically employed to deal with stress when an individual sees the requirements of a situation as unmanageable. Suppression has consistently been found to be associated with increased worry and is a similar construct to cognitive avoidance, as operationalised in Ouellet et al. (9) model. Reappraisal, on the other hand, is a cognitive strategy that aims to view a situation in a different way that minimises resultant stress. In contrast to suppression, the use of reappraisal is associated with lower levels of anxiety. Meta-analyses confirm that suppression and cognitive reappraisal are reliably associated with anxiety as predicted, such as social anxiety disorder (10, 11). The degree, however, to which suppression and reappraisal moderate the impact of intolerance of uncertainty on worry and COVID-19-related fear has yet to be studied.

Further, in the context of health, worry is typically focused on health-related concerns, such as the experience of physical symptoms. In health anxiety, it is the interpretation of ambiguous physical symptoms as threatening that is thought to trigger health anxiety and the cascade of thoughts, emotions and behaviours that maintain heightened anxiety [see (12)]. These misinterpretations of ambiguous symptoms are frequently operationalised as anxiety sensitivity (AS), since it is often physical manifestations of anxiety that are misinterpreted (13). Research suggests that both anxiety sensitivity and intolerance of uncertainty are associated with an increase in health anxiety (14). Further, a recent study demonstrated that anxiety sensitivity was a predictor of COVID-19-related fear (15). However, the relationships between intolerance of uncertainty, anxiety sensitivity, worry and emotion regulation strategies have not been studied together as predictors of COVID-19 related fear.

The overall aim of this study was to examine relevant theoretical predictors of COVID-19 related fear, taken from models of anxiety, health anxiety and emotion regulation, as described above in a general population using an online battery of questionnaires. Considering the literature, we were interested in the examination of the relationship between intolerance of uncertainty, anxiety and emotion regulation. We hypothesised that COVID-19 related fear would be predicted by intolerance of uncertainty, anxiety sensitivity, suppression, cognitive reappraisal and worry. We further hypothesised that emotion regulation strategies would moderate the relationship between intolerance of uncertainty and worry, which would, in turn will predict COVID-19-related fear.

METHODS

Participants

Participants were recruited through advertisements in social media, including WhatsApp, Instagram, and Twitter. Participants needed to be over the age of 18, but no other exclusion criteria were applied. All participants gave informed consent electronically. A total of 1,090 participants responded to the advertisement and opened the online questionnaires, all provided complete responses. Among them, 1,064 responses were identified as unique and valid after checking the catch questions. The study was conducted in accordance with the Declaration of Helsinki. The study was approved by the Ethics Committee of the Department of Psychology at Shahid Beheshti University.

Questionnaires and Procedure

A battery of questionnaires comprised of the following questionnaires in order of appearance was presented online to participants. Three catch (attention check) questions were placed between questionnaires to assure the quality of responses. Individuals with two or more incorrect responses were excluded from the study ($n = 26$). The link to online questionnaires was shared on social media, such as WhatsApp, Instagram and Twitter, between April 8 and 20th, 2020 in Farsi. At the time of the survey in Iran, the lockdown was in place, major travel between cities was prohibited and many businesses, all the schools and universities, public places like mosques and shrines were closed. Additionally, people were advised to leave home only to get essential foodstuffs or medical attention. Based on the reports from local authorities, the total confirmed cases of COVID-19 on April 8th were 62,589 people in Iran and increased by April 20th to 82,211 positive cases. At the end of this period, 5,118 people in Iran had died from coronavirus (retrieved from: https://www.worldometers.info/coronavirus/).

Fear of Illness and Virus Evaluation

FIVE (16) is a 35-item questionnaire measuring an individual's fear of contamination and illness, fear of social distancing, behaviours related to illness and virus fear, and impact of illness and virus fears. We used this measure to assess COVID-related fear. In subscales about fear of contamination (e.g., I am afraid I might die if I get a bad illness or virus) and fear about social distancing (e.g., I am afraid I will be sad and lonely because of bad illness or virus), participants rated their fear on Likert Scale (0 = I am not afraid of this at all, 3 = I am afraid of this all the time). In the subscale on behaviours related to illness and virus fear (e.g., I ask people if they are sick), participants rated how often they have done things that show adherence to mitigation measures in the last week on a Likert scale (0 = I haven't done this in the last week, 3 = I did this all the time last week). In the subscale on the impact of illness and virus, participants rated how true a statement is about them [e.g., On average in the last week, being afraid of an illness or virus has caused me to feel very strong emotions in my body (e.g., anger, anxiety, sadness, irritable feelings, etc.)] on a Likert scale (0 = not for me at all, 3 = definitely true). This measure has been translated and validated in Iran, and the Farsi version has been proved to be a valid and reliable measure. The alpha for the total score is equal to 0.82. The alpha for each subscale is fear of contamination ($\alpha = 0.790$), fear of social distancing ($\alpha = 0.863$), behaviours related to illness ($\alpha = 0.699$), and the impact ($\alpha = 0.747$). Subjects were asked to answer the questionnaire having the COVID-19 pandemic in their mind.

Intolerance of Uncertainty Scale-Short Form (IUS-12)

Intolerance of Uncertainty Scale [IUS-12; (17)] is a 12-item scale measuring an individual's reaction to ambiguous situations, impending uncertainty, and an unknown future on a five-point Likert scale (1 = not at all characteristic of me; 5 = entirely characteristic of me) (17). The questionnaire provides a total score based on two factors namely: prospective anxiety (composed of seven items) and inhibitory anxiety (composed of five items). The Farsi version of the questionnaire has been used in several previous studies and shown to be a valid and reliable measure (18). Cronbach's alpha in the current sample was = 0.89.

Penn State Worry Questionnaire

The Penn State Worry Questionnaire [PSWQ; (19)] is a 16-item scale measuring an individual's disposition to worry, as well as the frequency, intensity, and tendency for worry. Participants rate items on a five-point Likert scale (1 = not at all typical of me; 5 = very typical of me). The questionnaire produces a total score with higher scores representing greater levels of pathological worry (19). The Farsi version of the questionnaire has been used in several previous studies and proven to be a valid and reliable measure [Cronbach's alpha = 85; (20, 21)]. Cronbach's alpha in the current sample was = 0.78.

Emotion Regulation Questionnaires (ERQ-10)

The Emotion Regulation Questionnaire [ERQ; (22)] is a 10-item scale that measures the habitual use of two emotion regulation strategies: reappraisal and suppression. Participants rate items on a seven-point Likert scale (1 = "strongly disagree," 4 = "neutral," and 7 = "strongly agree"). Higher mean scores on each of these subscales indicates that the strategy is more strongly endorsed (22). The Farsi version of the questionnaire has been used in several previous studies and has been shown to be a valid and reliable measure [Cronbach's alpha = 91, (23, 24)]. Cronbach's alpha in the current sample was = 0.75.

Anxiety Sensitivity Index (ASI-3)

The Anxiety Sensitivity Index [ASI−3; (25)] is an 18-item scale that measures the tendency to fear symptoms of anxiety resulting from the belief that such sensations could have harmful consequences. Participants rate items on a five-point Likert scale (0 = very little; 4 = very much). The physical and cognitive subscales were used for the current study. The Farsi version of the questionnaire has been used in several previous studies and has been demonstrated to be a valid and reliable measure [Cronbach's alpha = 0.90, (26)]. Cronbach's alpha in the current sample was = 0.91.

General Self-Efficacy Scale

The General Self-Efficacy Scale [GSE; (27)] scale is a 10-item scale measuring general self-efficacy as a prospective and operative construct on a four-point Likert-type scale (1 = not at all true; 4 = completely true). The scale produces a total score, with higher scores representing greater self-efficacy (27). The Farsi version of the questionnaire has been used in several previous studies and proven to be a valid and reliable measure [Cronbach's alpha = 0.85; (28, 29)]. Cronbach's alpha in the current sample was = 0.89.

Patient Health Questionnaire (PHQ-9)

The Patient Health Questionnaire [PHQ-9; (30)] is a 9-item questionnaire measuring depressive symptoms on a four-point Likert scale (0 = not at all; 3 = nearly every day). The questionnaire scores range from 0 to 27, with scores of ≥5, ≥10, ≥15, representing mild, moderate and severe levels of depressive symptoms (30). The Farsi version of the

questionnaire has been used in several previous studies and has been shown to be a valid and reliable measure [Cronbach's alpha = 0.88; (31)]. Cronbach's alpha in the current sample was = 0.87.

Data Preparation and Analyses

Data pre-processing, correlations, and group comparisons were completed in R (v 4.0.0.). SPSS (v25 statistical package IBM SPSS Statistics, Armonk, NY, USA) has been used for the remainder of the analyses. For our preliminary analyses, we calculated correlations between fear of illness and virus and other measures, as well as inter-correlations of the subscales of the FIVE. Mediation analyses were conducted in SPSS using the PROCESS macro (32). The dependent variable was fear of illness and virus. We tested whether worry mediated the relationships between intolerance of uncertainty and COVID-related fear. As such, a hierarchical regression equation was constructed with intolerance of uncertainty entered on the first step of the equation, and worry entered on the second step. This allowed the direct and indirect effects of worry to be calculated to test for mediation. Individuals who had two or more incorrect responses to the catch questions were excluded from the final analyses. This left a final sample of 1,064. In relevant analyses, age, gender, and other demographic variables have been included in the model. Where applicable, a Bonferroni correction for multiple comparisons was applied and the results reported here are after those corrections.

RESULTS

A total of 1,064 responses (97.6% of total) were identified as valid and unique (see procedure) and included in our final analyses. Among these participants, the majority identified themselves as female (n = 704; 66.2%), 357 (33.6%) identified as male and 3 (0.3%) participants as other. Nearly half of the sample were single (n = 521; 49%), 500 (47%) were married, 40 (3.8%) were divorced, and 3 (0.3%) were widowed. Participants were aged between 18 and 76 years (Mean ± SD = 34.50 ± 9.9). The sample was relatively well educated, with 16 (1.5%) participants having less education than a high school diploma, 96 (9%) having completed only a high school diploma, 406 (38.2%) having a bachelor's degree, 374 (35.2%) and the remainder having completed postgraduate qualifications (n = 172; 16.2%). The vast majority of participants (n = 900; 84.6%) did not report existing health conditions. The remainder had a range of conditions that led them to be at risk of COVID-19, such as diabetes (n = 15), MS (n = 13), cancer (n = 4), or cardiovascular disease (n = 18). All participants were Farsi speaking, 983 (92.4%) participants were living in Iran. The total number of confirmed cases, the number of daily cases at the time of completion, the total number of deaths and the daily number of deaths at the time of completion of the questionnaire was calculated by collecting the data from official publicly available stats announced on https://www.worldometers.info/coronavirus/.

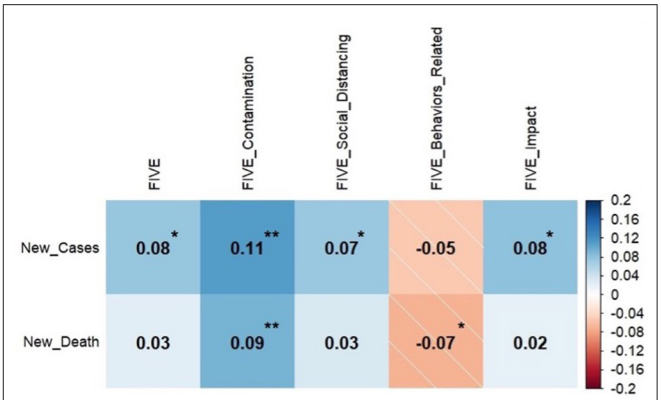

FIGURE 1 | Correlation between the number of confirmed cases and death due to COVID-19 and fear of illness and virus evaluation (N = 983, *p < 0.05, **p < 0.01).

The Effect of Place of Living on Fear of Corona Virus and COVID-19 Impact

Group comparisons revealed that participants living in Iran had a higher level of fear of contamination as measured by FIVE (n = 983; M = 5.16 ± 2.8) compared to those living outside of Iran (n = 81; M = 4.4 ± 2.8); $t_{(1,062)}$ = 2.14, p = 0.03, Cohen's d = 0.271). In addition, those who were living in Iran had a higher level of fear of the impact of COVID-19 on their lives (M = 2.6 ± 2.2) than those living abroad (M = 2.1 ± 2.2); $t_{(1,062)}$ = 1.96, p = 0.05, Cohen's d = 0.227). Based on these findings, we excluded those participants who lived outside Iran. Hence, the results are based on 983 people who responded and lived in Iran at the time of data collection.

Correlation Analysis

Figure 1 presents the between FIVE's total score and subscales' scores and the number of new cases and death at the time of completing the questionnaire. As can be seen, there is a significant positive correlation between the number of new cases, FIVE's total score, fear of contamination, fear of social distancing, and fear of the impact of the condition on the person's life. There was a positive correlation between fear of contamination and the number of announced deaths. Finally, there was a significant negative correlation between the number of new death and adherence to safe behaviours. Further correlational analysis revealed that age was significantly and negatively correlated with intolerance of uncertainty (−0.09, p = 0.004), worry (−0.11, p = 0.001), anxiety sensitivity (−0.16, p < 0.001). Age was positively correlated with emotion regulation reappraisal subscale (0.11, p = 0.001) and general self-efficacy (0.13, p < 0.001). However, all correlations were small.

All subscales of the FIVE questionnaire were intercorrelated (rs < 0.26, ps < 0.001). High correlations between the FIVE total score and subscales scores and all other measures were all identified. There were significant correlations (all ps < 0.001) between the FIVE total scores and intolerance of uncertainty (0.5), worry (0.47), emotion regulation reappraisal (−0.24),

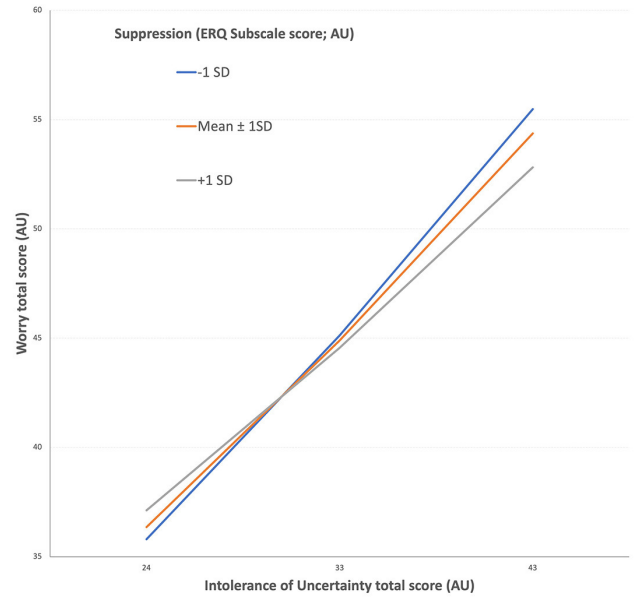

FIGURE 2 | Suppression (Emotion Regulation Questionnaire subscale, ERQ) moderates the relationship between Intolerance of Uncertainty (X axis) and Worry (Y axis). The figure displays the relationship between worry and intolerance of uncertainty among those with low, mid, and high levels of suppression. In low to medium levels of intolerance of uncertainty, high and low suppression groups don't show significant differences in worry, but in high levels of intolerance of uncertainty, higher suppression is associated with lower worry, while lower suppression is associated with higher levels of worry. AU, Arbitrary Unit.

anxiety sensitivity: physical and cognitive concerns (0.5), and general self-efficacy (−0.35). The pattern of correlation between all the FIVEs' subscales and the measures described above was the same with a similar correlation coefficient and p-values < 0.001.

In the interpretation of the findings of correlation analyses, it should be noted that considering the sample size the results (rs < 0.5) were weak to moderate. Weak to moderate correlation findings are required to be replicated in different samples and populations to be tested for their validity.

Mediation Analysis

We tested whether worry (PSWQ) mediated the relationship between intolerance of uncertainty on COVID-related fear, as measured by the total score on the FIVE. Mediation analysis (Model 4) showed that the total effect of intolerance of uncertainty on FIVE total score (path c) was significant [$F_{(1,981)} = 323.00$, $p < 0.001$, $R^2 = 0.25$; b = 0.48, $t_{(981)} = 17.97$]. The effect of intolerance of uncertainty on worry (path a) was also significant [$F_{(1,981)} = 770.09$, $p < 0.001$, $R^2 = 0.44$; b = 0.94, $t_{(981)} = 27.75$]. Worry predicted COVID-related fear (path b) (b = 0.17, $t_{(980)} = 7.02$, $p < 0.001$). The direct effect of intolerance of uncertainty on COVID-related fear remained significant (b = 0.32, $t_{(980)} = 9.12$, $p < 0.001$), but the indirect effect (path a*b) was also significant (b = 0.16, $0.1141 < CI < 0.2113$), indicating that worry partially mediated the relationship between intolerance of uncertainty and COVID-related fear. In order to ensure that the effects of our analyses were robust, we re-ran the analyses, including anxiety sensitivity and self-efficacy in the model as covariates. When we did so, the pattern of results was unchanged, with all previously significant effects remaining significant. When the above analysis repeated with the inclusion of the age and gender as covariates, no new interaction was found and the observed effects remained significant (indirect effect of IUS on COVID-related fear through worry: b = 0.15, $0.1063 < CI < 0.1997$).

Post-hoc Analyses: Moderated Mediation

Since suppression was not correlated with COVID-related fear, as we had predicted, we were interested to see whether the relationship between suppression and COVID-related fear might vary as a function of worry or intolerance of uncertainty. As such, we constructed a *post-hoc* moderated mediation analysis (Model 7) to test the moderating role of emotion suppression on the mediatory role of worry in the relationship between intolerance of uncertainty and COVID-related fear. There was a significant interaction between suppression, IUS and worry as the dependent variable [$F_{(3, 979)} = 262.92$, $p < 0.01$, b = −0.02, $t_{(979)} = -2.99$]. The indirect effect of suppression on the interaction between IUS and worry was significant for all levels of emotion suppression (see **Figure 2** below). Similarly, when age and gender were included as covariates into the above-mentioned analysis, the observed significant interaction remained significant [$F_{(5, 977)} = 168.81$, $p < 0.01$, b = −0.02, $t_{(977)} = -3.02$).

This finding suggests that higher levels of intolerance of uncertainty result in higher levels of worry when people use suppression as an emotion regulation strategy ***less***. Consistent with this, amongst those high in intolerance of uncertainty who use suppression more as an emotion regulation strategy have ***lower*** levels of worry. That is, for those with high levels of intolerance of uncertainty, suppression appeared to be a strategy that minimised worry, and in turn COVID-related anxiety.

DISCUSSION

In the current study, we examined the factors that are associated with fear in the context of the COVID-19 pandemic. We showed that the case and death rate were positively correlated with individuals' COVID-related fear. Lower adherence to mitigation measures was associated with a higher death rate as well. High fear of contamination was also associated with higher intolerance of uncertainty, lower use reappraisal for emotion regulation, and lower perceived self-efficacy. However, these correlations were small, according to the usual conventions of interpreting the size of correlations. Consistent with our hypotheses, worry mediated the relationship between intolerance of uncertainty and fear of COVID-19. Furthermore, the use of suppression as the strategy for emotion regulation moderated the relationship between intolerance of uncertainty and worry. Contrary to expectations, this shows that for those who had high levels of intolerance of uncertainty, the more they used suppression as an emotion regulation strategy, the less they tended to worry.

While the finding that worry mediated the relationship between intolerance of uncertainty and COVID-related anxiety was predicted, the fact that suppression was associated with less worry amongst those high in intolerance of uncertainty was surprising. The most robust findings in the literature regarding emotion regulation strategies demonstrate that the use of cognitive reappraisal is associated with better emotional outcomes (such as anxiety), while the use of suppression is linked to poorer emotional outcomes (22). In the context of the current pandemic, the findings of our study suggest a somewhat different relationship. That is, more use of suppression as an emotion regulation strategy was associated with a lower contribution of intolerance of uncertainty to worry. This suggests among individuals with high levels of intolerance of uncertainty, suppression may have been helpful in lowering the worry during this acute stressor. It is worthwhile noting that our study was conducted cross-sectionally at a time of high uncertainty in a new pandemic. Some studies suggest that while in short-term suppression can under some circumstances reduce the effect of uncertainty on worry. However, in the longer term, suppression can nevertheless lead to other negative outcomes, such as a worsening in self-evaluation over time (33). We cannot exclude this possibility in this cross-sectional study. On the other hand, others have proposed that the flexibility to choose an appropriate strategy for the situation might be an adaptive approach to emotion regulation (34). According to this view, in real high-risk situations where a negative outcome is likely (such as in a pandemic), the use of suppression to try and reduce worry might be helpful, even though in less dangerous situations this approach would no longer be helpful. Given that this study occurred in the early stages of a pandemic in a country where, at the time, there was very rapid community spread with high death rates, our results could be accounted for by the flexibility argument. That is, there is uncertainty, and suppression may act to reduce the focus on the realistic appraisal of uncertainty associated with COVID-19. Prospective research, however, is needed to confirm this explanation.

As predicted, worry partially mediated the relationship between intolerance of uncertainty and fear of COVID. Intolerance of uncertainty describes an individual's negative beliefs when facing uncertainty (35). Previous research in our group has demonstrated that negative interpretation bias in both clinical and subclinical populations contribute to an increase in intolerance of uncertainty (36, 37). The nature of the COVID-19 pandemic increased both actual and perceived uncertainty in society. COVID-19 is a particularly unpredictable illness with high variability in how symptoms appear from person to person, the level of immunity created in people after infection, and the long and varied incubation period. Given that worry is a cognitive phenomenon that attempts to solve a perceived problem, one might expect worry to increase when there is uncertainty related to future events (35, 38). Previous studies suggest that intolerance of uncertainty contributes to increases in worry in a non-clinical population (35), but this relationship has not been studied in the context of a real-world stressor. Results of the current study confirm that the relationship between intolerance of uncertainty, worry and fear of an illness can be extrapolated to a truly uncertain environment. We showed that while an increase in intolerance of uncertainty contributed to an increase in worry, worry contributed to an increase in COVID-related fear. These findings have important clinical implications as previous studies suggest we can influence worry, and one evidence-based method to do this would be through cognitive bias modification (CBM). Numerous studies now confirm that modification of interpretation bias can result in changes in the level of worry by reducing negative interpretations (39, 40). Indeed, both a systematic review of meta-analyses (41) and a recent network meta-analysis (42) indicate that CBM for interpretation bias is an effective method of reducing anxiety. Importantly, CBM for interpretation can be delivered online and repeated over several sessions, which makes it highly scalable. In situations like a pandemic where increased uncertainty can reliably be predicted to result in increased worry and for some individuals the development of excessive fear, CBM for interpretation could be a useful tool to reduce the impact of the pandemic on COVID-related fear. Importantly, when demographic variables such as age and gender were included into the analyses, the observes effects remained significant and direction of findings did not change. This may suggest that the observed effects are independent from the age and gender, but future studies may focus on them using designs specified to assess their impact.

Notwithstanding the specific contribution of this study to the literature, there are some limitations that need to be considered when interpreting the findings. Like all other online studies, the context and the environment in which participants completed the questionnaires was not controlled. We tried to include catch questions and excluded participants answering questions from outside of Iran to minimise the effect of different contexts. In addition, participants required the internet and knowledge related to it to access the questionnaire. This limitation resulted in the inability of specific groups that either don't have access to the internet or don't have the knowledge to work with online material, and this may have affected the generalizability of the results. Furthermore, this is a cross-sectional study, and longitudinal designs are needed to disentangle the results related to suppression in this study. Finally, factors that may contribute to behaviours in lockdown or social distancing can be more complicated to be included in a single study. Future studies may include socioeconomic factors in their study and investigate their influence.

Taken together, this study has a unique contribution to the studies on the psychological impact of COVID-19 in the general population. Our sample consisted of over 900 unique and validated responses. Our findings suggest that suppression can be an important factor in stressful conditions that may influence the adaptation of a person to the situation. That is, the use of suppression appeared to reduce worry amongst those who scored highest in intolerance of uncertainty. Hence, our findings suggest that at least for some people who find tolerating uncertainty difficult in times of uncertainty, suppression can reduce worry, and in turn COVID-related

anxiety. Furthermore, these relationships remained significant when controlling for other possible predictors of COVID-related anxiety, such as anxiety sensitivity and self-efficacy, which were themselves associated with COVID-related anxiety. This finding suggests that suppression could be a strategy that can be adaptive in environments where a real risk exists for those who find it difficult to tolerate uncertainty and high levels of uncertainty are present. Furthermore, these results confirm that worry is a proposed mechanism through which intolerance of uncertainty impacts COVID-related fear.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee at the Department of Psychology, Shahid Beheshti University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AK was involved in design, data collection, supervision, analysis, writing, and finalisation. LS and MD were involved in data analysis, design, and writing. MM, SR, ZD, CG-M, FT, PA, SA, and AB were involved in the design, data collection, and writing. EG and PH were involved in the design, data collection, analyses, and writing. All authors contributed to the article and approved the submitted version.

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ORIGINAL RESEARCH
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A Comparison of COVID-19 Stigma and AIDS Stigma During the COVID-19 Pandemic: A Cross-Sectional Study in China

Manyun Li[1], Jiang Long[2], Xuyi Wang[1], Yanhui Liao[3], Yueheng Liu[1], Yuzhu Hao[1], Qiuxia Wu[1], Yanan Zhou[4], Yingying Wang[1], Yunfei Wang[1], Qianjin Wang[1], Yuejiao Ma[1], Shubao Chen[1] and Tieqiao Liu[1]**

[1] Department of Psychiatry, and National Clinical Research Center for Mental Disorders, The Second Xiangya Hospital of Central South University, Changsha, China, [2] Shanghai Mental Health Center, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [3] Department of Psychiatry, Sir Run Run Shaw Hospital, School of Medicine, Zhejiang University, Hangzhou, China, [4] Department of Psychiatry, Hunan Brain Hospital (Hunan Second People's Hospital), Changsha, China

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Daria Smirnova,
Samara State Medical University, Russia

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Levent Kuey,
Istanbul Bilgi University, Turkey
Juan Moisés De La Serna,
Universidad Internacional de La Rioja, Spain

***Correspondence:**
Tieqiao Liu
liutieqiao123@csu.edu.cn
Shubao Chen
chenshubao@csu.edu.cn

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Objective: To understand the current situation of stigmatizing attitudes toward Coronavirus Disease 2019 (COVID-19) in China and compare it with acquired immunodeficiency syndrome (AIDS).

Methods: Convenient sampling and vignette-based methods were used to recruit participants on WeChat. A demographic form and adopted stigma scale were used to collect participants' demographic information and stigmatizing attitudes toward COVID-19 and AIDS.

Results: A total of 13,994 questionnaires were included in this study. A high portion of participants tend to avoid contact with individuals affected with COVID-19 (74.3%) or AIDS (59.0%), as well as their family members (70.4% for COVID-19 and 47.9% for AIDS). About half of the participants agreed that affected persons could not only cause problems to their own family but also have adverse effects on others (59.6% and 55.6% for COVID-19, 56.9 and 47.0% for AIDS). The agreements with statements about perceived stigma were similar but slightly higher than those about personal stigma in both COVID-19 and AIDS. Participants' agreements with all statements regarding personal and perceived stigma attitudes between COVID-19 and AIDS were all statistically significant ($p < 0.001$). Participants obtained COVID-19-related information mainly from social media (91.3%) and newspaper or television (77.1%) during the epidemic, and 61.0% of them thought information from newspapers or television was the most reliable.

Conclusion: Several similarities and differences of people's attitude toward COVID-19 and AIDS were found. Avoidance, blame, and secondary discrimination to diagnosed persons and their surrounding persons were the main representations of COVID-19-related stigma. Stigma of COVID-19 had less moral link but more public panic. Experience from HIV-related stigma reduction and prevention can be applied to reduce COVID-19-related stigma.

Keywords: COVID-19, AIDS, stigma, physical avoidance, public panic

INTRODUCTION

Novel Coronavirus Disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-COV-2). The disease spectrum caused by this virus ranges from asymptomatic, fever, cough, and fatigue to severe acute respiratory distress syndrome (ARDS), and even death (1). According to a report of 72,314 cases in China, 81% patients' symptom was sorted as mild, 14% were severe that need ventilation in an intensive care unit (ICU), and 5% were critical that had respiratory failure, septic shock, and/or multiple-organ dysfunction or failure (2). SARS-COV-2 spreads mainly via respiratory and closed contact (3) and is infectious during the latent period (4) which ranges from 2 to 14 days (median: 4–5 days) (5). As the strong infectivity (median $R_0 = 5.7$, 95% CI: 3.8–8.9) and fast transmission of SARS-COV-2 (6), COVID-19 soon spread around the world. The WHO proclaimed COVID-19 as a public health emergency and designated it a pandemic on March 11, 2020 (7). There are several vaccines available for COVID-19 which could provide protection for those older than 16 to some extent (8). However, some variations of SARS-COV-2 have been detected globally and the efficacy of vaccines has absolute marked differences (9, 10).

Stigma was first proposed by Erving Goffman in 1963, which was defined as a "sign" or an attribute that reduces an individual's status in the eyes of society (11). It was also interpreted as a mark of shame and disapproval that result in a person apart from others (12). It refers to people's negative emotional experience of disease, including personal stigma and perceived stigma. Personal stigma is a process of stereotype, prejudice, and discrimination, while perceived stigma indicates that someone is approved of the public discrimination against the group (13). Extreme fear of a disease and self-defense may be related to stigma. Mental disorders, physical disability, and emerging infectious diseases have been reported with different degrees of stigma (14). Stigma has always been a major focus throughout the pandemic of an infectious disease (3). The impact of infectious disease stigma is no less than the disease itself. Not only does it influence the patients' quality of life and social ability, but it also affects the publics' attitude toward disease prevention, service delivery, medical resource allocation, and health policymaking (15). Isolation measures were taken during the outbreak of COVID-19, which effectively decreased the morbidity and mortality of COVID-19 but may increase stigma inversely (16). Some scholars pointed that compared with other regions, people resident in the infectious area were more likely to be prejudiced and discriminated (17). The fear of getting infected of COVID-19 and self-defense might contribute to stigmatizing attitude (18), and the stigma of this infectious disease may inversely lead to delayed help-seeking. COVID-19-related stigma may pose a serious threat to COVID-19 patients and survivors, as well as their families and surrounding people. Several incidents of stigmatization, even physical violence toward patients, survivors, and medical workers, have occurred during this pandemic all around the world (19). There were numerous studies investigating sleeping disorder, anxiety, depression, post-traumatic stress disorder, and other mental disorders related since the outbreak of COVID-19; however, few have focused on COVID-19-related stigma (20). Since there is no effective therapy toward COVID-19 so far, people's attitude to COVID-19 is worth investigating.

Acquired immunodeficiency syndrome (AIDS), caused by human immunodeficiency virus (HIV), is another kind of infectious disease transmitted mainly *via* unprotected sexual activity, contaminated blood transfusion, and contaminated needles and from mother to child during pregnancy (21). Numerous studies about AIDS and its stigma have been done (22), and several systematic reviews have been published (23, 24). Previous stigma-related studies on AIDS reported that HIV-positive individuals were more vulnerable to receive stigma from others, which usually contain health, moral, and racial dimensions and promoted stigma including intrapersonal, interpersonal, and social aspects (25). Both COVID-19 and AIDS are infectious diseases with no definite therapy, and suffering from COVID-19 or AIDS will cause a certain damage to both individuals and our society. Therefore, we try to learn COVID-19 stigma by comparing with AIDS stigma, as Logie thought that we can learn the experience of studying AIDS stigma and leverage the approaches used to reduce AIDS stigma to address COVID-19 stigma (26).

Hence, we conducted this study with the aims of (1) investigating publics' stigmatizing attitudes toward COVID-19 and (2) comparing publics' stigmatizing attitudes between COVID-19 and AIDS to find the similarities and differences. From this study, we hope to provide some theoretical basis for psychological intervention toward COVID-19 stigma and further policymaking.

MATERIALS AND METHODS

Participants

Participants were recruited online, and inclusion criteria were (1) age $\geq$16, (2) can fully understand the informed consent and questionnaire, (3) willing to participate in the survey and can sign the informed consent online.

Procedures and Materials

Data were obtained using the convenient sampling method through a WeChat-based questionnaire including demographic questionnaire, a stigma scale that was adopted from the Explanatory Model Interview Catalog-Community Stigma Scale (EMIC-CSS) (27), and Depression Stigma Scale (DSS) (28). Participants' demographic information such as gender, age, education, and occupation was collected through a demographic questionnaire. The 18-item stigma-related scale consists of personal stigma aspect and perceived stigma aspect with nine items separately (seen in **Supplementary Table S1**) and was used to measure participants' stigma attitudes toward COVID-19 and AIDS. A vignette-based survey method was used in this study. A hypothetical case diagnosed with

COVID-19 and a case diagnosed with AIDS were listed separately, followed by 18 questions evaluating participants' personal and perceived stigma toward the hypothetical case. Participants were asked to choose their own answers from "strongly agree," "agree," "uncertain," "disagree," and "strongly disagree." The vignettes and stigma-related questions were as follows.

Vignette of COVID-19: "Li Ming (pseudonym) has been living in Wuhan. After the outbreak of COVID-19, he consciously isolated himself at home and wore a mask when he went out occasionally. Li Ming recently had a fever, cough and other symptoms. He was diagnosed with new coronavirus pneumonia and has been hospitalized. Li Ming did not know he was infected with the virus until he has been diagnosed."

Vignette of AIDS: "Zhang Yi (pseudonym) has been living in Wuhan. After the outbreak of the COVID-19, he consciously isolated himself at home and wore a mask when he went out occasionally. Zhang Yi recently had a fever, fatigue and other symptoms. He was diagnosed with AIDS and has been hospitalized. Zhang Yi did not know he was infected with HIV until he has been diagnosed."

Public's personal stigma attitudes were measured by the following nine questions: (1) If I were him, I would prefer to keep people from knowing about my situation; (2) I'm not willing to provide home service (such as delivery) for him or visit his home; (3) I think that he was affected by the disease because of his carelessness; (4) I think that his situation will cause problems to his family; (5) I think that his situation will have an adverse effect on others; (6) I will look down on him; (7) I try to avoid contact with him, especially physical contact; (8) I try to avoid contact with his family; and (9) I will look down on his family because of his situation.

Public's perceived stigma attitudes were measured by replacing "I think/will…" with "Most people think/will…" of the above nine questions.

We also investigated the usual source that participants used to get the COVID-19-related knowledge during the epidemic to estimate the role of each medium in spreading information.

Ethical Considerations

The study protocol was approved by the Ethics Committee of Second Xiangya Hospital, Central South University. Informed consents were listed on the first page of the questionnaire independently. Before answering questions, potential participants were asked to read informed consents carefully and determined whether they were willing to participate in this study. Those who click "yes" would obtain the whole questionnaire to complete, while others were displayed an end page of this study and appreciation.

Statistical Analysis

Frequency and percentage were used to describe demographic data while percentage frequencies and 95% confidence interval (CI) were computed for stigma items. Categories of "strongly agree" and "agree" were merged into "agreement" for descriptions. A paired *T*-test was used to compare participants' stigmatizing attitudes between the two vignettes. All data analyses were conducted in SPSS 25.0, and $p < 0.05$ was considered as statistically significant.

TABLE 1 | Demographic characteristics of participants ($N = 13,994$).

	n	(%)
Gender		
Male	7,757	55.4
Female	6,237	44.6
Age	30.4 ± 9.6	
Residence		
Countryside	4,765	34.1
City	9,229	65.9
Residence during the epidemic		
Hubei province	1,864	13.3
Other province in China except Hubei	12,017	85.9
Overseas	113	0.8
Education (years)		
≤9	901	6.4
≤12	5,352	38.3
≤16	6,273	44.8
>16	1,468	10.5
Marriage		
Single	5,968	42.6
Married	7,423	53.1
Others (divorced/widowed)	603	4.3
Income per year (thousand)		
≤50	5,815	41.6
60–100	5,256	37.6
110–190	2,091	14.9
≥200	832	5.9
Occupation		
Clinical staff	1,790	12.8
Civil servant	964	6.9
Employees	4,517	32.3
Medical students	1,017	7.3
Non-medical students	1,783	12.7
Self-employed	2,999	21.4
Others	924	6.6

RESULTS

Demographic Information

In total, 19,355 questionnaires were collected and 5,341 were excluded after manual review. The screening principles were as follows: (1) <2 s to finish each item, (2) ≥2 questionnaires from the same IP (only the first one was retained), (3) obvious errors, e.g., a 17-year-old person chooses "married" in the marriage item. Finally, 13,994 participants (55.4% male) were included with the efficiency of 72.3%. The average age was (30.44 ± 9.63) (x ± s); 65.9% of the participants were from city. Over 54.3% participants were with the educated year longer than 12 years, and 13.3% were residents in Wuhan province during the epidemic. More demographic details are seen in **Table 1**.

Personal Stigma Toward COVID-19 and AIDS

Participants' own attitudes toward COVID-19 and AIDS are presented in **Table 2**. Participants were most likely to agree to avoid contact either with people diagnosed with COVID-19 or with their family members, as 74.3% participants strongly agreed or agreed to avoid contact with people diagnosed with COVID-19 and 70.4% strongly agreed or agreed to avoid contact with their family, while 59.0 and 47.9% participants tended to avoid contact with individuals diagnosed with AIDS and their families. Participants' agreements with the above two statements between COVID-19 and AIDS were significantly different. The third highest agreed statement toward COVID-19 was "I think his situation will cause problems to his family" (59.6%), while 56.9% endorsed with the statement toward AIDS. There was also a high proportion of participants that thought that sufferers would have an adverse effect on others (55.6% for COVID-19 and 47.0% for AIDS). Endorsement with unwillingness to provide home service (such as delivery) or visit his home was 39.5% for COVID-19 and 35.1% for AIDS patients. Participants' agreement with keeping people from knowing their situation was 21.2% for COVID-19 and 38.4% for AIDS. Belief that suffering from COVID-19 or AIDS was patients' own fault was 23.0% for COVID-19 and 39.3% for AIDS. Agreement with the statement that they would look down upon the individuals with disease was 11.6% for COVID-19 and 17.8% for AIDS. Even 14.5% participants for COVID-19 and 17.8% for AIDS agreed that they would look down on patients' family because of the patients' situation. Participants' agreements with all of the above statements about their own attitudes between COVID-19 and AIDS were statistically significant ($p < 0.001$).

Perceived Stigma Toward COVID-19 and AIDS

Participants' agreements with statements about public attitudes are described in **Table 3**. Over 70% participants tended to agree that others would try to avoid contact with COVID-19 individuals (76.4%) and their family (74.3%), while the proportions of agreements in vignette of AIDS were 61.3% for individuals and 49.8% for their family. In the COVID-19 vignette, most participants agreed that the patients would cause problems to their family (64.0%) and have side effects on others (59.2%), while in the AIDS vignette, the percentages of agreement were 59.9 and 53.5%, separately. Belief that most people were unwilling to provide home service (such as delivery) for the individual or visit his home was 51.6% for COVID-19 vignette, and 43.2% for AIDS vignette. More detailed information is described in **Table 3**. Participants' agreements with all of the above statements about most other people's attitudes between COVID-19 and AIDS were also statistically significant ($p < 0.001$).

Usual Source to Get COVID-19-Related Knowledge

Participants received COVID-19-related information was mainly from social media (91.3%), newspaper or television (77.1%), initiative network inquiring (53.7%), and community publicity (32.6%) during the epidemic. Among that, over 60% of participants obtained most of the information from social media while 61.0% participants regarded the newspaper and television as the most reliable resource; details are listed in **Table 4**.

DISCUSSION

This study explored publics' stigmatizing attitudes toward COVID-19 during the epidemic and compared it with stigmatizing attitudes toward AIDS. The results showed that for COVID-19 beliefs about avoiding contact with individuals with COVID-19 and their families, individuals with COVID-19 would cause problems to or have an adverse effect on their families and others were much higher than other statements either in personal stigma or perceived stigma. For perceived stigma, unwillingness to provide home service or visit the home of individuals with COVID-19 was also among the highly agreed statements. Participants' highly agreed statements toward AIDS were similar with COVID-19 but had a slightly lower proportion, which were significantly different.

In the personal stigma dimension of COVID-19, people tend to keep distance with individuals diagnosed with COVID-19, which is in accordance with the study by Sing Lee (29); they found that social distance might be related to severe acute respiratory syndrome (SARS) stigma. As close contact was one of the common transmission methods of COVID-19 (30), the Chinese government took several effective measures to stop people from contacting each other immediately after the outbreak of COVID-19, such as isolation, social distancing, community containment, and travel restriction (3). These policies effectively lower the transmission rate of COVID-19 but may produce stigmatization at the same time. Isolated individuals are more likely to suffer from stigmatization and social rejection (31). Some researchers claimed that stigma might negatively affect those with COVID-19 as well as their families, friends, caregivers, and communities (3). They might be experiencing "secondary" or "associative" stigma (32). There were several reports about COVID-19-related stigma to healthcare providers. In this study, numerous participants reported unwillingness to provide home service, which is similar to the existing views that the stigmatized group may experience stigmatizing behaviors such as isolation, refusal to provide service, and bullying (33). A relieving discovery was the low agreements about the statement of "I will look down on him or his family." This may be because COVID-19 spreads mainly through respiratory, and stigmatization against an individual is relatively lower than avoiding physical contact. It should be noted that in this study, 21.2% participants tended to keep it a secret if they were diagnosed with COVID-19, which can seriously expand the transmission and mislead the government into making wrong decisions about the epidemic and increase the difficulty of epidemic control.

In perceived stigma dimension, agreements with statements about COVID-19 were roughly similar to the statements described in personal stigma, but the proportion of each statement was slightly higher. That might be because people tend

TABLE 2 | Percentage and 95% CI of participants who "agree" or "strongly agree" with statements about their own attitudes toward the person described in the vignette ($N = 13,994$).

Statements	COVID-19		AIDS		p^a
	n	%	*n*	%	
If I were him, I would prefer to keep people from knowing about my situation	2,968	21.2 (20.6–21.9)	5,368	38.4 (37.6–39.2)	<0.001
I will look down on him	1,627	11.6 (11.1–12.2)	2,485	17.8 (17.1–18.4)	<0.001
I think his situation was caused by his own fault	3,224	23.0 (22.3–23.7)	5,502	39.3 (38.5–40.1)	<0.001
I think his situation will cause problems to his family	8,340	59.6 (58.8–60.4)	7,962	56.9 (56.1–57.7)	<0.001
I will look down on his family because of his situation	2,035	14.5 (14.0–15.1)	2,403	17.2 (16.5–17.8)	<0.001
I think his situation will have an adverse effect on others	7,779	55.6 (54.8–56.4)	6,704	47.0 (46.2–47.8)	<0.001
I will try to avoid contact with him, especially physical contact	10,401	74.3 (73.6–75.0)	8,254	59.0 (58.2–59.8)	<0.001
I will try to avoid contact with his family	9,853	70.4 (69.7–71.2)	6,575	47.9 (47.1–48.7)	<0.001
I am not willing to provide home service (such as delivery) for him or visit his home	5,523	39.5 (38.7–40.3)	4,912	35.1 (34.3–35.9)	<0.001

[a] *The p value of paired-t test.*

TABLE 3 | Percentage and 95% CI of participants who "agree" or "strongly agree" with statements about most others people's attitudes toward the person described in the vignette ($N = 13,994$).

Statements	COVID-19		AIDS		p^a
	n	%	*n*	%	
Most people think he would prefer to keep people from knowing about his situation	3,382	24.2 (23.4–24.9)	6,389	45.7 (44.8–46.5)	<0.001
Most people will look down on him	2,343	16.7 (16.1–17.4)	4,431	31.7 (30.9–32.4)	<0.001
Most people think that his situation was caused by his own fault	5,527	39.5 (38.7–40.3)	7,597	54.3 (53.5–55.1)	<0.001
Most people think that his situation will cause problems to his family	8,951	64.0 (63.2–64.8)	8,379	59.9 (59.1–60.7)	<0.001
Most people will look down on his family because of his situation	2,608	18.6 (18.0–19.3)	3,442	24.6 (23.9–25.3)	<0.001
Most people think that his situation will have an adverse effect on others	8,288	59.2 (58.4–60.0)	7,388	53.5 (52.7–54.3)	<0.001
Most people try to avoid contact with him, especially physical contact	10,688	76.4 (75.7–77.1)	8,579	61.3 (60.5–62.1)	<0.001
Most people try to avoid contact with his family	10,399	74.3 (73.6–75.0)	6,976	49.8 (49.0–50.7)	<0.001
Most people aren't willing to provide home service (such as delivery) for him or visit his home	7,224	51.6 (50.8–52.5)	6,050	43.2 (42.4–44.1)	<0.001

[a] *The p value of paired-t test.*

TABLE 4 | Usual source that participants got COVID-19 related knowledge during the epidemic (*n*, %).

	Newspapers/TV	Social media	Initiative network inquiring	Community publicity
Channels to get epidemic information	10,786 (77.1)	12,777 (91.3)	7,514 (53.7)	4,556 (32.6)
Channel to obtain most of the information	3,169 (22.6)	8,441 (60.3)	1,860 (13.3)	524 (3.7)
The most reliable channel	8,535 (61.0)	3,685 (26.3)	1,185 (8.5)	589 (4.2)

to answer the questions in an acceptable way to cater to public requirements (34).

AIDS stigma has been investigated by many scholars. In this survey, we found a number of similarities and differences between AIDS and COVID-19 stigma. A large proportion of participants were inclined to agree with avoidance of patients and their surrounding people and hold the opinion that patients would encumber others. This might be due to the similarity of infectivity and the psychological perspective that the negative emotions aroused by the two diseases generate similar patterns of stigmatization (35). Participants were more likely to keep it a secret if they suffered from AIDS compared with COVID-19 for both personal and perceived stigma. Policy and moral condemnation may contribute to this difference. The Chinese government has already made some punishment policies to reduce the incidence of concealment and omission during the pandemic of COVID-19. Ways of transmission are quite different between these two diseases—primarily sexual and blood-to-blood for AIDS and primarily droplet transmission for COVID-19 (3). Hence, AIDS is usually conceptually linked to morality and equated with sexual promiscuity, homosexuality, drug abuse, and personal irresponsibility (36), while people with COVID-19 are less morally condemned. A higher proportion of participants thought that individuals with AIDS were more likely to be responsible for their situation and be looked down upon, but they may cause less problem to others compared with people with COVID-19. This might also relate to the different transmission methods of the two diseases and may indicate that stigma of COVID-19 had less moral link but more public panic.

Public response is closely related to the information they get and media report. Media report can powerfully influence public attitudes. Social media and newspapers/TV are the main usual source for the public to get information about COVID-19. Social media could affect people's attitudes of risk perception while legacy media could affect public perceptions of protective behaviors. When the COVID-19 crisis was reported on TV or social media, some information might be misunderstood. Misinformation and rumors may produce public anxiety and panic and lead to a series of related behaviors such as prohibiting medical workers from going back home for fear of being infected. These media platforms are supposed to enhance public awareness without increasing fear and panic (37). Hence, measures should be taken to ensure the correct dissemination of information and reduce rumors during and after the pandemic.

In the present era, increasing our ability to reduce the stigmatization associated with emerging infectious diseases is required in controlling such diseases. A variety of methods have been taken with the attempt to reduce stigmatization associated with AIDS, such as basic public education about AIDS, publicized symbolic acts by public leaders or famous people, media campaigns, and designation of December 1 as World AIDS Day. These efforts have achieved some success (38). Our study showed many similarities between COVID-19-related stigma and AIDS-related stigma; therefore, we could use the anti-AIDS-related stigma approaches to reduce COVID-19 stigma. Anti-stigma approaches toward mental disorders could also be considered. A pilot study on an anti-stigma course toward mental disorders, which consisted of three components, namely, social contact, role-playing, and critical reflection strategies, showed that participants' stigma attitudes were significantly reduced after the 18-week anti-stigma course (39). Another study examining the potential impact of an anti-stigma intervention on help-seeking attitudes, which included education about depression, information about help-seeking, and contact with a person with lived experience, showed improvements in help-seeking attitudes (40). Our data indicate that providing accurate COVID-19-related information through social media and newspapers/TV may be effective as these are the main sources they used to get COVID-19-related information. Public education may be another useful approach, and the above-mentioned participants' highly agreed statements should be taken into consideration.

To our knowledge, this is the first study to compare COVID-19 related stigma with AIDS related stigma. This survey has some limitations that need to be noticed. Firstly, convenience sampling method was used to collect data from the public by anonymous internet questionnaires, which might be the major limitation. Compared with random sampling method, convenience sampling method might easily lead to sampling error and bias, so that our respondents cannot represent well the population level. The sampling error may lead to inaccuracy conclusions. However, we tried to get as large a sample size as we can and be more cautious with our conclusions in order to avoid inaccuracy conclusions. Secondly, this was a cross-sectional study conducted during the pandemic, which can only reflect participants' attitude toward COVID-19 during the outbreak in China. Public's attitudes toward COVID-19 may change as we know more about this disease; we now are conducting a follow-up study to further investigate it. Thirdly, COVID-19 and AIDS are both infectious diseases but differ in transmission. There is no definite answer to whether the stigmatizations between these two diseases are completely comparable. A previous study has compared Chinese health professionals' attitudes toward patients with AIDS vs. patients with hepatitis B and found that health professionals had negative biases against AIDS patients and less willingness to interact with AIDS patients compared with hepatitis B patients (41), which indicates that stigmatizing attitudes toward COVID-19 and AIDS may be comparable to some extent. Logie also pointed out that we can use the experience of studying AIDS-related stigma and the approaches used in order to explore COVID-19-related stigma (26). Fourthly, we did not compare publics' stigma toward COVID-19 with stigma against non-communicable diseases such as mental disorders in this study. More efforts will be made to the comparison mentioned above in our future study. Another limitation is that the scale we used was adopted from the Explanatory Model Interview Catalog-Community Stigma Scale, which may not evaluate all aspects of COVID-19-related stigma. Hence, we just illustrate COVID-19-related stigma by describing the proportion of agreement with statements of the listed stigma-related items. Further non-convenience sampling and longitudinal study should be done to investigate more aspects of COVID-19-related stigma.

CONCLUSIONS

Several similarities and differences in people's attitude toward COVID-19 and AIDS were found in this cross-sectional study. Avoidance, blame, and secondary discrimination to diagnosed persons and their surrounding persons were the main representations of stigma. Stigma of COVID-19 had less moral link but more public panic. Social media, television, and newspapers played a cardinal role in dissemination during the pandemic. Experience from AIDS-related stigma reduction and prevention can be applied to reduce COVID-19-related stigma. Social media, television, and newspapers should be made the best use, and the abovementioned highly agreed statements should be taken into consideration in further anti-stigma campaigns.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The study protocol was approved by the Ethics Committee of Second Xiangya Hospital, Central South University. Informed consents were listed on the first page of the questionnaire independently. Before answering questions, potential participants were asked to read informed consents carefully and determined whether they were willing to participate in this study. Those who click yes would obtain the whole questionnaire to complete while others were displayed an end page of this study and appreciation.

AUTHOR CONTRIBUTIONS

This study was conceptualized by TL, SC, YaL, and XW. The database was organized by YZ, YiW, YM, and YuL. Data analysis was done by ML and YuW. The manuscript with inputs was drafted by ML and YH. Reviewed by TL, SC, and JL. All authors read and approved the final manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.782501/full#supplementary-material

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COVID-19 Vaccine-Related Psychological Stress Among General Public in China

Yong-Bo Zheng[1,2†], Jie Sun[1,3†], Lin Liu[1†], Yi-Miao Zhao[4,5], Wei Yan[1], Kai Yuan[1], Si-Zhen Su[1], Zheng-An Lu[1], Yue-Tong Huang[1], Lin Liu[4,5], Na Zeng[4,5,6], Xi-Mei Zhu[1], Yi-Miao Gong[1], Xiao Lin[1], Shi-Qiu Meng[4], Samuel Yeung Shan Wong[7], Mao-Sheng Ran[8], Jie Shi[3], Le Shi[1], Thomas Kosten[9,10,11,12], Yan-Ping Bao[4,5*] and Lin Lu[1,2,4*]*

[1] NHC Key Laboratory of Mental Health (Peking University), National Clinical Research Center for Mental Disorders (Peking University Sixth Hospital), Peking University Sixth Hospital, Peking University Institute of Mental Health, Beijing, China, [2] Peking-Tsinghua Centre for Life Sciences and PKU-IDG/McGovern Institute for Brain Research, Peking University, Beijing, China, [3] Pain Medicine Center, Peking University Third Hospital, Beijing, China, [4] National Institute on Drug Dependence and Beijing Key Laboratory of Drug Dependence, Peking University, Beijing, China, [5] School of Public Health, Peking University, Beijing, China, [6] Beijing Friendship Hospital, Capital Medical University, Beijing, China, [7] JC School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong, Hong Kong SAR, China, [8] Department of Social Work and Social Administration, University of Hong Kong, Hong Kong, Hong Kong SAR, China, [9] Department of Psychiatry, Baylor College of Medicine, Houston, TX, United States, [10] Department of Pharmacology, Baylor College of Medicine, Houston, TX, United States, [11] Department of Neuroscience, Baylor College of Medicine, Houston, TX, United States, [12] Department of Immunology, Baylor College of Medicine, Houston, TX, United States

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***Correspondence:**
Yan-Ping Bao
baoyp@bjmu.edu.cn
Lin Lu
linlu@bjmu.edu.cn
Thomas Kosten
kosten@bcm.edu

[†] These authors have contributed equally to this work

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Background: The COVID-19 pandemic is our generation's greatest global challenge to our public health system. Vaccines are considered one of the most effective tools available for preventing COVID-19 infection and its complications and sequelae. Understanding and addressing the psychological stress related to COVID-19 vaccination may promote acceptance of these vaccines.

Methods: We conducted an online survey from January 29 to April 26, 2021 to explore stress levels related to COVID-19 vaccination among the general public in China. Participants were asked to evaluate their psychological stress of considering whether or not to get vaccinated at the beginning period of the COVID-19 mass vaccination, after getting access to the information about the vaccine, as well as after getting vaccinated, using visual analog stress scale. Multiple linear regression analysis was performed to explore factors potentially associated with COVID-19-related psychological stress levels before and after getting vaccinated.

Results: A total of 34,041 participants were included in the final analysis. The mean stress score concerning COVID-19 vaccination was 3.90 ± 2.60 among all participants, and significantly decreased over time. In addition, the vaccine-related stress level significantly decreased after accessing information about the COVID-19 vaccine (N = 29,396), as well as after getting vaccinated (N = 5,103). Multivariable regression analysis showed higher stress levels related to COVID-19 vaccination in participants who were younger, having lower education level, having history of chronic diseases, mistrusting vaccine's efficacy, experience of vaccine allergy events, being affected by the COVID-19 epidemic, and having mental illness symptoms. Moreover, mistrust in vaccine efficacy and experience of vaccine allergy events had a long-term impact on psychological stress levels about COVID-19 vaccination even after getting vaccinated.

Conclusions: The current findings profiled the COVID-19 vaccine-related psychological stress among the general public in China. Population-specific management and interventions targeting the stress related to COVID-19 vaccination are needed to help governments and policy makers promote individual's willingness to get vaccinations for public well-being during the COVID-19 pandemic.

Keywords: COVID-19 vaccine, psychological stress, vaccination, health knowledge, general public, China

INTRODUCTION

The COVID-19 pandemic is our generation's greatest global challenge to our public health system. As of October 15th, 2021, over 239.4 million people were infected and over 4.8 million individuals were dead of COVID-19 worldwide (1). In China, the number of confirmed infectors was 125.2 thousand, and the number of deaths was about 5.7 thousand as of October 17th, 2021 (2). The Chinese government has implemented timely and effective containment measures since the outbreak of the COVID-19 pandemic, thus the pandemic was long term well-controlled since March 2020 (2). Vaccines are considered one of the most effective tools available for preventing COVID-19 infection and its complications and sequelae (3). Since the first human clinical trial of a COVID-19 vaccine commenced on March 3rd, 2020 (4), a total of 296 COVID-19 vaccines have been developed as clinical and pre-clinical candidates by August 20th, 2021 (1). Despite the validated safety and efficacy of several COVID-19 vaccines, public concern about potential adverse events associated with vaccines still exists (5–7), and affects individuals' willingness, hesitance and refusal to get COVID-19 vaccination (8, 9). Reducing psychological stress or concerns about COVID-19 vaccine would foster confidence and acceptance of vaccination (10). Therefore, it is important to understand COVID-19 vaccine-related stress and identify vulnerable populations with a high stress level to achieve vaccination campaigns success.

Information about COVID-19 vaccine was widely publicized by expert professionals, social media, and government (11, 12). Fake news and insufficient information about COVID-19 vaccine were one of the main causes of adverse psychological responses, and sufficient and transparent news may potentially relieve the associated psychological stress and promote the acceptance of vaccination in some countries (12–14). However, it is unclear how public attitudes toward and psychological stress about COVID-19 vaccines will change when faced with the spread of large amounts of conflicting information about the COVID-19 vaccine (15, 16). It is imperative to profile the details of the psychological stress about COVID-19 vaccination and to explore associated risk factors at the early stages of mass vaccination in China, a country with the largest population in the world.

The World Health Organization declared that over 6.49 billion vaccine doses were already administrated worldwide by October 14th, 2021 (1), and the Chinese government officially announced the number had reached 2.23 billion doses by October 16th, 2021 in China (17). With a substantial number of participants getting vaccinated, their psychological status after vaccination should also be monitored. Despite COVID-19 vaccines being safe for most people aged 18 years and older, rare adverse events still occur. Mild side effects, such as arm soreness, mild fever, tiredness, and headaches are reported after vaccination (18, 19). Moreover, the efficacy of vaccines had not been well-validated in general public before mass vaccinations, and the debate on the efficacy continued even among people who got vaccinated (20). Understanding, describing and addressing the change of psychological stress levels after taking the COVID-19 vaccine among the general public may help the government and policy makers to provide comprehensive and accurate information to those who are hesitant or resistant to getting vaccinated, and build up their confidence in the ongoing vaccination campaign. However, to our knowledge, no current studies have investigated the general public's COVID-19 vaccine-related psychological stress after getting vaccinated.

Based on these considerations, this study had three objectives. First, we sought to identify psychological stress levels and risk factors associated with COVID-19 vaccination when considering getting vaccinated among the general population in China. Second, we sought to determine the influence of accessing information about COVID-19 vaccines on the psychological stress level about vaccination in the general populations. Third, we aimed to explore the change in COVID-19 vaccine-related psychological stress before and after vaccination, as well as to distinguish vulnerable individuals for continued COVID-19 vaccine-related psychological stress after getting vaccinated.

METHODS

Study Design

This was a cross-sectional, nationwide study conducted via an online survey from January 29 to April 26, 2021, a period when mass vaccination was conducted in China. A self-report questionnaire was designed to investigate COVID-19 vaccine-related psychological stress level among the general public in China, and delivered through Joybuy (http://www.jd.com/), as detailed elsewhere (21, 22). Joybuy platform provides online health products and services with 0.50 billion active users in March, 2021 in China. The study followed the American Association for Public Opinion Research (AAPOR) reporting guidelines and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. It was approved by the ethics committee of Peking University Sixth Hospital (Institute of Mental Health). Written informed

consent was received online before the respondents began the questionnaire.

Participants

The respondents were all registered members of Joybuy. A total of 74,588 individuals clicked on the survey link, and 34,291 respondents provided informed consent and submitted the questionnaires. Among 34,291 respondents, 4,203 of them provided repeated surveys, and merely the former one was reserved. Two hundred and fifty respondents who were younger than 18 years, were also excluded because obtaining online informed consent from their parents may be not realistic. Finally, a total of 34,041 respondents were included, with the response rate of 46.0% and the effective rate of 99.3%.

Outcome Measures

The primary outcomes were psychological stress scores, assessed using a visual analog stress scale (23). The stress score ranged from 0 to 10 points, in which 0 represented no stress level and 10 indicated highest level of stress. All participants were asked to evaluate their psychological stress of considering whether or not to get vaccinated at the beginning period of the COVID-19 mass vaccination. Participants who proactively accessed information about the COVID-19 vaccine were asked to evaluate their psychological stress levels after getting access to the information about the vaccine. Moreover, the psychological stress levels of COVID-19 vaccine after getting vaccinated were evaluated among the vaccinated participants.

Additionally, participants were asked to report their sources of stress of considering whether or not to get vaccinated, with the following multiple-choices (16, 24, 25): adverse effects after vaccination of themselves or their families; information about severe adverse effects caused by the vaccine; coverage of vaccine safety incidents reported by the media; misinformation about vaccine-related research reported by the media. The vaccinated populations were also asked to report their sources of stress after getting vaccinated, with the following multiple-choices (24, 25): adverse effects after vaccination of themselves or their families; the efficacy of the vaccine; the safety and quality of the vaccine.

Covariates

The covariates could be briefly categorized into the following five parts: (1) demographic characteristics and medical conditions, including gender, age, living area (urban vs. rural), education attainment, marital status, and monthly family income, history of chronic diseases, history of mental disorders, and family history of mental disorders; (2) experiences related to the COVID-19 epidemic, including suspect or confirmed infection, infection status of family members or friends, participation in frontline work, job loss due to the COVID-19 epidemic, risk in epidemic regions, experience of quarantine, self-evaluated risk of getting infected, as well as attitudes toward the epidemic in China; (3) information related to the COVID-19 vaccine, including trust in its efficacy after getting vaccinated, experience of being actively involved in getting flu vaccinations, family members experience of being actively involved in getting flu vaccinations, and history of allergic events from previous vaccinations; (4) current mental status: anxiety, depression, insomnia, and posttraumatic stress disorder (PTSD) symptoms; (5) investigation period. According to previous literature (21, 26), cutoff scores of 5 for the Generalized Anxiety Disorder−7 scale, 5 for the Patient Health Questionnaire−9, 8 for the Insomnia Severity Index, and 33 for the Posttraumatic Stress Disorder Checklist for DSM-5 were adopted to detect symptoms of anxiety, depression, insomnia, and PTSD.

Statistical Analysis

Descriptive statistics were used to present demographic data as well as the sources of psychological stress associated with COVID-19 vaccination. Among all participants, one-way analysis of variance (ANOVA) was used to compare differences of the psychological stress levels among the 3 time groups (Jan. 29–Feb. 28 vs. Mar. 1–Mar. 30 vs. Apr.1–Apr.26). For vaccinated participants, the two-way repeated measures ANOVA with one between-subjects factor (3 time groups: Jan. 29–Feb. 28 vs. Mar. 1–Mar. 30 vs. Apr.1–Apr.26) and one within-subject factor (before vaccination vs. after vaccination) was used to test the differences of psychological stress levels before and after getting vaccinated COVID-19 vaccine at 3 time period. Similarly, repeated measures ANOVA was used to test the differences in psychological stress levels before and after accessing information at 3 time period. Bonferroni *post hoc* analysis was further conducted when the interaction was statistically significant, and *p* values were adjusted using Bonferroni correction with the level of significance of $p < 0.05$ for the comparison.

The mean scores and standard deviation of psychological stress levels associated with COVID-19 vaccination before and after getting vaccinated were calculated and presented in different populations. Analysis of variance and independent *t*-tests were used to compare the psychological stress levels of COVID-19 vaccination before and after getting vaccinated among stratified populations. To explore factors potentially associated with COVID-19-related psychological stress levels before and after getting vaccinated, multiple linear regression analysis was performed, and β values and 95% CIs are presented. No statistical method to handing missing data was used in this analysis because of the limited missing data. Respondents with missing data were furtherly excluded in the multiple linear regression analysis. All of the variables that were statistically significant in the unadjusted model were entered into the multivariable models that explored risk factors associated with vaccine-related stress before and after getting vaccinated. Multicollinearity between the independent variables was checked by calculating the variance inflation factor (VIF), and VIF > 5 indicated multicollinearity (27). Separate models excluding highly correlated covariates were performed if included independent variables were multicollinear. The level of significance was $p < 0.05$. All of the statistical analyses were performed using SPSS statistical software version 22 (IBM Corp).

RESULTS

Demographic Characteristics

34,041 participants from 34 provinces in China were included in the final analysis, of whom 40.4, 51.1, and 8.5% responded

TABLE 1 | Characteristics and population-stratified COVID-19 vaccine-related psychological stress level when considering vaccine uptake among all participants.

Factors	Total, no. (%)	Stress score (*SD*)	*P*
Overall	34,041 (100.0)	3.90 (2.60)	
Gender			0.842
Female	18,309 (53.8)	3.90 (2.55)	
Male	15,732 (46.2)	3.89 (2.66)	
Age			<0.001
18–39 years	20,727 (60.9)	3.96 (2.61)	
40–59 years	12,713 (37.3)	3.82 (2.57)	
≥60 years	601 (1.8)	3.50 (2.67)	
Living area			0.992
Urban	26,942 (79.1)	3.90 (2.59)	
Rural	7,099 (20.9)	3.90 (2.63)	
Level of education			<0.001
Less than college	7,084 (20.8)	4.04 (2.67)	
College degree or higher	26,957 (79.2)	3.86 (2.58)	
Marital status			0.951
Married	26,392 (77.5)	3.90 (2.59)	
Unmarried	7,649 (22.5)	3.90 (2.64)	
Monthly family income, ¥[a]			<0.001
0–4,999	8,438 (24.8)	4.09 (2.68)	
5,000–11,999	15,961 (46.9)	3.91 (2.57)	
≥12,000	9,642 (28.3)	3.71 (2.58)	
History of chronic diseases			<0.001
No or unknown	30,938 (90.9)	3.87 (2.60)	
Yes	3,103 (9.1)	4.14 (2.62)	
History of mental disorders			<0.001
No or unknown	33,873 (99.5)	3.89 (2.60)	
Yes	168 (0.5)	4.90 (2.76)	
Family history of mental disorders			<0.001
No or unknown	33,614 (98.7)	3.89 (2.60)	
Yes	427 (1.3)	4.78 (2.73)	
Have you been infected with COVID-19?			<0.001
No	33,937 (99.7)	3.89 (2.60)	
Suspect or confirmed infected	104 (0.3)	5.13 (2.72)	
Have any of your family members or friends been infected with COVID-19?			<0.001
No	33,618 (98.8)	3.89 (2.60)	
Yes	423 (1.2)	4.73 (2.68)	
Have you been a frontline worker since august 2020?			0.161
No	28,261 (83.0)	3.91 (2.57)	
Yes	5,780 (17.0)	3.85 (2.75)	
Has the epidemic led to your job loss since august 2020?			<0.001
No	31,253 (91.8)	3.84 (2.59)	
Yes	2,788 (8.2)	4.53 (2.68)	
Risk in epidemic regions			<0.001
Low	33,346 (98.0)	3.87 (2.59)	
Middle/High	695 (2.0)	5.20 (2.60)	
Have you ever experienced quarantine since august 2020?			<0.001
No	30,160 (88.6)	3.85 (2.59)	
Yes	3,881 (11.4)	4.25 (2.68)	
Evaluate your risk of getting infected in the future			<0.001
Low	30,602 (89.9)	3.78 (2.59)	
Middle/High	3,439 (10.1)	4.90 (2.52)	
Attitudes toward the epidemic in China [b]			<0.001
Positive	14,373 (42.2)	3.63 (2.64)	
Neutral	18,117 (53.2)	4.06 (2.52)	
Negative	1,551 (4.6)	4.45 (2.89)	
Do you trust in efficacy of COVID-19 vaccine?			<0.001
No	1,472 (4.3)	5.15 (2.86)	
Moderate	5,887 (17.3)	4.64 (2.47)	
Highly	26,682 (78.4)	3.66 (2.56)	
Have you ever been actively involved in getting flu vaccination?			0.165
No	22,526 (66.2)	3.91 (2.75)	
Yes	11,515 (33.8)	3.87 (2.57)	
Have your family members ever been actively involved in getting flu vaccination?			<0.001
No	18,551 (54.5)	3.96 (2.58)	
Yes	15,490 (45.5)	3.82 (2.63)	
Have you ever had any allergy events from previous vaccinations?			<0.001
No	29,991 (88.1)	3.74 (2.55)	
Yes	4,050 (11.9)	5.06 (2.69)	
Anxiety symptoms			<0.001
No	26,848 (78.9)	3.50 (2.52)	
Yes	7,193 (21.1)	5.39 (2.35)	
Depressive symptoms			<0.001
No	26,178 (76.9)	3.49 (2.52)	
Yes	7,863 (23.1)	5.25 (2.40)	
Insomnia symptoms			<0.001
No	24,693 (72.5)	3.51 (2.55)	
Yes	9,348 (27.5)	4.93 (2.43)	
PTSD symptoms			<0.001
No	24,009 (70.5)	3.40 (2.53)	
Yes	10,032 (29.5)	5.10 (2.37)	

(Continued)

TABLE 1 | Continued

Factors	Total, no. (%)	Stress score (*SD*)	*P*
Investigation period			<0.001
January 29, 2021–February 28, 2021	13,739 (40.4)	4.17 (2.58)	
March 1, 2021–March 31, 2021	17,396 (51.1)	3.76 (2.60)	
April 1, 2021–April 26, 2021	2,906 (8.5)	3.45 (2.57)	

COVID-19, coronavirus disease 2019; PTSD, posttraumatic stress disorder; SD, standard derivation.

[a] *1 ¥ = USD$0.14.*

[b] *Participants who thought the COVID-19 epidemic would end within 1 year, 1–10 years, and over 10 years or long lasting were defined as positive, neutral, and negative attitudes toward, respectively.*

to the survey during Jan. 29–Feb. 28, Mar. 1–Mar. 30, and Apr. 1–Apr. 26, respectively. Of the total sample, most of the participants were female (53.8%), aged between 18 and 39 (60.9%), lived in an urban area (79.1%), had a college degree or higher (79.2%), and were married (77.5%). 29,396 participants (86.4%) actively accessed information about the COVID-19 vaccine. 78.4 and 17.3% of the participants highly and moderately trusted the efficacy of the COVID-19 vaccine and agreed that vaccination was an effective measure for COVID-19 prevention, 4.3% did not trust the efficacy of the COVID-19 vaccine. 5,103 (15.0%) participants had been vaccinated against COVID-19, and about one third of the participants (11,515) had obtained a flu vaccination. 4,050 participants (11.9%) reported their experience of vaccine allergy events. In addition, 21.1, 23.1, 27.5, and 29.5% of participants reported symptoms of anxiety, depression, insomnia, and PTSD, respectively. The demographic characteristics, medical conditions, COVID-19 epidemic-related information, vaccine-related information, and mental status of the total samples are presented in **Table 1**, and of the vaccinated participants in **Supplementary Table 1**.

The Sources of COVID-19 Vaccine-Related Psychological Stress

81.3% of all participants experienced any psychological stress about vaccination. The sources of this psychological stress about the COVID-19 vaccine were ranked as follows (**Figure 1A**): 57.3% were concerned about the adverse effects after vaccination of themselves or their families; 35.7% were concerned by the news of severe adverse effects associated with the vaccine; 27.0% were concerned by vaccine safety incidents reported in the media; and 14.7% of participants were concerned by some misinformation from vaccine-related research. After getting the COVID-19 vaccine, 58.6% of participants had psychological stress and the reasons for psychological stress about the COVID-19 vaccination were ranked as follows (**Figure 1B**): 43.6% of participants were concerned about the adverse effects in themselves or their families after vaccination; 25.6% of participants worried about the efficacy of vaccine; and 17.7% of participants concerned the safety and quality of vaccine.

The COVID-19 Vaccine-Related Psychological Stress Levels

The mean stress score concerning COVID-19 vaccination was 3.90 ± 2.60 among all participants. The stress levels about vaccination were significantly decreased from Jan. 29 to Apr. 26 (Jan. 29–Feb. 28: 4.17 ± 2.58, Mar. 1–Mar. 30: 3.76 ± 2.60, Apr. 1–Apr. 26: 3.45 ± 2.57; [$F_{(2,34038)} = 142.90$, $p < 0.001$, **Figure 2A**]), and *post hoc* analysis found that comparisons of vaccine uptake stress levels between any 2 months were significantly different, with all $p < 0.001$ by using Bonferroni's correction.

The 29,396 participants who actively accessed information about COVID-19 vaccines, significantly decreased their psychological stress levels after accessing associated information when compared to stress levels before the access, and the levels also decreased over time from Jan. 29 to Apr. 26 (information accessing: [$F_{(1,29393)} = 295.39$, $p < 0.001$]; time: [$F_{(2,29393)} = 162.32$, $p < 0.001$]; interaction of information accessing and time: [$F_{(2,29393)} = 7.11$, $p = 0.001$; **Figure 2B**]). *Post hoc* analysis found that the stress level was significantly decreased after accessing the information when compared to that before at all 3 months (before vs. after: from 4.13 ± 2.55 to 4.00 ± 2.48 during Jan. 29–Feb. 28, from 3.71 ± 2.58 to 3.52 ± 2.50 during Mar. 1–Mar. 30, from 3.44 ± 2.54 to 3.19 ± 2.52 during Apr.1–Apr. 26, all $p < 0.001$ by Bonferroni's correction), and was decreased during the 3 months from Jan. 29 to Apr. 26.

In addition, the 5,103 vaccinated participants had significantly decreased psychological stress levels about COVID-19 vaccination after getting vaccinated than before vaccination at all 3 months (vaccine uptake: [$F_{(1,5100)} = 231.29$, $p < 0.001$]; time: [$F_{(2,5100)} = 65.22$, $p < 0.001$]; interaction of vaccine uptake and time: [$F_{(2,5100)} = 2.06$, $p = 0.127$]; from 3.79 ± 2.91 to 3.41 ± 3.07 during Jan. 29–Feb. 28, from 2.89 ± 2.66 to 2.38 ± 2.70 during Mar. 1–Mar. 30, from 2.61 ± 2.56 to 2.15 ± 2.61 during Apr. 1–Apr. 26; **Figure 2C**).

Associated Factors With the COVID-19-Related Psychological Stress Level

Table 2 shows the associated factors with the level of COVID-19 vaccine-related psychological stress when considering getting vaccinated at the beginning period of the COVID-19 mass vaccination among general public. Multiple linear regression analysis showed that older adults ($\beta = -0.38$, $p < 0.001$) displayed a lower level of COVID-19-related psychological stress. Participants with a history of chronic diseases ($\beta = 0.10$, $p = 0.031$) and low education level ($\beta = -0.08$, $p = 0.019$) had significantly higher psychological stress levels. Several epidemic-related factors were associated with psychological stress levels about COVID-19 vaccination, including experience of job loss due to the COVID-19 epidemic ($\beta = 0.24$, $p < 0.001$), quarantine experience ($\beta = 0.11$, $p = 0.008$), and self-evaluated high risk of COVID-19 infection ($\beta = 0.50$, $p < 0.001$). In addition, individuals with neutral or negative attitudes toward the epidemic in China had increased psychological stress levels (neutral: $\beta = 0.26$, $p < 0.001$; negative: $\beta = 0.38$, $p < 0.001$)

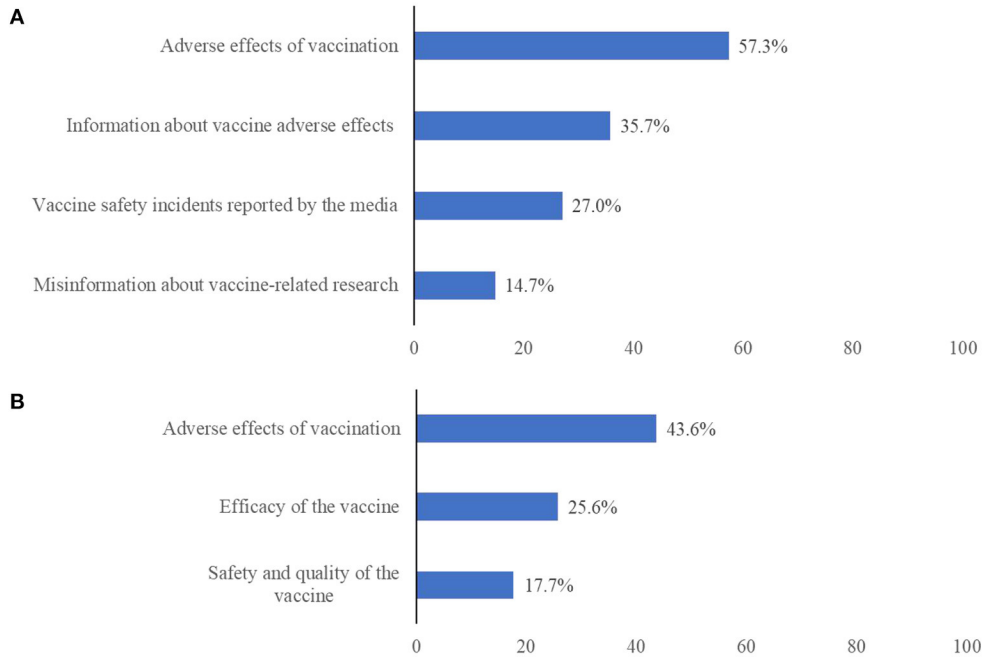

FIGURE 1 | The sources of psychological stress associated with COVID-19 vaccine uptake **(A)** at the beginning period of the COVID-19 mass vaccination ($N = 34{,}041$), and **(B)** after vaccination ($N = 5{,}103$).

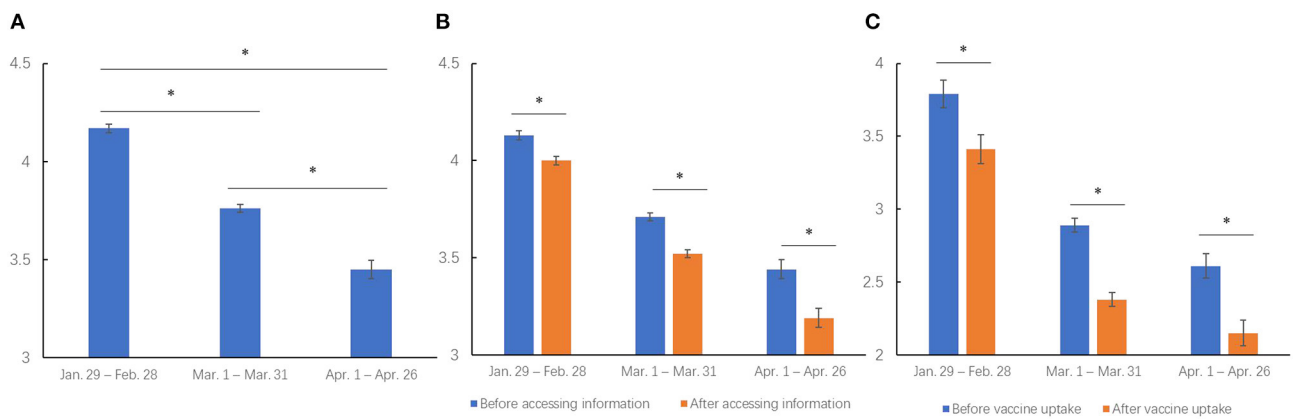

FIGURE 2 | COVID-19 vaccine-related psychological stress levels **(A)** at the beginning period of the COVID-19 mass vaccination ($N = 34{,}041$), **(B)** before and after accessing information about vaccination ($N = 29{,}396$), **(C)** before and after getting vaccinated ($N = 5{,}103$) from Jan. 29 to Apr. 26, 2021. *indicated statistically significant with $p < 0.05$.

compared to those with positive attitudes toward the epidemic in China.

Regarding the information about the COVID-19 vaccine, trust in the COVID-19 vaccine's efficacy was associated with an individual's psychological stress level about vaccination. Specifically, individuals with moderate or high trust in the efficacy of the COVID-19 vaccine in the prevention of infection displayed a lower psychological stress level (moderate: $\beta = -0.26$, $p < 0.001$; highly: $\beta = -0.98$, $p < 0.001$) compared to the participants who mistrusted the COVID-19 vaccine. In addition, participants with experiences of family members who were actively involved in flu vaccination reported lower psychological stress levels, compared with participants without these experiences ($\beta = -0.07$, $p = 0.006$). Participants with experience of vaccine allergy events had a significantly elevated psychological stress level ($\beta = 0.71$, $p < 0.001$). Participants with any mental symptoms (anxiety: $\beta = 0.71$, $p < 0.001$; depression: $\beta = 0.20$, $p < 0.001$; insomnia: $\beta = 0.32$, $p < 0.001$; PTSD: β

TABLE 2 | Multivariable linear regression of factors associated with psychological stress levels of COVID-19 vaccination at the beginning period of the COVID-19 mass vaccination among general public.

	β (95% CI)	*P*	VIF
40–59 years (ref: 18–39 years)	0.001 (−0.054, 0.056)	0.974	1.08
≥60 years (ref: 18–39 years)	**−0.378 (−0.575, −0.180)**	**0.001**	1.05
College degree or higher (ref: less than college)	**−0.079 (−0.145, −0.013)**	**0.019**	1.12
5,000–11,999 monthly family income, ¥[a] (ref: 0–4,999 monthly family income)	0.007 (−0.058, 0.072)	0.833	1.62
≥12,000 monthly family income, ¥[a] (ref: 0–4,999 monthly family income)	−0.058 (−0.132, 0.016)	0.123	1.71
History of chronic diseases (ref: no)	**0.100 (0.009, 0.190)**	**0.031**	1.06
History of mental disorders (ref: no)	−0.054 (−0.425, 0.317)	0.776	1.05
Family history of mental disorders (ref: no)	0.093 (−0.140, 0.327)	0.433	1.05
Suspect or confirmed infected with COVID-19 (ref: no)	−0.267 (−0.744, 0.211)	0.274	1.07
Family members or friends infected with COVID-19 (ref: no)	0.202 (−0.035, 0.438)	0.095	1.06
Job loss due to the COVID-19 epidemic (ref: no)	**0.237 (0.142, 0.332)**	**<0.001**	1.04
Middle/high- risk in epidemic regions (ref: low-risk)	0.166 (−0.020, 0.351)	0.080	1.07
Quarantine experience (ref: no)	**0.111 (0.029, 0.193)**	**0.008**	1.05
Self-evaluated middle/high risk of getting infected (ref: low risk)	**0.504 (0.417, 0.591)**	**<0.001**	1.07
Neutral attitudes toward the epidemic in China (ref: positive)	**0.256 (0.203, 0.309)**	**<0.001**	1.09
Negative attitudes toward the epidemic in China (ref: positive)	**0.376 (0.250, 0.503)**	**<0.001**	1.08
Moderate trust in efficacy of the COVID-19 vaccine (ref: distrust)	**−0.259 (−0.396, −0.121)**	**<0.001**	4.17
Highly trust in efficacy of the COVID-19 vaccine (ref: distrust)	**−0.978 (−1.105, −0.851)**	**<0.001**	4.25
Family members experience of actively involved in getting flu vaccination (ref: no)	**−0.072 (−0.123, −0.020)**	**0.006**	1.02
Experience of vaccine allergy events (ref: no)	**0.707 (0.626, 0.788)**	**<0.001**	1.07
Anxiety symptoms (ref: no)	**0.713 (0.605, 0.820)**	**<0.001**	2.97
Depressive symptoms (ref: no)	**0.203 (0.096, 0.310)**	**<0.001**	3.16
Insomnia symptoms (ref: no)	**0.315 (0.243, 0.387)**	**<0.001**	1.61
PTSD symptoms (ref: no)	**0.772 (0.694, 0.850)**	**<0.001**	1.95
Investigation period	**−0.209 (−0.250, −0.167)**	**<0.001**	1.03

COVID-19, coronavirus disease 2019; PTSD, posttraumatic stress disorder; VIF, variance inflation factor.
[a] *1 ¥ = USD$0.14.*
Bold values indicated statistically significant with p < 0.05.

= 0.77, $p < 0.001$) had significantly higher psychological stress levels about COVID-19 vaccination. Moreover, psychological stress level about vaccination decreased over time during the investigation period ($\beta = -0.21$, $p < 0.001$).

The factors associated with psychological stress levels about COVID-19-vaccine after vaccination among the vaccinated participants are presented in **Table 3**. VIF of all factors suggested no significant collinearity. Participants with high trust in the efficacy of the COVID-19 vaccine showed significantly lower psychological stress levels ($\beta = -0.43$, $p = 0.007$). Significantly higher psychological stress levels occurred among those with high psychological stress levels at the beginning period of vaccination ($\beta = 0.73$, $p < 0.001$), experiences of vaccine allergy events ($\beta = 0.55$, $p < 0.001$), anxiety symptoms ($\beta = 0.51$, $p < 0.001$), and PTSD symptoms ($\beta = 0.35$, $p < 0.001$).

DISCUSSION

The present study investigated COVID-19 vaccine-related psychological stress levels among the general population in China based on a nationwide, large-sample survey. The psychological stress level of COVID-19 vaccination significantly decreased over time, after accessing information about the COVID-19 vaccine, as well as after getting vaccinated. Several risk factors contributing to the psychological stress level of COVID-19 vaccination when considering getting vaccinated were identified, including younger age, lower education level, history of chronic diseases, mistrust in vaccine efficacy, experience of vaccine allergy events, being affected by the COVID-19 epidemic, and having mental illness symptoms. Moreover, mistrust in vaccine efficacy and experience of vaccine allergy events had a long-term impact on psychological stress levels about COVID-19 vaccination even after getting vaccinated. These findings provide a comprehensive profile of COVID-19 vaccine-related psychological stress levels before and after getting vaccinated and may contribute to promoting the willingness to be vaccinated and improve the general population's well-being during the COVID-19 pandemic.

The psychological stress level of COVID-19 vaccination may lead to the hesitation and rejection of vaccination (28). Due to the COVID-19 experience and ignorance about vaccines, the psychological stress about COVID-19 vaccination was common at the beginning of COVID-19 mass vaccinations. Despite the widely validated efficacy of the COVID-19 vaccine, some individuals still mistrusted the efficacy of the COVID-19 vaccine (5–7, 29). Participants who held negative attitudes

TABLE 3 | Multivariable linear regression of factors associated with COVID-19 vaccine-related psychological stress after vaccination among the vaccinated participants.

	β (95% CI)	*P*	VIF
COVID-19 vaccine related stress level before getting vaccinated	**0.725 (0.706, 0.744)**	**<0.001**	1.24
40–59 years (ref: 18–39 years)	−0.014 (−0.111, 0.083)	0.777	1.09
≥60 years (ref: 18–39 years)	−0.178 (−0.584, 0.229)	0.391	1.04
College degree or higher (ref: less than college)	−0.099 (−0.231, 0.033)	0.143	1.16
5,000–11,999 monthly family income, ¥[a] (ref: 0–4,999 monthly family income)	−0.067 (−0.190, 0.056)	0.285	1.78
≥12,000 monthly family income, ¥[a] (ref: 0–4,999 monthly family income)	−0.126 (−0.262, 0.009)	0.068	1.87
History of mental disorders (ref: no)	0.251 (−0.393, 0.896)	0.445	1.07
Family history of mental disorders (ref: no)	−0.059 (−0.476, 0.358)	0.781	1.08
Suspect or confirmed infected with COVID-19 (ref: no)	0.181 (−0.536, 0.898)	0.620	1.09
Family members or friends infected with COVID-19 (ref: no)	0.290 (−0.062, 0.642)	0.106	1.08
Job loss due to COVID-19 epidemic (ref: no)	0.129 (−0.071, 0.329)	0.206	1.07
Middle/high- risk in epidemic regions (ref: low-risk)	0 (−0.383, 0.382)	0.998	1.08
Quarantine experience (ref: no)	0.108 (−0.030, 0.246)	0.124	1.06
Self-evaluated middle/high risk of getting infected (ref: low risk)	0.079 (−0.079, 0.237)	0.325	1.06
Neutral attitudes toward the epidemic in China (ref: positive)	−0.022 (−0.117, 0.074)	0.657	1.07
Negative attitudes toward the epidemic in China (ref: positive)	0.019 (−0.234, 0.272)	0.883	1.06
Moderate trust in efficacy of the COVID-19 vaccine (ref: distrust)	−0.135 (−0.489, 0.220)	0.457	3.21
Highly trust in efficacy of the COVID-19 vaccine (ref: distrust)	**−0.417 (−0.722, −0.112)**	**0.007**	3.30
Experience of actively involved in getting flu vaccination (ref: no)	0.055 (−0.039, 0.148)	0.250	1.02
Experience of vaccine allergy events (ref: no)	**0.551 (0.385, 0.717)**	**<0.001**	1.18
Anxiety symptoms (ref: no)	**0.514 (0.313, 0.715)**	**<0.001**	2.77
Depressive symptoms (ref: no)	0.060 (−0.135, 0.255)	0.544	2.88
Insomnia symptoms (ref: no)	0.074 (−0.057, 0.204)	0.267	1.49
PTSD symptoms (ref: no)	**0.350 (0.210, 0.489)**	**<0.001**	1.80
Investigation period	**−0.084 (−0.162, −0.007)**	**0.033**	1.05

COVID-19, coronavirus disease 2019; PTSD, posttraumatic stress disorder; VIF, variance inflation factor.

[a] *1 ¥ = USD$0.14.*

Bold values indicated statistically significant with $p < 0.05$.

toward the efficacy of the COVID-19 vaccine had significantly higher psychological stress levels about vaccination. However, previous research has suggested that accessing information about COVID-19 vaccine generally had both good and bad effects, since fake news increased psychological stress levels, while accurate information reduced individuals' psychological stress levels (12, 15, 16). Promoting the efficacy of the COVID-19 vaccine built up the confidence and reduced the psychological stress of vaccination (10). The results of this survey showed that the psychological stress level decreased after vaccination, which indicates that the observed safety of vaccination in real life may relieve the misinformation and associated psychological stress level. Therefore, combating misinformation and disseminating accurate information about the COVID-19 vaccine will reduce psychological stress levels about COVID-19 vaccination in the general population and promote vaccination programs.

Consistent with early findings (12), the results of this study showed that the fear of adverse effects was another strong source of increased psychological stress about the COVID-19 vaccination even after getting vaccinated. Participants with experiences of vaccine allergy events had a significantly elevated psychological stress level when considering getting the COVID-19 vaccine (18, 19). Severe adverse effects generally occurred immediately or over a short period after getting vaccinated (18, 19), and the psychological stress level of COVID-19 vaccination among the vaccinated participants with no adverse effects decreased after vaccination. However, some participants still experienced psychological stress even after getting COVID-19 vaccination due to the participants mistrusting the efficacy of the vaccination and experiencing vaccine allergy events. The findings further imply the importance of guarantee the efficacy and safety of the vaccines (10, 12). For participants with consistent psychological stress about the COVID-19 vaccine, specific strategies and policies should be made to help relieve their psychological stress even after getting vaccinated.

Moreover, we found that family members' experiences of involvement in flu vaccination had a positive effect on individual's psychological stress about COVID-19 vaccination. We proposed that families, as a unit, to get vaccinated may be helpful to relieve other family members' psychological stress about the COVID-19 vaccination. In addition, acceptance of the vaccine among family members, especially parents, would have a positive effect on their children's vaccination in the future (30).

Except for information about the vaccine, the pandemic itself may have long-term impacts on individuals' psychological status (21, 31). In this study, epidemic-related factors, including job loss due to the COVID-19 epidemic, experience of quarantine, self-evaluated high risk of getting infected, and negative attitudes toward the epidemic in China were associated with elevated psychological stress levels when considering the COVID-19 vaccination. The COVID-19 pandemic may have both negative (e.g., increased risk of vaccine-preventable diseases outbreaks) and positive effects (e.g., need for a coronavirus vaccine may increase people's appreciation for vaccines in general) on individual willingness for vaccination; however, it still unclear which effect is dominant (32). This study indicates that mental health status during the COVID-19 pandemic will impact psychological stress levels about COVID-19 vaccination in the general population. Individuals with health issues (e.g., chronic physical or mental illness) were at greater risk of being infected with COVID-19, thus these populations deserve to be in the priority groups for vaccination (33). Given the urgent need and psychological stress of vaccination among the general population, it is crucial for government and policy makers to facilitate COVID-19 vaccination and reduce the relevant psychological stress.

This study showed that some demographic factors and history of chronic diseases may also influence the psychological stress of vaccination. Older adults were regarded as the critical group for determining the success of this vaccine campaign (34). In this study, older adults had decreased COVID-19 vaccine-related psychological stress levels. However, the old adults were generally found to be less willing to get vaccinated (35). We suspect that the discrepancy of acceptance and psychological stress about COVID-19 vaccination could be related to the co-existence of better stress resilience and vaccine apathy among older adults (13). Similarly, individuals with low education levels had greater psychological stress levels about vaccination, which could be explained by poor awareness and health literacy, lower trust and interaction with healthcare professionals, and cost-based concerns among them (36). Generally, comorbidity did not affect individuals' acceptance of vaccine uptake (8), but may increase unrelated psychological stress about their comorbid illnesses. Thus, more strategies and interventions should be developed to relieve psychological stress about vaccination in those with history of chronic disease.

The current findings have potential implications for vaccine rollout policies in China and other countries. First, to build public confidence in vaccine programs and relive vaccine related stress, the government officials should guarantee the safety and effectiveness of vaccines (25). Second, as the main avenues of delivering COVID-19 vaccine-related information, the social media should disseminate accurate and proper information about the COVID-19 vaccine (11). Third, the government and health authorities should keep more supervision on specific targeted populations, even after getting vaccinated. Last but not least, more researches on vaccine-related psychological problems were proposed.

The strengths of this study include its extensive geographic coverage across China, and large sample size. Participants with different characteristics were recruited from all 34 province-level regions in China. In addition, to the best of our knowledge, this is the first study that systematically investigated the COVID-19 vaccine-related psychological stress level. However, our study has several limitations. First, this was an online survey via Joybuy platform, and we used a convenience sampling method. Although this study had extensive geographic coverage across China and a large sample size, most respondents were young, highly educated, living urban areas, with no history of mental disorders, non-infectors, as well as actively involved in accessing information about the vaccine; thus, the representativeness of the sample might be limited, and self-selection bias would exist. Second, we assessed the psychological stress levels using self-reported visual analog scales, rather than well-constructed tools. Third, this was a cross-sectional study. Therefore, associations between psychological stress levels when considering vaccine uptake and risk factors cannot necessarily be considered causal relationships. Fourth, the recall bias cannot be avoided, as the stress vaccine-related stress at different occasions were recalled and self-reported by individuals at one-time point investigation.

CONCLUSIONS

The current findings profiled the COVID-19 vaccine-related psychological stress among the general public in China. This information can provide help for policy making, recognition of vulnerable populations, and framework design for population-specific management to reduce the COVID-19 vaccine-related psychological stress levels and promote the acceptance of the vaccine and improve public health well-being during the COVID-19 pandemic.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding authors.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Peking University Sixth Hospital. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

Y-BZ, JSu, TK, Y-PB, and LLu designed the protocol. Y-BZ, LL (third author), Y-MZ, Y-TH, and LL (tenth author) were involved in data collection. Y-BZ, Y-MZ, S-ZS, Z-AL, and NZ analyzed the data. Y-BZ, JSu, LL (third author), WY, and KY drafted the manuscript. X-MZ, XL, S-QM, SW, M-SR, JSh, LS, TK, Y-BZ,

and LLu revised the manuscript. All the authors have read and approved the final version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.774504/full#supplementary-material

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BRIEF RESEARCH REPORT
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The Persian Language Version of the Obsession With the COVID-19 Scale for Adolescents

Faramarz Asanjarani[1], *Monika Szczygieł*[2]* *and Amna Arif*[3]

[1] Department of Counseling, Faculty of Education and Psychology, University of Isfahan, Isfahan, Iran, [2] Department of Neurocognitive Psychology, Faculty of Pedagogy and Psychology, Institute of Psychology, Pedagogical University, Kraków, Poland, [3] Department of Education, Social Sciences and Humanities, University of Management and Technology, Lahore, Pakistan

Objective: The worldwide pandemic of coronavirus disease (COVID-19) has caused significant public health burdens and psychological dysfunctions. In this challenging time, adolescents require special care. The Persian version of the Obsession with COVID-19 Scale (OCS) for adolescents was developed to screen for dysfunctional obsession associated with the coronavirus during the global pandemic. The structure and internal consistency of the OCS were established.

Design and Measures: Although there are different language versions of the OCS, this is the first study to validate the psychometric properties of the OCS in Iranian adolescents. Seven hundred and nine students (369 girls) participated in the study. Demographic questions and the OCS were administered.

Results: The findings provided support for the existence of a unidimensional structure that met the criteria for configural, metric, and full scalar invariance across gender (girls and boys), inhabitancy (urban and rural), and infection experience (infected and non-infected). The OCS is short and highly reliable measurement. However, further research is necessary to establish the validity of the scale in Iranian population.

Conclusions: The development of such valid scales is an essential part of both research and practice during times of crisis, like a global pandemic. Diagnosis of pandemic related to obsessive thoughts in adolescents is needed as the COVID-19 pandemic is still ongoing and as experts point out, it can be expected that the effects of the pandemic will be observed in the coming years. The Persian version makes it possible to conduct international comparative research on the anxiety related to the COVID-19 pandemic.

Keywords: COVID-19, obsession, mental health, adolescent, validation

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Mustafa Amin,
Universitas Sumatera Utara, Indonesia

***Correspondence:**
Monika Szczygieł
monika.szczygiel@up.krakow.pl

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INTRODUCTION

Impacts of COVID-19 on Daily Life and Mental Health

Since December 2019, the coronavirus epidemic, also known as COVID-19, originated from Wuhan, China, and spread rapidly worldwide (1). Scientifically, the virus is referred to as Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) (2). The most common COVID-19 symptoms are fever, fatigue, dry cough, myalgia, dyspnea, etc., and can develop 2–14 days after

infection through respiratory droplets and close contact (1, 3). In this article, we will refer to this disease as COVID-19.

The rapid emergence of the COVID-19 outbreak worldwide has dramatically changed daily behavior, significantly impacting the population's physical, social, mental, and financial well-being (4). Across the world, individuals must navigate school closures, employment insecurity, and social behavior changes, which are likely to negatively affect their mental health and coping abilities (5, 6). Recognizing that increased stress can lead to maladaptive behaviors to cope with stress and anxiety, health professionals highlighted the need for all individuals to manage stress and maintain their mental health during this highly uncertain period (6, 7).

Some of the most common social problems of the COVID-19 outbreak are fear of contracting this highly contagious virus, fear of losing loved ones, the spread of misinformation about COVID-19, the lack of medical treatment, the lack of adequately equipped units to treat patients, problems with lock-out [e.g., prolonged home isolation and social distancing; (8) insecurity, fear of unemployment, loss of income, etc.], depression, anxiety, phobia, insomnia, trauma, etc., are also common consequences associated with the COVID-19 outbreak (9). As a result, an increase in the suicide rate is common during and after the pandemic, which has also been reported during the COVID-19 pandemic (10, 11). Studies indicated that mental health problems and mediators increase the risk of suicide (12). It has also been reported that the physical performance of individuals and immunological stabilities are related to psychological states (3). However, studies reported increased psychological problems and low quality of life across nations and professions (e.g., healthcare professionals to general people) (13).

While studies are increasingly focusing on the mental health effects of pandemics on adults, relatively few studies focus on the effects of pandemics on children and adolescents (14). A study conducted by Chen et al. (15) showed that COVID-19 affects symptoms of mental disorders, including obsessive-compulsive disorder (OCD), fear, hypochondria, depression, and neurasthenia in college students. Adolescents may struggle with thoughts of a pandemic by observing the changing life situation at home as well as at school. In this study, which is part of a larger cross-cultural study, we investigated the factor structure and reliability of the Obsession with COVID-19 Scale [OCS; (16)] for Iranian adolescents. Below we present our rationale regarding why it is essential to focus on the emotional sphere of adolescents.

Pandemic and Adolescents

In times of pandemic, as in disasters, there is an increased risk of Post Traumatic Stress Disorder (PTSD), depression, and anxiety (17). In a survey of 8,079 Chinese adolescents aged 12–18 years, Zhou et al. (18) reported a high prevalence of depression (43%), anxiety (37%), and combined symptoms of depression and anxiety (31%). In addition, Odriozola-González et al. (19) reported that during the current pandemic, adolescents experience a new period of insecurity: worry about their relatives' health and work, the ubiquitous problem of death, sudden separation from friends, and school interruption. In a sample of universities in Spain, many students experienced moderate to extremely severe anxiety (21%) and depression (34%) during the first weeks of quarantine. Another psychological impact of the epidemic on adolescents is post-traumatic stress disorders that affect brain development. PTSD in children is associated with changes in fronto-limbic circuits that may contribute to increased threat reactivity and weaker emotion regulation (20).

Anxiety is also a common psychological problem experienced by adolescents during epidemics. According to Cao et al. (21), having a relative or acquaintance infected with COVID-19 was a risk factor for anxiety in a Chinese undergraduate student population (21). Studies also show that absenteeism in children and adolescents is associated with reduced physical activity, more screen time, irregular sleep patterns, and less appropriate diets (22).

Outbreaks may also be linked to increased suicide rates (23). Family confinement can trigger domestic violence during the COVID-19 pandemic. Some countries, such as France and Brazil, have reported an increase in reported domestic violence cases; children are at greater risk of abuse or neglect when they live in a home where there is domestic violence. It is reported that women and girls are more exposed to gender-based violence, including sexual violence, during this period (24). A pandemic situation is something that affects overall functioning. Adolescents face worries that may overwhelm their emotional coping resources. Therefore, it is crucial to screen students with high levels of obsessive thoughts related to COVID-19 and give them immediate help.

Current Study

Fear and obsession can increase the damage done by the disease itself. The emergence of COVID-19 (25) and its epidemic nature have exacerbated worldwide concerns that, in some cases, lead to stigma (26). A characteristic nature of infectious disease compared to other conditions is fear. Obsession and fear are directly related to the rate and environment of transmission (quickly and invisibly) and morbidity and mortality. With a high level of anxiety, individuals may not think clearly and rationally when reacting to COVID-19. Therefore, it is necessary to investigate the level of obsession with COVID-19 to provide better services for those involved. Adolescence, for which the consequences of a pandemic may have particularly negative emotional effects, deserve special attention. Therefore, we decided to test psychometric properties of the OCS (16) in Iranian adolescents.

Iran has been one of the first countries to report the outbreak of COVID-19 and has been since affected by the pandemic. Therefore, adolescents for a long time may feel tense and loneliness because they cannot spend time with friends as previously (5). Prolonged loneliness can lead to depression and anxiety disorders (13). The OCS (16) was the first measure developed to assess maladaptive coronavirus anxiety and obsession with the COVID-19. The OCS has been validated in the United States (16), Bangladesh (i.e., CAS) (27), Turkey (28), Pakistan (29), and Korea (30). It is unidimensional scale that consists of four items: "I had disturbing thoughts that I may have caught the coronavirus; I had disturbing thoughts that certain people I saw may have the coronavirus; I could not stop thinking

about the coronavirus, and I dreamed about the coronavirus." The research conducted so far indicated excellent psychometric properties of the OCS and international comparability of the results. As the psychological effects of the COVID-19 pandemic are observed worldwide, it is vital to expand the use of the scale in more countries. Since the pandemic affects people all over the world, it is possible to compare the feelings, beliefs and behaviors of people from different cultural contexts. Iran was one of the first countries to be affected by the virus and is still struggling with high number of mortality and social consequences, such as school closure. This study, which aimed to assess the psychometric properties of a scale measuring obsessive thoughts about a pandemic in Iranian adolescents, is an important contribution to the development of tools for individual diagnosis and comparative research.

Therefore, the study's main objective is to investigate the factor structure of the OCS in the Iranian sample. We tested the unidimensional factor model in accordance with previous findings. We were interested in testing the structure among the whole sample and checking whether there is the same structure regardless of the various group. Therefore, we tested measurement invariance across gender (girls, boys), inhabitancy (urban, rural), and infection experience (infected, non-infected). Finally, we calculated the reliability of the OCS in the whole sample and tested subgroups. We assumed that the OCS is unidimensional, the structure is comparable between various groups, and the scale has acceptable internal consistency. We also tested whether there are differences between various groups in the level of obsessive thought. We assumed that girls may have a higher score in the OCS than boys, that adolescents who were infected (or someone from their family members was infected) may report more obsessive thought than those from a non-infected group and there are no significant differences between adolescents from rural and urban areas.

METHODS

Participants and Procedure

This study was part of a bigger project comparing Iran and Pakistan regarding COVID-19 stress and its effects on the adolescents population. For the purpose of this study, we used convenience cluster sampling. Students were selected from different parts of Markazi province, Iran, to include both rural and urban participants. Before the translation of the scale, author of the OCS was contacted by the first author to receive permission. After receiving the permission, the official steps of translating the scale were followed (explained in the measure section). Then, students were contacted through their school, and after receiving their parental consent, parents and adolescents were asked to complete an informed consent form. Then, students were able to complete the questionnaires using the link sent to their mobile phones. The questionnaires were designed using an Iranian online website called Porsline (*www.porsline.ir*). The link was sent to 1,000 students. After screening missing data, 709 students (girls $n = 369$, boys $n = 339$) were included in the study. We followed WHO definition of adolescence and include in this period students from 10 to 19 years old. Participants mostly aged 12–16 y.o., however, there were four students at age 11, 17, 18, and 19. All of them attended guidance school or high school. Recruitment of the participants was both from rural ($n = 297$) and urban ($n = 412$) Iran. To determine this, we asked the students if they were from the cities or the countryside. Among them, 131 people indicated that the student or one of the close family members had been infected COVID-19, 578 participants or their family members were not infected.

Measures

Demographic Questionnaire

As the study was part of a larger project, participants were asked to complete a demographic questionnaire, which included the following questions: gender (52% girls, 48% boys), inhabitancy (42% rural, 58% urban), age, the device used for online classes (92% mobile phones, 8% tablet), internet type (100% mobile network), and whether COVID-19 has infected them or their family members (82% non-infected, 18% infected).

Obsession With COVID-19 Scale-Persian Version

The OCS is a recently developed, 4-point measure of persistent and disturbing thinking about COVID-19 that demonstrates solid reliability and validity using two U.S. samples (16). To translating the OCS, the scale was initially translated by two bilingual English translators. Both translators were experts in psychology (one M.A. and one Ph.D.). The agreement between the two translators was investigated to ensure inter-rater reliability. Inter-rater reliability is related to the stability of the translation reported by two or more translators from the same measurement (31). The original OCS scale was compared with the translated version, achieving acceptable inter-rater reliability among the two raters. Next, the final Persian translation was back-translated into English by bilingual Persian/English speaker and was approved by one of the authors, an expert in psychology and a fluent English speaker. Before main study, four students and one expert were asked to complete the questionnaire to see if the language was appropriative for their ages. Using a scale from 0 (not at all) to 4 (almost every day), respondents reported how often they thought persistent and disturbing about COVID-19 over the past 2 weeks. Higher scores indicate more obsessive thinking about COVID-19.

Methods of Data Analysis

To check whether the structure of the OCS was unidimensional as it was theoretically assumed, we used confirmatory factor analysis (CFA). The results were calculated in *lavaan* [R package (32)]. To evaluate the model-to-data fit, we applied common fit indices and evaluation criteria that indicate good model fit: χ^2–non-significant, the root means the square error of approximation (RMSEA)—smaller than 0.08, the standardized root mean squared residual (SRMR)—smaller than 0.08, the comparative fit index (CFI)—above 0.95, and the Tucker-Lewis index (TLI)—above 0.95 (33, 34). Factor loadings (β) should be above the minimum recommended value > 0.40 (35).

Because the assumption of multivariate normality was violated, Mardia's test: skewness 2925.86, $p < 0.001$, kurtosis 66.10, $p < 0.001$, and variables were

TABLE 1 | Descriptive statistics and CFA in the Iranian sample.

	Item	*M*	*SD*	Range	Skew	Kurtosis	Item-scale *r*	*β* CFA
1	I had disturbing thoughts that I may have caught the coronavirus.	0.77	0.89	0–4	1.16	0.90	0.85	0.83
2	I had disturbing thoughts that certain people I saw may have the coronavirus.	0.91	0.97	0–4	1.07	0.70	0.84	0.77
3	I could not stop thinking about the coronavirus.	1.26	1.09	0–4	0.70	−0.28	0.83	0.69
4	I dreamed about the coronavirus.	0.10	0.39	0–3	4.62	24.64	0.49	0.41

N = 709; all factor loadings and item-scale Pearson's r correlations are on the level p < 0.001.

TABLE 2 | Descriptive statistics and factor loadings in subgroups.

	Girls	Boys	Urban	Rural	Non-infected	Infected
Descriptive statistics OCS						
N	369	339	297	412	578	131
M	0.82	0.70	0.78	0.74	0.75	0.81
SD	0.69	0.63	0.67	0.66	0.65	0.74
Range	0–3	0–3	0–3	0–3	0–3	0–3
Skewness	0.94	1.17	1.00	1.08	1.00	1.15
Kurtosis	0.29	1.26	0.50	0.86	0.60	0.73
Multivariate normality (Mardia test)						
Skewness	1452.50***	1444.10***	1196.23***	1719.92***	527.94***	2441.20***
Kurtosis	43.14***	0.42***	41.76***	45.34***	22.91***	61.11***
β						
OCS1	0.84	0.81	0.78	0.87	0.89	0.81
OCS2	0.78	0.75	0.79	0.76	0.75	0.77
OCS3	0.71	0.64	0.68	0.69	0.71	0.68
OCS4	0.44	0.43	0.35	0.45	0.61	0.35

****p < 0.001.*

ordinal, we used the Diagonally Weighted Least Squares estimator [DWLS; (36)] to test structure of the OCS.

We applied the following criteria to evaluate measurement invariance models. We tested configural invariance in a model with no equality constraints imposed based on common model fit indices. We established metric invariance by fitting models where factor loadings on respective items were constrained to be equal across the groups. Finally, we examined scalar invariance based on constraint intercepts to be equal across the groups. To evaluate models, we used Chen's (37) recommendations: difference of fit indices between nested models in a large sample size ($N > 300$) should be smaller than 0.015 for RMSEA, 0.03 for SRMR, and 0.01 for CFI and TLI. We also applied the principle that the χ^2/df ratio should be smaller than 3 to evaluate model as proper (38). To test internal consistency we assessed the Cronbach's alpha level with 95% *CI* and composite reliability [tested via online calculator (39)]. For all tests that we run, we adopted an alpha level of 0.05. The number of observations is sufficient to carry out the planned analyzes (40). Student's *t*-test and Mann-Whitney' *U* test were conducted to compare the OCS scores between groups (gender, inhabitancy, infection). Cohen's *d* was calculated to provide effect size for *t* and *U* test: 0.20 small effect, 0.50 medium effect, 0.80 large effect (41).

RESULTS

Descriptive statistics and the structure of the OCS were established. The unidimensional model that consists of four items obtained the required value of chi-square: $\chi^2_{(2)} = 0.37$, $p = 0.831$, $N = 709$, and the model-to-data fit indices were very satisfactory: RMSEA = 0 [0, 0.044, 90% *CI*], SRMR = 0.01, CFI = 1.00, and TLI = 1.00. All factor loadings were adequate because their values varied from 0.41 to 0.83. Item-scale Pearson's correlations varied from $r = 0.49$ to $r = 0.85$ (see **Table 1**) and indicate good properties of the scale.

Then, we tested whether the OCS had the same measurement characteristics across all groups involved in the study (gender, inhabitancy, infection experience). Multivariate normality of the OCS in all groups was tested (see **Table 2**). The results indicated that the assumption was violated. Because the variables were ordinal, we applied the DWLS estimator in all tested models (36).

First, measurement invariance across gender was established. The results indicated perfect model fit-to-the data for girls and boys. Moreover, in accordance with adopted criteria, equivalence on the configural, metric, and scalar level was fulfilled (see **Table 3**). All factor loadings were acceptable (>0.4, see **Table 2**). Then, we tested measurement invariance across inhabitancy. The results indicated an excellent model fit for adolescents from urban and rural areas. Additionally, the results confirmed

TABLE 3 | Measurement invariance of the OCS across gender, inhabitancy, and infection groups.

	N	*df*	χ^2	RMSEA [90% *CI*]	SRMR	CFI	TLI
Gender							
Girls	369	2	0.08	0 [0–0]	0.007	1	1
Boys	339	2	0.65	0 [0–0.077]	0.023	1	1
Configural	–	4	0.72	0 [0–0.007]	0.013	1	1
Metric	–	7	1.47	0 [0–0]	0.017	1	1
Scalar	–	10	1.69	0 [0–0]	0.018	1	1
Inhabitancy							
Urban	297	2	0.48	0 [0, 0.074]	0.019	1	1
Rural	412	2	0.09	0	0.008	1	1
Configural	–	4	0.57	0	0.01	1	1
Metric	–	7	1.09	0	0.013	1	1
Scalar	–	10	2.83	0	0.018	1	1
Infection							
Infected	131	2	0.03	0	0.008	1	1
Non-infected	578	2	0.42	0 [0, 0.051]	0.012	1	1
Configural	–	4	0.45	0	0.01	1	1
Metric	–	7	4.89	0 [0, 0.052]	0.03	1	1
Scalar	–	10	5.11	0 [0, 0.028]	0.03	1	1

In χ^2 test all $p > 0.05$.

multivariate invariance on the configural, metric, and scalar level (see **Table 3**). Although in urban children loading factor in OCS4 was slightly below the adopted criteria ($\beta = 0.35$), other loading factors were acceptable (>0.4, see **Table 2**). Finally, we tested measurement invariance across infection experience. The results indicated a very good model-fit-to-the-data for infected and non-infected children. It can be assumed that configural, metric, and scalar equivalence exists. Although we observed between configural and metric level ΔSRMR = 0.02, and according to assumptions, this change is slightly higher than criterion—should be <0.015—other criteria were fully met (see **Table 3**). In non-infected children we observed loading factor below 0.4 in OCS4 ($\beta = 0.35$), but others loading factors were acceptable (>0.4, see **Table 2**). Descriptive statistics for each group are presented in **Table 2**.

Then, we compared groups. The results indicated that girls significantly exceed boys in the level of COVID-19 obsession thoughts: $t_{(706)} = 2.35$, $p = 0.019$ and difference is small ($d = 0.18$). There was no differences in the OCS score between adolescents from rural and urban areas: $t_{(707)} = -0,80$, $p = 0.422$, $d = 0.06$ and groups of infected and non-infected: $U = 36832.5$, $p = 0.628$, $d = 0.09$. The results in all groups indicated right-skewed distribution, which means that most adolescents revealed a low level of obsession with COVID-19.

Summing up, results indicated that the OCS is a unidimensional scale that met the criteria for configural, metric, and full scalar invariance across gender (girls, boys), inhabitancy (urban, rural), and infection experience (infected, non-infected). Considering the full invariance of the OCS between groups, the descriptive statistics of the scale were calculated for the whole Iranian sample. The average level of OCS was weak ($M = 0.76$, $SD = 0.66$, $N = 709$, range 0–3), its distribution was right-skewed (skewness = 1.05, $W = 0.90$, $p < 0.001$) and close to mesokurtic (kurtosis = 0.69). The results in all groups indicated that most adolescents revealed a low level of obsession with COVID-19. Descriptive statistics for each group are presented in **Table 2**.

Finally, the reliability of the OCS was established for each group: Cronbach's α [95% *CI*] = 0.78 [0.74, 0.81] for girls, 0.75 [0.70, 0.79] for boys, 0.78 [0.74, 0.81] for rural children, 0.74 [0.69, 0.79] for urban children, 0.83 [0.81, 0.85] for infected with COVID-19, and 0.74 [0.66, 0.81] for those who were not infected. Composite reliability for the whole scale was 0.779.

DISCUSSION

The main objective of this study was to test the factor structure and reliability of the Obsession with COVID-19 Scale in an Iranian adolescents. The results confirmed unidimensionality of the OCS and its measurement invariance across gender, inhabitancy, and infections experience. Moreover, the Persian language version of OCS had a high internal consistency in entire sample and across various groups. The findings provided more evidence for a universality of the OCS structure presented by researchers from various countries (27–30). Thus, the Persian language version of the scale may contribute to further international research on the level of COVID-19 obsession.

Although the obsessive thoughts of COVID-19 disease is raised worldwide (42), the current study revealed relatively low level of obsessive thoughts about pandemic in Iranian adolescents. However, it doesn't mean that there are no adolescents who experience such obsessive thoughts. Students differ in the level of experienced COVID-19 thoughts, therefore OCS may be used as a screening tool that enables the observation of extremely high level of obsessive thoughts. There were no differences in the level of obsessive thought related to COVID-19 due inhabitancy and infection experience. It is likely that regardless of these factors, adolescents may count on appropriate help and access to medical care. However, girls reported more obsessive thoughts than boys. This result is consistent with previous findings that girls tend to report significantly higher depression and anxiety levels (43). Small differences between girls and boys may result from specific situation which is pandemic.

Our study has clear advantages and limitations. The OCS has only four items which facilitates its use in a short time. In the future, however, it can be consider modifying the scale and removing the last item. The fourth item had relatively lower psychometric properties compared to the other items, which is probably due to its separate content (related to dreams, not to daily thoughts). One of the limitations of our analysis is also that the infected/non-infected and rural/urban groups were unequal. Although measurement invariance in these groups is confirmed, it should be remembered that this group bias may influence the mean results of the tested population (especially the inhabitancy; infection is not something permanent).

Moreover, our sampling was not random and is limited to the group that we had access. We also did not controlled the language fluency and nationality of the participants. We tested adolescents who attended Iranian school and we assumed that all of them speak fluently in Persian language. This point is more than important because our study has all the disadvantages of self-report research (44). The results could be affected by temporary mood, level of mindfulness in reading items and instructions, the belief that participation in the study is important and makes sense, willingness to present themselves in a chosen way (45). The presented results should be treated as a starting point for further validation studies. The study was conducted only among adolescents which limits the possibility of generalizing the results to the whole Iranian population. Adults may experience more COVID-19 thoughts as they try to deal with own problems as well as resolve their children issues.

Moreover, this study was dedicated to establishing factor structure and reliability but convergent and divergent validity also should be tested. The future study should focus on relations between OCS to e.g. behaviors to avoid contamination or relations with obsessive-compulsive personality traits in adolescents and adults. Further studies should also check test-retest reliability to establish whether the responses are stable over time.

Diagnosis of pandemic related obsessive thoughts in adolescents is needed as the COVID-19 pandemic is still on going. As experts point out, it can be expected that the effects of the pandemic will be observed in the coming years (46). The period of adolescence is the time when young people establish relationships. During pandemic such developmental aim is difficult to meet. Pandemic as a global and extremely dynamic event has become a source of stress for billions of people around the world demanding unusual countermeasures (7). The lockdown led to the forced isolation of entire societies. A broadly defined lifestyle required change: the way we spend our free time, work and study (6). As this is the first time that modern generations have faced this kind of threat, it is important to test impact of pandemic on the young people mental health. As the pandemic is a global phenomenon, it is a special opportunity to check the impact of state policies on the mental health of citizens in different countries.

During crises, such as a global pandemic, seeking social support is often one of the most adaptable ways to deal with stress. Still, many government agencies have published guidelines on social distancing and hygiene. In other words, many of the recommendations to prevent the spread of COVID-19 include social distancing, which might prevent effective social support, which is required for well-being (47, 48). Many other strategies for dealing with stress, such as active coping with stress to alleviate problems, have also been reported to be effective during a crisis. Others, such as coping with substance use, have been found to be universally incompatible. Other strategies, such as distraction, might be context-dependent (49, 50). Prolonged restrictions of this type may have negative effects on mental health not only immediately but also in the long term. The use of a screening tool will help to prevent negative effects of pandemic on adolescents' future life.

CONCLUSIONS

Summing up, the COVID-19 pandemic triggered physical, psychological, social, and economic impacts that have resulted in intense anxiety, depression, obsession, compulsion, etc. Adolescents are particularly vulnerable to emotional difficulties, therefore, it is crucial to support such group. To do so, it is essential to have reliable tools to diagnose the thoughts related to pandemic. It is possible thanks to the Persian version of the OCS which is a unidimensional and reliable scale. It can be dependably used for psychological research and individual diagnosis across various groups, including boys, girls, infected, non-infected, rural, and urban adolescents. As this study should be treated as a starting point for further studies, more data should be collected in the future to establish validity of the OCS in Iranian population.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Counseling Department Review Board in University of Isfahan, Iran. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

FA, MS, and AA contributed to the concept of the study. FA organized and conducted the research. MS performed the statistical analysis. All authors wrote the manuscript and accepted its final version.

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COVID-19-Related Psychological Trauma and Psychological Distress Among Community-Dwelling Psychiatric Patients: People Struck by Depression and Sleep Disorders Endure the Greatest Burden

Amira M. Ali[1,2], *Abdulmajeed A. Alkhamees*[3]*, *Eman S. Abd Elhay*[4], *Samah M. Taha*[4] and *Amin O. Hendawy*[5,6]

[1] Department of Behavioral Medicine, National Institute of Mental Health, National Center of Neurology and Psychiatry, Tokyo, Japan, [2] Department of Psychiatric Nursing and Mental Health, Faculty of Nursing, Alexandria University, Alexandria, Egypt, [3] Department of Medicine, College of Medicine and Medical Sciences, Qassim University, Buraydah, Saudi Arabia, [4] Department of Psychiatric Nursing and Mental Health, Faculty of Nursing, Mansoura University, Mansoura, Egypt, [5] Department of Biological Production, Tokyo University of Agriculture and Technology, Tokyo, Japan, [6] Department of Animal and Poultry Production, Faculty of Agriculture, Damanhour University, Damanhour, Egypt

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***Correspondence:**
Abdulmajeed A. Alkhamees
A.alkhamees@qu.edu.sa

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COVID-19 has created a general state of worry and distress, especially among vulnerable groups such as those with psychiatric diagnoses. Worldwide, psychiatric care provision has drastically suffered during the pandemic, with many patients unable to access proper care, which may have implications for increased mental health consequences in patients with psychiatric disorders (e.g., relapse and suicide). This cross-sectional study used structural equation modeling to investigate COVID-19-related trauma and distress among Arab psychiatric population during COVID-19 quarantine. Patients with pre-existing psychiatric disorders ($N = 168$) completed an online survey that comprised the Depression Anxiety Stress Scale 21 (DASS-21), the Impact of Event Scale-Revised (IES-R), and a questionnaire on COVID-19-related attitudes/perceptions, sources of information, used protective measures, and socio-demographic information. Respondents commonly reported feeling down-hearted/blue, trouble concentrating, along with symptoms of avoidance and rumination related to the pandemic. Patients with depression and sleep disorders expressed higher COVID-19-related trauma than patients with other disorders. Perceived physical health mediated the effect of co-morbid chronic physical disorders on COVID-19 trauma, psychological distress, perceived vulnerability to COVID-19, and perceived likelihood of recovery in case of contracting COVID-19. Perceived physical health and perceived vulnerability to COVID-19 were strong direct predictors of COVID-19-related trauma and psychological distress. Staying at home negatively predicted COVID-19 trauma and exerted an indirect negative effect on psychological distress via COVID-19 trauma. COVID-19 trauma, age, and marital status directly predicted psychological distress, with COVID-19 trauma being the strongest predictor. Educational level, income, having family members working in the medical field, keeping up to date with the news on deaths/infected cases or the development of

COVID-19 drugs or vaccines, satisfaction with available information on COVID-19, and using different protective measures were not associated with significant differences in COVID-19 trauma and psychological distress scores. Immuno-psychiatric interventions should be designed to target COVID-19-trauma and distress among younger single patients with perceived poor physical health, especially those diagnosed with depression and sleep disorders.

Keywords: coronavirus disease 2019/COVID-19, psychological trauma, psychological distress, psychiatric disorders/co-morbid physical disorders, stay-at-home, major depression disorder/sleep disorders, age/unemployment/single/marital status, Arabic/Arab/Saudi Arabia

INTRODUCTION

The ongoing coronavirus disease 2019 (COVID-19) pandemic has been associated with the flaring of numerous psychological symptoms such as fear, anxiety, depression, stress, worry, anger, traumatic emotional experiences, and hopelessness in the general public since it first erupted in 2019 until now (1). Among 140732 individuals across 103 studies conducted during the COVID-19 outbreak, the prevalence of anxiety was 27.3% (95% CI: 23.7 to 31.2%) in the general population and 39.6% (95% CI: 30.1 to 50.1%) in COVID-19 patients (2). The levels of distress and trauma symptoms develop at higher levels in individuals who have been in contact with COVID-19 patients (e.g., healthcare providers and family members of COVID-19 patients) due to the development of vicarious trauma (3, 4). However, the general public and vulnerable groups are not exempted from experiencing negative emotional reactions. This is because of numerous distressing features of the pandemic: (1) wide geographical expansion of the disease, (2) announcement of COVID-19 as a global pandemic by the World Health Organization (WHO) entailing confirmed information on human-to-human transmission of the disease, (3) aggressive nature of the disease and rising death rates, (4) lack of disease-specific treatments, (5) uncertainty concerning the protective effects of evolving vaccines, (6) economic consequences of the outbreak, and (7) terrorizing images and stories of the pandemic communicated by mass media and social media (1, 5–10).

In several instances, stories informed about COVID-19 involve propagated and dangerously inaccurate beliefs, which support the contagion of fear alongside the disease itself (11–15). In particular, fears frequently reported are relevant to the negative impact of the pandemic on household finances of individuals and their significant others, unavailability of health care, insufficient food supply, job loss/unavailability, and excessive fear of contracting the disease (1, 6, 16, 17). In fact, Arpaci and colleagues have developed a measure of COVID-19 phobia based on criteria described in disease classification systems such as DSM-IV (8). In accordance, several studies reported negative consequences of COVID-19 phobia in different parts of the world (6–8, 17). Death due to lack of presenting to the hospital because of fear of contracting COVID-19 is a documented example (17).

Social distancing, primarily being locked down at home has been adopted in most countries as the most protective strategy against COVID-19. However, this strategy may cause several negative physical and psychological problems such as obesity, depression and domestic violence (18–20). For large-size families, especially with children under the age of 18 years, prolonged exposure to human sounds within the context of home confinement may cause excessive sensory input, sense of crowding—especially in small-size households, and lack of privacy leading to detrimental effects on health and well-being (21, 22). Large-scale studies show that being in self-isolation during COVID-19 was associated with greater depression, health anxiety, generalized anxiety disorder (GAD), financial worry, insomnia, acute stress, and loneliness among adults in the United States (US) (23, 24). The number of days in isolation correlates with the intensity of COVID-19-related distress (25). Meanwhile COVID-19 fear, deficient coping, and vicarious trauma associated with frequent exposure to social media/news concerning COVID-19 are identified mechanisms for increased COVID-19 psychopathology during the lockdown, especially in psychiatric/neurological patients, women, young age, and students (26, 27).

Imposed isolation, along with false or misleading information about COVID-19, may tigger a sense of perceived loss of control and jeopardize people's existential need to feel safe. Fuelled by alarmist saturation publicity, conspiracy theories—illogical, erroneous, and unhelpful disease-related beliefs/arguments (e.g., the virus causing COVID-19 is man-made)—propagate (28–30). COVID-19 associated conspiracy beliefs spread in a manner analogous to a virus (15, 29). Conspiracy beliefs develop stronger in response to widespread and significant events, which are enclosed within contradiction, uncertainty, misinformation, or unsatisfactory mundane explanations. These beliefs are largely endorsed by distressed individuals to help them achieve a sense of comfort. They operate by promoting cognitive closure—lower attention to and misappraisals of anomalous/threatening stimuli, increasing the occurrence of perceptual abnormalities and persecutory ideation (11, 12, 28, 31). An investigation involving community-dwelling individuals in the UK early during the pandemic reports that COVID-19 news moderated the effect of low political trust and COVID-19 fear on psychotic-like experiences (e.g., paranoia, hallucinations, and compulsive buying), especially among employees and students (32). Meanwhile, hospitalized psychiatric patients expressed a belief that the hospital staff orchestrated the pandemic to restrict leave and delay discharge (28). Indeed, psychiatric patients demonstrate increased proneness to COVID-19 conspiracy beliefs (28, 33), which are evoked by several liability factors

including environmental conditions and psychological processes: low socioeconomic status (e.g., being unmarried and low level of education), powerlessness, perceptions of alienation from decision makers and breakdown in containment and social order, increased health-related concerns, adverse childhood experiences, maladaptive personality traits such as schizotypal and paranoia, psychiatric problems, as well as other non-psychotic psychological characteristics (e.g., social isolation, stress) (28, 31).

A longitudinal study evaluated the emotional impact of COVID-19 (posttraumatic stress as well as depression, anxiety, and stress symptomatology) in the general public in China twice over the course of 4 weeks. It reported reduction in the intensity of COVID-19-related traumatic stress over time. However, the intensity of trauma was significantly above the cut-off point at both instances. Meanwhile, the intensity of the symptoms of depression, anxiety, and stress was significantly high at both measurements (34). A meta-analysis of longitudinal studies reports a slight significant increase in mental symptomatology early during the pandemic. However, symptoms of anxiety and general mental dysfunction declined by mid-2020 while the levels of depression remained persistently high (35). Thus, adaptation to the prolonged pandemic may lessen the trauma but does not abolish it and associated symptoms of emotional negativity (34, 35). Likewise, the feeling of loneliness during strict lockdown is reported to decrease over time among the general public. However, some individuals (e.g., unemployed and unmarried) may still experience intense loneliness (36). Various social factors are reported to interfere with psychological responses and resilience during the pandemic (37). For example, psychological distress is higher among individuals with female gender, student status, young age, single social status, employment, increased number of people in the household (3–5 persons), change in daily routine, and loss of income (25, 26).

People vulnerable to stress, who usually have low social support, coping problems, and poor adaptation, may develop psychopathology and severely suffer under conditions of collective distress such as the current crisis of the global COVID-19 pandemic (19, 38–41). COVID-19 phobia is reported to increase depression, anxiety, phobic-anxiety, paranoia, obsession-compulsion symptoms, emotional coping, and dysfunctional behaviors in the general population (26, 32, 42). Meta-analytic data emphasize that pre-existing psychiatric illnesses represent a key risk factor for increased mental distress during COVID-19 (27). Available data show worsening in the levels of psychiatric symptoms such as anxiety, depression, stress, insomnia, suicidal ideation, impulsivity, posttraumatic stress symptoms, and dysfunctional eating in patients with pre-existing psychiatric disorders during the COVID-19 pandemic (41, 43, 44). Indeed, COVID-19 related fear/anxiety is reported to trigger relapse in a remitting patient with schizophrenia (38) as well as in two elders with depressive disorder (45). Apart from those case studies, an investigation during COVID-19 lockdown in India reports relapse in 30% of 132 patients with severe mental disorders who were stable before COVID-19. Stopping psychiatric medications was evident in one out of five patients, and it was associated with worsening of psychiatric symptoms (46).

Challenges regarding limiting COVID-19 transmission among psychiatric inpatients and caregivers have drastically affected the provision of psychiatric care across the world during the COVID-19 crisis. There is more dependence on telemedicine (telepsychiatry, even at the emergency department), restrictions on hospital admission, and enrolling patients into COVID-19 positive and negative units based on testing for COVID-19 status (47, 48). Although the use of telepsychiatry has increased in many Arab countries after COVID-19, several barriers (relevant to patients and systems) render this service less effective for counseling and treatment (49). In the meantime, some small- to medium-sized psychiatric hospitals also refuse to receive new inpatients because of poor medical conditions, which would possibly deteriorate distress symptoms for patients with mental illness (47).

In addition to being unable to access proper healthcare, the pandemic is associated with challenges for obtaining food, housing, income, and medication, which may lead to a rise in drug non-compliance and negative perceptions among sufferers of psychiatric disorders who are already a stigmatized group (50). In general, people with psychiatric disorders exhibit poor physical health, physical co-morbidities, nutritional deficiencies, and short life expectancy (51–53). All these factors increase vulnerability to COVID-19 (54, 55). In fact, the incidence of COVID-19 is high in patients with psychiatric disorders, especially those with depression and schizophrenia (56, 57). Additionally, having a prior psychiatric diagnosis is associated with high mortality among hospitalized COVID-19 patients (53, 57). On the other hand, cytokine storms in severe COVID-19 are reported to trigger damages in the central nervous system resulting in the development of psychiatric disorders (e.g., post-traumatic stress disorder (PTSD), depression, sleep disorder, etc.) in a considerable proportion of recovering COVID-19 patients (56, 58).

The emotional influence of COVID-19 on vulnerable groups such as people with psychiatric problems needs to be further explored (43), with less known about patients in the Arab world, which comprises 22 countries inhabited by 423 million people (59). To bridge the gap, the current study evaluated psychological distress and COVID-19-related psychological trauma in a sample of Arab patients with psychiatric disorders. We hypothesized that COVID-19-related psychological trauma would predict psychological distress. We also hypothesized that participants' perceptions of COVID-19 (as a worrisome condition, high perception of susceptibility to the disease and less likelihood of getting recovered) and prolonged staying at home would be associated with higher levels of psychological distress and psychological trauma. COVID-19 frequently strikes patients with chronic diseases (e.g., diabetes, hypertension, etc.) (55, 60), and COVID-19-related distress is reported to be high among people with chronic disorders (61). Accordingly, we expected that people with perceived poor physical health and those with co-morbid physical disorders would experience more distress and trauma symptoms. We also proposed that patients working or having a family member working in the healthcare field would experience more trauma and distress. General anxiety and COVID-19 conspiracy beliefs among psychiatric inpatients (major depression and substance abuse) in the

UK is significantly associated with COVID-19 countermeasure necessity and compliance such as social distancing and political restrictions (33). In parallel, frequent use of precautionary measures (e.g., handwashing with hydroalcoholic solution and mask wearing regardless of the presence or absence of symptoms) is associated with higher psychological distress in the general public in Spain (62). Therefore, we assumed that patients with higher levels of distress or trauma would use more protective measures than patients with lower levels of distress or trauma.

METHODS

Study Design, Participants, and Procedure

An online questionnaire administered via Google Forms was distributed through WhatsApp and Twitter groups to 1160 anonymous respondents from Saudi Arabia. All participants who reported an age of 18 years or above and signed a digital informed consent were directed to the questionnaire. Data were collected during the official confinement period in Saudi Arabia over the course of four days between April the second and April the fifth, 2020. For this cross-sectional study, 168 respondents reporting a pre-existing diagnosis of a psychiatric disorder, which is diagnosed by a psychiatrist were recruited. The study plan was approved by the Institutional Review Board of Al Qassim University (No. 19-08-01).

Study Instruments

The structured questionnaire used in this study consisted of several parts. Part 1 comprised sociodemographic and clinical data such as age, income, education, employment, marital status, family size, type of household, working or having a family member working in the medical field, having a chronic physical disorder, health changes in the past 14 days (experiencing symptoms of fever, nasal congestion, muscle ache, etc.), visiting doctor/hospital or being admitted to the hospital during the past 14 days, direct and indirect contact with suspected or confirmed COVID-19 patients, contact with surfaces/tools contaminated with the virus causing COVID-19, being screened for, quarantined, or diagnosed with COVID-19.

Part 2 comprised perceptions and attitudes toward COVID-19—perceived physical health was assessed by one question "rate your physical health status on a scale from 1 = very bad to 5 = very good"; perceived vulnerability to COVID-19 was assessed by one question "rate your perceived vulnerability to COVID-19 on a scale from 1 = very unvenerable to 5 = very vulnerable"; perceived possibility of recovery if they contract COVID-19 was assessed by one question "rate the possibility of your recovery from COVID-19 if you get infected on a scale from 1 = very low to 5 = very high"; confidence in COVID-19 diagnostic methods was assessed by one question "rate your confidence in the methods used to diagnose COVID-19 on a scale from 1 = very unconfident to 5 = very confident"; perception of COVID-19 as a worrisome condition was assessed by one question "rate your agreement with the statement "there is extreme unnecessary worry concerning COVID-19 on a scale from 1 = strongly disagree to 5 = strongly agree".

Part 3 inquired about protective measures used by the respondents against COVID-19 such as wearing mask, keeping a one-meter distance, avoiding sharing eating utensils at household, and hand washing, along with the duration of being in self-isolation/stay-at-home.

Part 4 inquired about patients' information on COVID-19-related death rates, and the development of drugs or vaccines for COVID-19, their sources of information, and their satisfaction with the available information "How satisfied are you with the information available on COVID-19?", 1 = very unsatisfied to 5 = very satisfied.

Part 5 comprised the Arabic version of the Depression Anxiety Stress 21 (DASS-21) (63). The scale comprises 21 items in three subscales, each comprising 7 items, which measure symptoms of depression, anxiety, and stress over the past seven days. Item responses are rated on a 4-point scale that ranges from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). The overall score of the scale reflects psychological distress. The Arabic DASS-21 has been validated previously (64–66), and its reliability in the current sample is excellent ($\alpha = 0.96$) (63). In our analysis, we used the total score of the DASS-21 not of the subscales. This is because psychometric evaluations of the Arabic DASS-21 indicate its usefulness as a unidimensional measure of distress rather than being a distinct measure of depression, anxiety, and stress (64, 65).

Part 6 comprised the validated Arabic version of the Impact of Event Scale-Revised (IES-R) (67). The IES-R comprises 22 items in three subscales, which describe major features (intrusion, avoidance, and hyperarousal) of PTSD relevant to a specific trauma (68): psychological trauma relevant to the COVID-19 outbreak in this study. In this regard, each item on the IES-R has been altered to make the experience it depicts relevant to the COVID-19 outbreak such as thought of COVID-19 when I didn't mean to (item 6), pictures of the COVID-19 pandemic popped into my mind (item 9), tried not to think about COVID-19 (item 11), had sudden waves of strong feelings about COVID-19 (item 16), reminders of COVID-19 induced physical reactions such as sweating and palpitation (item 19), and had dreams about COVID-19 (item 20). The extent of distress induced by traumatic symptoms relevant to COVID-19 are rated on a 5-point equal response intervals (from 0 to 4), with higher scores indicating higher levels of traumatization (69). Internal consistency of the IES-R in the current sample is excellent ($\alpha = 0.92$).

Statistical Analysis

Quantitative variables with non-normal distribution were described using the median and interquartile range (IQR: 25–75%). Categorical variables were described using number and percentage. Independent-sample *t*-test and one-way ANOVA were used to describe between group differences in the DASS-21 and IES-R scores. A series of Spearman correlations involving sociodemographic variables and risk factors for psychological distress and psychological trauma (e.g., having family members working in the medical field, perceived vulnerability to COVID-19, etc.) with the DASS-21 and the IES-R were conducted. A structural equation model (SEM) predicting psychological distress and COVID-19-related trauma included variables with

significant correlations. To improve model fit, most non-significant predictors/direct paths were trimmed/eliminated from the model, except for those relevant to key predictors (e.g., staying at home, co-morbid physical disorders, and age) because they are relevant to the addressed hypotheses and model fit was already good. Maximum likelihood with a bootstrap involving 2000 random samples was used to obtain 95% bias-corrected confidence interval for all effects (70). Model fit was considered good based on a non-significant chi-square (χ^2) index, along with comparative fit index (CFI) and Tucker-Lewis index (TLI) >0.95, in addition to root mean square error of approximation (RMSEA) and standardized root-mean-square residual (SRMR) <0.06 (71). The analyses were conducted in SPSS and Amos, and significance was considered at a probability of less than 0.05 in two-tailed tests.

RESULTS

This study recruited 168 anonymous patients with psychiatric disorders through a web survey in Saudi Arabia during the lockdown period. The sociodemographic characteristics of the participants are described in **Table 1**. The majority of respondents were females. Forty-five (26.8%) respondents reported having a chronic physical disease (e.g., diabetes, hypertension, etc.). None of the respondents worked in the medical field while 13.7% of the respondents had a family member working in the medical field. Regarding family size, 33.3% of the respondents came from families comprising 3–5 members while 56.5% came from families comprising more than six members; the rest came from families comprising two members or less. As for the type of household, 56.5% of the respondents lived in villas, 17.3% lived in floors on villas while 29.2% lived in apartments. Independent sample *t*-test and one-way ANOVA test (**Supplementary Materials**) revealed significant differences in psychological distress scores among groups of age, marital status, and employment ($p = 0.009$, 0.007, and 0.004) while psychological trauma scores were significantly different only among education groups ($p = 0.039$).

GAD and depressive disorder were the most commonly reported psychiatric diagnoses (**Table 2**). Co-morbidity was recorded. Sleep disorders, obsessive compulsive disorder (OCD), and eating disorders were the mostly noted co-morbid conditions among patients with GAD and depressive disorder. Independent *t*-test revealed that psychological distress scores did not vary between groups of physical disorders or among groups of different psychiatric diagnoses (all p values > 0.05, **Supplementary Materials**). However, patients with depressive and sleep disorders expressed significant differences in COVID-19-related psychological trauma $t(160.2) = -3.21$, $p = 0.002$ and $t(69.5) = 2.41$, $p = 0.019$, respectively.

Direct and indirect exposure to someone suspected to have COVID-19 as well as exposure to surfaces/tools infected with the virus were reported in 1.2% of the respondents while the rest reported that exposure did not happen or did not know if they were exposed or not. As for health changes in the past 14 days, 31.1, 19.8, 17.4, 15.6, and 15.0% of the respondents reported symptoms of headache, muscle ache, dizziness, sore throat, and nasal congestion while 47.3% of the respondents reported not experiencing any symptoms. Of all the respondents, 19.0% visited the hospital or contacted a doctor in the past 14 days, 0.6% were admitted to the hospital, 3.6% were tested for COVID-19, 1.2% were quarantined for COVID-19, and none were diagnosed with COVID-19. COVID-19-related psychological trauma scores were higher in patients experiencing dizziness $t(44.5) = -2.53$, $p = 0.015$ and lower in patients not experiencing symptoms in the last 14 days $t(165.3) = 2.32$, $p = 0.021$. Psychological distress scores were significantly higher among patients experiencing sore throat

TABLE 1 | Sociodemographic characteristics of the participants.

Sociodemographic characteristics	(*N* = 168) No (%)
Gender	
Females	119 (70.8)
Males	49 (29.2)
Age (years)	
18–30	87 (51.8)
>31	81 (48.2)
Marital status	
Single	80 (47.6)
Married	77 (45.8)
Divorced/widowed	11 (6.6)
Education	
School education	51 (30.4)
University degree	117 (69.6)
Employment	
Employed	49 (29.3)
Unemployed	139 (82.7)
Monthly income (Saudi Rial▲)	
<15000	94 (56.0)
>=15000	74 (44.0)

▲*: One Saudi Rial is equivalent to 0.27 US Dollar or 0.23 Euro.*

TABLE 2 | Descriptive statistics of the clinical characteristics of the participants.

Clinical characteristics	(*N* = 168)
Diagnosis	
Anxiety disorders	70 (41.7%)
Depression	68 (40.5%)
Sleep disorders	40 (23.8%)
OCD	26 (15.5%)
Eating disorders	15 (8.9%)
PTSD	12 (7.1%)
Other disorders▲	34 (20.3%)
Having chronic physical disorder	
Yes	123 (73.2%)
No	54 (26.8%)
IES-R MD (Q1-Q3)	30.0 (14.0–43.0)
DASS-21 MD (Q1-Q3)	21.0 (6.0–39.8)

▲*: Other disorders included personality disorders, bipolar disorder, and psychotic disorders, OCD, obsessive compulsive disorder; PTSD, post-traumatic stress disorders; DASS-21, Depression Anxiety Stress Scale-21; IES-R, Impact of Event Scale-Revised; MD, median; Q1, first quartile; Q3, third quartile.*

TABLE 3 | Participants' perceptions of their general health status, COVID-19 diagnostic methods, their vulnerability to COVID-19, the possibility of their recovery if they contract COVID-19, and COVID-19 as a worrisome condition.

Patients' perceptions	(*N* = 168)		
	<3 No (%)	3 No (%)	>3 No (%)
General physical health status	14 (8.3)	37 (22.0)	117 (69.7)
Confidence in COVID-19 diagnose methods	7 (4.2)	32 (19.0)	129 (76.8)
Perceived vulnerability to COVID-19	99 (58.9)	51 (30.4)	18 (10.7)
Perceived possibility of personal recovery if you contract COVID-19	18 (10.7)	37 (22.0)	113 (67.3)
There is unnecessary worry concerning COVID-19	116 (69.0)	23 (13.7)	29 (16.3)

TABLE 4 | Participants' sources of COVID-19-related information and their use of protective measures against COVID-19.

COVID-19-related information and protective measures	(*N* = 168) No (%)
Updated with the news on COVID-19 deaths/infected cases	
Yes	153 (91.1)
No	15 (8.9)
Updated with the news on drugs/vaccines for COVID-19	
Yes	117 (69.6)
No	51 (30.4)
Sources of information	
Social Media	69 (20.9)
Local mass Media	53 (16.1)
Ministry of health	137 (41.5)
World Health Organization	71 (21.5)
Satisfaction with the available information on COVID-19 mean (SD)	4.2 (1.0)
Protective measures	
Wearing mask	30 (18.0)
Washing hands	140 (83.8)
Avoiding handshake	105 (62.9)
Keeping distance for one meter	82 (49.1)
Avoiding sharing eating utensils	38 (22.8)
Doing nothing	16 (9.6)
Home stay less than 12 hours per day▲	107 (63.7)
Not going outside at all	61 (36.3)

▲*: One participant stayed at home for up to 18 hours per day.*

t(31.89) = −2.64, $p = 0.013$ and difficulty breathing t(19.46) = −3.18, $p = 0.031$.

Descriptive statistics of items of the DASS-21 (**Supplementary Material**) indicate that feeling down-hearted and blue was the most commonly experienced symptom; median (Q1-Q3) = 2.0 (1.0–3.0), followed by being unable to become enthusiastic about anything feeling rather touchy; median (Q1-Q3) = 1.0 (0.0–3.0), and feeling that life was meaningless; median (Q1-Q3) = 1.0 (0.0–2.8). Mouth dryness, breathing difficulty, and trembling (e.g., hand) were the least reported symptoms; median (Q1-Q3) = 0.0 (0.0–1.0) followed by felt close to panic; median (Q1-Q3) = 0.0 (0.0–2.0). The most commonly reported symptoms on the IES-R (**Supplementary Material**) were avoided letting myself get upset when I thought about it or was reminded of it, thought about it when I did not mean, stayed away from reminders, tried not to think about it, had trouble concentrating, felt watchful and on guard, and tried not to talk about it; median (Q1-Q3) = 2.0 (0.0–3.0).

Table 3 shows that the majority of the respondents perceived their health status as good. However, 58.9% perceived themselves as vulnerable to COVID-19. Most respondents (69%) perceived COVID-19 as a worrisome condition—the mean score of respondents' agreement to the statement "there is extra unnecessary worry about COVID-19" was 2.0 ± 1.4. Scores below 3 on this item indicate disagreement to the statement. A considerable proportion of the participants had high confidence in the available diagnostic measures of COVID-19, and they perceived their possibility of recovery would be high if they contract COVID-19.

Acknowledging the Saudi Ministry of Health as their main source of COVID-19-related information, most patients reported being updated with the latest news on COVID-19 deaths/and number of infected cases as well as the news on drug/and vaccine discovery. No statistically significant differences in trauma and distress scores were noted among those following the latest news on COVID-19-related deaths/infected cases or the development of COVID-19 drugs or vaccines or those using various sources of information on COVID-19 (**Supplementary Material**).

Only 9.6% of the participants did not use protective measures and wearing a mask was less common. Handwashing, avoiding hand shake, and keeping a one-meter distance were commonly used by most participants (**Table 4**). There were no significant differences in the scores of psychological trauma and psychological distress among those using different protective measures. Only those who avoided sharing eating utensils at household expressed a statistical significant difference in psychological trauma t(54.6) = −2.18, $p = 0.034$. The scores of psychological trauma and psychological distress significantly varied among those with partial and complete compliance with stay-at-home orders t(127.8) = 2.50, $p = 0.014$ and t(127.2) = 2.21, $p = 0.029$, respectively.

As shown in **Table 5**, psychological distress and psychological trauma were strongly correlated. While psychological distress significantly correlated with age, marital status, and employment; psychological trauma correlated only with education among all sociodemographic factors. Monthly income was not correlated with either distress or trauma ($p > 0.05$, **Supplementary Material**). Both psychological distress and psychological trauma positively correlated with perceived vulnerability to COVID-19 and negatively correlated with perceived health status and perceived possibility of personal recovery. Psychological trauma negatively correlated with home stay and confidence in diagnostic methods of COVID-19. Perceiving COVID-19 as a worrisome condition correlated with psychological trauma ($r = 0.155$, $p = 0.045$) but not with psychological distress (**Supplementary Material**). Satisfaction

TABLE 5 | Correlations among trauma, psychological distress, sociodemographic characteristics, and perception of vulnerability to COVID-19.

Variables	1	2	3	4	5	6	7	8	9	10	11
1. DASS-21	–										
2. IES-R	0.714**	–									
3. Age	−0.240**	−0.097	–								
4. Sex	−0.054	−0.079	0.122	–							
5. Marital status	0.248**	0.081	−0.615**	0.014	–						
6. Education	0.064	0.155*	−0.146	−0.176	0.077	–					
7. Employment	0.184*	0.144	−0.366**	−0.271**	0.180*	0.037	–				
8. Perceived health status	−0.400**	−0.348**	0.070	−0.061	−0.069	0.005	−0.058	–			
9. Perceived vulnerability to COVID-19	0.297**	0.236**	0.033	0.052	0.024	−0.143	−0.064	−0.200**	–		
10. Confidence in diagnostic methods of COVID-19	−0.150	−0.180*	0.070	0.025	−0.064	0.110	−0.100	0.298**	−0.163*	–	
11. Perceived possibility of personal recovery	−0.208**	−0.289**	−0.096	−0.037	0.073	−0.082	−0.013	0.396**	0.236**	−0.180*	–
12. Home stay	−0.151	−0.180*	0.231**	0.367**	−0.075	0.053	0.117	0.052	0.097	−0.75	0.097

*, **: *Correlation is significant at the level of 0.05 and 0.01, respectively.*

with the available information on COVID-19 was negatively correlated with psychological distress and COVID-19-related trauma ($r = -0.247$ and -0.255, p values $= 0.001$). Psychological trauma negatively correlated with lack of use of any protective measures ($r = -0.187$, $p = 0.015$) and positively correlated with not sharing eating utensils at household ($r = 0.180$, $p = 0.020$).

After trimming most non-significant variables and paths, the SEM path analysis model predicting psychological trauma and psychological distress (**Figure 1**) had excellent fit on all fit measures (χ^2 (16) = 13.1, p = 0.665, CFI = 1.00, TLI = 1.02, RMSEA = 0.00, SRMR = 0.04). The model accounted for 19.0 and 59.0% of the variances in psychological trauma and psychological distress, respectively. As shown in **Figure 1**, perceived health status and vulnerability to COVID-19 were strong predictors of COVID-19-related trauma and psychological distress. Age, marital status, and COVID-19-related trauma predicted psychological distress, with the later expressing the strongest effect. Stay-at-home had a significant direct negative effect on COVID-19-related trauma and a significant indirect negative effect on psychological distress mediated by COVID-19-related trauma (β = −0.107, 95% CI: −0.177 to −0.038, $p = 0.017$).

Perceived vulnerability to COVID-19 had a strong indirect effect on psychological distress via COVID-19-related trauma (β = 0.112, 95% CI: 0.039 to 0.184, p = 0.009); it also mediated the indirect effect of perceived health status on COVID-19-related trauma (β = −0.033, 95% CI: −0.078 to −0.007, p = 0.022). COVID-19-related trauma mediated the indirect effect of perceived health status on psychological distress (β = −0.240, 95% CI: −0.324 to −0.163, p = 0.001). Although age had no significant effect on perceived health status, it exerted significant indirect effects via perceived health status on perceived vulnerability to COVID-19 and perceived likelihood of recovery in case of contracting the disease (β = −0.024, 95% CI: −0.065 to −0.004, p = 0.047) and (β = 0.046, 95% CI: 0.008 to 0.106, p = 0.048), respectively. The indirect effects of age on psychological distress and psychological trauma were marginal ($p = 0.082$ and 0.074, respectively). Having a co-morbid chronic physical disease expressed significant indirect effects on perceived vulnerability to COVID-19, perceived likelihood of recovery in case of contracting the disease, COVID-19-related trauma, and psychological distress via perceived health status (β = 0.050, 95% CI: 0.014 to 0.108, $p = 0.016$), (β = −0.096, 95% CI: −0.172 to −0.049, $p = 0.000$), (β = 0.085, 95% CI: 0.027 to 0.151, $p = 0.010$) and (β = 0.086, 95% CI: 0.022 to 0.150, $p = 0.018$), respectively.

DISCUSSION

To our knowledge, this is the first study to examine COVID-19-related psychological trauma and psychological distress among Arab patients with psychiatric disorders. COVID-19-related psychological trauma was evident, especially among patients with depression and sleep disorders, and it was a strong predictor of distress. Feeling down-hearted and blue, a depressive symptom, was the most reported distress symptom. Psychological distress was common among patients who were young, unemployed, and single. Staying at home was protective against COVID-19-related psychological trauma and psychological distress. Most participants perceived COVID-19 as a worrisome condition, and those with high perceived poor health status, high perceived vulnerability to COVID-19, and low perceived chance of recovery in case they contract the disease were more likely to exhibit high psychological distress scores.

Although no statistically significant differences in trauma and distress scores were noted between genders (**Supplementary Materials**), age was a significant negative predictor of psychological distress in our sample, which is consistent with several studies reporting higher distress among youth during the pandemic (3, 9, 37, 72). Age is an important factor that is closely linked to several other interrelated variables (e.g., education, marital status, employment, health status, loneliness, etc.) (70). For example, age was negatively correlated with marital status and employment, which were both positively correlated with COVID-19-related trauma (**Table 5**). As noted above, age exerted an indirect negative effect on perceived vulnerability to COVID-19 and an indirect positive effect on

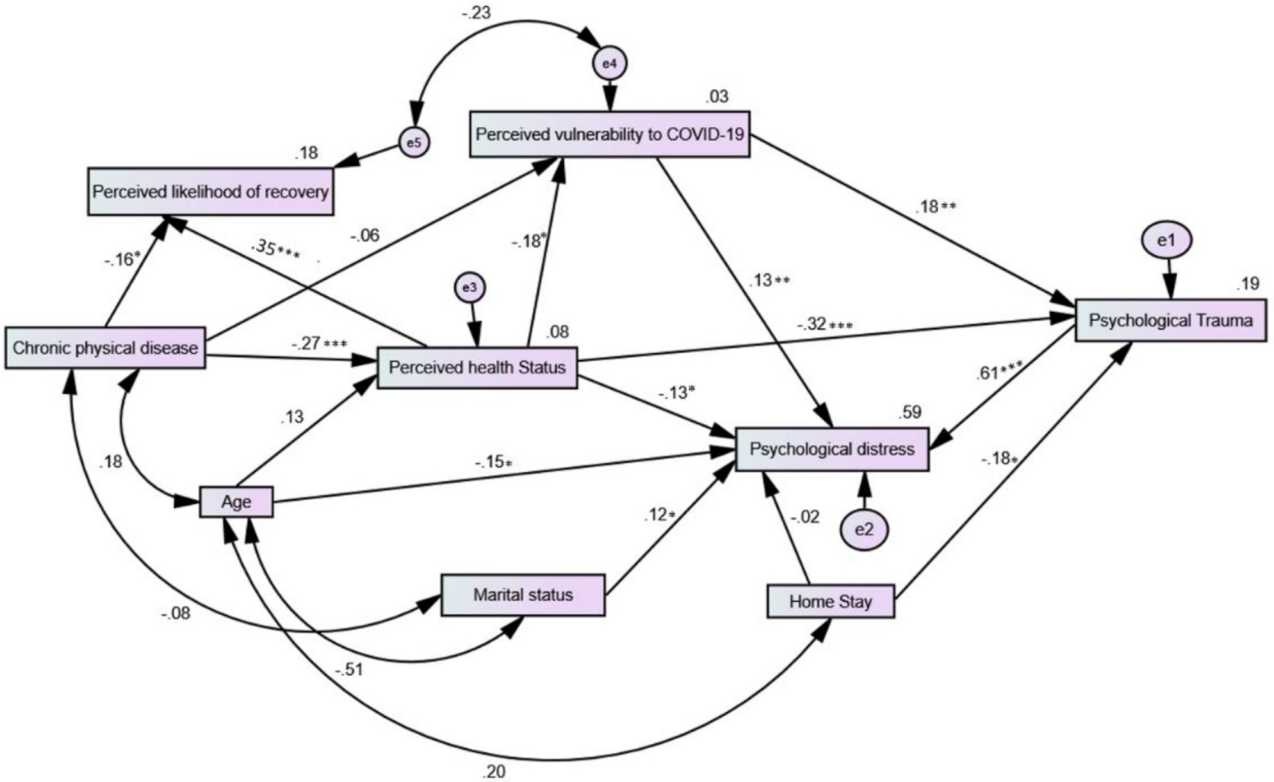

FIGURE 1 | Structural equation path model predicting COVID-19-related psychological trauma and psychological distress in Arab patients with psychiatric disorders.

perceived likelihood of recovery should the patients contract COVID-19. Age was also negatively associated with obtaining COVID-19-related information from the website of the WHO and the Ministry of Health (**Supplementary Material**). In fact, age along with marital status, educational level, and professional status are reported to affect resilience scores among the general public in several countries during COVID-19, with age expressing the strongest effect among all sociodemographic variables (37). Thus, interventions designed to mitigate COVID-19-related trauma may consider young age as a key effector, especially when it is associated with unemployment, low education, and single marital status.

Contrary to expectations and reports associating high COVID-19 related distress with chronic non-infectious diseases (61), having a chronic physical disorder was not directly associated with COVID-19-related distress or trauma. This may be attributed to the fact that many patients with chronic disorders may enjoy good health, especially when they stick to a healthy lifestyle (adequate exercise, diet, and sleep) (73). This logic may be true given that having a chronic physical disorder negatively predicted perceived health status and exerted indirect effects through that variable on psychological trauma and COVID-19-related distress as well as perceived vulnerability to COVID-19. In line, high levels of psychological distress are reported to prevail when physical disorders are associated with poor health status and low wellbeing such as during periods of active disease (52, 74). In addition to its mediating effect, perceived health status was also a direct predictor of both psychological distress and COVID-19-related trauma. Consistent with our findings, Chinese psychiatric patients with poor physical health expressed more depressive, anxiety, and stress symptoms (44). Likewise, a systematic review pinpoints perceived poor physical health as a predictor of distress among the general public, healthcare providers, and COVID-19 patients (43). Overall, patients with physical co-morbidities, especially those with perceived poor physical health, may be at high risk for COVID-19-related trauma and distress.

Among different psychiatric diagnoses, COVID-19-related trauma symptoms were significantly higher among patients diagnosed with depressive disorder and sleep disorders, which were also comorbid with one another. This finding is consistent with those of an Italian study reporting an association between low sleep quality and high distress in the general public exhibiting COVID-19-related PTSD (72). In fact, a meta-analysis involving cross-trait meta-analysis and Mendelian randomization analysis reports 29 loci shared between PTSD and major depressive disorder, along with a causal effect of genetically determined depressive phenotypes on PTSD. The authors concluded that PTSD, from a genetic point-of-view, is likely to be a subtype of depressive disorders (75). Taken together, depressed patients, particularly those with symptoms of dysfunctional sleep would require special immuno-psychiatric attention in order to prevent the development of COVID-19-related trauma.

Staying at home is reported to contribute to loneliness, decreased social support, and dysphoric mood (23, 24, 36). Contrary to our expectations, prolonged stay-at-home was protective against psychological trauma and distress. This could be related to alleviation of COVID-19 phobia secondary to reduction of direct contact with others (e.g., at work, supermarkets, etc.). In this context, young Italian people who worked outside their domicile during COVID-19 strict lockdown are reported to exhibit higher levels of anxiety and stress than the general public (3). It is also possible that trauma and distress symptoms were low in those with complete compliance with stay-at-home orders due to family interactions and social connectedness associated with large family size—predominantly, more than half the respondents came from families comprising more than 6 members. In support of this view, living with others or in a rural area, having greater social support and more close friends are documented protective factors against loneliness during COVID-19 in the UK (36). In line, perceived social support is reported to moderate the relationship between loneliness and anxiety during COVID-19 in China (76). Longitudinal data indicate that adolescents adhering to stay-at-home orders who feel socially connected are less prone to depression/anxiety, COVID-19 worries whereas those with online learning difficulties, increased conflict with parents, and COVID-19 worries experience an increase in mental health problems during the COVID-19 lockdown (16). On the other hand, data from Canada show that the presence of children under the age of 18 in the household is associated with increased alcohol use, suicidal ideation, parent conflicts with children, domestic violence, worsening of children's mental health as well as more frequent positive interactions with their children and feelings of closeness due to the pandemic (21).

Crowdedness during the confinement period may contribute to distress; however, the perception of human sounds is reported to be context-specific (22). In this study, family size was positively associated with the type of household ($r = 0.359$, $p < 0.01$), with the majority of the respondents living in villas or in a floor on a villa. Thus, the housing conditions would provide plenty of space and privacy. In line, compared with house dwellers, apartment dwellers experience more exposure to mechanical sounds, which is associated with lower self-reported health and lower restorative quality of the home (feeling away) during the lockdown (22).

Although none of the respondents worked in the medical field, some patients had a family member working in the medical field. However, those patients expressed no variation in COVID-19-related trauma or distress scores, which is contradictory to what is reported in the literature (3). This finding would be interpreted within the context of data collection, which took place during the beginning of the confinement period where the number of patients infected with COVID-19 in the entire Saudi Arabia was around 1000. Thus, it is possible that family members working in the medical field may had less contact with COVID-19 patients, entailing less vicarious trauma (4).

Strength, Implications, and Limitations

This study is the first to describe the psychological impact of COVID-19 and its correlates among Arab patients with psychiatric disorders. It examined psychological distress: non-specific negative emotions of combined feelings of anxiety and depression, which are closely associated with mental disorders (77). This is because the DASS-21 is not a diagnostic measure, and it primarily captures psychological distress rather than discrete symptoms of depression or anxiety (78). In line, a meta-analysis states that the reported incidence of depression and anxiety during the pandemic as assessed by various specific diagnostic measures (e.g., Generalized Anxiety Disorder, Hamilton Depression Scale, etc.) is highly heterogenous (79).

The findings identified some of the key risk factors of mental health consequences of COVID-19, which may inform immuno-psychiatric and resilience promoting efforts toward patients with psychiatric disorders, who represent one of the most vulnerable groups to COVID-19 and its adverse effects. The results highlight the importance of screening (e.g., online, on the phone) patients with psychiatric disorders for COVID-19-related trauma as well as symptoms of distress in order to mitigate mental health risks among those patients. Vulnerable individuals who may need special support are mainly those who are young, single, unmarried, with physical comorbidities, poor perceived physical health, and high perceived vulnerability to COVID-19. Patients diagnosed with major depression and sleep disorders are particularly vulnerable to COVID-19 trauma.

This study also has a number of limitations, which may limit the generalizability of the findings: cross-sectional design, selection bias (by recruiting only educated patients who use social media from a single Arab country), social desirability bias (self-reported data), and recall bias. Psychiatric diagnoses were self-reported, even though they were indicated to be performed by psychiatrists. Because of noted psychiatric comorbidities, it was not possible to investigate the contribution of the main psychiatric diagnosis to COVID-related distress and trauma in SEM. However, collecting data through an online survey was the only convenient way because face-to-face contacts were strictly forbidden during the confinement period. It is worth mentioning that data collection took place early during the pandemic while research signifies a temporary increase in mental symptomatology at the initial periods of the pandemic followed by a drop by mid-2020 to the levels reported before the pandemic (35). In addition, the pre-COVID-19 level of psychological distress in the current sample has not been assessed, which makes us unable to affirm that distress estimated is purely attributed to the pandemic. Therefore, the results must be interpreted with caution. Meanwhile, the pandemic is ongoing and the need to ensure prompt provision of adequate healthcare to acute psychiatric patients remains immense.

CONCLUSION

COVID-19-free patients with psychiatric disorders endorse COVID-19-psychological trauma, and subsequently experience psychological distress. Experiencing symptoms of dizziness, sore throat, and difficult breathing was associated with higher COVID-19-related trauma and distress. Patients

were up to date with the latest information about COVID-19 mortality and treatment, and the ministry of health was the main source of information in addition to the WHO and social media. Satisfaction with information available about COVID-19 did not correlate with distress or trauma. Patients largely complied with protective measures, and trauma symptoms were higher among those not sharing their eating utensils at household. Sociodemographic variables (age, marital status, and employment), perceived health status, and beliefs about risk of infection and chances of personal recovery significantly predicted distress and trauma. Staying at home was protective against COVID-19 trauma and emotional reactions.

To prevent mental health consequences, the findings suggest that more research attention should be directed toward fostering adaptive coping among young, unemployed, and single patients, especially those with depression and sleep disorders as well as those with physical disorders who perceive their physical health as poor or perceive themselves more vulnerable to COVID-19. Research is needed to investigate whether psychological distress in Arab psychiatric patients is associated with COVID-19-related conspiracy theories as well as burdensome consequences of the outbreak such as difficulties with access to healthcare services as well as availability of job/income, food, support system, etc. Longitudinal investigations are required to inform whether the emotional reaction of psychiatric patients changes over the course of the pandemic.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in Mendeley repository at: https://data.mendeley.com/datasets/8k3vmfxpd3/draft?a=67415321-61f7-4920-bd2a-749b365ff6fb (access on 27 September 2021).

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board of Al Qassim University (No. 19-08-01). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AMA, AAA, and AOH conceptualized the study and designed the methodology. AAA collected the data. ESAE and SMT cleaned the data. AMA and AOH analyzed and interpreted the data and edited and revised the final draft. AMA, ESAE, SMT, AAA, and AOH wrote the initial draft of the manuscript. All authors have critically revised and approved the final draft of the manuscript.

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SUPPLEMENTARYMATERIAL

The Supplementary Material containing relevant analyses that are not reported in this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.799812/full#supplementary-material

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The Role of Self-Care Activities (SASS-14) in Depression (PHQ-9): Evidence From Slovakia During the COVID-19 Pandemic

Beata Gavurova[1]*, *Boris Popesko*[2], *Viera Ivankova*[3] and *Martin Rigelsky*[4]

[1] Center for Applied Economic Research, Faculty of Management and Economics, Tomas Bata University in Zlín, Zlín, Czechia, [2] Department of Business Administration, Faculty of Management and Economics, Tomas Bata University in Zlín, Zlín, Czechia, [3] Institute of Earth Resources, Faculty of Mining, Ecology, Process Control and Geotechnologies, Technical University of Košice, Košice, Slovakia, [4] Department of Marketing and International Trade, Faculty of Management and Business, University of Prešov, Prešov, Slovakia

In the ongoing situation, when the world is dominated by coronavirus disease 2019 (COVID-19), the development of self-care programs appears to be insufficient, while their role in mental health may be crucial. The aim of the study was to evaluate the associations between self-care activities and depression in the general Slovak population, but also in its individual gender and age categories. This was achieved by validating the self-care screening instrument, assessing differences, and evaluating the associations using quantile regression analysis. The final research sample consisted of 806 participants [males: 314 (39%), females: 492 (61%)] and data were collected through an online questionnaire from February 12, 2021 to February 23, 2021. Patient Health Questionnaire (PHQ-9) for depression ($\alpha = 0.89$) and Self-Care Activities Screening Scale (SASS-14) [health consciousness (HC) ($\alpha = 0.82$), nutrition and physical activity (NPA) ($\alpha = 0.75$), sleep quality (SLP) ($\alpha = 0.82$), and interpersonal and intrapersonal coping strategies (IICS) ($\alpha = 0.58$)] were used as screening measures. Mild depressive symptoms were found in 229 participants (28.41%), moderate depressive symptoms in 154 participants (19.11%), moderately severe depressive symptoms in 60 participants (7.44%) and severe depressive symptoms in 43 participants (5.33%). The main findings revealed the fact that individual self-care activities were associated with depression. This supported the idea that well-practiced self-care activities should be an immediate part of an individual's life in order to reduce depressive symptoms. Sleep quality played an important role, while HC indicated the need for increased attention. Other dimensions of self-care also showed significant results that should not be overlooked. In terms of depression, females and younger individuals need targeted interventions. The supportive educational intervention developed based on the self-care theory can help manage and maintain mental health during a stressful period, such as the COVID-19 pandemic. Health policy leaders should focus on health-promoting preventive self-care interventions, as the demand for them increases even more during the pandemic.

Keywords: depression, mental health, health consciousness, nutrition and physical activity, sleep quality, coping strategies, COVID-19, self-care behavior

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***Correspondence:**
Beata Gavurova
gavurova@utb.cz

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INTRODUCTION

With the onset of coronavirus disease 2019 (COVID-19), people's daily lives changed within a few days as daily routines were interrupted and people were locked up at home. In this context, the ongoing COVID-19 pandemic represents a health burden not only in terms of the spread of a life-threatening infection, but also serious psychological consequences (1–4). The fear of infection as well as sudden changes in everyday life play a major role in this situation. Many countries have imposed strict measures and restrictions to successfully defeat COVID-19, with lockdown, quarantine, and isolation being the main strategies for victory (5). On the other hand, isolation and social distance are factors that increase the risk of poor mental health (6). Moreover, individuals had to face an unknown disease, worries about transmission, insecurity, but also new realities such as wearing a mask, home office, or home schooling (7, 8). In this way, evidence has shown that people are less able to control critical situations and manage stressful events related to severe acute respiratory syndrome compared to the stressful events of everyday life (9). Based on all these findings, the COVID-19 pandemic can be considered as a global trauma with consequences for mental health (6, 10).

From a mental health perspective, depression is a huge burden on health (11). In Slovakia, together with the COVID-19 pandemic, depressive symptoms also appeared across the population (12, 13), while depression is considered not only a health but also an economic burden in this country (14). In addition, it has been proven that Slovak family members of patients in intensive care units report a higher prevalence of depression (15), which can also be expected in COVID-19 disease. Young people, patients as well as females can be considered as risk and vulnerable groups in this country (16–20). On the other hand, there is little evidence among the general Slovak population, which was confirmed by the results of a new international study conducted by Zhang et al. (21). Although depression is a well-examined problem in Europe (22, 23), Slovakia is a European country that has long overlooked and neglected this serious health problem. There is an obvious insufficiency in the field of research, but also in the field of implementation of prevention and treatment strategies in practice (24). This is reflected in the lack of evidence-based interventions.

Following the above-mentioned facts, it should also be noted that the mental health of the population plays an important role in the success or failure of pandemic management, public policies and health measures to overcome the pandemic, but also in the success of communicating the importance of the measures, vaccination and COVID-19 risks (25). In this context, self-care behavior is considered to be one of the main strategies to eliminate not only the transmission of infection but also the psychological effects of the COVID-19 pandemic (26). Self-care covers a range of activities and approaches that an individual pursues to maintain physical and mental health, as well as to manage ill health (27). In these activities, individuals are encouraged by their self-care abilities, which represent the fundamental pillars of self-care, and by their self-efficacy, which facilitates the acquisition of the desired effects (28). According to Butler et al. (29), there are two objectives of self-care, namely to protect or manage stress and other negative situations, but also to maintain or enhance well-being and overall functioning. The authors also stated six life domains that need attention in terms of self-care activities: physical, professional, relational, emotional, psychological, and spiritual (29).

The lack of research efforts in Slovakia can be observed not only for depression, but also for self-care activities. In other words, this issue as a whole is not adequately researched in Slovakia. There is limited evidence on self-care behavior, while previous studies have focused mainly on professional helpers as a risk population group (30–32). The authors of these studies emphasized that increased and continuous attention is needed to promote the value of self-care behavior in this country. At the same time, they stated that health status plays an important role in self-care behavior (31, 32). The foreign evidence has shown that improvements in physical health, vitality, social functioning, emotions, and mental health can be expected if self-care interventions are involved in individuals' lives (33). Thus, the benefits of self-care activities are unquestionable (34) and their practice can be reflected in increased satisfaction (35). In this way, self-care is an important aspect of health promotion aimed at improving population health and well-being (33, 36). Self-care activities, as part of hygiene practices, are effective in coping with stress and preventing health problems, while the motivation to act and include self-care elements into daily routine plays an important role (37).

Bearing in mind the evidence presented above, it can be assumed that self-care activities are a core of mental health, especially in the stressful period of the COVID-19 pandemic. The main components of the self-care conceptual model take into account health literacy and self-awareness, health consciousness (HC), knowledge, mental well-being, healthy eating, physical activity, good hygiene, and risk avoidance (36, 38). Among these components, sleep quality (SLP) appears to be an important predictor of mental health and well-being, while physical and nutrition activity also plays a significant role (39). In terms of depression, several self-care activities, such as SLP, seemed to be inversely associated with this serious mental disorder (40). In this context, self-care behavior can be considered a predictor of depression (39).

In various countries, the presented issue has been examined mainly in terms of the role of depressive symptoms in self-care activities (41–44), but research area lacks knowledge about the role of self-care activities in depression (39, 40). Thus, this study contributes to addressing the limitations in the current literature by providing a better understanding of the problem. At the same time, international research has largely focused on patients rather than the general population, while the analyzes have covered only some of the activities that fall within the concept of self-care behavior. All these facts were the motivation for the authors of this study, which enriches scientific knowledge as such. It should also be noted that similar research has not yet been carried out in Slovakia. The presented study focuses on the associations between self-care and depression in a non-patient sample with respect to the whole concept of self-service activities. The resulting insights are of great importance for public health

in Slovakia, and the findings provide guidance to public health leaders in improving mental health and promoting self-care. This research is particularly needed during the COVID-19 pandemic, which left trauma in the lives of individuals.

METHODOLOGY

The aim of the presented study was to evaluate the associations between self-care activities and depression in the general Slovak population, but also in its individual gender and age categories.

Measures

The analytical procedures included a four-factor measure related to the concept of self-care, that is Self-Care Activities Screening Scale (SASS-14) (38). This instrument was developed to screen specific self-care activities during the COVID-19 pandemic with regard to HC and consists of the following dimensions (subscales): (i) health consciousness—HC ($\alpha = 0.82$), (ii) nutrition and physical activity—NPA ($\alpha = 0.75$), (iii) sleep quality—SLP ($\alpha = 0.82$), and (iv) interpersonal and intrapersonal coping strategies—IICS ($\alpha = 0.58$). The SASS-14 items offered possible responses using a 6-point Likert scale (numerical coding): (1) never, (2) very rarely, (3) rarely, (4) occasionally, (5) very frequently, (6) always. The higher the total and subscales scores, the higher the frequency of self-care activities performed by individuals.

The second measure was represented by the Patient Health Questionnaire (PHQ-9) for screening depression (45). This brief instrument in the form of a self-report questionnaire is able to diagnose not only depressive symptoms but also the severity of depression. The PHQ-9 instrument was selected based on its acceptance and common use in the professional and scientific community. The following responses were provided to PHQ-9 items (numerical coding): (1) not at all, (2) several days, (3) more than half the days, (4) nearly every day. The participants' responses recorded the period of the past 2 weeks before completing the questionnaire. The instrument provides a total score ranging from 9 to 36 with thresholds: 14–18 mild depressive symptoms, 19–24 moderate depressive symptoms, 25–29 moderately severe depressive symptoms, >29 severe depressive symptoms. Thus, the higher the total score, the more severe the depression. Cronbach's α was 0.89 (confidence interval—CI: 0.88–0.90).

Participants and Data Collection

A total of 958 responses were obtained, 152 of which were excluded due to non-compliance with criteria such as approved consent to participate in the survey, age over 18 years, but also due to system error, incomplete data, and irrelevant responses. Thus, 806 participants were included in the final research sample. In addition to screening measures presented above, the questionnaire also collected various socio-demographic information about participants. In terms of gender, there were 314 males and 492 females. Age was expressed using generational categories: participants born before 1980 (>41 years) = 176, between 1980 and 1989 (32–41 years) = 113, between 1990 and 1999 (22–31 years) = 427, in 2000, and later (<22 years) = 90. Females and young adults were slightly predominant in the research sample, but this limitation should not be considered as a bias that could significantly impair the results. In terms of social status, students slightly predominated (full-time student = 364, pensioner (old-age, disabled, etc.) = 26, maternity leave/guardianship = 18, unemployed = 31, entrepreneur = 50, employed = 317).

Data were collected through an online questionnaire from February 12, 2021 to February 23, 2021. Thus, the collection took 12 days, which can be considered a strength of research, as possible externalities during the pandemic with changing conditions were minimized. The subjects were the adult Slovak population. The data collection process was based on quota selection respecting gender, age and social status. The effort was to achieve a proportionally divided sample by gender. In terms of social status, a maximum of 30% of students, 50% of workers, and a maximum of 20% of other categories were expected. In terms of age, it was expected that 10% of participants were born in 2000 and later, while in the other three categories there was an effort to achieve approximately proportional representation. Some deviations from the country population could be observed, i.e., young people, females and students predominated. This can be considered a limitation of the study. On the other hand, the data collection was completed after 12 days as planned, because the risk of skewing results due to external social influences was more severe than the risk of some deficiencies in the sample. The time of collection was considered to be the most serious attribute of the negative effects on the sample during the pandemic.

The questionnaire was freely shared, but also promoted on the social network Facebook, while the target audience was controlled. Subsequently, the questionnaire was distributed to groups on the social network with a specific request for completion. Similar requests were sent by emails, which were obtained from publicly available databases.

Governance and Ethics

The study was conducted according to the guidelines of the Declaration of Helsinki (46). The research was approved by the Ethics Committee of the Clinical Trials Services, USP TECHNICOM, Technical University of Košice, Slovakia (Ref. 02/03/2021 IG Bioinformatics). At the beginning of the questionnaire, all participants received the same information about the research and they were provided with information about their rights and anonymity. All participants included in the research confirmed their informed consent. The participants did not receive any financial reward.

Statistical Analysis

The following statistical approach was selected to meet the main aim of this study. The characteristics of the central tendency (mean, median) were used for the statistical description. The level of reliability was verified by Cronbach's α. Non-parametric tests of differences (Wilcoxon signed-rank test, Kruskal Wallis test) were applied to evaluate possible differences in self-care activities and depression between individual population categories. The preference for non-parametric statistical methods was conditioned by the fact that several variables or groups of

TABLE 1 | Description of the data.

LV ID	MV ID	Questionnaire item	Mean	Median	Cr α (CI)
HC	HC 1	I am alert to changes in my health	4.84	5	0.82
	HC 2	I am usually aware of my health	5.25	5	(0.81–0.84)
	HC 3	I reflect about my health a lot	4.35	5	
	HC 4	I know my inner feelings about my health	4.95	5	
	HC 5	I am constantly examining my health	3.73	4	
NPA	NPA 1	I do physical activity (some sport, yoga, or dance) for at least 30 min a day	4.06	4	0.75
	NPA 2	I eat three servings of fruit and two of vegetables daily	4.36	5	(0.72–0.75)
	NPA 3	I think I am eating better than I used to (less sugar, salt, fried snacks, or precooked food)	4.06	4	
	NPA 4	I'm drinking an average of eight glasses of water a day	4.56	5	
SLP	SLP 1	I sleep 7–8 h a day	4.68	5	0.82
	SLP 2	I think that my rest is of quality	4.41	5	(0.79–0.84)
IICS	IICS 1	I am learning to do new things like: playing an instrument, sports, practicing a new language, cooking, painting, new apps, video games, etc.	3.80	4	0.58
	IICS 2	I actively participate in the initiatives of my community (e.g., clapping, singing, playing music, offering my support in what I could help, etc.)	2.53	2	(0.35–0.63)
	IICS 3	I am finding moments to be more connected to myself (I observe, write, or reflect on my thoughts, emotions, or behaviors)	4.25	4	
PHQ-9	PHQ-9 1	Little interest or pleasure in doing things	2.14	2	0.89
	PHQ-9 2	Feeling down, depressed, or hopeless	2.02	2	(0.88–0.90)
	PHQ-9 3	Trouble falling or staying asleep, or sleeping too much	1.92	2	
	PHQ-9 4	Feeling tired or having little energy	2.33	2	
	PHQ-9 5	Poor appetite or overeating	1.81	1	
	PHQ-9 6	Feeling bad about yourself—or that you are a failure or have let yourself or your family down	1.74	1	
	PHQ-9 7	Trouble concentrating on things, such as reading the newspaper or watching television	1.95	2	
	PHQ-9 8	Moving or speaking so slowly that other people could have noticed? Or the opposite —being so fidgety or restless that you have been moving around a lot more than usual	1.32	1	
	PHQ-9 9	Thoughts that you would be better off dead of or hurting yourself in some way	1.37	1	

LV, latent variable; MV, manifest variable, Cr α, Cronbach's α; CI, confidence interval; HC, health consciousness; NPA, nutrition and physical activity; SLP, sleep quality; IICS, interpersonal and intrapersonal coping strategies; PHQ-9, patient health questionnaire.

variables did not meet the conditions for the use of parametric tests (normality, homogeneity of variances). Correspondence analysis was performed using Pearson's χ^2-test. Finally, the associations between self-care activities and depression were verified using quantile regression (Percentile: $\lambda = 0.25, 0.50, 0.75$). Quantile regression analysis was preferred over other regression models, as this method is able to minimize the risk of skewing results due to identified deficiencies in the sample (deviations from the population).

The analytical calculations were performed using the programming language R v 4.1.1 (RStudio, Inc., Boston, MA, USA) and SPSS v 26 (Armonk, NY: IBM Corp.).

RESULTS

This section presents the main results and their interpretation. The results were obtained through several analytical procedures, including a statistical evaluation of the validity of the SASS-14 instrument, an assessment of the differences in the measured scores between gender and age categories, as well as a statistical examination of the associations between self-care activities and depression. At the beginning, a description analysis and a difference analysis were performed in order to provide a more detailed view of the analyzed data. Subsequently, a correspondence analysis focused on the links between gender-age characteristics, self-care activities in selected dimensions, and depression. At the end of this section, the main results of a quantile regression analysis were offered to determine the associations between self-care activities and depression.

Table 1 provides an overview of the latent variables (LV), which consist of manifest variables (MV) with the relevant identification number (ID), as well as their full wording. These LVs were included in the subsequent analyzes and were formed by the arithmetic mean of the individual MVs of the SASS-14 instrument and the sum of the PHQ-9 instrument. The measures of central tendency (mean, median) are offered for individual items of the questionnaire.

As stated in the methodology, the SASS-14 questionnaire items were scored in the interval 1 (never) to 6 (always), which means that the higher the number, the more frequent the specific self-care activity. In general, the mean and median values of the self-care activities ranged from 4 to 5 (**Table 1**). This finding revealed the fact that Slovak participants performed individual self-care activities occasionally or very frequently during the COVID-19 pandemic. The only exception was participation in

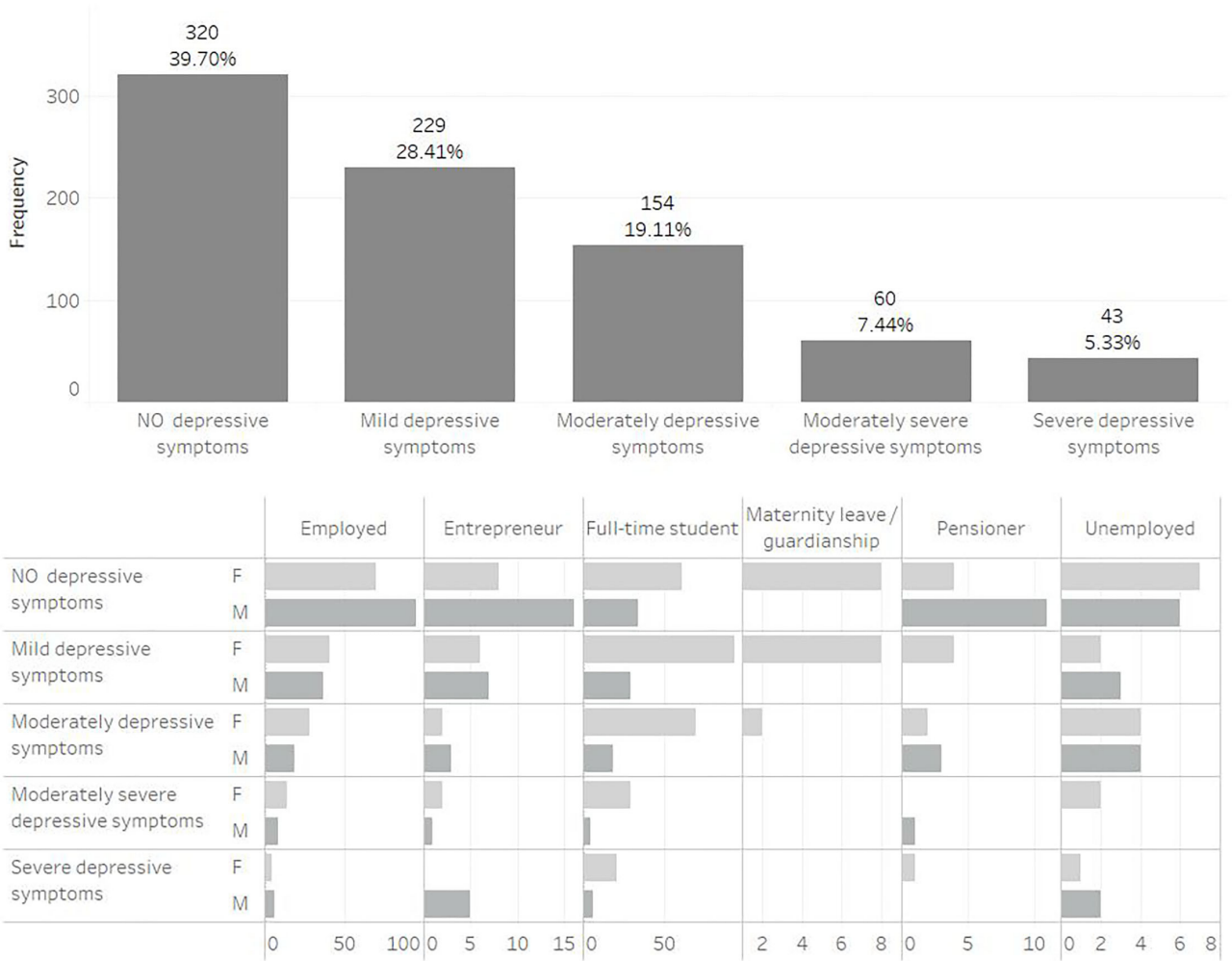

FIGURE 1 | Frequency of depressive symptoms among Slovak participants.

the initiatives of participants' community (IICS 2), which was very rare among participants (mean = 2.53; median = 2). On the other hand, health awareness was very frequent among participants (HC 2: mean = 5.25). Self-care behaviors such as alertness to changes in health (HC 1) or knowledge of inner feelings about health (HC 4) were also frequent. The PHQ-9 questionnaire items for depression were scored from 1 (not at all) to 4 (nearly every day). As can be seen, the mean values ranged from 1.32 to 2.33, indicating that Slovak participants reported individual depressive symptoms in several days during the past 2 weeks.

Based on the values of Cronbach's α, the reliability level could be considered acceptable in almost all cases analyzed. Only an item concerning IICS proved to be weaker in terms of reliability, and this could be considered as a certain limitation of the research.

Figure 1 provides more detailed information on depressive symptoms in Slovakia, while participants were assigned to one of five categories based on their depression score (PHQ-9). As can be seen, no depressive symptoms were found in 320 participants (39.70%). On the other hand, 229 participants (28.41%) reported mild depressive symptoms, 154 participants (19.11%) reported moderate depressive symptoms, 60 participants (7.44%) reported moderately severe depressive symptoms and 43 participants (5.33%) reported severe depressive symptoms. The results are also presented in terms of social status.

The following analyzes included the average scores of individual self-care activities (HC, NPA, SLP, and IICS) and the depression score (PHQ-9) as the sum of the values in the individual items. This approach was in line with the recommended procedure for adjusting selected scales.

Figure 2 shows self-care activities and depression in box plots, as well as the results of difference tests. This allows a closer look at the examined indicators. On this basis, significant differences between individual age categories and between gender categories were found in SLP, IICS, and depression (PHQ-9). This justifies the idea of examining the associations between self-care activities and depression in age and gender classifications. In terms of

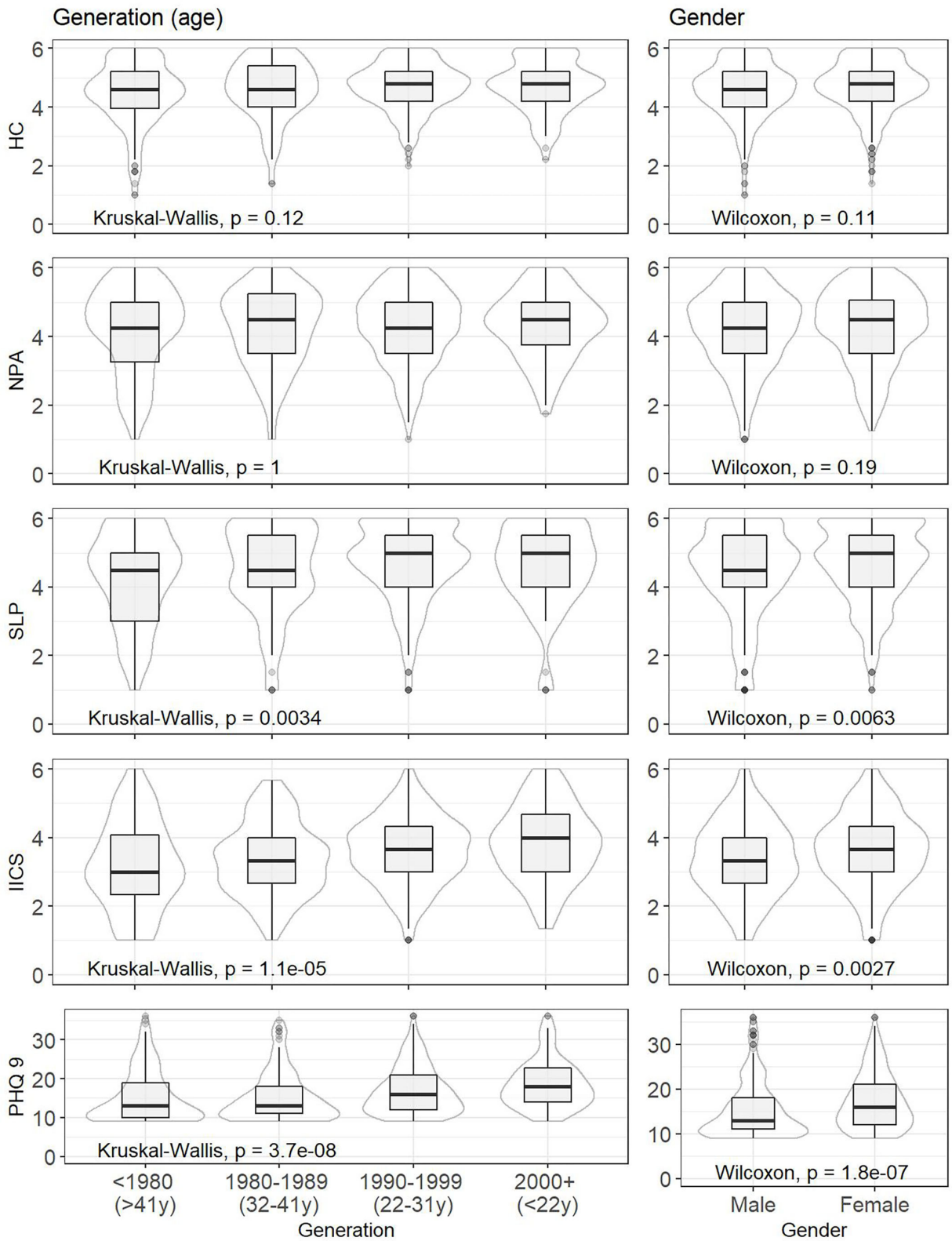

FIGURE 2 | Selected statistical characteristics of indicators and results of difference tests—classification by age and gender.

gender, females reported significantly higher levels of depression than males. Females also reported more self-care activities such as IICS and SLP. From an age perspective, younger participants were more prone to depression, and they reported more self-care activities such as IICS and SLP. Accordingly, significantly less IICS and SLP were observed among older participants aged 32 years and over (age categories: >41 years, 32–41 years).

Figure 2 also points to the median values of the indicators in individual population groups. The median value of 15 was found for all participants, which means mild depressive symptoms. Mild depressive symptoms were also common for females (median = 16), but not for males (median = 13). The youngest participants reported mild depressive symptoms, but their median score was on the verge of mild and moderate depression (median = 18). This was not the case for the oldest participants (median = 13).

The following correspondence analysis was used to assess the links between self-care activities, depression, and gender-age characteristics. The identification of the closest links can be important from a public health point of view, as it more precisely defines the population group to which increased attention should be paid. Self-care and depression indicators were transformed into percentiles (<25th perc., 25th−50th perc., 50th−75th perc., >75th perc.) and gender-age categories were merged (oldest males: M and >41 years, older males: M and 32–41 years,

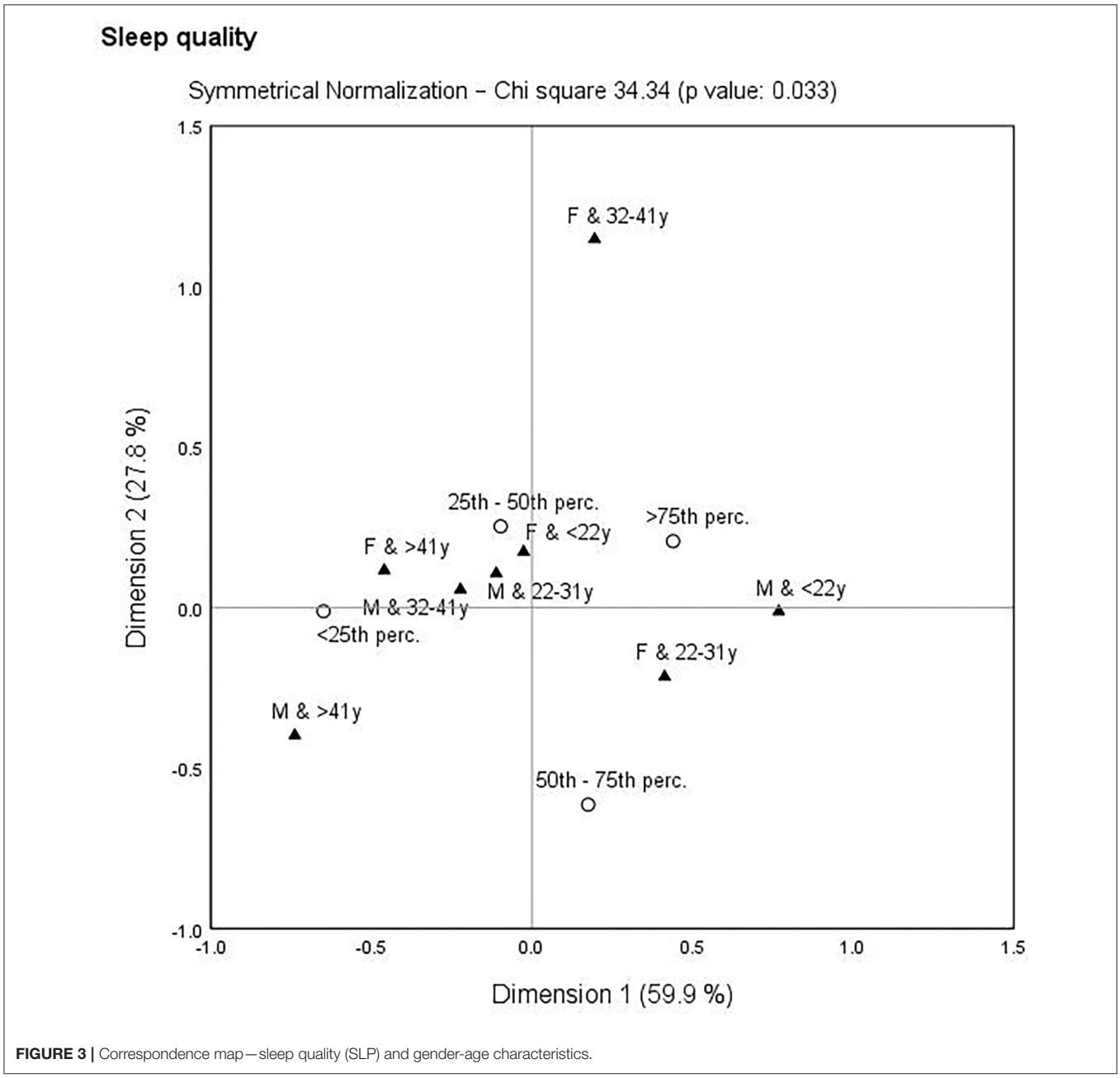

FIGURE 3 | Correspondence map—sleep quality (SLP) and gender-age characteristics.

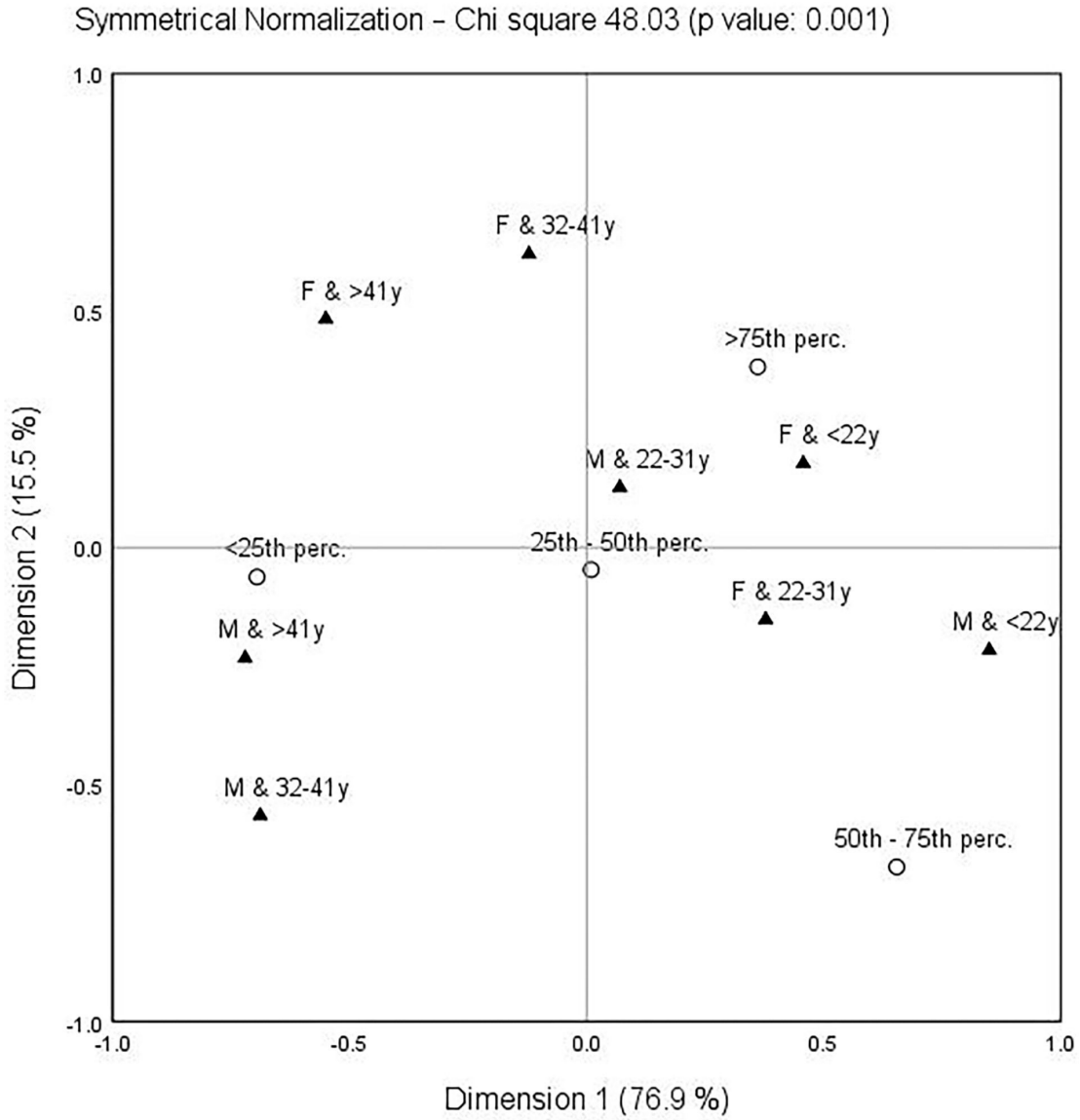

FIGURE 4 | Correspondence map—interpersonal and intrapersonal coping strategies (IICS) and gender-age characteristics.

younger males: M and 22–31 years, youngest males: M and <22 years, oldest females: F and >41 years, older females: F and 32–41 years, younger females: F and 22–31 years, youngest females: F and <22 years). Based on the results, there was no significant link in terms of HC ($\chi^2 = 23.89$, p-value = 0.298) and NPA ($\chi^2 = 15.41$, p-value = 0.802). In contrast, significant links with gender-age characteristic were identified for SLP ($\chi^2 = 34.34$, p-value = 0.033), IICS ($\chi^2 = 48.03$, p-value = 0.001), and depression (PHQ-9: $\chi^2 = 76.00$, p-value = <0.001). These links are shown in **Figures 3**–**5**.

With a focus on **Figure 3**, which is devoted to SLP and gender-age characteristics, several links could be observed. It is clear that younger participants showed higher SLP compared to older participants. In other words, younger participants were concentrated around the higher SLP. It is also evident that females aged 32–41 years appeared as a distant group.

Figure 4 deals with IICS and gender-age characteristics. It was possible to identify closer links than in the previous figure. The three closest links were found, namely the oldest males (>41 years) were concentrated around the lowest IICS (<25th perc.), younger males (22–31 years) were concentrated around the moderate IICS (25th—50th perc.), and the youngest females (<22 years) were concentrated around the highest IICS (>75th perc.).

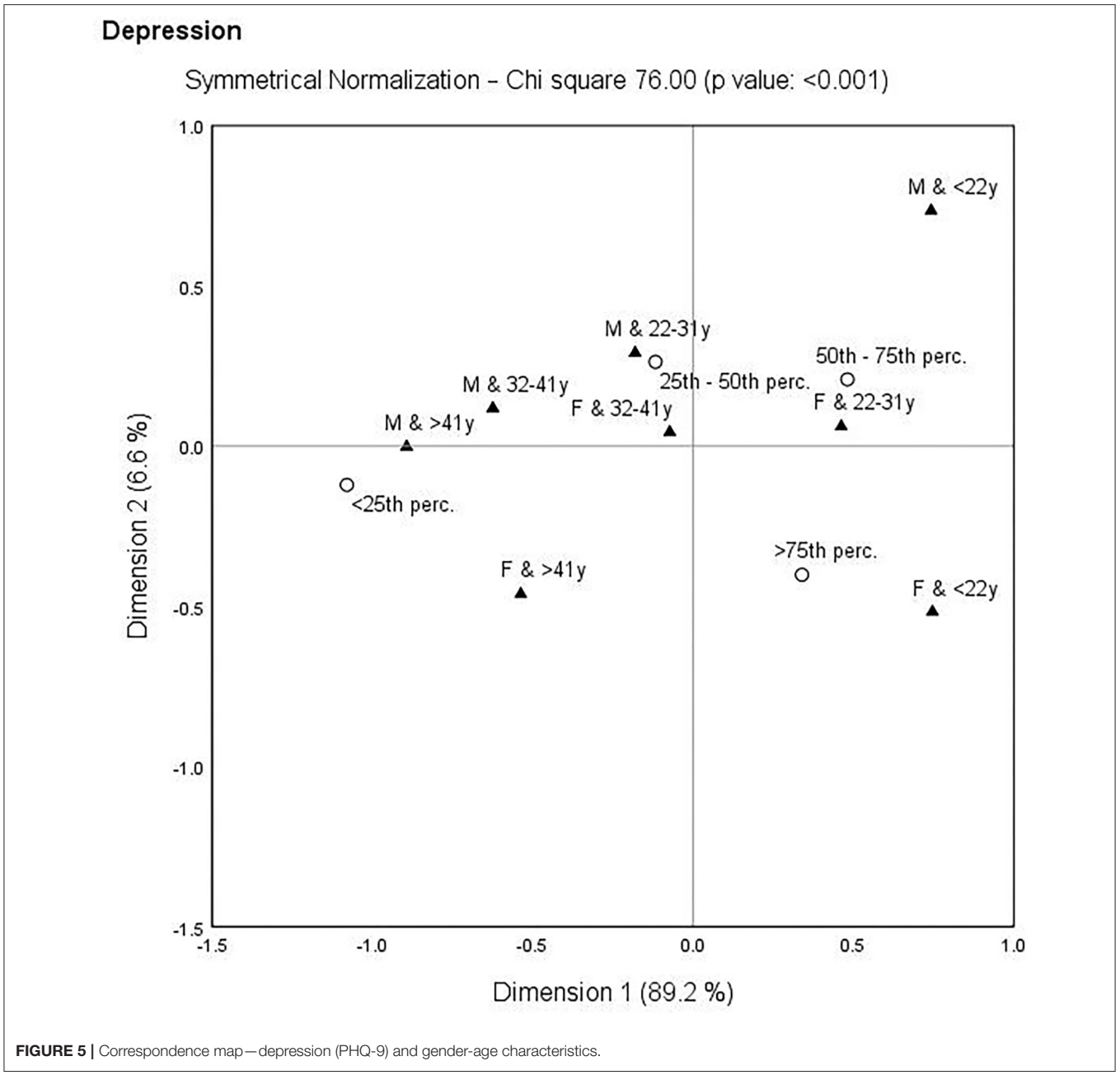

FIGURE 5 | Correspondence map—depression (PHQ-9) and gender-age characteristics.

Finally, the closest links were observed in **Figure 5**, which deals with depression (PHQ-9) and gender–age characteristics. It was possible to highlight the link of the oldest males (>41 years) with the lowest depression (<25th perc.), but also the link of the youngest females (<22 years) with the highest depression (>75th perc.).

The purpose of the following quantile regression analysis was to evaluate the associations between self-care activities and depression. In this analysis, depression, as a dependent variable, was divided into quartiles (25th percentile, 50th percentile, 75th percentile). Prior to the application of the analysis, the assumption of multicollinearity was evaluated, while the value of the variance inflation factor did not exceed the limit value of 10 in any of the analyzed cases.

Based on the results of the quantile regression analysis shown in **Table 2**, several significant associations could be confirmed. For all participants, IICS and HC were positively associated with the lowest depression ($\lambda = 0.25$). There were negative associations between SLP and the lowest depression in all participants, males and females. For females, it was also possible to observe that HC was positively associated with the lowest depression.

Consequently, SLP was negatively associated with moderate depression ($\lambda = 0.50$) in all participants, the oldest participants

TABLE 2 | Quantile regression analysis—associations between self-care activities and depression for all participants and their categories by age and gender.

Coef	All	<1980 (>41 years)	1980–1989 (32–41 years)	1990–1999 (22–31 years)	2000+ (<22 years)	Males	Females
$\lambda = 0.25$							
(Intercept)	**10.34† (1.36)**	**9.45† (2.72)**	**12.08** (4.74)**	**2.59** (4.88)**	**16.07*** (5.97)**	**10.8† (2.15)**	**11.61† (2.02)**
IICS	**0.57** (0.26)**	0.2 (0.63)	0.22 (0.75)	0.41 (1.18)	0.52 (1.02)	0.25 (0.41)	0.63* (0.36)
HC	**1*** (0.31)**	0.65 (0.74)	0.59 (0.83)	0.57 (1.07)	1.12 (1.36)	0.59 (0.47)	**1.48*** (0.48)**
NPA	−0.31 (0.26)	−0.13 (0.7)	0.2 (1.02)	0.39 (−0.3)	−0.88 (1.13)	−0.05 (0.42)	−0.21 (0.38)
SLP	**−0.86† (0.25)**	−0.53 (0.65)	−1.18 (0.76)	0.42 (−2.23)	−1.13 (0.8)	**−0.75** (0.37)**	**−1.53† (0.35)**
Pseudo R^2	0.038	0.035	0.052	0.021	0.058	0.033	0.055
$\lambda = 0.5$							
(Intercept)	**15.59† (1.89)**	**9.65*** (3.31)**	**17.34*** (6.36)**	**3.15*** (5.62)**	**16.35** (7.01)**	**11.84† (2.64)**	**15.24† (2.5)**
IICS	0.58* (0.3)	−0.13 (0.72)	0.73 (0.99)	0.45 (1.48)	0.52 (1.21)	0.36 (0.47)	0.83* (0.43)
HC	**1.49† (0.39)**	1.62* (0.89)	0.92 (1.07)	0.62 (1.99)	1.46 (1.54)	0.9 (0.58)	**1.78*** (0.54)**
NPA	−0.57* (0.33)	0.55 (0.81)	−1 (1.25)	0.45 (−0.59)	−0.94 (1.39)	−0.28 (0.51)	−0.58 (0.42)
SLP	**−1.5† (0.28)**	**−1.37** (0.67)**	−1.31 (0.87)	0.42 (−4.39)	−0.78 (0.97)	−0.67 (0.43)	**−1.69† (0.36)**
Pseudo R^2	0.042	0.039	0.092	0.046	0.071	0.028	0.069
$\lambda = 0.75$							
(Intercept)	**21.22† (2.47)**	**16.71† (3.73)**	**33.26† (5.73)**	**3.49† (7.49)**	**16.26** (6.77)**	**21.52† (4.02)**	**19.2† (2.94)**
IICS	0.56 (0.42)	0.93 (0.87)	0.77 (0.94)	0.55 (0.1)	−0.23 (1.2)	0.31 (0.58)	0.61 (0.56)
HC	**1.63† (0.49)**	1.61 (1.02)	0.74 (1.07)	0.66 (1.44)	**3.08** (1.48)**	1.13 (0.73)	**2.29† (0.6)**
NPA	−0.69* (0.41)	0.19 (0.94)	**−3.95† (1.14)**	**0.54† (0.07)**	−0.56 (1.45)	−0.6 (0.8)	−0.33 (0.48)
SLP	**−1.74† (0.33)**	**−2.1** (0.84)**	−0.76 (0.82)	0.43 (−5.36)	−1.07 (1.01)	**−1.56*** (0.58)**	**−2.15† (0.42)**
Pseudo R^2	0.057	0.054	0.186	0.062	0.069	0.057	0.066

*HC, health consciousness; NPA, nutrition and physical activity; SLP, sleep quality; IICS, interpersonal and intrapersonal coping strategies; PHQ-9: patient health questionnaire. Significant results are highlighted in bold. *p-value < 0.1. **p-value < 0.05. ***p-Value < 0.01. † p-value < 0.001.*

(>41 years) and females. Also, a significant positive association between HC and moderate depression was observed in all participants and females.

In terms of the highest depression rates ($\lambda = 0.75$), a significant association was confirmed in each category of participants. For all participants, the youngest participants (<22 years) and females, HC was positively associated with the highest depression. A significant negative association between SLP and the highest depression was identified for all participants, the oldest participants (>41 years), males and females. Interestingly, NPA was negatively associated with the highest depression in participants aged 32–41 years, while a positive association was observed in participants aged 22–31 years.

The above-mentioned associations could be summarized and interpreted as follows. More IICS were associated with more depression in all participants with the lowest depression score. Higher HC was associated with more depression, especially in all participants and females. More NPA was associated with less depression in people aged 32–41 years, but with more depression in people aged 22–31 years. Higher SLP was associated with less depression, especially for all participants and females.

DISCUSSION

This study contributes to the issue of self-care and mental health, which has an important position in social and professional discussions, especially during the COVID-19 pandemic. Based on the results, it can be concluded that Slovak participants performed self-care activities occasionally or very frequently during the COVID-19 pandemic. This can be considered a positive aspect during the COVID-19 pandemic, as self-care behavior is very beneficial in the lives of individuals (29, 34). From a public health perspective, it is important that individuals take care of themselves, especially during a difficult pandemic period. Among Slovak participants, health awareness appeared to be a very frequent self-care behavior. Overall, HC was the area of self-care that showed the highest scores. The key message of this finding is that individuals were heavily focused on their health during the health crisis. This can be further supported by public health interventions in such a way that it becomes an integral part of their lives, not only in a crisis situation. On the other hand, participation in community initiatives was very rare. This means that Slovaks did not engage in activities such as clapping, singing, playing music from home, which were popular in other countries during the pandemic.

This indicated the diversity of cultures that should be taken into account when creating targeted health-promoting self-care programs. The youngest participants and females reported significantly more self-care activities, especially in terms of IICS and SLP. Focusing on depression, Slovak participants reported individual depressive symptoms for several days during the past 2 weeks. In other words, all participants reported mild depressive symptoms. For public health professionals, this means the need for increased attention and constant monitoring of mental health. Females and young people were the most vulnerable group in terms of depression, and these population groups need increased attention from policy makers when developing successful mental health strategies. These findings support an interesting fact that females and young people were at higher risk of depression despite their higher levels of SLP and IICS. On the other hand, vulnerability of females and young people to psychological symptoms (including depression) during the COVID-19 pandemic was also demonstrated in many other studies (26, 47–50). Xiong et al. (10) also confirmed that common risk factors for mental discomfort during the pandemic were female gender, younger age (under 40 years), but also chronic or psychiatric disease and frequent exposure to social media and news concerning COVID-19. Using correspondence analysis, this study supported that participants' gender-age characteristics were linked with IICS, SLP, and depression. Therefore, gender and age should be taken into account when developing targeted public health strategies. The results agreed with the above-mentioned findings, thus more depression and self-care activities were observed in younger people, while lower scores were found in older people.

This study revealed the fact that several self-care activities were significantly associated with depression. Di Benedetto et al. (40) also emphasized that individuals with the healthiest self-care behaviors were also characterized by the lowest levels of depression. Daniali et al. (44) also revealed a significant association between depression and self-care behavior among Iranian patients with chronic diseases. The opposite perspective was examined among patients with diabetes in a study conducted by Chan et al. (41), who revealed that depression was associated with self-care activities, such as lower rates of reduced or stopped smoking and drinking, less exercise, less regular lifestyle, but also more use of health care and higher rates of foot care. Similar results were confirmed by Chen et al. (42), who found that self-care behaviors affected life satisfaction, while depression affected self-care behaviors and life satisfaction. This evidence confirmed the fact that depression is indirectly and directly associated with self-care (42, 43). The study supports the idea that self-care plays an important role in mental health. This is the key idea that public health professionals should focus on in order to improve the mental health of the population.

Specifically, higher HC was associated with higher depression in all participants (without classification) and females, regardless of depression score, but also in the youngest people (<22 years) with the highest depression score. This can be explained by the fact that those who paid more attention to their health during the COVID-19 pandemic also reported more depressive symptoms. It is well-known that emotional attention is positively related to perceived mental discomfort (51). In other words, individuals with greater concerns about their health may be sensitive to depression during a serious situation such as the COVID-19 pandemic (52, 53). The intensity of worried thoughts and health concerns about COVID-19 were found to be positively correlated with anxiety and depression, and negatively with SLP (54). In terms of the findings revealed in this study, Lee (55) also found that HC is positively related to fear and anxiety and not related to information seeking. According to the authors, health-conscious individuals were more likely to experience mental discomfort than those with low HC. In the context of this study, it is necessary to consider the effect of the pandemic on individuals and what information individuals had or what sources of information they sought. If this information caused health concerns during the pandemic, a higher rate of depression is understandable. Public health efforts should focus on eliminating disruptive information that could adversely affect HC. At this point, health literacy among the population should be underlined (43, 56). According to Wang et al. (57), health literacy has a multiple mediating effect on the relationship between depression and self-care behavior. Therefore, it is important to know what information individuals have and how this information shapes their behavior, mental state and frailty, especially during the COVID-19 pandemic. Health literacy and access to health information are known to improve quality of life (58), but the right information should be provided and communicated in an appropriate way.

It was also found that more NPA was associated with less depression in people aged 32–41 years, but with more depression in people aged 22–31 years. This discrepancy needs to be examined, as evidence from many studies has shown that physical activity and healthier eating habits predict better well-being (59, 60) and lower rates of depression (61–63). In this context, a reduction in exercise duration was considered a risk factor for depression, while an increase in exercise frequency was found to be a protective factor against depressed mood (64). Thus, the promotion of health activities is welcome (65, 66). Some inconsistencies could be observed in healthy eating, as some studies have supported the significant relationship between healthy nutrition and depression (67), while others have not (44). This indicates that NPA is a complex component of self-care and that further deeper investigation is needed to address these discrepancies. The type of questionnaire should also be considered.

Again, interestingly, this study showed that more IICS were associated with more depression in individuals with the lowest depression score. The opposite view was presented by Lara et al. (68), whose results indicated that active coping strategies may be helpful in the management of negative mental states during the COVID-19 pandemic. Miklowitz (69) also stated that cognitive and interpersonal coping strategies are effective for depressive symptoms. Thus, the findings in this study showed some inconsistency with previous findings, which encourages further investigation.

Regarding the quality of sleep, the findings were in line with well-known facts. Accordingly, higher SLP was associated with more depression, especially for all participants (without

classification) and females regardless of depression score, for males with the lowest and highest depression score, and for people aged 41 years and over with the highest and moderate depression score. This finding indicated that less depression could be expected with higher SLP, and the opposite view suggested that lower SLP may lead to more depression. In this context, it was possible to support the idea that good SLP is inversely associated with higher levels of depression (40). In contrast, poor SLP can be considered one of the most significant risk factors for mood disorders during the COVID-19 pandemic (70). Lee et al. (71) also emphasized that individuals with poor SLP are more likely to have some or severe problems not only with depression or anxiety, but also with physical activity, self-control and daily activity, and this may be reflected in an impaired quality of life. Thus, it can be concluded that SLP significantly predicts the severity of depressive symptoms (39, 72), and the presented study enriches this knowledge.

In conclusion, the internal consistency of the SASS-14 measure was good with acceptable to high (0.58–0.82) reliability in its subscales, which is in line with the results of the authors of this screening measure (38). The applied tools for measuring depression and self-care activities proved to be reliable for their use in the Slovak population by researchers and experts working in public health.

Public Health Implications

The findings revealed in this study emphasize the importance of a proactive approach to self-care and the integration of self-care behavior into mental health programs that respect gender and age differences. It is recommended to develop and implement programs to improve self-care behavior across the entire Slovak population, not just patients. The supportive educational intervention developed based on the self-care theory can help manage and maintain mental health not only during a stressful period, such as the COVID-19 pandemic. These programs should focus on increasing and maintaining motivation to practice and include self-care activities in daily routines. This effort would be positively reflected in public health outcomes, as higher levels of self-care knowledge, motivation and skills are expected (73). Gender and age should also be taken into account when developing public health programs aimed at self-care behavior and mental health. In terms of poor mental health, females and younger individuals need targeted interventions. Above all, self-care requires a commitment to an individual's own well-being as a priority (29). In this context, efforts to improve self-care behavior may be more effective if depression is also effectively managed (74).

As the study revealed a positive association between HC and depression, increased attention during the COVID-19 pandemic should be focused on information that shapes HC. One possible explanation for this result could be the high exposure to information about COVID-19, which grows into constant exposure to overwhelming news headlines and misinformation (26, 75). Therefore, in an effort to improve self-service behavior and mental health, emphasis should be placed on the reliability and clarity of information, accessibility, careful communication, and relevant resources. Given the links between health literacy and self-care, health literacy also has a justified place in this problem. A higher health literacy is significantly correlated with greater self-care behavior (76, 77). In addition, health literacy is considered a mediating variable between depression and self-care (57). Therefore, public health leaders should take steps to increase health literacy.

Health-promoting preventive self-care interventions are promising to increase the well-being of healthy individuals (78), and the demand for them increases even more during the pandemic. In the current situation, when the world is dominated by COVID-19, the development of self-care programs in Slovakia appears to be insufficient, but their role in the mental health of the population may be crucial. Despite the importance of this issue, it is still a poorly examined problem. Also, at the level of Slovak public policies, not enough attention is paid to this issue. Expanding the knowledge base would help speed up the process of efforts to implement successful evidence-based strategies. It is therefore appropriate to encourage international cooperation in order to create a valuable information platform, which should then be applied at policy level (79).

Strengths and Limitations

The study enriches the knowledge base about self-care behavior and its relation to mental health. Thus, this study clarifies the associations between self-care activities and depression in the Slovak population, while respecting gender and age characteristics. As previous literature has focused on the role of depression in individual self-care activities, the results of this study provide novelty in terms of the role of self-care activities in depression. In addition, the research covered the whole concept of self-care and respected gender and age differentiation. The fact that the study is focused on a non-patient sample can also be considered a strength. The findings are of great importance for public health and offer guidance to Slovak public health leaders in terms of improving mental health. Last but not least, this study is an important appeal for the development of health-promoting preventive self-care programs, which are lacking in Slovakia.

Despite the many strengths of this study, it is necessary to point out its limitations, which could be addressed in future research. In particular, the disproportionate nature of the sample could be included in the limitations of this study. Thus, there was a higher proportion of females and the social status of students (younger participants). However, this limitation need not be considered disruptive to the results and value of knowledge. The analysis was performed in the decomposition of identifiers, thus the problem of disproportionality of the sample was dispersed. Also, it must be emphasized that self-care is not the only factor in depression. Thus, the results should not be considered the only right pathway. Future research should address these limitations. Another limitation could be the fact that the SASS-14 measure is a new instrument and the factor of IICS showed relatively lower reliability values, which were accepted by the authors of the instrument. Therefore, future research should focus on this factor in order to find out whether it would show relatively low reliability also in other population groups. Regarding the limitations of the used models, it should be noted that causality

was not examined in this study. For this reason, the findings cannot be interpreted as causal. All the results can only be understood in terms of associations, while a consideration of causal relationships can be misleading.

CONCLUSION

The aim of the presented study was to evaluate the associations between self-care activities and depression in the general Slovak population, but also in its individual gender and age categories. The study answered the question how self-care activities are associated with depression. This provided a deeper insight into the issue, and the main findings support the general idea that well-practiced self-care activities should be an immediate part of an individual's life in order to improve mental health, especially to reduce depressive symptoms. In this context, SLP plays an important role, while HC indicates the need for increased attention during the pandemic. Public health efforts should focus on improving SLP and alleviating disturbing information that could adversely affect HC, and these efforts could be reflected in reducing depression. In this way, health literacy should be improved in Slovakia. Other dimensions of self-care have also shown significant results that should be taken into account. In terms of poor mental health, females and younger individuals need targeted interventions in this country. The findings call for immediate support for self-care behavior and the development of successful strategies aimed at the non-patient population. Slovak health policy leaders should focus on health-promoting preventive self-care interventions, as the demand for them increases even more during the pandemic. Gender and age characteristics should also be taken into account in this effort.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The study was conducted according to the guidelines of the Declaration of Helsinki. The research was approved by the Ethics Committee of the Clinical Trials Services, USP TECHNICOM, Technical University of Košice, Slovakia (Ref. 02/03/2021 IG Bioinformatics). All participants included in the research confirmed their informed consent. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

BG: conceptualization, investigation, resources, writing—original draft preparation, visualization, writing—review and editing, supervision, project administration, and funding acquisition. BP: conceptualization, visualization, writing—review and editing, supervision, project administration, and funding acquisition. VI: conceptualization, investigation, resources, writing—original draft preparation, visualization, writing—review and editing, and supervision. MR: conceptualization, methodology, formal analysis, investigation, data curation, writing—original draft preparation, and writing—review and editing. All authors contributed to manuscript revision, read, and approved the submitted version.

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SYSTEMATIC REVIEW
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COVID-19 Pandemic and Overall Mental Health of Healthcare Professionals Globally: A Meta-Review of Systematic Reviews

Muhammad Chutiyami[1], Allen M. Y. Cheong[2,3]*, Dauda Salihu[4], Umar Muhammad Bello[3,5], Dorothy Ndwiga[1], Reshin Maharaj[1], Kogi Naidoo[6], Mustapha Adam Kolo[7], Philomina Jacob[8], Navjot Chhina[6], Tan Kan Ku[6], Liza Devar[1], Pratitha Pratitha[1] and Priya Kannan[9]*

[1] School of Nursing, Institute of Health and Management, Sydney, NSW, Australia, [2] School of Optometry, The Hong Kong Polytechnic University, Kowloon, Hong Kong SAR, China, [3] Centre for Eye and Vision Research, Hong Kong, Hong Kong SAR, China, [4] School of Nursing, The Hong Kong Polytechnic University, Kowloon, Hong Kong SAR, China, [5] Department of Physiotherapy, Yobe State University Teaching Hospital (YSUTH), Damaturu, Nigeria, [6] Institute of Health and Management, Melbourne, VIC, Australia, [7] Department of Geography, University of Maiduguri, Maiduguri, Nigeria, [8] Health Careers International Pty Ltd., Kochi, India, [9] Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Kowloon, Hong Kong SAR, China

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Edited by:
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***Correspondence:**
Muhammad Chutiyami
muhammad.c@ihm.edu.au
Allen M. Y. Cheong
allen.my.cheong@polyu.edu.hk

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Objective: This meta-review aimed to provide a comprehensive overview of overall mental health of healthcare professionals during the COVID-19 pandemic.

Method: We conducted a comprehensive literature search on Academic Search Premier, CINAHL, Cochrane Library, and MEDLINE. A predefined eligibility criterion was used to screen the articles. The methodology quality of eligible studies was assessed using Joanna Briggs Institute checklist for systematic reviews. The data were narratively synthesised in line with the meta-review aim.

Result: Forty systematic reviews (represented as $K = 40$), which reported data from 1,828 primary studies (N) and 3,245,768 participants, met the inclusion criteria. The findings from a pooled prevalence indicate that anxiety (16–41%, $K = 30$, $N = 701$), depression (14–37%, $K = 28$, $N = 584$), and stress/post-traumatic stress disorder (18.6–56.5%, $K = 24$, $N = 327$) were the most prevailing COVID-19 pandemic-related mental health conditions affecting healthcare workers. Other reported concerns included insomnia, burnout, fear, obsessive-compulsive disorder, somatization symptoms, phobia, substance abuse, and suicidal thoughts. Considering regions/countries, the highest anxiety was reported in the United-Kingdom [22.3, 95% Confidence Interval (CI):7–38, $N = 4$] compared to other countries, while the highest depression was in the Middle-East, (41, 95% CI:16–60, $N = 5$) and stress in the Eastern Mediterranean region (61.6, 95% CI:56.4–66.8, $N = 2$) compared to other regions. The most significant risk factors include female gender, younger age, being a nurse, and frontline professional. The most-reported coping strategies include individual/group psychological support, family/relative support, training/orientation, and the adequacy of personal protective equipment.

Conclusion: It was concluded that healthcare professionals (nurses, doctors, allied health) have experienced various mental health issues during COVID-19 pandemic.

The meta-review, therefore, recommends targeted interventions and health policies that address specific mental health issues to support health professionals worldwide during the duration of the COVID-19 pandemic and similar future health crises.

Systematic Review Registration: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD4202126200, identifier: CRD42021262001.

Keywords: COVID-19, health professional, mental health, review–systematic, coping strategies

INTRODUCTION

Coronavirus pandemic (COVID-19) has caused an unprecedented concern across the globe since the current outbreak began in 2019 in Wuhan, China (1). The outbreak was declared a pandemic by the World Health Organisation (WHO) in March 2020 (2). As of 4 September 2021, over 200 million cases and 4.5 million deaths have been reported across more than 200 countries/territories worldwide (2). The number of cases and mortalities continue to increase across different countries despite efforts to control and manage the threat. Recent mutations in the virus represent a constant concern, with new strains, such as the Bengal variant identified in India (3), leading to second and third waves of the disease transmission in multiple countries (2).

The COVID-19 pandemic has resulted in significant impacts not only among the general population and affected patients but also among the health professionals (interchangeably referred to as healthcare workers (HCWs) who care for infected patients. Although the pandemic has affected various aspects of health and well-being, mental health is among the most reported concerns (4–6). Countries that have experienced high caseloads, such as Italy (7) and Spain (8), have reported a higher prevalence of mental health issues among healthcare workers (HCWs) relative to less-affected regions. During the early stages of the outbreak, the highest prevalence of mental health concerns was reported in China, where the outbreak originated (4). Similar to the current COVID-19 outbreak, previous pandemics, including those associated with Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS), were characterised as mental health disturbances in both the general population and among health professionals (9–11). The current COVID-19 pandemic has several aspects of psychiatric interest and relevance considering the uncertainties and hopelessness among the general population, of which efforts have not been successful in overcoming the outbreak (12). Marazziti and Stahl (12) added that psychiatrists could play a significant role in supporting nurses, doctors and other frontline professionals as well as managing the long-term consequences of the pandemic. Ghebreyesus (13) further necessitates the need for preparedness and getting services ready, particularly in resource-poor countries before another outbreak through supporting the countries in establishing community-based mental health services for everyone. Therefore, addressing the mental health needs of the general population at large and health professionals, in particular, is of paramount importance.

Many primary studies have been conducted to examine various mental health aspects among health professionals or the general population in different countries, including African (14), American (15), Asian (16–18), and the European (19–22) countries. Similarly, several systematic reviews have been conducted to summarise these mental health concerns among health professionals (23–26). Most systematic reviews have been conducted to explore specific aspects of mental health among health professionals, such as anxiety and depression (26–28), insomnia (29), and post-traumatic stress disorder (PTSD) (30, 31). Other systematic reviews have been conducted in specific categories of HCWs, such as nurses (32), dental professionals (33), or surgeons (10). Systematic reviews have also been limited to certain regions/countries, such as China (34). These systematic reviews have been conducted at different stages of the outbreak, focusing on different factors; the consolidation of these findings is of paramount importance to provide comprehensive evidence regarding the prevalence and risk factors associated with mental health issues among HCWs to guide policymakers and other stakeholders in the allocation of resources and interventions. This review attempted to summarise existing systematic reviews examining the impacts of the ongoing COVID-19 pandemic on various aspects of mental health among health professionals. The primary aim of the current systematic review of systematic reviews (termed a meta-review) was to provide a comprehensive overview of the overall mental health of healthcare professionals during the COVID-19 pandemic. Our secondary aim was to report coping strategies reported alongside the mental health problems to open windows for further studies. For the purposes of this article, the term COVID-19 is used interchangeably to refer to both COVID-19 and SARS-CoV-2 pandemic.

METHODS

A systematic review of systematic reviews (referred to as a meta-review) was adopted for this study. The reporting of this meta-review was guided by the standards established by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) extension statement (35). The review question was formulated using a PICO (Participants, Intervention, Comparator, Outcome) framework. The participants comprised HCWs, including nurses, medical doctors, and allied health professionals such as physiotherapists. For this review, the intervention was considered to be exposure to COVID-19, and the comparator group included members of the general population or non-health professionals. The assessed outcomes were the prevalence and risk factors of various mental health issues. The review was registered with

the international prospective register of systematic reviews (PROSPERO: CRD42021262001).

Eligibility Criteria

Studies were included if they were systematic reviews with or without meta-analyses; were published in the English language; could be obtained in full-text format; and assessed the impacts of COVID-19 among health professionals (medical doctors, nurses, allied health professionals). Scoping reviews and rapid reviews were included if they employed key systematic approaches to the review process, including a predefined search strategy, screening, data extraction, and synthesis. Systematic reviews that included the general population but performed a separate analysis of HCWs were included. Additionally, systematic reviews that synthesised data including previous pandemics but reported separate COVID-19-related findings were also included. Exclusion criteria included traditional literature reviews, narrative reviews (non-systematic), primary studies, non-COVID-19-related studies, and reviews assessing the COVID-19 impacts on non-health professionals.

Information Sources

Four electronic databases, including Academic Search Database, CINAHL Complete, Cochrane Database of Systematic Reviews, and MEDLINE Complete, were searched for eligible studies examining the mental health impacts of COVID-19 pandemic among HCWs. The search was supplemented with a Google Scholar search (first 10 pages), and a "snowballing" approach was used to identify additional resources from reference lists and citations cheques. The search was not restricted by a publication start date, and all databases were searched until June 2021.

Searches

A comprehensive search of each database was conducted using keywords/medical subheading (MeSH) terms to identify relevant systematic reviews. Boolean operators and truncations were also used. EBSCOHost was used to search Academic Search Database, CINAHL Complete, and MEDLINE Complete using the same search terms: (COVID-19 OR Coronavirus OR SARS-COV2) AND ("mental health" OR psychological OR depression OR post-trauma* OR anxiety OR stress* OR burnout OR insomnia OR suicide*) AND ("healthcare worker*" OR "medical staff" OR "health professional*" OR nurse* OR physician* OR "medical doctor") AND ("systematic review" OR "rapid review" OR "scoping review"). Cochrane Database of Systematic Reviews was searched using the terms; (COVID-19 OR Coronavirus OR SARS-COV2) AND ("healthcare worker*" OR "medical staff" OR "health professional*" OR nurse* OR physician* OR "medical doctor"). The search of Google Scholar was conducted using the term "covid-19 healthcare worker mental health." The search was limited to articles published in the English language.

Selection of Evidence

The predefined eligibility criteria were applied to the selection process, which involved the sequential screening of the titles, abstracts, and full texts of the systematic reviews identified by the electronic database search. Three reviewers (MC, UMB, and PJ) screened and selected articles using the predefined inclusion and exclusion criteria. Two of the reviewers (MC and PJ) screened the studies independently and resolved discrepancies by discussion, while the third reviewer (UMB) was involved if an agreement was not reached. The selected studies were systematic reviews examining any aspect of mental health among health professionals during the COVID-19 pandemic.

Data Extraction

Data extraction was performed using a Microsoft Excel package specifically designed to meet the aim of the review. The extraction form was designed by three reviewers (DS, UMB and MAK) and included author's details, the aims of the review/research question(s), types of primary studies included in the review, location of primary studies included in the review, type of health professionals (e.g., nurses) assessed in the review, specific mental health domains assessed, measures/instruments used for assessments, detailed results, and author's conclusions. Two reviewers (LD and PP) extracted the data from the included studies. Differences were resolved through discussion between the two authors. A third reviewer (MC) cross-checked all extracted data for accuracy and completeness.

Critical Appraisal of the Included Studies

Quality appraisals of the included studies were performed using the Joanna Briggs Institute (JBI) checklist for systematic reviews (36). The instrument consists of 11 items that assess different aspects of a systematic review, each of which can be answered using the options "Yes," "No," "Unclear," or "Not Applicable" (36). An appraisal of each included systematic review was conducted independently by two reviewers (PJ and NC). The outcomes of the two reviewers were cross-checked by a third reviewer (MC), and all discrepancies were resolved by the third reviewer through re-examining the article. For this review, the number of items receiving a "yes" answer for each study was counted and used to determine the quality of the review. Although the JBI checklist for systematic reviews does not provide a classification guideline for determining the study quality, we considered studies that satisfied at least 70% of the criteria (8 out of 11 items) to be of good quality.

Synthesis of Results

A meta-analysis was deemed inappropriate for this meta-review, as some of the included studies were already meta-analysed. Conducting a meta-analysis on a review that includes a meta-analysis risks inflating the statistical significance of the results (37). Therefore, an in-depth narrative synthesis was conducted by four of the reviewers (MC, AMYC, DS, UMB).

The narrative synthesis involved a detailed examination of the narrative and numeric summary findings and the reported conclusions regarding the impacts of the COVID-19 pandemic on any aspect of mental health among health professionals, including the prevalence of mental health issues and associated risk factors among medical doctors, nurses, and allied health professionals. The impact of COVID-19 on the overall prevalence of mental health issues was reported for those studies that did not include a comparison with non-health professionals. For

studies that reported a comparison against a non-healthcare population, the impact was reported as either significant or non-significant. Where available and possible, the effect sizes, study designs included in the systematic reviews (narrative synthesis or meta-analysis), and the quality of the systematic review was considered when drawing conclusions.

RESULTS

Selection of Included Studies

The study selection steps are reported in **Figure 1**. The initial search from the four databases (Academic Search Premier, CINAHL, MEDLINE, and Cochrane) resulted in the identification of 503 articles, and the supplemental search performed on Google Scholar resulted in 19 relevant articles, resulting in a total of 522 articles. Duplicate articles were removed, and an English language limitation was applied to the database search, which resulted in the identification of 143 articles. These 143 articles were screened according to titles and abstracts against the eligibility criteria, resulting in the identification of 96 articles that potentially met the inclusion criteria. One study without available full text was removed, and the full texts of the remaining 95 studies were retrieved and screened for eligibility. Finally, 40 studies were identified as fully meeting the eligibility criteria. The reference lists of these 40 studies were reviewed, which did not result in the identification of any additional studies. Therefore, 40 studies were included in the final review.

Characteristics of the Included Studies

The 40 systematic reviews (represented as K) included in this meta-review were published between 2020 and 2021 (**Supplementary Table 1**). The total number of primary studies (represented as N) included in the systematic reviews was 1,828; however, three reviews ($K = 3$, 7.5%) included studies beyond COVID-19, such as those examining the impacts of SARS or MERS. A total of 3,245,768 subjects (represented as n) were included, although the majority of the systematic reviews did not report either genders or ages ($K = 22$, 55%); eight reported one but not the other ($K = 8$, 20%), and only ten reviews reported both ($K = 10$, 25%). Eleven studies reported genders, with women ($n = 468{,}851$, 53.8%) constituting high proportion. Twelve studies reported an age range between 18 and 75 years. Ten studies reported on a mixture of health professionals and the general population ($n = 2{,}204{,}914$, 67.9%), whereas 30 studies included only health professionals with ($n = 1{,}040{,}854$, 32.1%). The most commonly used search databases among the included systematic reviews were PubMed ($K = 29$, 72.5%), MEDLINE ($K = 20$, 50%), Embase ($K = 20$, 50%), Web of Science ($K = 14$, 35%), PsycINFO ($K = 12$, 30%), Google Scholar ($K = 10$, 25%), Scopus ($K = 10$, 25%), and CINAHL ($K = 8$, 20%). The most commonly reported study design was cross-sectional ($K = 32$, 80%). The General Anxiety Disorder 7 (GAD-7, $K = 28$, 70%), Patient Health Questionnaire (PHQ, $K = 26$, 65%), Depression Anxiety Stress Scale (DASS, $K = 21$, 52.5%), Zung Self-Rating Depression Scale (SDS, $K = 17$, 42.5%), Zung Self-Rating Anxiety Scale (SAS, $K = 17$, 42.5%), Insomnia Severity Index (ISI, $K = 16$, 40%), Pittsburgh Sleep Quality Index (PSQI, $K = 16$, 40%) were the most commonly reported instruments used for the assessment of mental health and associated factors.

Critical Appraisal of the Included Studies

The included systematic reviews were evaluated using quality assessment criteria, with scores ranging from 3/11 to 11/11 based on the JBI checklist (**Table 1**). The majority of the studies (31/40) were considered of good quality, which we defined as meeting at least 70% of the (8/11) assessment criteria. All included studies satisfied the first criterion of stating a clear and explicit research question or aim, whereas half (20/40) of the studies failed to meet the criterion of assessing publication bias. All studies were included in the synthesis of findings, regardless of their quality assessment score.

Study Findings

Overall Mental Health

Seven reviews, which synthesised data from 51 primary studies ($N = 51$), reported the overall mental health impacts of COVID-19 on HCWs (**Table 2**). Of these, the prevalence rate was assessed in four reviews, two of which reported pooled prevalence values calculated from meta-analyses, ranging from 11.6% [95% confidence interval (CI): 9.2–14.6%, $N = 3$] (64) to 34% (95% CI: 24–44%, $N = 28$) (23). One review (40) reported a positive correlation between COVID-19 and the incidence of psychiatric disorders ($N = 8$).

Overall mental health risk factors include being a woman (58, 61) and being divorced (61). Compared with non-HCWs, health professionals reported a higher rate of mental health problems (23, 24, 39). Among health professionals, nurses (24, 58, 61) and doctors (40) were associated with the highest risk of developing any mental health problem. Additionally, longer working hours (61), fewer years of working experience (61), a lack of access to personal protective equipment (PPE) (61) and close contact with infected patients (41, 61) were associated with a higher incidence of mental health problems.

Anxiety

Anxiety or anxiety symptoms were assessed in 30 reviews, which synthesised data from 701 primary studies (**Table 2**). Of these, the prevalence rate was reported in 26 reviews, including 20 reviews that reported pooled prevalence values calculated from meta-analyses, ranging from 16% (95% CI: 12–20%, $N = 23$) (27) to 41.42% (95% CI: 36–47%, $N = 75$) (28). Among reviews without meta-analysis, the prevalence rate was estimated to be as high as 65.2% in Italy (25). The most-reported anxiety assessment tool was the GAD-7, which was reported in 15 reviews (**Table 2**).

The sociodemographic risk factors associated with the incidence of anxiety or anxiety-like symptoms included female gender (24, 29, 42, 45, 50, 58, 62), living in a rural area (24), being married (62), having a child (62), and younger age ($\leq$40 years) (24, 39, 42, 50, 52, 62). Additionally, pre-existing illness (24), having physical COVID-19 symptoms (62), exposure to a COVID-19 patient (38, 48, 54, 62), working in a COVID-19 unit or hospital (62), working in an intensive care unit (ICU) (50), a lack of social support (54, 62), a lack of access to adequate

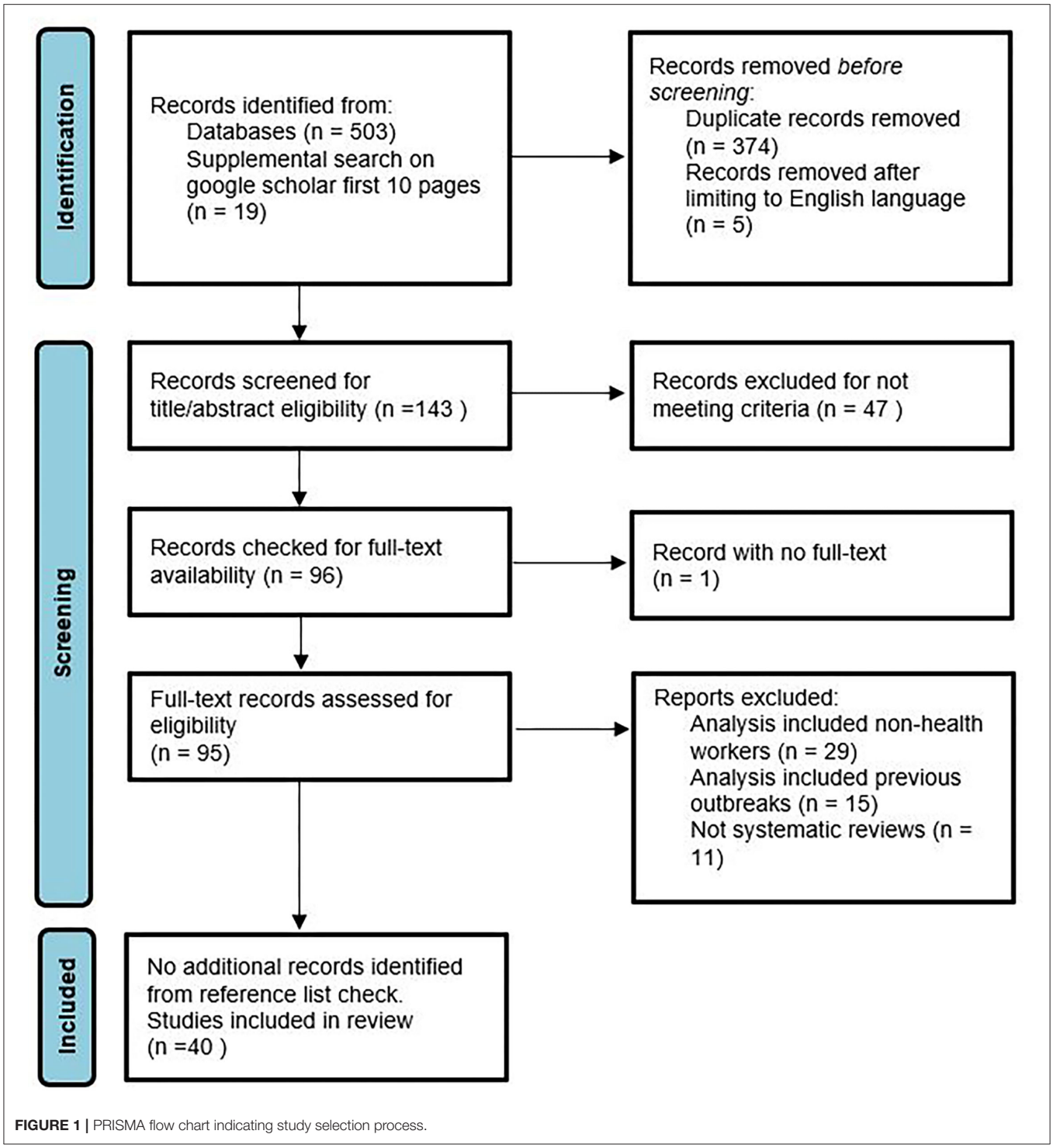

FIGURE 1 | PRISMA flow chart indicating study selection process.

PPE (54, 62), and insufficient knowledge regarding COVID-19 (54) were also associated with increased anxiety and anxiety-like symptoms.

The risk of developing anxiety was higher among nurses (29, 34, 42, 45, 50, 53, 55, 58, 65), and frontline professionals (24, 34, 42, 45, 50, 63, 65). The prevalence of anxiety among frontline nurses (39%, 95% CI: 32–46%, $N = 24$) was higher than among other nurses (32%, 95% CI: 27–38%, $N = 42$) (32) and overall health professionals (29.0%, 95% CI: 23.4–34.7%, $N = 22$) (34). Compared with the pre–COVID-19 prevalence, anxiety significantly increased during the COVID-19 pandemic (50). Health professionals with pre-existing insomnia were significantly more prone to developing anxiety symptoms [odds ratio (OR): 13.6, 95% CI: 10.5–17.5] (39).

TABLE 1 | Outcome of the critical appraisal of the included studies.

S/ no	Study references	Criteria assessed based on JBI checklist											Total criteria met
		1	2	3	4	5	6	7	8	9	10	11	
1	Al Maqbali et al. (32)	1	1	1	1	1	-	-	1	1	1	1	9
2	Arora et al. (23)	1	1	1	1	1	1	1	1	1	1	0	10
3	Cenat et al. (27)	1	1	1	1	1	1	1	1	1	1	1	11
4	De Brier et al. (38)	1	1	1	1	1	1	1	1	0	1	1	10
5	da silva Neto et al. (39)	1	1	1	1	1	1	1	1	1	0	0	9
6	da silva and Neto (40)	1	1	1	1	-	-	1	1	1	-	1	8
7	da silva and Neto (41)	1	1	1	1	1	1	-	-	-	1	1	8
8	Danet (42)	1	1	1	1	1	-	-	1	-	1	1	8
9	De Kock et al. (24)	1	1	1	1	1	1	1	1	-	1	1	10
10	De Pablo et al. (43)	1	1	1	1	1	-	1	1	0	1	0	8
11	D'Ettorre et al. (30)	1	1	1	0	1	-	1	1	0	1	0	7
12	Dong et al. (34)	1	1	1	1	1	1	1	1	1	1	1	11
13	Falasi et al. (31)	1	1	-	1	1	-	1	1	0	1	1	8
14	Galanis et al. (44)	1	1	1	1	1	0	0	1	1	1	0	8
15	Gohil et al. (33)	1	1	1	1	-	-	1	1	0	1	0	7
16	Hao et al. (45)	1	1	1	1	1	-	1	1	1	-	1	9
17	Krishnamoorthy et al. (46)	1	1	1	1	1	1	-	1	1	1	0	9
18	Kunz et al. (25)	1	1	-	0	1	1	0	1	0	1	0	6
19	Kunzler et al. (47)	1	1	1	1	1	1	1	1	-	1	1	10
20	Li et al. (48)	1	1	1	1	1	0	1	1	1	1	1	10
21	Luo et al. (49)	1	1	1	1	1	-	-	1	0	1	1	8
22	Mahmud et al. (28)	1	1	1	1	1	1	1	1	1	1	1	11
23	Marvaldi et al. (26)	1	1	1	1	1	-	1	1	1	1	1	10
24	Moitra et al. (50)	1	1	1	1	-	-	1	1	0	1	-	7
25	Muller et al. (51)	1	1	1	1	1	1	1	1	0	1	1	10
26	Pappa et al. (29)	1	1	1	1	1	1	1	1	0	1	1	10
27	Phiri et al. (52)	1	1	1	1	1	1	1	1	1	1	-	10
28	Salari et al. (53)	1	1	-	1	1	0	0	1	1	1	0	7
29	Sanghera et al. (54)	1	1	1	1	-	-	-	1	-	1	1	7
30	Santabarbara et al. (55)	1	1	1	1	1	1	-	1	1	1	-	9
31	Saragih et al. (56)	1	1	1	1	1	1	1	1	1	1	1	11
32	Sharifi et al. (57)	1	1	1	1	1	1	-	1	-	1	1	9
33	Shaukat et al. (58)	1	1	1	0	-	-	-	1	0	1	0	5
34	Sheraton et al. (59)	1	1	-	1	1	1	1	1	1	1	1	10
35	Sriharan et al. (60)	1	1	1	1	1	1	1	1	0	1	1	10
36	Thatrimontrichai et al. (61)	1	-	1	0	0	-	1	-	0	0	1	4
37	Varghese et al. (62)	1	1	1	1	1	1	1	1	1	1	1	11
38	Vindegaard and Benros (63)	1	1	0	0	-	0	0	-	0	0	1	3
39	Wu et al. (11)	1	1	1	1	1	-	1	1	1	1	-	9
40	Zhao et al. (64)	1	1	1	1	1	1	1	1	1	1	0	10

Criteria 1 to 11- 1, clarity of review question; 2, appropriateness of inclusion criteria; 3, appropriateness of search strategy; 4, adequacy of search sources; 5, appropriateness for criteria in appraising included studies; 6, appraisal conducted by 2 or more reviewers independently; 7, methods to minimise errors in data extraction; 8, appropriate methods to combine studies; 9, assessment of publication bias; 10, recommendation for policy/practise based on reported data; 11, appropriateness of directives for new research. Key, 1, meet criteria; 0, Not meet criteria;, -, Unclear.

Study location appears to contribute to the levels of anxiety reported among HCWs. In China, the prevalence of anxiety in Hubei Province, where the outbreak originated, was 37.9% (95% CI: 28.7–47.1%), which was higher than in other regions of China (30.8%, 95% CI: 25.1–36.5%) (34). Three reviews (48, 52, 62) conducted sensitivity analyses according to country or region. Phiri et al. (52) indicated that a higher incidence of anxiety was reported in the United Kingdom (UK: 22.3%, 95% CI: 7–38%, $N = 4$) compared with the United States of America (USA: 19.99%, 95% CI: 17%−23%, $N = 4$), China (18.98%, 95% CI: 16–22%, N

TABLE 2 | Mental health impacts of COVID-19 on health professionals.

Outcomes	Measure	References	Impact of COVID-19 on outcome			Effect size/comment
			Impact classified/ compared between groups		Overall impact (no comparison)	
			Significant	Not significant		
Overall mental health/ psychological problems	BAI, CES-D, CPDI, DASS-21, GAD-7, GHQ-12; HADS-A, HAMA, HAMD, IES-R, ISI, ITQ, PHQ-9: PTSD-SS, PSQI, SAS, SASR, SDS, SOS, SRQ, STAI, WHO-5	Arora et al. (23)			✓	34% (95%CI: 24–44) $N = 28$
	NA	De Brier et al. (38)	✓			β: 5.347, (95%CI:3.831;8.184) $N = 1$. Contact with infected patients
	GAD-7, GHQ, PHQ-4, PHQ-9, SCL-90,	da Silva and Neto (40)	✓			Meta-correlation between covid and psychiatric disorder = 0.72% (95%CI: 0.66–0.78) $N = 8$
	NA	Luo et al. (49)			✓	Range = 14 to 72%, $N = 5$
	NA	Shaukat et al. (58)			✓	23% $N = 1$
	NA	Sheraton et al. (59)		✓		OR = 1.39 (95%CI: 0.99–1.96), Z = 1.89 $N =$ 5. compared to non-HCW
	NA	Zhao et al. (64)			✓	11.6% (95% CI: 9.2–14.6) $N = 3$, $n = 3{,}327$
Anxiety/ Anxiety symptoms	#GAD-7, SAS	Al Maqbali et al. (32)			✓	37% (95% CI 32–41), $N = 73$. Nurses only
	NA	De Brier et al. (38)	✓			AOR: range from 1.57 to 2.06, $N = 2$ Contact with infected patients
	BAI, DASS-21, GAD-7, GAD-2, HAMA, SAS,	Cenat et al. (27)		✓		16% (95%CI:12–20) $N = 23$, > 15% (95%CI:11–20) $N = 31$
	AS, DAS, GAD-7, HAMA, SAS, SCL-90, SF-36	da Silva Neto et al. (39)	✓			13%, OR = 1.62 (95%CI:1.33–1.96) $N = 7$, higher than non-HCW, 5%
	DASS-21, GAD-7, SF-36, STAI	Danet (42)			✓	Range = 20–72%, $N = 7$
	DASS-21, GAD-7	De Kock et al. (24)			✓	Range = 14.5–44.6%, $N = 2$
	NA	de Pablo et al. (43)	✓			22.2% (95%CI: 13–36) $N = 4$, $n = 7{,}716$
	DASS-21, GAD-7, SAS	Dong et al. (34)			✓	34.4% (95%CI: 30–39) N = 22. China
	DASS-21, GAD-7, HAMA, SAS, SLC-90	Hao et al. (45)			✓	28.6% (95%CI: 22–36) $N = 16$
	NA	Krishnamoorthy et al. (46)			✓	24% (95%CI: 16–32) $N = 16$
	NA	Kunz et al. (25)			✓	65.2% N = 1. Only highest prevalence reported (Italy)
	NA	Kunzler et al. (47)		✓		SMD = −0.08 (95%CI: −0.66–0.49) $N = 13$, n = 5,508. compared to before covid
	NA	Luo et al. (49)			✓	26% (95%CI: 18–34) $N = 12$
	# BAI, DASS-21, HAMA, HADS, GAD, SAS	Mahmud et al. (20)			✓	41.42% (95% CI: 36–47) $N = 75$, $n = 147{,}435$
	NA	Marvaldi et al. (26)			✓	30% (95 %CI, 24.2–37.05) $N = 22$, $n = 51{,}942$
	NA	Moitra et al. (50)			✓	Not quantified. $N = 10$
	NA	Muller et al. (51)			✓	24% (95%CI: 9–90) $N = 22$, $n = 47{,}630$
	BAI, DASS-21, HAMA, GAD-7, SAS	Pappa et al. (29)			✓	23.2% (95%CI: 18–29) $N = 12$

(Continued)

TABLE 2 | Continued

Outcomes	Measure	References	Impact of COVID-19 on outcome			Effect size/comment
			Impact classified/ compared between groups		Overall impact (no comparison)	
			Significant	Not significant		
	DASS-21, GAD-7, HADS	Phiri et al. (52)			✓	21.9% (95%CI: 19-25) N= 69
	DASS-21, GAD-7, SARS, SAS	Salari et al. (53)			✓	25.8% (95% CI 20.5–31.9%) *N* = 23
	DASS-21, GAD-7, HAMA, SAS	Sanghera et al. (54)			✓	Range = 12.3–35.6% *N* = 33
	BAI, DASS-21, GAD-7, HADS, STAI-S, SAS	Santabarbara et al. (55)			✓	25% (95% CI: 21–29%) *N* = 71
	NA	Saragih et al. (56)			✓	40% (95% CI: 29–52%) *N* = 40
	DASS-21, GAD-2/7, HADS, HAMA, PHQ-4, SAS	Li et al. (48)			✓	22.1% (95% CI, 18.2–26.3%) *N* = 57
	GAD-7, SAS	Shaukat et al. (58)			✓	Range = 23–44% *N* = 2
	NA	Thatrimontrichai et al. (61)			✓	25.9%, *N* = 18, *n* = 6,305/24,297. Asia
	NA	Varghese et al. (62)			✓	32% (95%CI: 21–44%) *N* = 21, *n* = 13 641. Nurses
	NA	Vindegaard and Benros (63)			✓	Not quantified. *N* = 8.
	NA	Wu et al. (65)			✓	29% (95%CI 23.6–34.7) *N* = 23, *n* = 50,143 Nurses/doctors; 19.9% (12.4–28.6) *N* = 7, n = 2,521 other professionals
	NA	Zhao et al. (64)			✓	23.2% (95% CI: 17–31) *N* = 14, *n* = 13,020
Burnout	MBI	Danet (42)			✓	Range = 12–36% (emotional exhaustion and depersonalisation) *N* = 2
	NA	de Pablo et al. (43)	✓			25% (95%CI: 13–43) *N* = 1, *n* = 32
	NA	Galanis et al. (44)			✓	emotional exhaustion 34.1%, depersonalisation 12.6%, lack of personal accomplishment 15.2%; *N* = 6. Nurses
	NA	Kunz et al. (25)			✓	45.6%, *N* = 1. Only highest prevalence reported (Belgium)
	NA	Moitra et al. (50)			✓	Not quantified. *N* = 2
	MBI	Sanghera et al. (54)			✓	Range = 3.1–43.0%, *N* = 5
	MBI, questionnaire, Pfi	Sharifi et al. (57)			✓	Not quantified. *N* = 12
	MBI, questionnaire	Sriharan et al. (60)			✓	Range = 13–39%, *N* = 2. Nurses
Depression/ depressive symptoms	#PHQ-9, SDS	Al Maqbali et al. (32)			✓	35% (95%CI: 31–39) *N* = 62, nurses
	NA	De Brier et al. (38)	✓			AOR: range from 1.52 to 2.97, *N* = 2. Contact with infected patients.
	BDI, DASS-21, HAMD, PHQ-2, PHQ-9, SDS	Cenat et al. (27)		✓		14% (95%CI:11–17) *N* = 18, < general population 17% (95%CI:13–22) *N* = 28
	DS, HAMD, PHQ-4, PHQ-9, SDS	da Silva Neto et al. (39)	✓			12.2%, OR = 1.3246; 95%CI 1.0930 to 1.6053) *N* = 7, > other professionals 9.5%
	DASS-21, IPQ, PHQ-9, SDS	Danet (42)			✓	Range = 25–65%, *N* = 10

(Continued)

TABLE 2 | Continued

Outcomes	Measure	References	Impact of COVID-19 on outcome			Effect size/comment
			Impact classified/ compared between groups		Overall impact (no comparison)	
			Significant	Not significant		
	DASS-21, PHQ-9	De Kock et al. (24)			✓	Range = 8.9–50.4% *N* = 2
	Estimate	de Pablo et al. (43)	✓			17.9% (95%CI: 7–40) *N* = 4, *n* = 7,716
	DASS-21, PHQ-9, SDS	Dong et al. (34)			✓	31.1% (95 CI: 25–38) *N* = 18. China
	DASS-21, HAMD, PHQ-2, PHQ-9, SCL-90, SDS	Hao et al. (45)			✓	24.1% (95% CI: 16–32) *N* = 14
	NA	Krishnamoorthy et al. (46)			✓	25% (95%CI:19–32) *N* = 16
	NA	Kunz et al. (25)			✓	57.9%, *N* = 1. Only highest prevalence reported (Italy)
	NA	Kunzler et al. (47)		✓		SMD =-0.16 (95%CI:−0.59–0.26) *N* = 7, *n* = 2,226. compared to before covid
	#SDS, CES-D, DASS-21, HADS	Mahmud et al. (20)			✓	37.12% (95% CI:32–42) *N* = 69, *n* = 144,649
	NA	Marvaldi et al. (26)			✓	31% (95 %CI, 26–37) *N* = 25, *n* = 68,030
	NA	Moitra et al. (50)			✓	Not quantified. *N* = 18
	NA	Muller et al. (51)			✓	28% (95%CI: 5–51) *N* = 19, *n* = 35,219
	BDI-II, DASS-21, CES-D, PHQ-2, SDS	Pappa et al. (29)			✓	22.8% (95%CI: 15–32) *N* = 10
	DASS-21, HADS, PHQ-9	Phiri et al. (52)			✓	23.4% (95%CI: 21–26) *N* = 66
	DASS-21, SDS, BDI-II, HAD	Salari et al. (53)			✓	24.3% (95%CI: 18–32%) *N* = 21
	DASS-21, PHQ-9, PHQ-4, SDS, HAMD	Sanghera et al. (54)			✓	Range = 13.5–44.7%, *N* = 32
	NA	Saragih et al. (56)			✓	37% (95% CI: 29–45%) *N* = 30
	CES-D, DASS-21, HADS, PHQ-2, PHQ-4, PHQ-9	Li et al. (48)			✓	21.7% (95% CI:18–25) *N* = 55
	NA	Shaukat et al. (58)			✓	50.4%, *N* = 1
	NA	Thatrimontrichai et al. (61)			✓	27.2%, *N* = 14, *n* = 10,617/39,014. Asia
	NA	Varghese et al. (62)			✓	32% (95% CI: 21–44) *N* = 17, *n* = 12 294
	NA	Vindegaard and Benros (63)			✓	Not quantified. *N* = 6
	#GHQ-9, SDS, WHO-5	Wu et al. (65)			✓	31% (95%CI:25–38) *N* = 23, *n* = 41,889 Nurses/doctors; 14.1% (7.4–22.4) *N* = 6, *n* = 2,471 other professionals
	NA	Zhao et al. (64)			✓	23.9% (95% CI: 15–36) *N* = 11, *n* = 11,922
Fear	NA	De Brier et al. (38)	✓			AOR: 1.41, (95%CI:1.03;1.93), *N* = 1. Contact with infected patients.
	Self-questionnaire	De Kock et al. (24)			✓	87%, *N* = 1. Dentist. Fear of infection from patient or co-worker
	NA	Gohil et al. (33)			✓	Range = 60–96.6%, *N* = 12; Dental. Fear of contagion
	NA	Thatrimontrichai et al. (61)			✓	77.1%, *N* = 4, *n* = 2,743/3,558. Asia

(Continued)

TABLE 2 | Continued

Outcomes	Measure	References	Impact of COVID-19 on outcome			Effect size/comment
			Impact classified/ compared between groups		Overall impact (no comparison)	
			Significant	Not significant		
Insomnia	AIS, ISI, PSQI	Cenat et al. (27)	✓			37% (95%CI:33–40) *N* = 6, HCW, higher than general population 16% (95%CI:8–30) *N* = 8
	ISI	da Silva Neto et al. (39)			✓	Range = 34–38.4%, *N* = 3
	ISI	De Kock et al. (24)			✓	34%, *N* = 1.
	NA	de Pablo et al. (43)			✓	44.5% (95%CI: 38–51) *N* = 3, *n* = 3,490
	ISI-7, PSQI	Hao et al. (45)			✓	44.1% (95% CI:31.3–57.0%) *N* = 5
	NA	Krishnamoorthy et al. (46)			✓	37% (95%CI:32–42) *N* = 4
	AIS, ISI, PSQI	Mahmud et al. (20)			✓	43.76% (95% CI: 36–52) *N* = 21, *n* = 33,370
	NA	Moitra et al. (50)			✓	Not quantified. *N* = 10
	AIS, ISI	Pappa et al. (29)			✓	38.9% (95%CI: 27–42) *N* = 5
	NA	Phiri et al. (52)			✓	23.98% (95%CI: 16–32) *N* = 4
	AIS, ISI, PSQI	Sanghera et al. (54)			✓	Range = 33.8–36.1%, *N* = 12
	ISS, PSQI	Shaukat et al. (58)			✓	34%, *N* = 1
	NA	Sheraton et al. (59)	✓			OR = 2.19 (95%CI: 1.33–3.62), Z = 3.08 *N* = 2. compared to non-HCW
	NA	Thatrimontrichai et al. (61)			✓	35%, *N* = 3, *n* = 2,072/5,919. Asia
	NA	Varghese et al. (62)			✓	38.3%, (95% CI = 5.8%−78.6) *N* = 2, *n* = 261
	NA	Wu et al. (65)			✓	47.3% (95%CI:39–56) *N* = 7, *n* = 13,375 Nurses/doctors; 31.8 (27.2–36.5) *N* = 2, *n* = 1,380 other professionals
Obsessive compulsive symptoms	NA	Hao et al. (45)			✓	16.2% (95%CI: 3.0–30) *N* = 4
	NA	Vindegaard and Benros (63)			✓	Not quantified. *N* = 1
Phobia	SLC-90, SCL	Hao et al. (45)			✓	35.0% (95% CI: 8.6–61) *N* = 4
PTSD/ emotional stress/ distress	NA	De Brier et al. (38)	✓			AOR: 1.60, (95%CI:1.25;2.04), *N* = 1. PTSD. Contact with infected patients.
	IES-R, K-6, SCL-90, SRQ-20	Cenat et al. (27)		✓		21% (95%CI:5–57) *N* = 4, HCW PTSD < general population 22% (95%CI:8–50) *N* = 9; 17% (95%CI:13–22) *N* = 9, HCW distress > general population 10% (95%CI:5–21) *N* = 10
	ASDI, IES-R; PSS	Al Maqbali et al. (32)			✓	43% (95% CI: 37–49), *N* = 40, nurses. Emotional stress
	NA	da silva and Neto (41)			✓	Not quantified, *N* = 31. HCW stress in ICU
	DASS-21, DSM-5, ASAISTSS	Danet (42)			✓	Range = 37–78% *N* = 10. stress
	NA	de Pablo et al. (43)			✓	29.9% (95%CI: 9–65) *N* = 3, *n* = 6,789. Distress; 7.7% (95%CI: 6–11) *N* = 22, *n* = 470 PTSD
	DASS-21, IES-R, IES-6, PCL-C, PTSD-SS	Dong et al. (34)			✓	29.1% (95%CI: 24–34) *N* = 9. Stress & PTSD, China

(Continued)

TABLE 2 | Continued

Outcomes	Measure	References	Impact of COVID-19 on outcome			Effect size/comment
			Impact classified/ compared between groups		Overall impact (no comparison)	
			Significant	Not significant		
	CBI, GPS, IES-R, PCL-6, PCL-C	d'Ettorre et al. (22)			✓	Range = 6.6%-58.6%. *N* = 16, PTSD
	NA	Falasi et al. (31)			✓	Range = 3.4% (India) to 71.5% (China) *N* = 5. Acute PTSD
	IES-R, PTSD-SS, PCL-C, PSS-10	Hao et al. (45)			✓	25.6% (95% CI: 12–39) *N* = 5. PTSS
	NA	Krishnamoorthy et al. (46)			✓	41% (95% CI:19–65) *N* = 4 distress; 13% (11–16%) *N* = 2. PTSS
	NA	Kunz et al. (25)			✓	73.6% *N* = 1. Only highest prevalence reported (Spain). PTSD
	NA	Kunzler et al. (47)		✓		SMD = 0.49 (95% CI:−0.60–1.57) *N* = 3, *n* = 1,570. compared to before covid. Stress
	IES, DASS-21, PSS, PTSD	Mahmud et al. (20)			✓	44.86% (95% CI: 36.98–52.74) *N* = 41, *n* = 82,783. Stress
	NA	Marvaldi et al. (26)			✓	20.2% (95 %CI:9.9–33) *N* = 6 PTSD; 56.5% (95 %CI:31–81), *N* = 3 Acute stress
	NA	Muller et al. (51)			✓	37% (95%CI: 7–97) *N* = 13, *n* = 20,391
	IES-R, PCL-5	Phiri et al. (52)			✓	25% (95%CI: 19–31) *N* = 19. PTSD
	CES-D, IES-R, PSS-10, PSS	Sanghera et al. (54)			✓	Range = 5.2–32.9% *N* = 11 acute stress; 7.4–37.4% *N* = 13. PTSD
	NA	Saragih et al. (56)			✓	49% (95% CI: 22–75) *N* = 7 PTSD; 37% (95% CI: 25–50) *N* = 15 Distress
	NA	Li et al. (48)			✓	21.5% (95% CI, 1–35%) *N* = 9
	IES, PTSD-SS	Shaukat et al. (58)			✓	Range = 23.4–71%, *N* = 2. Stress disorder
	NA	Varghese et al. (62)			✓	18.6% PTSD (95% CI = 4.8%−38) *N* = 3, *n* = 638; 40.6% stress (95% CI = 25.4–56.8%,) *N* = 10, *n* = 4,204. Nurses
	#GHQ-12, IES, K6, PSS-10	Wu et al. (65)			✓	41.2 (19.8–64.5) *N* = 5, *n* = 10,165. Distress
	NA	Zhao et al. (64)			✓	28% (95% CI: 9.5–59) *N* = 5, *n* = 4,327. PTSS
Somatization symptoms	NA	Hao et al. (45)			✓	10.7% (95% CI: 1.9–19.6%) *N* = 5
	NA	Kunz et al. (25)			✓	Not quantified. *N* = 1. Reported as higher among nurses than doctors (Italy)
Substance abuse	NA	Kunz et al. (25)			✓	6.2% *N* = 1. Only highest prevalence reported in nurses and doctors (Spain)
Suicidal thought/ self-harm	NA	Phiri et al. (52)			✓	5.8% (95%CI: 5–7) *N* = 4

 # other measures not specified; N, number of studies; n, number of participants; AOR, Adjusted Odds Ratio; ASDI, Acute Stress Disorder Inventory; BAI, Becks Anxiety Inventory; BDI, Beck Depression Inventory; CES-D, Centre for Epidemiology Scale for Depression; CPDI, COVID-19 Peritraumatic Distress Index; DASS-21, Depression, Anxiety Stress Scale; DSM-5, PTSD Symptoms Severity Scale; GAD-7, Generalised Anxiety Disorder; GHQ, General Health Questionnaire; HADS-A, Hospital Anxiety Depression Scale–Anxiety; HAMA, Hamilton Anxiety Scale; HAMD, Hamilton Depression Scale; HCW, Healthcare Workers; IES-R, Impact of Event Scale-Revised; ISI, Insomnia Severity Scale; IPQ, Illness Perception Questionnaire; ITQ, International Trauma Questionnaire; K-6, Kessler-6 Item Psychological Distress Scale; MBI, Maslach Burnout Inventory; OR, Odds Ratio; PHQ, Patient Health Questionnaire; Pfi, Stanford Professional Fulfilment Index; PTSD-SS, Post Traumatic Stress Disorder-Short Scale; PTSS, Posttraumatic Stress Symptoms; PSQI, Pittsburgh Sleep Quality Index; PCL-C, PTSD Checklist Civilian; PTSD-SS, Posttraumatic Stress SAS, Self-rating Anxiety Scale; SASR, Stanford Acute Stress Reaction; SCL, Symptoms Checklist; SDS, Self-rating Depression Scale; SF, Health Questionnaire; SMD, Standardised Mean Difference; SOS, Stress Overload Scale; STAI, State-Trait Anxiety Inventory; SRQ, Stress Response Questionnaire; SRQ-20, Self Reporting Questionnaire-20; STSS, Secondary Traumatic Stress Scale; WHO-5, World Health Organization-5.

= 24), and Italy (13.44%, 95% CI: 6–20%, $N = 6$). Li et al. (48) by contrast, reported that the Middle-East presented with the highest pooled estimated prevalence of anxiety (28.9%, 95% CI: 21.6–36.8%, $N = 7$), whereas, the lowest incidence was reported for North America (14.8%, 95% CI: 13.9–15.7%, $N = 2$). In Asia, China yielded a pooled prevalence of 19.1% (95% CI: 15.5–23.0%, $N = 37$), which was slightly lower than the pooled prevalence reported for all other studies from East Asia (20.5%, 95% CI: 15.7–25.8, $N = 40$). Other regions examined included Europe (23.9%, 95% CI: 19.6–28.4%, $N = 4$) and South Asia (21.0%, 95% CI: 11.7–31.4%, $N = 3$). Varghese et al. (62) examined the pooled prevalence among nurses across various regions and reported the highest pooled prevalence for the Eastern Mediterranean region (41.9%, 95% CI: 10.7–77.3%, $N = 3$, $n = 907$) compared with the Western Pacific/Southeast region (30.9%, 95% CI: 17.2–46.5%, $N = 10$, $n = 10{,}579$) and the European region (30.5%, 95% CI: 16.7–46.3%, $N = 7$, $n = 2{,}067$) (62).

Depression

Depression and depressive symptoms were assessed in 28 reviews, which synthesised data from 584 primary studies (**Table 2**). The prevalence rate was reported in 24 reviews, including 17 that reported the pooled prevalence values calculated from meta-analyses, which ranged from 14% (95% CI: 11–17%, $N = 18$) (27) to 37.12% (95% CI: 32–42%, $N = 69$) (28). Among reviews without meta-analyses, the prevalence rate was estimated to be as high as 65% (42). The most-reported depression assessment tools were the PHQ, versions 2 and 9, which were reported in 10 reviews (**Table 2**).

Exploring sociodemographic risk factors associated with depression revealed that female gender (24, 29, 42, 45, 50, 62), being single or not married (42), and younger age (≤40 years) (24, 39, 50, 52, 62) were associated with a higher incidence of depressive symptoms. Additionally, spending too much time reading COVID-19-related information (50), less work experience (42), a lack of social support (48), and pre-existing organic illnesses were associated with higher levels of depression (24). The risk of developing depression or depressive symptoms was higher among nurses (29, 42, 50, 65), frontline professionals (24, 42, 50, 63, 65), professionals working in surgical units (24), COVID-19 units and hospitals (62), and professionals with direct patient contact (38, 48, 54, 58). Depression was significantly associated with poor sleep quality and insomnia (39, 50). Health professionals with insomnia had a 13-fold higher risk of developing depressive symptoms than those without insomnia (OR: 13.5517, 95% CI: 10.4771–17.5285, $p < 0.0001$) (39).

Compared with the pre-COVID-19 prevalence, depressive symptoms significantly increased during the COVID-19 pandemic (50). The prevalence of depression among frontline nurses (33%, 95% CI: 24–43%, $N = 19$) was higher than that among other nurses (33%, 95% CI: 29–37%, $N = 36$) (32) and that among overall health professionals (29.2%, 95% CI: 21.7–36.7%) (34). Similarly, the prevalence of moderate to severe depression among frontline HCWs (14.6%, 95% CI: 6.3–23.0%) was higher than that among second-line HCWs (8.7%, 95% CI: 3.9–13.4%) (45).

Three reviews (48, 52, 62) conducted sensitivity analyses according to country or region. Phiri et al. (52) indicated that the highest depression prevalence was reported for the Middle East (41%, 95% CI: 16–60%, $N = 5$) compared with those reported for China (22.13%, 95% CI: 18%−27%, N = 24), Italy (20.39%, 95% CI: 10–31%, $N = 5$), and the UK (19.29%, 95% CI: 7%−32%, N = 5). Li et al. (48) also reported higher depression prevalence in the Middle East (34.6%, 95% CI: 25.1–44.9%, $N = 5$) compared with those in South Asia (28.8%, 95% CI: 18.1–40.8%, $N = 3$) and Europe (22.0%, 95% CI: 18.9–25.3%, $N = 4$). The pooled estimates were lowest for North America (18.7%, 95% CI: 17.8–9.7%, $N = 2$) and East Asia (19.1%, 95% CI: 15.2–23.4%, $N = 39$). Varghese et al. (62) examined the pooled prevalence of depression among nurses across various regions. The highest prevalence of depression was found in the Eastern Mediterranean region (61.2%, 95% CI: 16.9–96.2%, $N = 2$, $n = 592$) compared with the Western Pacific/Southeast region (27.4%, 95% CI: 13–44.7%, $N = 9$, $n = 11{,}181$) and European region (30.9%, 95% CI: 20.4–42.5%, $N = 5$, $n = 433$) (62).

PTSD/Stress/Distress

Emotional stress, distress, and PTSD were assessed from 24 reviews, which synthesised data from 327 primary studies (**Table 2**). Of these, the prevalence rate was reported by 21 reviews, including 15 that reported pooled prevalence values calculated from meta-analyses, ranging from 18.6% (95% CI: 4.8–38%, $N = 3$) (62) to 56.5% (95% CI: 31–81%, $N = 3$) (62). Among reviews without meta-analysis, the prevalence rate was estimated to be as high as 78% (42). The most-reported distress and PTSD assessment tool was the Impact of Event Scale (IES), which was reported in 10 reviews (**Table 2**).

The risk of developing PTSD, stress, or distress was generally higher among women (30, 31, 42, 50, 62), younger professionals (30, 42, 50, 52, 62), professionals with limited experience (30, 42), and those living with family members (31). Similarly, the risk of experiencing psychological stress or distress was higher among nurses (31, 42, 49, 50, 54, 65) and frontline professionals than among other HCWs (24, 31, 49). Prevalence of stress and distress was higher among frontline nurses (46%, 95% CI: 39–54%, $N = 17$) than among nurses working on the second line (42%, 95% CI: 31–53%, $N = 20$) (32). Similarly, frontline health professionals experience higher levels of distress (mean = 2.66 ± 0.93) than other health professionals (mean = 2.46 ± 0.83) (42). The disproportionate need for technological supplies in ICU settings, combined with the scarcity of these supplies, promotes high rates of psychological stress among HCWs who work in ICU settings (41). Similarly, a lack of adequate PPE (24), direct exposure to patients (54, 58, 62), working in ICU or emergency settings (42), working in a perceived unsafe environment (30), working in COVID-19 hospitals (62), and working in regions with high caseloads (49) were associated with an increased risk of developing stress or distress. Emotional stress was also associated with a lack of training and social support (30) and a history of mental illness or chronic disease (24, 42).

Varghese et al. (62) examined the pooled prevalence among nurses across various regions. The highest prevalence was reported for the Eastern Mediterranean region (61.6%, 95% CI:

56.4–66.8%, $N = 2$, $n = 763$) compared with the Western Pacific/Southeast region (47.2%, 95% CI: 14.7–81%, $N = 4$, $n = 3{,}165$) and the European region (34.2%, 95% CI: 21.2–48.6%, $N = 3$, $n = 232$) (62).

Insomnia

Insomnia was assessed by 16 reviews, which synthesised data from 91 primary studies (**Table 2**). The prevalence rate was reported in all 16 reviews, including 9 that reported pooled prevalence values calculated from meta-analyses, ranging from 23.98% (95% CI: 16–32%, $N = 4$) (52) to 47.3% (95% CI: 39–56%, $N = 7$) (65). The most-reported insomnia assessment tool was the ISI, which was reported in 7 reviews (**Table 2**).

Insomnia risk factors include female gender (24, 50), occupation as a nurse (50, 65), being a frontline professional (24, 42, 50), existing organic illness (24), and younger age (≤30 years) (52). Additionally, direct exposure to a COVID-19 patient (54), fear for self-infection (54, 58), working in an isolation unit (54), living in a rural area (24), and a lack of faith in psychological support (54) were associated with the increased incidence of insomnia.

Burnout

Burnout was assessed from 8 reviews, which synthesised data from 62 primary studies (**Table 2**). Of these, the prevalence rate was reported in 6 reviews, and only 1 study reported the pooled prevalence from a meta-analysis (43), which indicated an overall pooled prevalence for burnout of 25% (95% CI: 13–43%, $N = 3$) (43). Other reviews reported estimated prevalence values ranging from 12% (42) to 45.6% (25). The prevalence of burnout domains was reported in one review (44), which indicated that emotional exhaustion (34.1%), depersonalisation (12.6%), and lack of personal accomplishment (15.2%) were common reasons cited for burnout among nurses ($N = 6$). The most-reported burnout assessment tool was the Maslach Burnout Inventory (MBI), which was reported in 4 reviews (**Table 2**).

Burnout prevalence was higher among women (42, 50, 60) and younger professionals (44, 54). Decreased social support (44), fewer years of experience (<5 years) (60), more time spent working in quarantine areas (44), working in high-risk environments (44), working with insufficient resources (44), increased workload (44), and lower levels of specialised training (44) were significant risk factors for burnout. Among various health professionals, nurses (42, 54, 60) and frontline HCWs (42) were more at risk of developing burnout than other health professionals.

Other Mental Health Impacts

Other reported mental health impacts associated with the COVID-19 pandemic included fear of infection (4 reviews, $N = 26$), obsessive-compulsive disorder (2 reviews, $N = 5$), phobia (1 review, $N = 4$), somatisation symptoms (2 reviews, $N = 6$), substance abuse (1 review, $N = 1$), and suicidal ideations or self-harm (1 review, $N = 4$) (**Table 2**).

The fear of infection ranged from 60 to 96.6% ($N = 12$) among dental professionals (33). Additionally, a prevalence of 77.1% ($N = 4$, $n = 3{,}558$) for fear of infection was reported in Asia (61). One review (45) reported pooled prevalence values for obsessive-compulsive disorder (16.2%, 95% CI: 3–30%, $N = 4$), phobias (35%, 95% CI: 8.6–61, $N = 4$) and somatisation symptoms (10.7%, 95% CI: 1.9–19.6%, $N = 5$), and another review (52) reported a pooled prevalence for suicidal ideation (5.8%, 95% CI: 5–7%, $N = 4$). The prevalence of substance abuse was reported to be 6.2% among nurses and doctors in Spain (25).

Interventions/Coping Strategies Reported Alongside the COVID-19-Related Mental Health Issues

Strategies for overcoming mental health problems encountered during the COVID-19 pandemic included identifying people at risk (61), seeking individual or group-level professional psychological support (42, 51), attending counselling (51), practising mindfulness exercises (61), pursuing religious or spiritual channels (42), obtaining online information (51), refocusing and performing positive appraisal (42), ensuring family safety (24), seeking support from families or relatives (51, 61), asking for support from nurse leaders (60), practising resilience (24, 61), being in a committed relationship (24, 61), attending training or orientation for infectious disease unit (24, 60, 61), verifying access to adequate PPE (24, 51, 60, 61), reducing workloads (57), and reducing job-related stressors (57). One review reported participants, who prefer to overcome their psychological distress alone without any intervention (51).

DISCUSSION

To our knowledge, this is the first meta-review to investigate the impacts of COVID-19 pandemic on the overall mental health and well-being of HCWs (allied health professionals, doctors, and nurses). One strength of this meta-review is the large sample size included, which was drawn from 1,828 individual studies performed worldwide to evaluate the psychological impacts of COVID-19 on health professionals.

The most prevalent mental health problems identified in this review included anxiety, depression, and stress/PTSD. Other prevailing mental health problems include burnout, insomnia, fear of infection, obsessive-compulsive disorder, phobia, somatisation symptoms, substance abuse, and suicidal ideation/self-harm. Significant risk factors associated with the incidence of mental health issues include female gender, young age, low educational level, being a nurse, being a frontline health professional, experience, and country of residence. This meta-review reports the most comprehensive evidence to date regarding the mental health prevalence and risk factors among global HCWs associated with the COVID-19 pandemic. Mental health is among the commonly reported concerns associated with COVID-19 (4–6), particularly among individuals in the general population who have limited knowledge regarding the pandemic and tend to experience a high prevalence of adverse mental health conditions (4). Although the healthcare professions have stronger knowledge and experience in managing the pandemic condition, their mental health concerns are no different, or even higher than the general population. Accordingly, the overall pooled prevalence of mental health issues was reported to be higher among HCWs, compared to the general population (27, 39) but

lower than that among COVID-19 patients (46). Additionally, hard-affected countries, such as Italy (25), were associated with a higher prevalence of mental health issues relative to other regions. During the early stages of the outbreak, the highest prevalence of mental health issues was reported in Hubei Province, China, where the outbreak originated (4). Similar to the COVID-19 outbreak, previous pandemics, including SARS and MERS, were also characterised by mental health disturbances among health professionals (10, 11).

The findings of this meta-review further indicated that female HCWs are at a greater risk of mental health concerns than their male counterparts, which was identified for anxiety, depression, stress, insomnia, and burnout. Although none of the studies included in this review examined the nature of this association, the additional domestic burden among women has reportedly increased during COVID-19, including childcare, which likely contributed to worse mental health (66). Bahrami et al. (67) were of the opinion that metacognitive belief in uncontrollability, advantages, and the avoidance of worry may have contributed to the higher prevalence of anxiety in women than in men. Similar patterns of increased psychological disturbances were observed among females in the general population (6, 68) and among other professionals, such as teachers (69) during the COVID-19 pandemic. Additionally, the study reported by Hou et al. (68) examining differences during the COVID-19 pandemic indicated that men showed more resilience to stress, whereas women experienced more stress and anxiety symptoms.

Anxiety was the most prevalent mental health problem reported among HCWs during the COVID-19 pandemic, according to the findings of this review. The highest reported anxiety prevalence was 65.2% (25). The prevalence of anxiety varies across professions, with nurses reporting higher levels of anxiety than other professionals, which might be attributable to nurses having more frequent contact with the patients relative to other health professionals. Various studies have reported severe or dysfunctional anxiety levels among nurses due to the nature of various nursing roles (24, 65, 70). A similar prevalence of anxiety has been reported among teachers during the COVID-19 pandemic (69). The review by de Oliveira Silva et al. (69) reported an anxiety prevalence between 10 and 49.4% among teachers, which was associated with workload and the demand for online teaching. Higher anxiety was also found among pregnant women during the third trimester of pregnancy, associated with poor social support and increased demand on them to use COVID-19 protective measures (71). The causes of increased anxiety are likely multifaceted and are further complicated by the impacts of the pandemic.

The findings of this meta-review further indicated that the highest prevalence of depression was reported at 65% (42). Unsurprisingly, the rate of depression was higher among professionals in contact with COVID-19-positive patients and those working in COVID-19 units (24, 42, 50, 63, 65), which is likely to be associated with increased interaction with dying or suffering patients. Additionally, professionals with insomnia were 13 times more likely to develop depressive symptoms than those without insomnia (39). Increased depression incidence may be associated with a fear of contracting the infection or infecting family members, as has been reported in some studies (33, 51). A recent review study examining frontline professionals also indicated an association between depressive symptoms and the direct diagnosis or treatment of COVID-19 patients (5). High rates of depression or depressive symptoms have also been reported among the general population (4, 6), which has been associated with increased alcohol use (4) and suicidal ideation (6).

Stress-related symptoms were identified as common psychological concerns among HCWs. The findings of this meta-review indicated various emotional stress conditions associated with COVID-19, including acute stress, distress, and PTSD symptoms. The prevalence was reported as high as 78% for distress and 71.5% for PTSD. Stress, including PTSD in particular, may be associated with the exposure of HCWs exposure to adverse conditions, coupled with the increased demand for work. Previous studies conducted during pandemics also reported that HCWs in emergency units were exposed to traumatic stressors, such as the burden of rapid decision-making, demands to manage patient and family expectations, unexpected daily caseloads, and high fatality rates (9, 72). The pattern of stress identified among HCWs in the current review is similar to that described by teachers (69). Similar to anxiety and depression, being a nurse or frontline professional was identified as a significant risk factor for stress associated with COVID-19. In line with previous studies, the burden of stress among HCWs may be influenced by poor social support, coupled with fear of getting infected or infecting family members (9, 70, 71).

The findings of the current review further indicate differences in the mental health concerns of health professionals across regions. For instance, in China, HCWs in various provinces were reported to experience less anxiety than those working in Hubei Province, where the outbreak originated (30.8 vs. 37.9%). The current review further identified that the three most commonly occurring psychological concerns (anxiety, depression, and stress) were experienced at higher rates in some countries than in others. The highest prevalence of anxiety was reported in the UK (22%), whereas the highest prevalence of depression was reported in the Middle East (41%), and the highest stress level was observed in the Eastern Mediterranean region (61.6%). By contrast, the lowest prevalence of anxiety was reported in Italy (13.44%), the lowest prevalence of depression was reported in the UK (19.29%), and the European region experienced the least stress (34.2%). Previous studies indicate that higher levels of mental health concerns observed in particular regions or countries may be associated with large caseloads or poorly functioning healthcare systems (4, 73).

Other mental health concerns identified in this meta-review include burnout, fear of infection, phobia, somatisation symptoms and substance abuse, each affecting more than one-quoter of the professionals except somatization symptoms. Of these, fear of infection is the most prevalent, with a prevalence rate of as high as 96.6% among dental professionals while somatization symptoms were the least reported mental health concern among the professionals, accounting for about 10%. Fear of covid-19 was reported to spread faster than the virus (13) and is strongly associated with the uncertainties about the outbreak, of which many countries, including high-income countries, are

struggling to contain the outbreak (12, 13). On this note, Pakpoup and Griffiths (74) opined the need for understanding the different factors underpinning the fear associated with the virus to determine the needed education and prevention programs, and which groups of people to target. These programs could be instrumental towards overcoming the fear of COVID-19 and affected individuals to engage in preventative behaviours (74). Burnout on the other hand, may be associated with increased rates of hospitalisation coupled with longer working hours, particularly among frontline professionals. During the initial stages of the outbreak, burnout was highest among nurses, especially the depersonalisation sub-scale (75). This is largely associated with longer working hours, of which those with younger age were most affected compared to experienced and/or older professionals (75).

Review Limitations

Although this meta-review provides comprehensive evidence regarding the overall mental health impacts of the COVID-19 pandemic among health professionals, various limitations must also be considered when interpreting these findings. First, many of the included systematic reviews were associated with the potential for bias, as assessed by the JBI systematic review checklist (36) (**Table 1**). However, this could be associated with the rapid nature of the pandemic evolution, coupled with the need to quickly fill research gaps. Second, systematic reviews both with and without meta-analyses were included in this meta-review; therefore, no additional meta-analyses were conducted. Instead, the findings were narratively synthesised, and the only effect sizes available are those that were reported by the included studies. Third, it is unclear from the included systematic reviews if the HCWs had underlying conditions prior to the COVID-19 pandemic, which may have exacerbated the development of the various mental health issues identified in this review. Finally, the current review only reported coping strategies identified alongside the prevalence and risk factors associated with the various mental health conditions. Additional studies remain necessary to specifically investigate interventional techniques capable of supporting the mental health of health professionals during pandemics such as COVID-19.

Conclusions

Based on the findings of this meta-review, health professionals (nurses, doctors, and allied health professionals) experience various forms of COVID-19-related mental health issues. The most prevalent mental health issue is anxiety, followed by depression and stress/PTSD. Other significant mental health problems include insomnia, burnout, fear of infection, obsessive-compulsive disorder, somatisation symptoms, and suicidal ideation/self-harm. Female gender and younger age were the most significant sociodemographic risk factors associated with COVID-19-related mental health impacts. Other risk factors included being a nurse and being a frontline professional. The findings of this meta-review have implications for both practise and policies, therefore, we recommend targeted interventions and health programs that address specific mental health issues to support health professionals worldwide during pandemics such as COVID-19. This is in line with the position paper of the World Psychiatric Association (76), which recommended continued psychiatric support including telepsychiatry, promoting adherence to physical health measures such as social distancing, as well as respecting the human rights of individual with mental disorders. McDaid (77) added the need for strategies to support overall mental health recovery beyond the pandemic, which could be tailored to individual country context.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding authors.

AUTHOR CONTRIBUTIONS

MC, DS, and UB: conceptualisation and study protocol. PJ and MK: articles search. MC and PJ: article screening and selection. DS, LD, and PP: data extraction. NC, PJ, and TK: quality assessment. MC, AC, DS, and UB: data analysis. RM, KN, and PK: supervision and review for intellectual content. MC, DS, and DN: writing first draft of manuscript. All authors: final approval of manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.804525/full#supplementary-material

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Problematic Mobile Phone Use and Life Satisfaction Among University Students During the COVID-19 Pandemic in Shanghai, China

Wenning Jiang[1], *Jin Luo*[2,3], *Hannan Guan*[4,5], *Feng Jiang*[2,3]* *and Yi-Lang Tang*[6,7]

[1] Antai College of Economics and Management, Shanghai Jiao Tong University, Shanghai, China, [2] School of International and Public Affairs, Shanghai Jiao Tong University, Shanghai, China, [3] Institute of Healthy Yangtze River Delta, Shanghai Jiao Tong University, Shanghai, China, [4] School of Education, Shanghai Jiao Tong University, Shanghai, China, [5] Department of Education Information Technology, East China Normal University, Shanghai, China, [6] Department of Psychiatry and Behavioral Sciences, Emory University, Atlanta, GA, United States, [7] Atlanta Veterans Affairs Medical Center, Decatur, GA, United States

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Chinese Academy of Medical Sciences and Peking Union Medical College, China
Xin Li,
East China University of Science and Technology, China

***Correspondence:**
Feng Jiang
fengjiang@sjtu.edu.cn

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Objective: This study examined problematic mobile phone use (PMPU) and its relationship with life satisfaction in Chinese university students during the pandemic.

Methods: An anonymous online survey was conducted in a university in China. The Mobile Phone Addiction Index (MPAI) and the Satisfaction with Life Scale (SWLS) were used to assess the severity of problematic mobile phone use and life satisfaction, respectively. Data on demographic and health-related factors were also collected.

Results: A total of 1,491 undergraduate students (73.3% were male) completed the survey. On average, students in the survey reported spending 7.4 ± 4.3 h/day on phone use. Their MPAI score was 38.1 ± 13.3 and SWLS score was 24.9 ± 6.8, respectively. After controlling for confounding factors, the MPAI score was significantly associated with lower life satisfaction. Multiple linear regression revealed that higher monthly allowances, frequent insomnia, longer phone use duration were significantly associated with PMPU.

Conclusion: University students in China spend nearly half of their waking hours on mobile phone use, significantly longer than before the COVID-19 pandemic. PMPU is associated with insomnia, lower life satisfaction and higher allowances. If the trend continues after the pandemic, interventions may be needed. Increase in-person interactions, limiting online social and gaming time, awareness campaign may be effective in reducing the impact of PMPU and improve life satisfaction.

Keywords: mobile phone use, life satisfaction, association, university students, China

INTRODUCTION

Smartphones have become a necessity and the most important communication tool because of their convenience and accessibility (1–3), and this is especially true for young people. Due to the technological advances, smartphones have been used in academic, professional, social and recreational activities, including those tasks that were previously only possible on computers. In the meantime, excessive smartphone use could lead to a series negative health outcomes, including depression, anxiety, sleep deprivation and insomnia (4–7), and low life satisfaction. Furthermore,

excessive smartphone use may increase the risk of problematic mobile phone use (PMPU), and even lead to smartphone addiction (8).

Of note, neither smartphone addiction nor internet addiction is officially listed as a diagnosis in any major diagnostic systems and it is controversial to consider it as a diagnostic entity. However, a few other terms have been used to describe this phenomenon: problematic mobile phone use, mobile phone addiction, excessive mobile phone use, and compensatory mobile phone use (9). PMPU is characterized by excessive attention and uncontrolled dedication to one's cell phone use (10).

In China, young people are the largest growing group of smartphone users, especially university students (11). University students tend to routinely use smartphones in their study and other daily activities (12). In 2018, a survey demonstrated that Chinese university students spend over 5 h/day on mobile phones, and ∼4/5 (79%) use smartphones in class (2).

The COVID-19 has dramatically changed people's lives in numerous ways. In the early stages of the pandemic, a range of emergency public health measures were adopted, such as universal masking, social distancing, locking down, school closure, and public transportation suspension. One adaptive behavioral change during the extraordinary times is increased use of the internet and smartphone for either professional use or personal use. One survey found that, during the COVID-19 pandemic, adolescents spent more time on the internet to study, play games, and chat with friends (13). This large-scale social isolation and overexposure to the mobile devices may contribute to a few mental health issues, including the potential to have PMPU.

As an important element in happiness, life satisfaction is the gap between what people have and what they want (14), which correlates positively with academic performance and productivity (15). It is believed that life satisfaction is affected by conditions such as health, socioeconomic status, and activities (16).

To date, although a few studies have examined internet use and smartphone use in adolescents, middle and high school students (17–22), few studies examined the smartphone use pattern and PMPU among university students in China during the COVID-19 pandemic. Furthermore, no studies have examined the association between PMPU and life satisfaction using standard structured instruments. Therefore, we designed this study and collected data among university students during the COVID-19 pandemic. We firstly surveyed the average time spent on smartphones, then examined the factors associated with PMPU, with focus on the relationship between PMPU and life satisfaction.

MATERIALS AND METHODS

Study Design and Participants

This cross-sectional study was conducted in a comprehensive university from July 7 to 17 in 2021. Before the start of the survey, we calculated the minimum sample size using the following formula:

$$n = \frac{N}{1 + \frac{4d^2(N-1)}{z_\alpha^2}}$$

where n is the minimum sample size, N the size of the students in Shanghai Jiao Tong University, d the maximum error of estimate, and z_α the critical value of normal distribution at the assumed confidence level.

Three schools (Antai College of Economics & Management; School of International and Public Affairs; School of Electronic, Information and Electrical Engineering) were selected as convenience samples, while all full-time undergraduates in the selected schools were invited to participate. The weblink of the study was posted via WeChat, a popular social app in mainland China.

The Ethics Committee in Shanghai Jiao Tong University approved the study protocol (approval number: H2021158I). Each participant provided written informed consent before they responded to the questionnaire.

Measures

Socio-Demographic Characteristics

We collected socio-demographic data of the participants, including gender, age, grade, place of hometown, ethnicity, major, monthly allowances, and relationship status. We also collected information on alcohol use, cigarette use, and insomnia based on literature review (2).

PMPU

PMPU was assessed using the Mobile Phone Addiction Index (MPAI), which has been widely used in various studies (23, 24). MAPI was developed by Leung to rate the comprehensive level of mobile phone addiction and related symptoms, including the inability to control craving, feel anxious and lost, withdrawal or escape, and productivity loss (25). All 17 items were rated on a 5-point Likert-type scale, ranging from 1 (Never) to 5 (Always), while higher total scores indicate higher levels of mobile phone addiction (23). The Cronbach's α of MPAI was 0.93 in the present study.

Life Satisfaction

Participants' overall life satisfaction was assessed using the Satisfaction with Life Scale (SWLS) (14), which has been widely used around the world with good reliability and validity (26, 27). The scale assesses an individual's satisfaction with life as a whole. It has 5 items, such as "The conditions of my life are excellent." Participants rated the items on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), with higher scores indicative of better-perceived life satisfaction. The Cronbach's α of SWLS in our samples was 0.94.

Data Analysis

One-sample K-S test was used to examine the normality of the data. Descriptive analyses for the sample's socio-demographic, PMPU, life satisfaction, and other related factors were conducted.

The associations between PMPU, life satisfaction, and other factors were examined with independent samples *t*-test, analysis of variance (ANOVA), chi-square test, and Pearson correlation analysis, as appropriate. The independent associations between PMPU and life satisfaction were determined with a stepwise multiple linear regression after controlling for significant correlates as identified in the univariate analyses. The independent factors associated with PMPU were identified through a stepwise method of multiple linear regression; MPAI score was entered as the dependent variable, while its significant correlates in univariate analyses were involved as the independent variables. Data analyses were carried out with the STATA software version 16.0 (Stata Corporation, College Station, TX, USA), with the significance level at the *p*-value of 0.05 (two-tailed).

RESULTS

In total, 4,561 undergraduates were invited to participate and 1,534 students responded (response rate of 33.63%). The relatively low response rate might be attributable to the busy schedules at the end of the Spring semester. Therefore, 1,491 undergraduates completed the survey without logical errors and were included in the statistical analysis.

Their mean age was 20.8 ± 2.9 years, and 73.3% were male. They spent 7.4 ± 4.3 h/day on smartphones, with the MPAI score of 38.1 ± 13.3. Their SWLS score was 24.9 ± 6.8. **Table 1** shows the detailed information of their social-demographic and related characteristics.

Table 2 displays the results of univariate analyses, showing the factors associated with PMPU and life satisfaction.

Table 3 shows the Pearson correlation coefficients of PMPU and life satisfaction with age and smartphone use time. Phone use time was significantly associated with MPAI score ($r = 0.135$, $p < 0.05$).

After controlling for other related factors, MPAI score was significantly associated with lower life satisfaction ($\beta = -0.10$, $p < 0.001$) (**Table 4**).

We also found that PMPU was significantly associated with higher monthly allowances, frequent insomnia, longer phone use time (**Table 5**).

DISCUSSION

Based on a large (>1,000), relatively homogenous sample of undergraduate students from a university, we found that students spent 7.4 ± 4.3 h/day on phone use. Their MPAI score was 38.12 ± 13.33 and SWLS score was 24.987 ± 6.81, respectively. We also found the MPAI score was significantly associated with lower life satisfaction. Multiple linear regression revealed that PMPU was significantly associated with higher monthly allowances, frequent insomnia, and longer phone use duration in this sample.

To our best knowledge, this survey was one of the first that examined the relationship between PMPU and life satisfaction among Chinese university students during the COVID-19 pandemic. This study found a negative association between

TABLE 1 | Characteristics of 1,491 participants.

Characteristic	*N*	%
Gender		
Male	1,093	73.31
Female	398	26.69
Grade		
Freshman	401	26.89
Sophomore	404	27.10
Junior	457	30.65
Senior	229	15.36
Hometown setting		
Urban	979	65.66
Rural	512	34.34
Ethnicity		
Han Chinese	1,376	92.29
Minority nationality	115	7.71
Major		
Engineering	494	33.13
Science	464	31.12
Economy	108	7.24
Others	425	28.50
Monthly allowances (RMB)		
<1,000	184	12.34
1,000–1,499	509	34.14
1,500–1,999	391	26.22
2,000–2,499	228	15.29
2,500–2,999	65	4.36
≥3,000	114	7.65
Relationship status		
Not dating nor married	864	57.95
Dating but unmarried	534	35.81
Married	54	3.62
Others	39	2.62
Insomnia		
No	623	41.78
Seldom (≤3 times/month)	450	30.18
Sometimes (1–2 times/week)	275	18.44
Often (3–5 times/week)	109	7.31
Daily (>5 times/week)	34	2.28
Cigarette use		
No	1,177	78.94
Ex-smoker	185	12.41
Current smoker	129	8.65
Alcohol use		
Never	862	57.81
Rare (≤2 times/month)	410	27.50
Sometimes (≤4 times/month)	145	9.73
Often (≤12 times/month)	47	3.15
Always (>12 times/month)	27	1.81
	Mean	**SD**
Age (years)	20.83	2.89
MAPI	38.12	13.33
SWLS	24.87	6.81
Phone use duration (hours)	7.39	4.32

MAPI, mobile phone addiction index; SWLS, the satisfaction with life scale.

TABLE 2 | Univariate analyses of factors associated with PMPU and SWLS.

Variable	MPAI score			SWLS		
	Mean ± SD	*t*/F	*P*	Mean ± SD	*t*/F	*P*
Gender		−0.60	0.549		3.29	**0.001**
Male	38.00 ± 13.41			25.22 ± 6.84		
Female	38.46 ± 13.13			23.91 ± 6.67		
Grade		1.49	0.214		1.23	0.297
Freshman	37.14 ± 13.53			24.37 ± 7.04		
Sophomore	37.89 ± 13.54			24.86 ± 6.97		
Junior	38.65 ± 12.92			25.11 ± 6.42		
Senior	39.18 ± 13.38			25.31 ± 6.89		
Place of hometown		0.01	0.916		0.79	0.430
Urban	38.09 ± 13.52			24.97 ± 6.86		
Rural	38.17 ± 12.98			24.68 ± 6.74		
Ethnic groups		−2.28	**0.022**		0.73	0.465
Han	37.89 ± 13.29			24.91 ± 6.81		
Minority nationality	40.84 ± 13.65			24.43 ± 6.89		
Specialty		4.65	**0.003**		7.08	**<0.001**
Engineering	37.87 ± 12.49			24.10 ± 6.32		
Science	36.74 ± 14.21			25.87 ± 7.22		
Economy	37.72 ± 12.26			23.48 ± 6.32		
Others	40.02 ± 13.38			25.04 ± 6.89		
Monthly allowances (RMB)		6.19	**<0.001**		1.57	0.166
<1,000	34.34 ± 14.55			24.90 ± 8.56		
1,000–1,499	37.56 ± 12.70			24.45 ± 6.26		
1,500–1,999	38.06 ± 12.60			24.67 ± 6.46		
2,000–2,499	41.05 ± 13.63			25.54 ± 6.71		
2,500–2,999	40.37 ± 11.71			24.92 ± 6.58		
≥3,000	39.82 ± 15.17			26.04 ± 7.44		
Relationship status		8.12	**<0.001**		6.40	**<0.001**
Not dating nor married	36.78 ± 13.39			24.34 ± 6.75		
Dating but unmarried	39.58 ± 12.53			25.31 ± 6.68		
Married	42.48 ± 16.25			27.31 ± 7.71		
Others	41.87 ± 14.62			27.21 ± 7.49		
Insomnia		37.96	**<0.001**		11.47	**<0.001**
No	33.90 ± 13.17			26.17 ± 6.85		
Seldom (≤3 times/month)	39.22 ± 12.03			24.37 ± 6.39		
Sometimes (1–2 times/week)	41.80 ± 12.26			23.85 ± 6.10		
Often (3–5 times/week)	45.19 ± 12.74			22.78 ± 7.51		
Daily (>5 times/week)	48.59 ± 16.36			22.76 ± 10.02		
Cigarette use		17.86	**<0.001**		1.11	0.331
No	37.11 ± 13.16			24.83 ± 6.71		
Ex-smoker	42.99 ± 12.15			25.48 ± 6.87		
Current smoker	40.33 ± 14.72			24.37 ± 7.67		
Alcohol use		10.63	**<0.001**		4.18	**0.002**
Never	36.34 ± 13.51			25.42 ± 6.86		
Rare (≤2 times/month)	39.89 ± 12.47			23.81 ± 6.41		
Sometimes (≤4 times/month)	42.34 ± 11.92			25.01 ± 6.54		
Often (≤12 times/month)	42.19 ± 13.50			23.83 ± 7.61		
Always (>12 times/month)	38.48 ± 17.32			24.63 ± 9.37		

Bold value for $p < 0.05$.

TABLE 3 | Pearson correlation analysis for PMPU and SWLS.

Variable	MPAI	SWLS
Age (years)	0.015	0.015
Phone use duration	0.135*	−0.015

*$p < 0.05$.

TABLE 4 | Association of PMPU and SWLS.

Variable	β	95% CI (Lower)	95% CI (Upper)	P
MAPI	−0.10	−0.13	−0.07	**<0.001**
Female	−1.15	−1.90	−0.40	**0.003**
Marriage				
Dating but unmarried	1.43	0.72	2.13	**<0.001**
Married	4.21	2.38	6.04	**<0.001**
Others	3.64	1.54	5.75	**0.001**
Insomnia				
Seldom	−1.28	−2.09	−0.48	**0.002**
Sometimes	−1.87	−2.82	−0.92	**<0.001**
Often	−2.85	−4.22	−1.48	**<0.001**
Daily	−2.67	−4.96	−0.37	**0.023**

Bold value for $p < 0.05$.

TABLE 5 | Independent correlates of PMPU.

Variable	β	95% CI (Lower)	95% CI (Upper)	P
Monthly allowances (RMB)				
1,000–1,499	3.52	1.39	5.66	**0.001**
1,500–1,999	3.24	1.02	5.46	**0.004**
2,000–2,499	5.85	3.38	8.31	**<0.001**
2,500–2,999	5.00	1.98	8.03	**0.006**
≥3,000	5.02	1.45	8.59	**0.002**
Insomnia				
Seldom (≤3 times/month)	5.00	3.47	6.54	**<0.001**
Sometimes (1–2 times/week)	7.47	5.67	9.27	**<0.001**
Often (3–5 times/week)	10.28	7.68	12.87	**<0.001**
Daily	14.01	9.61	18.42	**<0.001**
Phone use duration	0.28	0.12	0.43	**<0.001**

Bold value for $p < 0.05$.

excessive mobile phone use and life satisfaction, suggesting a link between PMPU and lower life satisfaction. While the mechanism and causality are unclear, some studies reported significant association between excessive mobile phone use and poor sleep quality, insomnia (28–30), depression and anxiety (6, 31), all of which may be linked to poor life satisfaction or quality of life (QOL) (32–34). Similar findings between PMPU and life satisfaction have been reported by other studies. Reports from the United States and Lebanon also found that PMPU was negatively associated with life satisfaction, mediated by academic performance and stress (35, 36). Another study of Chinese university students demonstrated that the severity of mobile phone addiction was significantly associated with lower scores on all domains of QOL measures (2).

In the current study, we found the average duration of mobile phone use was 7.39 h, which was much longer than previous studies, especially those prior to the COVID-19 pandemic. A study conducted in December 2018 in Shenzhen, a city in south China, showed that youth (18–24 years old) people used mobile phones for 3.78 ± 2.51 h per day before the pandemic (37). Xie et al. showed that male university students in pre-pandemic Macau used mobile phones 2.7 ± 2.4 h per day, while female students 3.0 ± 2.5 h (38). Another study in Turkey Inonu University before the COVID-19 pandemic found that 21.6% of students used cell phones for 3 h or less, 31.7% between 4 and 5 h, 18.5% between 6 and 7 h, and 28.2% longer than 8 h (39). The survey of Mobile phone usage in 2018 found university students in China on average spent over 5 h/day on mobile phones, which is much closer to our findings (2). The significant difference in mobile phone use among different studies may be due to different samples, time of survey and how the questions were asked. During the COVID-19 period, university students needed to use smartphones for academic activities, including online class and learning, which may explain the longer phone use (40), although our data did not differentiate between personal use and professional use.

An interesting finding of our study is that the MAPI score was lower than in several previous studies. For example, Liu et al. found that the MPAI score in male medical college students in Shanghai was 44.94 ± 12.08, female 45.25 ± 11.87 (41). A study of high school students in Sichuan and Chongqing showed a little higher MPAI score with a mean of 41.65 than our study (24). Again the sampling methods, samples' demographic features may explain some of the difference. It is also possible that although our sample reported longer time on smartphone, they had used it more academic activities instead of smartphone gaming, therefore less distress and impairments were experienced, as other types of smartphone activities such as internet gaming were associated with psychological distress (42, 43).

In the regression model, we found that PMPU was significantly associated with students' monthly allowances, which often reflect their family socioeconomic status. This finding is in line with findings of a study among Iranian medical university students, which demonstrated that family economic status was a significant predictor of mobile phone dependency (44). The exact mechanism between socioeconomic status and PMPU warrants further investigations.

Several limitations about this study need to be noted. First, due to the nature of a cross-sectional survey, a causal relationship between PMPU and other variables could not be examined. Second, some important information related to PMPU and life satisfaction, such as personality and academic performance, were not recorded. Third, we did not specify whether the time spent on smartphone was for academic activity, social communication or gaming, which may provide more helpful information regarding

intervention. Fourth, as the instruments were self-reported, the recall bias and response bias cannot be ruled out in the study. Finally, as the participating schools were selected by convenience, this could lead to sampling bias, therefore the generalizability of the conclusions may be limited.

CONCLUSIONS

In conclusion, we found university undergraduate students in China spend nearly half of their waking hours on mobile phone use, significantly longer than before the COVID-19 pandemic. PMPU is associated with insomnia, lower life satisfaction and higher allowances. Awareness campaign is needed. If this trend continues, interventions may be indicated, including facilitating in person interactions, limiting online social and gaming time. These changes may be effective in reducing the impact of PMPU and improve life satisfaction among students.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee in Shanghai Jiao Tong University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

FJ and Y-LT made substantial contributions to the study design. JL, WJ, and HG collected data. FJ analyzed the data. JL and FJ interpreted the results of analysis and completed the manuscripts. Y-LT critically revised the manuscript. All authors contributed to the article and approved the submitted version.

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Depression During COVID-19 Quarantine in South Korea: A Propensity Score-Matched Analysis

Yongjoo Kim[1], Hye-Young Kwon[2], Seungyoung Lee[3] and Chang-Bo Kim[4]*

[1] College of Korean Medicine, Sangji University, Wonju, South Korea, [2] Division of Biology and Public Health, Mokwon University, Daejeon, South Korea, [3] College of Nursing, Kyunghee University, Seoul, South Korea, [4] Seoul Health Foundation, Seoul, South Korea

Background: Quarantine, a public health measure used to control the coronavirus disease 2019 (COVID-19) pandemic, has been linked to an increased risk of developing adverse psychological sequelae. This study sought to investigate whether quarantining during the COVID-19 pandemic was associated with depression among Koreans.

Methods: Data were obtained from the Seoul COVID-19 Study of Quarantine (SCS-Q) and the 2019 Korea Community Health Survey (KCHS). Using propensity scores estimated based on sociodemographic and health conditions, 919 individuals undergoing quarantine in the SCS-Q were matched with 919 individuals who did not experience quarantine in the 2019 KCHS. Depressive symptoms were measured using the Korean version of the Patient Health Questionnaire-9 (PHQ-9), where major depression is defined as a PHQ-9 score $\geq$ 10. Logistic regression models were adjusted for sociodemographic and health-related factors.

Results: Depression prevalence was higher in quarantined individuals than in the control group (7.8 vs. 3.8%, $p < 0.001$). Logistic regression analyses revealed that quarantining was associated with higher likelihoods of having major depression [odds ratio (OR) = 2.28, 95% confidence interval (CI): 1.49, 3.51] after adjusting for relevant covariates.

Limitations: Due to the online nature of the SCS-Q, this study included a limited number of elderly participants, limiting the generalizability of the findings to the general Korean population.

Conclusions: The findings suggest that Koreans undergoing COVID-19 quarantine are at higher risk of depression. While further investigation is warranted, public health measures to control infectious disease outbreaks, such as quarantine, would benefit from incorporating strategies to address unintended adverse psychological effects, such as depression.

Keywords: COVID-19, quarantine, mental health, psychological impacts, depression, depressive symptoms, depressive disorder, South Korea

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***Correspondence:**
Hye-Young Kwon
haeyoungkwon0111@gmail.com

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INTRODUCTION

The novel coronavirus disease 2019 (COVID-19) pandemic is an urgent global public health issue. Quarantine is one of the most commonly used public health measures to address the spread of infectious disease outbreaks, limiting the movement of people who are at high risk of exposure to an etiological agent, even in the absence of clinical symptoms or laboratory results (1). However, due to the unpleasant nature of quarantine stemming from separation and restriction, adverse psychological sequelae are pervasive among individuals who undergo quarantine (2–4).

A growing body of literature has documented that quarantining is associated with elevated levels of psychological distress, including depression, anxiety, and suicidality (4–7). A recent review reported that quarantining due to infectious disease outbreaks can be followed by psychological and environmental stressors such as fears/concerns of infection, loss of social relationships and physical activities, and insufficient supplies and information, which in turn can lead to mental disorders, including depression, anxiety, and post-traumatic stress symptoms (4). In relation to COVID-19 quarantine, generally higher levels of psychological distress symptoms have been reported among individuals undergoing quarantine in China (3, 5), Ireland (8), and Italy (9). Moreover, a Canadian study found that, compared to individuals who did not undergo quarantine, those who experienced quarantine tended to have increased suicidality, self-harm intentions, and other unfavorable mental health outcomes (7). These previous studies necessitate further research to inform effective intervention strategies to address adverse psychological consequences during the implementation of quarantine.

In South Korea, after the first laboratory-confirmed case of COVID-19 was detected in January 2020, the spread of COVID-19 has been relatively successfully controlled to the extent that it does not require a nationwide lockdown (10). Based on the "3T" strategy (Testing-Tracing-Treating), mandatory quarantine has been widely implemented among high-risk populations. That is, individuals who had close contact with those who received positive laboratory test results, even in the absence of clinical symptoms, or individuals who traveled abroad were required to have a 14-day self-quarantine at home or dedicated facilities (10). Previous Korean studies have generally focused on the levels of psychological distress among the general public during the COVID-19 pandemic or individuals infected with COVID-19 (11–13). For instance, Kim and colleagues found higher levels of sleep disturbance and perceived stress among the general public residing where COVID-19 was prevalent (11). However, despite the accumulated number of individuals who experienced or were undergoing quarantine in South Korea and the increasing body of evidence showing the negative psychological impacts of quarantine among other populations, to date, there has been limited evidence to understand whether COVID-19 quarantine leads to an elevated risk of mental disorders among Koreans. Therefore, in this study, we sought to investigate the association between quarantining during the COVID-19 pandemic and depression among Koreans. Based on previous research, we hypothesized that individuals undergoing COVID-19 quarantine would have an elevated risk of depression and higher levels of depressive symptoms than those who did not experience quarantine.

METHODS

Sample and Data Source

In South Korea, all individuals who enter the country from abroad or make close contact with those affected by COVID-19 are recommended to undergo screening tests at local screening posts. Of those, individuals who receive negative test results are required to conduct self-quarantine in a dedicated facility or at home for 14 days, whereas those who receive a positive test result are transferred to designated hospitals or residential centers for surveillance. In Seoul Metropolitan City, local district governments and public health centers are in charge of the self-quarantine process, including managing screening posts, providing quarantine guidelines and necessary supplies, and monitoring and communicating with those who are quarantined.

The Seoul COVID-19 Study of Quarantine (SCS-Q) was conducted by the Seoul Health Foundation (SHF) in collaboration with the local district public health centers. The SHF is a public institute established by the Seoul Metropolitan City in order to develop and evaluate public health policies and interventions. In collaboration with local public health centers in Seoul, investigators at SHF developed and administered an online survey. All individuals aged 19 years or above who were undergoing self-quarantine at some point from October to November 2020 in Seoul were sampled and invited to participate in the survey. During the survey period, 5,175 individuals underwent self-quarantine. Of those, 1,139 individuals (overall response rate: 22.0%) agreed to participate in the survey and responded accordingly.

The survey questionnaire was composed of three parts: (a) sociodemographic information including age, sex, socioeconomic status, living arrangement, and residing area; (b) evaluation of quarantine-related processes and experiences; and (c) health-related factors such as depression, anxiety, health-related quality of life, self-rated health, and other medical histories.

The Institutional Review Board of Seoul Metropolitan City approved our study (IRB No. 2020-10-0001). We obtained online informed consent from all survey respondents prior to survey participation.

To select a control group, we used data from the Korea Community Health Survey (KCHS), which is a nationally representative study of Korean community-dwelling individuals aged 19 years or older, measuring information on sociodemographic, behavioral, and medical conditions, administered by the Korea Centers for Disease Control and Prevention (14). The KCHS measures information on sociodemographic, behavioral, and medical conditions. Of the individuals included in the 2019 KCHS, we focused on samples from Seoul, including 3,649 individuals.

Based on the information from the two samples ($N = 1,139$ from the SCS-Q and $N = 3,649$ from the 2019 KCHS), we used a propensity score matching method to match individuals

from the SCS-Q with individuals from the 2019 KCHS. First, we built logistic regression models to estimate the propensity to be quarantined with respect to age, sex, district of residence, education, employment status, income level, and chronic conditions such as hypertension, which were determined using a stepwise model selection process. Based on the propensity score estimated by the function of the aforementioned independent variables, the samples from the SCS-Q ($N = 919$) were matched to samples from the 2019 KCHS ($N = 919$), including a total of 1,838 individuals, as the final analytic sample of this study.

Measures

We used the Korean version of the Patient Health Questionnaire-9 (PHQ-9) to assess depressive symptoms. The PHQ-9 is a commonly used validated measure for depression and comprises nine items capturing symptoms of depression, including anhedonia, depressed mood, trouble sleeping, feeling tired, change in appetite, guilt/self-blame, trouble concentrating, feeling restless/slowed down, and suicidal thoughts, over the past 2 weeks (15). Per each item, response options represent the perceived frequency of the depressive symptom specified in each item during the past 2 weeks, including "never (0)," "several days (1)," "more than half of the days (2)," and "almost every day (3)," resulting in a total score ranging from 0 to 27 (15). Previous studies have reported excellent level of internal consistency reliability of PHQ-9 with Cronbach's alpha values ranging from 0.81 to 0.95 among US and Korean samples (16–19). A consistent result was found in our sample with a Cronbach's alpha value of 0.87. A meta-analysis reported that a cut-off of ≥10 is one of the most commonly used thresholds to identify major depressive disorder with a sensitivity of 0.85, and specificity of 0.89, when compared with a structured psychiatric interview (20). The validity and reliability of the Korean translated version of the PHQ-9 have been reported in previous studies (16, 18, 19). The Korean version of the PHQ-9 was administered to the 2019 KCHS cohort. In the SCS-Q, to assess depressive symptoms during quarantine, the timeframe of each item was modified from "over the past 2 weeks" to "during quarantine."

Statistical Analysis

For descriptive analyses, we examined means (standard deviations) for continuous variables and frequencies (proportions) for binary/categorical variables among individuals quarantined during the COVID-19 pandemic (from the SCS-Q) and the control group (from the 2019 KCHS study) before and after matching, respectively. We also examined and compared the distribution of PHQ-9 scores, major depression (PHQ-9 score $\geq$ 10), and mild depression (PHQ-9 score $\geq$ 5) in quarantined individuals and the control group after matching. We further examined and compared the distribution of major depression according to relevant covariates, including age (19–39, 40–64, 65+), sex, district of residence, education (high school graduate or less vs. some college education or more), employment status (wage worker, employer/self-employed, economically inactive, others), income level (lowest in quartiles vs. higher than lowest), marital status (single, married, divorced/widowed), living arrangement (living alone vs. others), comorbid conditions such as hypertension and diabetes, and self-rated health (good/very good vs. moderate or worse), among quarantined individuals and the control group after matching.

To investigate whether quarantine during the COVID-19 pandemic was associated with an increased likelihood of major depression, we used a logistic regression modeling approach linking major depression with respect to quarantine status and other relevant independent variables based on the matched data. For all statistical analyses, SAS 9.4 (SAS Institute, Inc. Cary, NC, USA) was used.

RESULTS

Descriptive Statistics

Table 1 shows the characteristics of the samples before and after matching. Before matching, significant differences were found in the distribution of relevant sociodemographic and health-related factors between those under quarantine during the COVID-19 pandemic ($N = 1,139$ individuals from the SCS-Q) and control groups ($N = 3,649$ individuals residing in the four local districts in Seoul from the 2019 KCHS). However, after the matching procedure based on the aforementioned propensity score method, those under quarantine during the COVID-19 pandemics (N=919 individuals from the SCS-Q) showed nearly identical characteristics, in terms of the relevant sociodemographic and health-related factors, with the control group ($N = 919$ individuals residing in Seoul from the 2019 KCHS).

Table 2 presents the differences in the distribution of depression measures in those under quarantine during the COVID-19 pandemic ($N = 919$) and in the control group ($N = 919$). Overall, individuals undergoing self-quarantine during the COVID-19 pandemic had higher levels of depressive symptoms (mean score 3.38 vs. 2.29, $p < 0.001$) and a higher prevalence of major (7.8 vs. 3.8%, $p < 0.001$) and mild depression (28.1 vs. 16.8%, $p < 0.001$) than those in the control group. Moreover, major depression was more prevalent among women than among men (10.4 vs. 5.3%), the younger age group (10.2% of those aged 19–39 vs. 5.6% of those aged 40+), economically inactive group than wage workers (11.6 vs. 6.3%), and those living alone than those not living alone (14.0 vs. 6.7%).

Quarantining and Depression

Table 3 demonstrates the findings from the logistic regression models linking quarantine during the COVID-19 pandemic with major depression (defined as a PHQ-9 score of 10 or above, representing moderate to severe level of depressive symptoms) among the study participants ($N = 3,649$). Overall, individuals undergoing quarantine during the COVID-19 pandemic were more likely to have major depression (OR = 2.28, 95% CI: 1.49, 3.51) than those in the control group, after accounting for relevant sociodemographic and health-related factors. We found a similar association (OR = 2.03, 95% CI: 1.61, 2.56) when using more relaxed criteria to define the outcome (mild/major depression, defined as a PHQ-9 score of 5 or above, representing mild, moderate, or severe level of depressive symptoms).

TABLE 1 | Sociodemographic and health-related characteristics of the SCS-Q sample and control group before and after matching.

Variables		Before matching						After matching					
		Quarantinees during COVID 19 pandemic		Control group		χ^2 or *t*-valtest statisticsue[a]	*P*-value	Quarantinees during COVID 19 pandemic		Control group		χ^2 or *t*-value[a]	*P*-value
		(*N* = 1,139)		(*N* = 3,649)				(*N* = 919)		(*N* = 919)			
Male, *N*(%)		565	(49.6%)	1,528	(41.9%)	21.08	<0.0001	468	(50.9%)	468	(50.9%)	0.00	NS
Age, Mean(SD)		39.01	(12.54)	52.35	(17.60)	28.27	<0.0001	39.82	(12.16)	40.10	(13.14)	0.49	NS
Age group													
	19-39	608	(53.4%)	941	(25.8%)	472.22	<0.0001	472	(51.4%)	466	(50.7%)	0.08	NS
	40-64	508	(44.6%)	1,690	(46.3%)			427	(46.5%)	433	(47.1%)		
	65 and over	23	(2.0%)	1,018	(27.9%)			20	(2.2%)	20	(2.2%)		
Dwelling district						31.42	<0.0001						
	Nowon-gu	330	(29.0%)	912	(25.0%)			256	(27.9%)	258	(28.1%)	0.06	NS
	Sungbuk-gu	341	(29.9%)	917	(25.1%)			276	(30.0%)	276	(30.0%)		
	Eunpyung-gu	261	(22.9%)	910	(24.9%)			208	(22.6%)	204	(22.2%)		
	Yangcheon-gu	207	(18.2%)	910	(24.9%)			179	(19.5%)	181	(19.7%)		
Income						102.44	<0.0001					0.17	NS
	Lowest	138	(12.1%)	146	(4.0%)			26	(2.8%)	29	(3.2%)		
Employment status						268.85	<0.0001					0.07	NS
	Wage worker	625	(54.9%)	1,620	(44.4%)			576	(62.7%)	554	(60.3%)		
	Employer/Self-employed	98	(8.6%)	407	(11.2%)			86	(9.4%)	115	(12.5%)		
	Economically inactive	312	(27.4%)	1,588	(43.5%)			241	(26.2%)	238	(25.9%)		
	Others	104	(9.1%)	34	(0.9%)			13	(1.4%)	12	(1.3%)		
Education						284.19	<0.0001					0.06	NS
	High school or less	254	(22.3%)	1,850	(50.7%)			155	(16.9%)	151	(16.4%)		
	Tertiary education	885	(77.7%)	1,799	(49.3%)			764	(83.1%)	768	(83.6%)		
Predisposing chronic diseases												0.16	NS
	Hypertension	96	(8.4%)	1,017	(27.9%)	183.90	<0.0001	83	(9.0%)	88	(9.6%)		
Propensity scores		0.38	(0.21)	0.19	(0.15)	28.45	<0.0001	0.32	(0.13)	0.32	(0.13)	0.00	NS

[a] *Test statistics were driven from t tests for continuous variables, McNemar's test for binary variables, and Chi-squared test for categorical variables.*

TABLE 2 | Distribution of depression-related measures among quarantined individuals during the COVID-19 pandemic and the control group.

	Quarantinees during COVID 19 pandemic (*N* = 919)		Control group (*N* = 919)		χ^2 or *t*-value	*P*-value
PHQ score		(4.30)	2.29	(3.257)	6.15	<0.0001
	3.38					
Major Depression[a], *N* (%)	72	(7.8%)	35	(3.8%)	747.56	<0.0001
Mild/Major Depression[b], *N* (%)	258	(28.1%)	154	(16.8%)	315.40	<0.0001
By sex					0.35	NS
Male	25	(5.3%)	14	(3.0%)		
Female	47	(10.4%)	21	(4.7%)		
By age					14.78	0.0001
19-40	48	(10.2%)	18	(3.9%)		
40-65	24	(5.6%)	17	(3.9%)		
65 and over	0	(0.0%)	0	(0.0%)		
By district					6.97	NS
Nowon-gu	23	(9.0%)	7	(2.7%)		
Sungbuk-gu	13	(4.7%)	12	(4.3%)		
Eunpyung-gu	13	(6.3%)	10	(4.9%)		
Yangcheon-gu	23	(12.8%)	6	(3.3%)		
By income level					45.00	<0.0001
Lowest	2	(7.7%)	10	(34.5%)		
Others	70	(7.8%)	25	(2.8%)		
By employment					6.27	NS
Wage worker	36	(6.3%)	9	(1.6%)		
Employer/Self-employed	5	(5.8%)	4	(3.5%)		
Economically inactive	28	(11.6%)	21	(8.8%)		
Others	3	(23.1%)	1	(8.3%)		
By education					21.28	<0.0001
High School	12	(7.7%)	19	(12.6%)		
Tertiary Education	60	(7.9%)	16	(2.1%)		
By marital status					15.68	<0.0001
Married	33	(6.3%)	11	(2.1%)		
Single	37	(10.2%)	14	(4.1%)		
Divorced/widowed	2	(5.6%)	10	(17.5%)		
By type of household					30.31	<0.0001
living alone	20	(14.0%)	9	(7.4%)		
others	52	(6.7%)	26	(3.3%)		
By Predisposing diseases						
Hypertension	3	(3.6%)	5	(5.7%)	55.35	<0.0001
Diabetes	2	(4.4%)	3	(7.9%)	61.49	<0.0001
By self-rated health					37.10	<0.0001
Good/very good	32	(7.6%)	1	(0.2%)		
Moderate/bad/very bad	40	(8.0%)	34	(6.7%)		

[a]*Major depression was defined as PHQ-9 score of 10 or above, representing moderate or severe levels of depressive symptoms.*
[b]*Mild/Major depression was defined as PHQ-9 score of 5 or above, representing mild, moderate, or severe levels of depressive symptoms.*

We also found other factors associated with depression, including sex, income, employment status, marital status, and self-rated health. For instance, women were more likely to have mild/major depression, defined as a PHQ-9 score of 5 or above, than men (OR = 1.37, 95% CI: 1.08, 1.75) after accounting for all other factors. Individuals in the lowest quartile of income were more likely to have mild/major depression (OR = 2.43, 95% CI: 1.33, 4.43) than those with higher incomes. Similarly, individuals with an economically inactive status were associated with a higher likelihood of having major depression, defined as a PHQ-9 score of 10 or above, than salaried workers (OR = 2.28, 95% CI: 1.42, 3.64). In addition, divorced/widowed individuals were more likely to have mild/major depression (OR = 1.79, 95% CI: 1.06, 3.01) than married individuals and those with

TABLE 3 | Association between quarantine during the COVID-19 pandemic and depression among the matched sample ($N = 1,838$).

Factors		Major depression[a]			Mild/major depression[b]		
		Odds ratio	95% confidence limits		Odds ratio	95% confidence limits	
Quarantine during pandemic	(Ref = Pre-pandemic)	2.28	1.49	3.51	2.03	1.61	2.56
Sex	(Ref = Male)	1.33	0.86	2.06	1.37	1.08	1.75
Age		0.99	0.97	1.01	0.98	0.97	0.99
Dwelling district	Nowon	1.29	0.73	2.28	0.86	0.63	1.16
(Ref = Seongbuk)	Eunpyeong	1.18	0.64	2.20	0.86	0.62	1.19
	Yangcheon	2.09	1.17	3.73	0.91	0.65	1.27
Income	(Ref = Middle or High)	2.38	1.07	5.28	2.43	1.33	4.43
Education level	(Ref = Tertiary)	1.61	0.98	2.65	1.34	0.98	1.81
Employment status	Employer/self-employed	1.32	0.62	2.82	1.15	0.78	1.71
(Ref = Salaried workers)	Economically inactive	2.28	1.42	3.64	1.18	0.89	1.55
	Others	4.16	1.29	13.40	1.85	0.78	4.38
Marital status	Single	1.18	0.66	2.12	0.98	0.71	1.35
(Ref = Married)	Divorced/widowed	1.92	0.85	4.31	1.79	1.06	3.01
Hypertension	Yes (Ref = No)	0.88	0.37	2.08	1.10	0.70	1.73
Diabetes	Yes (Ref = No)	1.10	0.39	3.11	1.10	0.62	1.96
Self-rated Health State	Moderate/bad/very bad (Ref = good/very good)	1.87	1.21	2.90	1.79	1.41	2.27
Family size		0.83	0.69	0.99	0.94	0.85	1.04

[a] *Major depression was defined as PHQ-9 score of 10 or above, representing moderate or severe levels of depressive symptoms.*
[b] *Mild/Major depression was defined as PHQ-9 score of 5 or above, representing mild, moderate, or severe levels of depressive symptoms.*

moderate or worse self-rated health were more likely to have major depression (OR = 1.87, 95% CI: 1.21, 2.90) than those with good or better self-rated health.

In terms of model fit, our primary model with major depression as a dependent variable, compared to our secondary model with mild/major depression as a dependent variable, generally showed more preferable range of Akaike information criterion (AIC, 818.18 for primary model vs. 1864.07 for secondary) and negative log-likelihoods values (−2*LogL, 83.52 for primary vs. 130.00 for secondary).

DISCUSSION

In the present study, we investigated whether self-quarantine during the COVID-19 pandemic was associated with an increased risk of depression among Korean adults. We used a propensity score matching method and found that individuals undergoing quarantine during the COVID-19 pandemic were more likely to have major and mild depression, as well as higher levels of depressive symptoms than those in the control group after accounting for relevant sociodemographic and health-related factors. To the best of our knowledge, this is the first study to document such associations among the Korean population.

Previous studies have demonstrated generally elevated levels of psychological distress in relation to the COVID-19 pandemic across the general population (2, 21–24) and among multiple subgroups, including individuals undergoing quarantine (3, 5), those infected with coronavirus (25, 26), and front-line healthcare workers (2, 24, 27), with some mixed findings (28, 29).

In terms of psychological distress during quarantine, a review study examining the mental health impacts of quarantine from previous infectious disease outbreaks (e.g., severe acute respiratory syndrome, Middle East respiratory syndrome-related coronavirus, Ebola virus, and H1N1) documented that quarantine has detrimental psychological impacts across multiple populations (4). In relation to the COVID-19 outbreak, Daly and colleagues used a nationwide study of Canadian adults conducted in March 2020, approximately 4 weeks after the early phase of the COVID-19 outbreak in Canada, and found that individuals who went through quarantine for any reason were more likely to have suicidal thoughts and intentional self-harm, as well as more unfavorable mental health status overall, than those who did not (7). The findings were more prominent among those quarantined due to the presence of COVID-19 symptoms or contact with someone who had COVID-19 symptoms, whereas the findings were less noticeable for those quarantined due to recent travel (7). Similarly, high levels of psychological distress (e.g., depressive/anxiety symptoms) have been reported among quarantined populations in China (3, 5), Ireland (8), and Italy (9).

More broadly, in terms of psychological distress among the general population, Ettman and colleagues examined the prevalence of depression measured using the PHQ-9 before and during the COVID-19 pandemic by using nationally representative samples of US adults and found that the prevalence was higher during the COVID-19 pandemic (March-April 2020) than before (2017–2018) for all categories of depression (mild/moderate/moderately severe/severe) (22). Similar findings have been reported for anxiety in the US

population (23). Pierce et al. revealed that the prevalence of clinically significant psychological distress symptoms, measured using the 12-item General Health Questionnaire (GHQ-12) was higher during the COVID-19 outbreak (April 2020) than before (2018–2019) among the UK general population, which was confirmed by the significant within-individual increase in GHQ-12 scores based on a nationally representative cohort study (30). Peng et al. demonstrated that, among 2,726 individuals aged 18–70 years who underwent 14 days of quarantine during the COVID-19 pandemic in Shenzhen City, China, the prevalence of depression was 6.2%; the association was more apparent among those who were younger, unmarried, and with lower levels of education (3). Studies have reported that the elevated psychological distress symptoms during the COVID-19 pandemics were more pronounced among women (vs. men), younger age groups (e.g., ≤40 vs. 40+ years), those with predisposing chronic physical/psychiatric conditions, those unemployed (vs. employed), and those who have greater exposure to media sources and social media (31, 32).

Moreover, Ma et al. found that, among 770 clinically stable patients with COVID-19 in China, more than 40% exhibited clinically relevant depression symptoms defined as having a PHQ-9 score ≥ 5, whereby the pattern was more pronounced among women (vs. men), those with family member(s) infected with COVID-19 (vs. those without), and those with severe COVID-19 infection (vs. mild/moderate infection) (26).

The findings of our study replicate and extend the prior literature linking quarantining and elevated psychological distress in the Korean population. Our findings are generally consistent with previous evidence showing more unfavorable mental health outcomes, including depression and anxiety, among individuals in North America (7), Asia (3, 5), and European countries (8, 9) quarantined due to the COVID-19 pandemic. More broadly, our findings align with previous literature documenting negative mental health outcomes during the COVID-19 pandemic among the general population (2, 21–24) and other subgroups, including individuals with suspected or laboratory-confirmed COVID-19 (25, 26) and healthcare workers (2, 24, 27). Consistent with previous studies, we also found that depression was more prevalent in women (vs. men), younger individuals (19–39 years vs. 40+), and those living alone (vs. not) during the COVID-19 quarantine.

Potential mechanisms linking COVID-19 quarantine and depression may include elevated levels of negative emotions, such as fear, concerns, frustration, and loneliness. Quarantining due to close contact with an infected individual may cause fear and concerns of infection (4, 7). Moreover, quarantining can lead to limited social relationships, physical activities, and elevated social isolation and loneliness. Insufficient provision of basic supplies and necessary information can also lead to increased psychological burden during quarantine (4, 7). Further prospective investigations are warranted to understand the mechanisms through which quarantine leads to negative psychological consequences.

Strengths and Limitations

The findings of our study should be interpreted in consideration of the following limitations. First, our study is susceptible to potential selection bias due to the online survey procedure, whereby elderly individuals under quarantine were less likely to participate in the SCS-Q, generally as a result of limited access to the online survey. Together with the fact that our survey was conducted in Seoul Metropolitan City, our findings may not be generalizable to the general Korean population. The control group was selected from participants of the 2019 KCHS before the COVID-19 pandemic. Therefore, the observed association between quarantine during the COVID-19 pandemic and depression may reflect the potentially negative psychological impacts of the COVID-19 pandemic, as well as the impacts of quarantine. However, we were not able to decompose such impacts, warranting further investigation.

Nevertheless, our study has several strengths. Despite the increasing number of individuals who experienced quarantine during the COVID-19 pandemic, to the best of our knowledge, there has been limited evidence regarding the impacts of quarantine on mental health among Koreans. We used a propensity score matching method, through which individuals undergoing quarantine were compared to those who did not experience quarantine but had similar characteristics in terms of sociodemographics and health conditions.

CONCLUSIONS

The findings of our study replicate and extend the findings of previous studies linking quarantine and depression in Korean populations. Our findings suggest that Korean adults who underwent self-quarantine during the COVID-19 pandemic may be at higher risk of developing depression regardless of age, sex, socioeconomic status, living arrangements, and health conditions. Our findings indicate that effective strategies should be developed to prevent and address the psychiatric burden among individuals undergoing quarantine. Specifically, recent studies have emphasized the urgent needs to develop and implement sufficient training and supportive resources to address negative psychological outcomes among quarantine hotel workers during the pandemic (33–35). Similarly, effective quarantine strategies for the general population would benefit from developing and disseminating an innovative virtual platform through which educational programs, coping and counseling sessions, and peer-group support communities can be provided to those undergoing quarantine during the pandemic.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Institutional Review Board of Seoul Metropolitan City approved our study (IRB No. 2020-10-0001). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HYK formulated the research question, designed the study, conducted the analysis, and interpreted the results. YK drafted the manuscript. HYK, SL, and CBK reviewed and revised the manuscript. All authors contributed to the acquisition of data, approved the final version of the manuscript, and consented to its publication.

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Associations of Depressive Symptoms, COVID-19-Related Stressors, and Coping Strategies. A Comparison Between Cities and Towns in Germany

Caroline Meyer[1*†], *Rayan El-Haj-Mohamad*[1,2†], *Nadine Stammel*[1,2], *Annett Lotzin*[3], *Ingo Schäfer*[3], *Christine Knaevelsrud*[1] *and Maria Böttche*[1,2]

[1] Department of Clinical Psychological Intervention, Freie Universität Berlin, Berlin, Germany, [2] Research Department, Center ÜBERLEBEN, Berlin, Germany, [3] Department of Psychiatry and Psychotherapy, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

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***Correspondence:**
Caroline Meyer
caroline.meyer@fu-berlin.de

[†]These authors have contributed equally to this work and share first authorship

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Background: The COVID-19 pandemic has led to a wide range of stressors related to depressive symptoms. Prevention measures like physical distancing have burdened the general population, especially in highly urbanized areas. However, little is known about the associations between pandemic-related stressors, coping strategies, and depressive symptoms in highly urbanized vs. less urbanized environments.

Methods: Participants were recruited in a cross-sectional online survey in Germany. Propensity score matching yielded a matched sample of city ($n = 453$) and town ($n = 453$) inhabitants. Depressive symptoms, COVID-19-related stressors, and coping strategies were compared between cities and towns. Multiple regression analysis was performed to determine associations between pandemic-related stressors and depressive symptoms for the two groups separately.

Results: City inhabitants showed significantly higher depression scores than town inhabitants ($t = 2.11$, df $= 897.95$, $p = 0.035$). Seven coping strategies were more often used by the city sample. Depressive symptoms were associated with "restricted physical social contact" and "difficult housing conditions" (adjusted $R^2 = 0.19$, $F_{[9,443]} = 12.52$, $p < 0.001$) in city inhabitants, and with "fear of infection" and "difficult housing conditions" (adjusted $R^2 = 0.20$, $F_{[9,443]} = 13.50$, $p < 0.001$) in town inhabitants.

Limitations: The data were collected at the end of the first wave and represent a snapshot without causal inferences. Pandemic-related stressors were measured with a newly developed scale.

Conclusion: Depressive symptoms, perceived stressors, and approach/avoidance coping strategies differed between city vs. town inhabitants. These differences should be considered in policy-making and mental health care.

Keywords: coronavirus, depression, restrictions, level of urbanization, pandemic stressors, mental health

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has affected the lives of hundreds of millions of people worldwide, changing their ways of living, working, and interacting with others. According to the latest figures provided by the World Health Organization (1), over 218 million people across the world have been infected and over 4.5 million people have died (1). To contain the spread of COVID-19, governments around the world have taken various non-pharmaceutical measures, including those that restrict physical social contact and movement. During the first wave of COVID-19 in Germany (02/2020 to 05/2020), these measures included contact restrictions (e.g., restricted personal contact), work-related restrictions (e.g., closure of shops and restaurants, working from home), restrictions in daily activity (e.g., reduced leisure activities), closure of educational institutions (e.g., schools, universities, and kindergartens), and border closures (2). These preventive measures have resulted in massive disruptions in economic systems and in people's personal lives, leading, among other problems, to job loss or reduced income (3). As a result of the variety of stressors caused by the pandemic and by preventive measures to contain the spread of infection, people have been confronted with a wide range of known risk factors for mental health problems, thus amplifying major mental health problems, and specifically depressive symptoms, worldwide (4–7). An increase in depressive and anxiety symptoms, as well as distress due to the pandemic, has also been reported in Germany (8, 9). As the virus spreads primarily through direct contact or airborne via droplets and aerosols, it spreads more easily in urbanized areas with a high population density (10). In general, people living in highly urbanized areas of high-income countries are more vulnerable to mental health problems than those living in less urbanized areas (11). Accordingly, the pandemic's impact on mental health has been found to be greater in highly urbanized and thus densely populated areas (12, 13). In a representative sample in Germany, a higher degree of urbanization was strongly associated with higher rates of mood disorders (14, 15). Moreover, studies have found that high population density, noise pollution, and light pollution in areas with a high degree of urbanization are responsible for higher levels of stress and consequently higher levels of affective disorders (16, 17). However, recent research has identified social stress, and specifically social isolation, as the most important risk factor for inhabitants of highly urbanized areas (18). During the pandemic, the long-term reduction of physical social contact, i.e., the social isolation, seems to have been associated with feelings of loneliness and disconnect from daily routine, leading to an increase in depressive and anxiety symptoms (19, 20). On the other hand, living in highly urbanized areas is not only a risk factor for inhabitant's mental health but also offers several advantages that can mitigate stressors due to the higher degree of urbanization. For instance, cities can provide better educational and professional opportunities, infrastructure, cultural opportunities, and health care (17, 21). However, many of these advantages and protective factors are no longer applicable due to the COVID-19 restrictions. In particular, measures to counteract social isolation were strongly restricted during lockdown, including cultural activities, social meeting points, public spaces and parks, restaurants or cafés, and other areas that enable and encourage social encounters (21).

Since many of the protective factors of life in cities are not present during the ongoing pandemic, it is additionally important to assess situational coping strategies that might buffer the pandemic-related stressors and might have an impact in terms of exacerbating or mitigating mental health problems [e.g. association between coping strategies and depression in older adults, (22)]. The most widely used measure to assess situational coping strategies is the Brief COPE (23, 24). According to a recent review (25), the most frequently used two-factor model classifies coping strategies into approach-related coping strategies, in which the individual actively approaches the stressor (e.g., active coping, acceptance), and avoidance-related coping strategies, in which the individual attempts to ignore the stressor or avoid its impacts (e.g., self-distraction, self-blame). Several studies have demonstrated an association between coping strategies and depressive symptoms during the pandemic. For instance, it was shown that approach-related coping strategies like positive reframing or active coping tend to be associated with lower levels of depressive symptoms (26–28). By contrast, avoidance-related coping strategies, such as self-distraction, behavioral disengagement, and self-blame, seem to be significantly associated with a higher degree of depressive symptoms (26–28). During the pandemic, the most frequently employed coping strategy is that of "acceptance" (27–29). Overall, the non-pharmaceutical measures that were implemented to control the number of infections during the first wave in Germany amplified the risk factors for depressive symptoms that are especially relevant in highly urbanized populations, such as social isolation, while simultaneously limiting the utilization of protective factors. Given the higher psychological burden in more urbanized areas and the restricted protective factors during the pandemic, a better understanding of pandemic-related stressors and protective factors such as coping strategies is needed. To develop adequate mental health response plans, it is crucial to understand the psychological consequences in areas with different population density and respective beneficial coping strategies. Therefore, the aim of this study was to compare the association of COVID-19-related stressors with depressive symptoms and coping mechanisms in relation to the level of urbanization in a German sample. In Germany, the majority of people (85%) live in urbanized areas such as towns (more than 5,000 inhabitants) or cities (more than 100,000 inhabitants). Due to Germany's high overall level of urbanization, living and working conditions in rural and suburban areas are strongly dependent on the infrastructure of the surrounding towns or cities, and the actual level of urbanization is therefore difficult to determine in suburbs and in rural areas. To minimize this heterogeneity, the present study focuses only on urban populations, with a town's population representing a moderate level of urbanization and population density and a city's population representing a high level of urbanization and population density.

In accordance with previous findings in the literature, the hypotheses of the study were threefold. First, we expected to find

higher levels of depressive symptoms in the highly urbanized areas (city sample) compared to the moderately urbanized areas (town sample) during the COVID-19 pandemic. Second, we expected pandemic-related stressors (e.g., restricted physical social contact, problems with childcare, restricted access to resources) to show a differential association with depressive symptoms between the two samples. Third, we expected coping strategies to differ between the city and the town sample as a possible result of different levels of depressive symptoms.

METHODS

Design and Sample

The cross-sectional study was part of a pan-European longitudinal study on psychopathology, pandemic-related stressors, and coping during the COVID-19 pandemic [30, study registry: https://doi.org/10.17605/OSF.IO/8XHYG]. An online survey was used to collect data from the general population in Germany between June and September 2020. Ethical approval was obtained from the Local Psychological Ethics Committee at the Center for Psychosocial Medicine (LPEK) at the University Medical Center Hamburg-Eppendorf (LPEK-0149).

Eligibility criteria included (1) minimum age of 18 years and (2) ability to understand and write in German. Prior to participation, all participants were informed about the aim of the study and provided informed consent. The link for the survey was sent via various networks to increase variability of the sample (e.g., social media, professional organizations, leisure and sports clubs). Participants received no compensation.

Measures

In addition to the primary and secondary outcome measures, sociodemographic variables were assessed, including propensity characteristics (i.e., age, gender, COVID-19 infection, migration background, refugee background, general health status, partnership, number of children, household income, education) as well as the main variable for matching, i.e., self-reported residential area (city, suburb, town, rural area).

Depressive Symptoms

The Brief Patient Health Questionnaire (PHQ-9) assesses depressive symptoms during the last two weeks with nine items (30) rated on a 4-point Likert scale (0 = "not at all" to 3 = "nearly every day"). The overall score ranges from 0 to 27, with higher scores indicating more depressive symptoms. The measure has been validated in several populations (31, 32) and has shown excellent reliability ($\alpha = 0.86$ to 0.91). The German version of the PHQ-9 is likewise well validated (32).

Pandemic Stressor Scale

The Pandemic Stressor Scale (33) assesses the perceived burden of COVID-19-related stressors during the last month with 30 items. Each item is rated on a 4-point Likert scale (0 = not at all burdened to 3 = strongly burdened), with an additional category "does not apply to me."

The items are based on recently published research examining the burden of the COVID-19 pandemic. An exploratory factor analysis of a German sample yielded a nine-factor solution, which was cross-validated by a confirmatory factor analysis using the data of an Austrian sample of the ADJUST study (33).

Overall, nine COVID-19-related stressors, each containing up to five items, were identified: "Restricted physical social contact," "Problems with childcare," "Work-related problems," "Fear of infection," "Burden of infection," "Restricted activity," "Crisis management and communication," "Restricted access to resources," and "Difficult housing conditions." Subscale scores were computed by calculating the average of the scores of the respective items. Before calculating the subscores, the category "Does not apply to me" was recoded into 0 ("Not at all burdened"). For details, see **Appendix A**.

Coping

The Brief COPE Inventory (23) is the short version of the COPE scale (34) and measures coping strategies on 14 two-item scales, with items rated on a 4-point Likert scale (1 = I haven't been doing this at all to 4 = I've been doing this a lot). The Brief COPE assesses situational coping responses to a specific stressor. In the current study, the COVID-19 pandemic was named as the specific stressor. According to Solberg et al. (25), the subscales of the Brief COPE are mostly categorized into two types of coping: approach coping styles (Use of emotional support, Use of instrumental support, Positive reframing, Acceptance, Active coping, Planning) and avoidance coping styles (Self-distraction, Denial, Substance use, Behavioral disengagement, Venting, Self-blame). The subscales humor and religion are not integrated in this dichotomy.

Statistical Analyses

First, propensity score matching was performed to reduce the risk of selection bias due to different group sizes, but mainly to control for various confounding variables arising from the convenience sampling (i.e., non-randomized assignment of the two groups). The potential confounding variables used in the propensity score matching included age, gender, previous COVID-19 infection, migration status (own or parental migration), refugee status, subjective physical health status, partnership, having children, household income, and level of education. For propensity score matching on the groups of towns and cities, we used 1:1 matching on propensity scores with nearest neighbor matching without replacement, which is the most common form of matching (35, 36). To evaluate the balance of covariates, standardized mean differences (SMD) and level of significance were assessed before and after matching using t-tests for metric variables and X^2 or Fisher's exact tests for categorical variables. An SMD of 0.1 or less indicates a negligible difference between two groups (37). A t-test was used to examine whether the groups differed with respect to the primary outcome of depressive symptoms.

Multiple regression analysis was performed separately for the city sample and the town sample to determine associations between pandemic-related stressors and depressive symptoms in each group. Finally, t-test analyses were conducted to determine whether the groups used different coping strategies.

Complete case analysis was used, as recommended for propensity score matching when data is missing at random (38).

This method excludes all cases with missing data in the primary outcome or at least one of the covariates. All statistical analyses were performed using R4.0.2.

RESULTS

Baseline Characteristics Before and After Matching

In total, $N = 2{,}782$ participants from all 16 Federal states of Germany participated in the cross-sectional online survey. We excluded participants who were not living in Germany at the time of the study ($n = 30$) or did not complete the Patient Health Questionnaire-9 (PHQ-9, $n = 502$), as this was the main outcome for the study. Given the aim of the present study, we excluded an additional n = 452 participants who lived in suburbs ($n = 263$) or rural areas ($n = 189$). The final sample before propensity score matching consisted of $N = 1{,}798$ participants, 1,319 of whom lived in a city (73.4%). Baseline characteristics before and after matching are shown in **Table 1**. Before matching, there were significant differences between city and town participants in terms of age (participants in towns were older), being in a partnership (more people in towns were living in a partnership), having children (more people in towns reported having children), and educational level (higher educational level in cities). The standardized mean difference of potential covariates ranged from−0.201 to 0.385.

To evaluate the quality of our matched sample, we used both the *p*-value and the standardized mean difference as criteria. After propensity score matching, city and town samples did not differ substantially in all reported covariates (all $p > 0.05$, **Table 1**), and the standardized mean difference was within 0.1 (**Figure 1**). The matching process resulted in a total sample of $n = 906$ participants, with $n = 453$ in each group. In the matched sample, the age ranged from 18 to 78 years ($M = 41.6$, SD = 12.4) and the majority of participants were female ($n = 627$, 69.2%).

Depressive Symptoms and COVID-19-Related Stressors in Cities and Towns

For all subsequent analyses, only the matched sample was considered. The city sample reported significantly higher levels of depressive symptoms compared to the town sample ($t = 2.11$, df = 897.95, $p = 0.03$, **Table 2**).

Overall, people from cities and towns perceived similar COVID-19-related stressors. In total, the perceived stressors exerted low or moderate levels of burden in both samples (lowest

TABLE 1 | Covariates before and after propensity score matching.

	Before propensity score matching			After propensity score matching		
	City ***n* = 1319**	**Town** ***n* = 479**	***p***	**City** ***n* = 453**	**Town** ***n* = 453**	***p***
Age [M(SD)]	39.9 (12.4)	41.7 (12.5)	0.006**	41.5 (12.4)	41.73 (12.4)	0.750
Female (%)	930 (70.8)	342 (71.5)	0.795	305 (67.3)	322 (71.1)	0.250
COVID-19 infection (yes, %)	9 (0.7)	2 (0.4)	0.738	3 (0.7)	2 (0.4)	1
Migration (yes, %)	193 (14.6)	74 (15.4)	0.690	75 (16.6)	70 (15.5)	0.717
Refugee (yes, %)	7 (0.5)	1 (0.2)	0.613	0 (0.0)	0 (0.0)	-
Health status (%)			0.128			0.391
Very good	474 (35.9)	151 (31.5)		153 (33.8)	142 (31.3)	
Good	570 (43.2)	240 (50.1)		203 (44.8)	231 (51.0)	
Satisfactory	219 (16.6)	73 (15.2)		79 (17.4)	65 (14.3)	
Poor	50 (3.8)	14 (2.9)		16 (3.5)	14 (3.1)	
Very poor	6 (0.5)	1 (0.2)		2 (0.4)	1 (0.2)	
Partnership (yes, %)	903 (68.5)	367 (76.6)	<0.001***	343 (75.7)	350 (77.3)	0.638
Children (yes, %)	482 (36.5)	264 (55.1)	<0.001***	248 (54.7)	252 (55.6)	0.841
Household income (%)			0.110			0.964
Very low income	49 (3.8)	22 (4.8)		19 (4.2)	22 (4.9)	
Low income	96 (7.5)	22 (4.8)		25 (5.5)	22 (4.9)	
Medium income	543 (42.6)	180 (39.6)		186 (41.1)	180 (39.7)	
High income	375 (29.4)	139 (30.6)		135 (29.8)	138 (30.5)	
Very high income	211 (16.6)	91 (20.0)		88 (19.4)	91 (20.1)	
Education (%)			<0.001***			0.738
<10 years schooling	4 (0.3)	0 (0.0)		0 (0.0)	0 (0.0)	
≥10 years schooling	166 (12.6)	65 (13.6)		68 (15.0)	60 (13.2)	
Vocational studies	382 (29.0)	202 (42.2)		188 (41.5)	189 (41.7)	
Completed studies	767 (58.2)	212 (44.3)		197 (43.5)	204 (45.0)	

*Fisher's exact test was performed for the variables COVID-19 infection, refugee, health status, and education. Pearson's χ^2 test was performed for gender, migration, partnership, children, and income. T-test was performed for age. **p < 0.01, ***p < 0.001.*

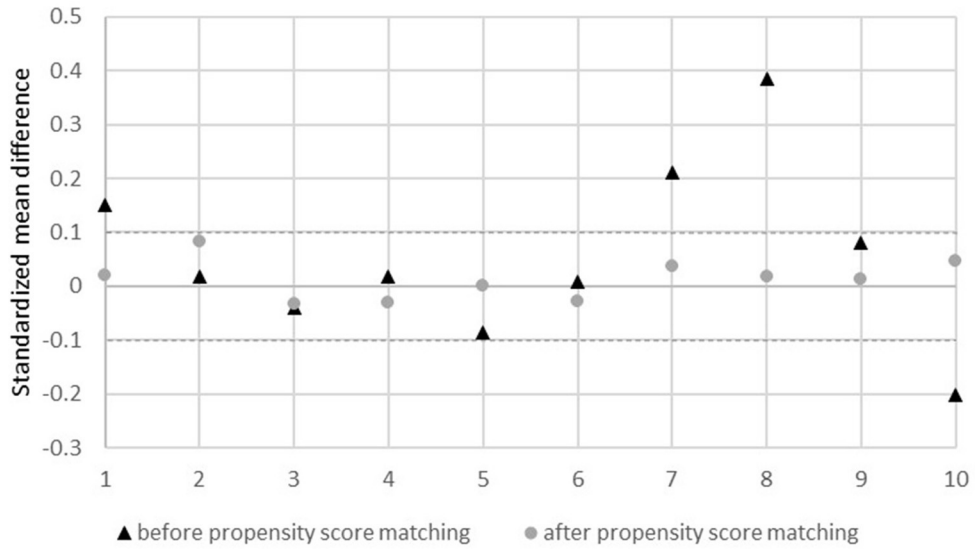

FIGURE 1 | Standardized mean difference before and after propensity score matching. 1, age; 2, sex; 3, infection yes/no; 4, migration yes/no; 5, refugee yes/no; 6, health status; 7, partner yes/no; 8, children yes/no; 9, income; 10, educational level.

TABLE 2 | Depressive symptoms measured by the PHQ-9 and stressors measured by the Pandemic Stressor Scale after propensity score matching.

	City		Town		*p*	Cronbach's α
	n	M (SD)	*n*	M (SD)		
Depressive symptoms						
PHQ-9	453	6.68 (5.13)	453	5.99 (4.72)	0.035*	0.86
Pandemic Stressor Scale						
Fear of infection	453	1.59 (0.73)	453	1.60 (0.73)	0.724	0.73
Restricted activities	453	1.56 (0.80)	453	1.46 (0.84)	0.063	0.72
Restricted physical social contact	453	1.51 (0.87)	453	1.43 (0.84)	0.163	0.85
Crisis management and communication	453	0.99 (0.75)	453	1.12 (0.79)	0.013*	0.71
Difficult housing conditions	453	0.65 (0.77)	453	0.52 (0.70)	0.005**	0.75
Work-related problems	453	0.64 (0.85)	453	0.77 (0.85)	0.024*	0.86
Problems with childcare	453	0.61 (1.08)	453	0.56 (1.00)	0.416	0.92
Restricted access to resources	453	0.60 (0.68)	453	0.60 (0.60)	0.849	0.62
Burden of infection	453	0.59 (0.79)	453	0.67 (0.84)	0.162	0.76

*PHQ-9, Patient Health Questionnaire-9. Differences in mean values between the subsamples were tested by t-test. *$p < 0.05$, **$p < 0.01$.*

burden $M = 0.59$, "burden of infection" in cities; highest burden $M = 1.60$, "fear of infection" in towns; range from 0 to 3). The following stressors were perceived to be the most stressful in both samples: problems with fear of infection ($M = 1.59$ in cities, $M = 1.60$ in towns), restricted activities ($M = 1.56$ in cities, $M = 1.46$ in towns), and restricted physical contact ($M = 1.51$ in cities, $M = 1.43$ in towns). Nevertheless, there were three significant differences between the town and city inhabitants: Participants in towns were more stressed because of work-related problems and "crisis management and communication" compared to those in cities. At the same time, participants living in cities were significantly more stressed due to the "difficult housing conditions" (**Table 2**).

Associations Between COVID-19-Related Stressors and Depressive Symptoms in Cities and Towns

We conducted correlation analysis (**Appendices B,C**) and multiple regression analyses (**Table 3**) to examine the relationship between depressive symptoms and the pandemic stressor subscales for each sample separately. Correlates of depressive symptoms differed between the city and town samples (**Table 3**).

For the city sample, depressive symptoms were associated with "restricted physical social contact" and "difficult housing conditions" (adjusted $R^2 = 0.19$, $F_{[9,443]} = 12.52$, $p < 0.001$). For the town sample, depressive symptoms were associated with "fear

TABLE 3 | Regression analysis of stressor subscales on depressive symptoms for city sample and town sample after propensity score matching.

	City ($n = 453$)				Town ($n = 453$)			
	b	***β***	**SE**	***p***	***b***	***β***	**SE**	***p*-value**
Intercept	3.01		0.64	<0.001***	1.02		0.63	0.106
Restricted physical social contact	1.31	0.22	0.32	<0.001***	0.25	0.04	0.30	0.404
Problems with childcare	−0.43	−0.09	0.24	0.072	0.18	0.04	0.23	0.425
Work-related problems	0.20	0.03	0.27	0.463	0.13	0.02	0.25	0.583
Fear of infection	0.51	0.07	0.36	0.156	1.66	0.26	0.33	<0.001***
Burden of infection	−0.21	−0.03	0.30	0.490	−0.26	−0.05	0.27	0.325
Restricted activities	−0.59	−0.09	0.34	0.081	0.40	0.07	0.29	0.166
Crisis management and communication	0.59	0.09	0.33	0.073	0.41	0.07	0.30	0.167
Restricted access to resources	0.17	0.02	0.37	0.642	−0.05	−0.01	0.37	0.892
Difficult housing conditions	2.10	0.31	0.36	<0.001***	1.76	0.26	0.34	<0.001***
Adjusted R^2	0.19				0.20			

****p < 0.001.*

TABLE 4 | Coping strategies by subsamples after propensity score matching and results of group comparison between city sample and town sample.

	City $n = 453$ [M (SD)]	Town $n = 453$ [M (SD)]	*p*	Cronbach's α
Approach coping strategies				
Acceptance	**3.69 (1.69)**	**3.44 (1.71)**	**0.028***	**0.66**
Positive Reframing	**3.20 (1.88)**	**3.02 (1.81)**	**0.144**	**0.74**
Planning	3.17 (1.66)	3.03 (1.63)	0.218	0.53
Active Coping	2.92 (1.62)	2.55 (1.60)	<0.001***	0.60
Emotional Support	2.70 (1.72)	2.26 (1.68)	<0.001***	0.74
Instrumental Support	1.83 (1.59)	1.54 (1.56)	0.005**	0.82
Avoidance coping strategies				
Self-Distraction	**3.29 (1.63)**	**3.09 (1.59)**	**0.061**	**0.55**
Venting	1.95 (1.48)	1.74 (1.45)	0.028*	0.58
Behavioral Disengagement	1.03 (1.21)	0.91 (1.10)	0.115	0.32
Substance Use	0.81 (1.39)	0.51 (1.13)	<0.001***	0.92
Self-Blame	0.67 (1.24)	0.64 (1.22)	0.666	0.69
Denial	0.55 (1.09)	0.60 (1.07)	0.406	0.51
Humor	2.41 (1.72)	2.05 (1.60)	<0.001***	0.69
Religion	0.62 (1.29)	0.75 (1.43)	0.151	0.82

*Differences in mean values between the subsamples were tested by t-test; the three most frequently used coping strategies are printed in bold. *p < 0.05, **p < 0.01, ***p < 0.001.*

of infection" and "difficult housing conditions" (adjusted $R^2 = 0.20$, $F_{[9,443]} = 13.50$, $p < 0.001$).

Coping Strategies in Cities and Towns

When comparing coping strategies between the two samples, the city inhabitants reported a higher use of seven out of fourteen coping strategies compared to those from towns. Participants living in cities reported significantly higher values on approach coping strategies (active coping, instrumental support, acceptance, emotional support) but also on avoidance coping strategies (venting, substance use) as well as the strategy "humor." The most frequently used coping strategies in both samples were acceptance, self-distraction, and positive reframing (**Table 4**).

DISCUSSION

The current study examined differences and similarities in depressive symptoms, COVID-19-related stressors, and coping strategies in city and town inhabitants in Germany. Through the use of propensity score matching, we were able to control for systematic differences between the two groups that may have resulted from convenience sampling. This allowed us to estimate, for the first time, a more precise representation of city and town inhabitants regarding the above-mentioned variables and shows the importance of the matched factors, as they varied significantly before matching. We found higher levels depressive symptoms in the city sample compared to the town sample in the matched

samples, confirming previous results while controlling for several confounding factors. The relationship between pandemic related stressors and depressive symptoms differed between city and town inhabitants. Furthermore, city inhabitants reported a more frequent use of several coping strategies.

We found significantly higher levels of depressive symptoms in participants from cities compared to those from towns. Our results are in line with previous studies describing generally higher depressive symptoms in urban areas (11, 14). Moreover, they also correspond to recent studies that investigated populations in high-income countries during the pandemic and found a link between higher levels of urbanization and higher levels of mental distress (39, 40). This seems to reflect the effect of the non-pharmaceutical lockdown measures that were implemented to control the number of infections during the first wave of COVID-19 in Germany, which focused on contact restrictions and especially restricted time spent in public places both outdoors and indoors (2). These measures therefore amplified social isolation, being one of the main risk factors for depressive symptoms in city inhabitants (18). In accordance with this, the stressor "restricted physical social contact" was perceived as one of the most burdensome pandemic-related stressors by the city inhabitants. It was also strongly associated with depressive symptoms in the city sample but not in the town sample, indicating a potentially stronger impact of contact restrictions on depressive symptoms in more densely populated areas, though our cross-sectional design does not allow for causal inferences. At the same time, most of the benefits of living in cities (e.g., cultural activities, social meeting points) were eliminated due to the pandemic-specific restrictions. In contrast, access to outdoor spaces and a view of nature were found to be protective factors during the pandemic and are related to reduced levels of depressive and anxiety symptoms, especially under strict lockdown conditions (41). Both of these natural "buffers" are less available in cities.

Our study also aimed at a more differentiated understanding of possible factors influencing depressive symptoms in both cities and towns. Concerning stressors and coping strategies, we found both similarities and substantial differences. The findings on pandemic-specific stressors illustrate the extent to which the inhabitants of cities and towns felt stressed in various areas of everyday life and leisure during the pandemic. In the present study, only three significant differences emerged ("work-related problems" and "crisis management and communication" were higher in towns, "difficulties in housing conditions" were higher in cities), while the majority of pandemic-related stressors were perceived as equally burdensome in cities and towns. For both groups, the stressors perceived as the most burdensome were "fear of infection," "restricted activities," and "restricted physical social contact." Studies have shown that infection-related stressors, i.e., fear of infecting others and loved ones, are perceived as highly stressful during the pandemic (42) due to the fact that the virus is life-threatening for people in high-risk groups [e.g., elderly, people with lung or heart diseases, (43)]. Furthermore, fear can also be explained by a lack of knowledge and by the unfamiliar and unpredictable new reality (44). The higher perceived stress with regard to restrictions of activities and physical social contacts appears to be self-evident due to the overall reported benefits of physical activity and social contacts (45).

"Work-related problems" as well as "crisis management and communication" were perceived as significantly more burdensome in towns. It is possible that people in cities can adapt more easily to crises due to a better infrastructure. This might, for example, include digitalization, better job opportunities in the case of job loss, better health care, and more services that offer support (46). These infrastructure advantages in cities could therefore mitigate the association between the aforementioned stressors and depressive symptoms. Previous research has already indicated an impact of media coverage on fears relating to COVID-19 (42). Garfin et al. (47) recommend using trustworthy and informative media and avoiding repetitive exposure to media with little new information. Especially in times of lack of knowledge, this is of high importance and could buffer the stressor "crisis management and communication." In cities, "difficult housing conditions" were perceived as significantly more stressful. One explanation could be that the limited options in cities (e.g., small apartments, fewer social alternatives to seeing friends or family members, limited public spaces) were perceived as more burdensome.

The relationship between pandemic-related stressors and the severity of depressive symptoms illustrates that "difficult housing conditions" are associated with depressive symptoms in both samples. This is in line with previous findings suggesting that poor housing conditions, and especially limited space, are related to higher levels of depressive symptoms (48). In cities, the "restricted physical social contacts" were also significantly related to depressive symptoms. COVID-19 measures resulted in limited to no social contact over several months. As mentioned above, it can be assumed that these measures, especially in cities, aggravated a trend that has been found in previous studies. As previous findings show, people have begun to feel lonely during the pandemic, which is strongly correlated with depressive symptoms (19, 20). In towns, "fear of infection" was significantly related to severity of depressive symptoms. Due to a lesser social anonymity in towns, a potential fear of stigmatization as a result of an infection could explain this additional significant finding (49).

With regard to coping strategies, it was found that city inhabitants use seven of the examined 14 coping strategies significantly more often compared to town inhabitants (approach-related strategies i.e., active coping, acceptance, emotional and instrumental support; avoidance-related coping strategies, i.e., venting, substance use as well as the coping strategy "humor"). There were no significant differences in the other seven strategies. Recent studies have shown that "active coping," "venting," and "substance use" in particular are associated with depressive symptoms due to the pandemic (27). One explanation for why city inhabitants, on average, use more often strategies to cope with the pandemic could lie in the fact that depressive symptoms are higher in cities than in the towns, meaning that there is a greater need to use these strategies. However, research has shown that more frequent use of positive coping strategies might not be predictive of better positive adjustment over time (50). At this point, it is also important to mention that the rank order of the frequency of coping

strategies used is the same in cities and towns. In both samples, "acceptance," "positive reframing," and "self-distraction" are used most frequently. This is in line with previous studies that also found "acceptance" and "self-distraction" to be among the most frequently used strategies during the pandemic (27–29). In a recent study, the coping strategy of "positive reframing" was the most beneficial in coping with depressive symptoms (27).

In our study, we found significant relationships between situational stressors and depressive symptoms even at an early stage of the pandemic. Presumably, these effects have intensified further over the course of the pandemic. The ongoing dilemma of lockdown and reopening has several implications, and the present findings emphasize that the level of urbanization has an impact on depressive symptoms as well as perceived COVID-19-related stressors.

LIMITATIONS

The study findings should be interpreted in the light of several limitations. First, the data were collected in the period of June 2020 to September 2020. This period was at the end of the first wave of the pandemic, when infection rates were low and relatively few restrictions were in place in Germany. Second, as the data were cross-sectional, they represent a momentary snapshot of the situation without providing any information about the time course. Also, no statements can be made about representativeness as the sample was circumstantial and purposeful and the rate of return is unknown. However, different recruitment strategies were applied to increase the variability of the sample (e.g., social media, interest groups, companies). Third, pandemic-specific restrictions were measured using a newly developed instrument (33). Fourth, some of the subscales of the Brief COPE showed questionable or poor reliability scores in our study (Cronbach's Alpha: 0.53–0.92). This has also been reported in other studies (51, 52) and seems to be a general problem of the questionnaire, which is also reflected in the inconsistent factor structure of the Brief COPE (53). Fifth, although the propensity score matching has several advantages for examining the hypotheses and ensured comparability of our samples, the current dataset does not contain all participants and the representativeness of the two subsamples may have been altered especially in the city sample.

CONCLUSION

Characteristics regarding depressive symptoms and coping strategies as well as the impact of pandemic-related stressors in cities and towns should be considered when addressing psychosocial support for vulnerable groups during and after the pandemic. Policy makers need to be aware of the special risks and needs in urban populations and should carefully evaluate the COVID-19-related measures taken in view of mental health costs and benefits. It seems to be important to investigate implications for different life circumstances and also to detect specific characteristics due to the level of urbanization. Future studies should therefore apply standardized measures of urbanization, e.g., by including population figures or other objective measures. Specifically, it becomes clear that restricted activities and physical social contact as well as housing conditions seem to be most burdensome in urban inhabitants. These stressors should receive special attention, both to better identify vulnerable people and to make future restrictions less stressful.

Long-term effects of the restrictions on mental health must be closely monitored, and mental health care offers need to be adapted to increased needs as early as possible.

This could be addressed in an easy and cost-effective manner by implementing low-threshold (online) interventions with instructions for self-help and self-care. In addition, longitudinal studies will be needed to differentiate between functional and dysfunctional coping strategies during and after the pandemic and to determine their effect on depressive symptoms. It is important to learn from this exceptional situation, to be able to give advice to vulnerable populations for the current situation and for potentially similar situations in the future.

DATA AVAILABILITY STATEMENT

The detailed sociodemographic information of the dataset does not fully protect the anonymity of the respondents. For this reason, the entire dataset cannot be made publicly available. However, excerpts of the data on a higher aggregation level can be provided upon justified request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Center for Psychosocial Medicine (LPEK) at the University Medical Center Hamburg-Eppendorf (LPEK-0149). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AL designed the study in cooperation with the project steering committee formed by the representatives of the ESTSS countries [see (54)]. AL, MB, and RE-H-M were responsible for the data collection in Germany. CM, RE-H-M, and MB carried out the statistical analyses and drafted the manuscript. AL, IS, NS, and CK carefully revised the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.791312/full#supplementary-material

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Impact of Long-Term Home Quarantine on Mental Health and Physical Activity of People in Shanghai During the COVID-19 Pandemic

Wentong Zhu[1†], *Doudou Xu*[2†], *Hui Li*[3†], *Gang Xu*[4], *Jingyan Tian*[5,6], *Luheng Lyu*[7], *Naifu Wan*[1], *Lijiang Wei*[1], *Wuwei Rong*[1], *Chenchen Liu*[1], *Beiwen Wu*[2*], *Xiaolan Bian*[3*] and *Ankang Lyu*[1*]

[1] Department of Cardiovascular Medicine, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [2] Department of Nursing, School of Medicine, Ruijin Hospital, Shanghai Jiao Tong University, Shanghai, China, [3] Department of Pharmacy, School of Medicine, Ruijin Hospital, Shanghai Jiaotong University, Shanghai, China, [4] School of Public Health, School of Medicine, Shanghai Jiao Tong University, Shanghai, China, [5] Department of Endocrine and Metabolic Diseases, Shanghai Institute of Endocrine and Metabolic Diseases, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [6] Shanghai National Clinical Research Center for Metabolic Diseases, Key Laboratory for Endocrine and Metabolic Diseases of the National Health Commission of the PR China, Shanghai Key Laboratory for Endocrine Tumor, State Key Laboratory of Medical Genomics, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [7] Department of Biochemistry and Molecular Biology, Miller School of Medicine, University of Miami, Miami, FL, United States

This study aimed to investigate the effects of long-term home quarantine on the mental health of people during the COVID-19 epidemic in Shanghai. We conducted an online questionnaire survey on March 26 2020 and collected data on demographics, level of physical activity (PA), and mental health status of the participants. We assessed the mental health status using the Patient Health Questionnaire (PHQ-9) and Generalized Anxiety Disorder Scale (GAD-7), whereas PA was assessed using International Physical Activity Questionnaire Short Form (IPAQ-SF). Of all 2,409 valid samples, participants reported performing a total of 2015.20 metabolic equivalent of task (MET)-minutes/week of total PA before the outbreak period and 1720.29 MET-minutes/week of total PA during the outbreak period ($p < 0.001$). Participants who spent a longer time at home reported to have a better performance on the PHQ-9 ($p = 0.087$) and GAD-7 ($p < 0.001$). A high level of PA was considered an protective factor against depression (OR = 0.755, 95% CI 0.603–0.944, $p < 0.001$). Additionally, a high level of PA had a preventative effect on anxiety (OR = 0.741, 95% CI 0.568–0.967, $p < 0.001$), and a longer working period during the outbreak was shown to be a risk factor for anxiety (11–29 days, OR 1.455, 95% CI 1.110–1.909; 30–60 days OR 1.619, 95% CI 1.227–2.316). Home confinement during the pandemic might not have a negative effect on mental health provided that people engage in more PA indoors. This study encourages interventions for mental health problems through physical exercise.

Keywords: COVID-19, home quarantine, mental health, physical activity, well-being

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Edited by:
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New York University, United States

****Correspondence:***
Ankang Lyu
lvankangrj@163.com
Xiaolan Bian
bxl40338@rjh.com.cn
Beiwen Wu
Gaoan2005new@163.com

[†]These authors have contributed equally to this work and share first authorship

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INTRODUCTION

The Coronavirus Disease 2019 (COVID-19) outbreak started in Wuhan, China in late 2019 and rapidly spread worldwide, resulting in over 140 million infections and 3 million deaths (1) as of April 20, 2021. Mandatory restriction of movement is commonly used to restrain the transmission of infectious diseases, especially respiratory diseases such as the 2003 SARS, MERS, and H1N1 (2). About a year ago, most of China, including Shanghai, adopted strict quarantine measures to control the pandemic. For example, Shanghai launched a Level 1 public health emergency response (3) on January 25, 2020. Facemasks were mandatory in public places, while mandatory temperature screenings were introduced at public places such as hospitals, tourist sites, and commercial centers. Any event that could possibly attract large crowds was banned or delayed. And a large proportion of the population switched to working from home.

China was the first country to bear the brunt of the COVID-19 pandemic, and also one of the first to resume social tranquility. Several studies have focused on psychological health among different groups of people in China. A Chinese survey showed that during the beginning stage of the pandemic, about a third of respondents from the general population suffered from moderate to severe anxiety (4). The burden of psychological stressors on healthcare workers during the epidemic was also a concern (5, 6). Wang et al. conducted a study on the prevalence and associated factors of psychological disorders of the COVID-19 epidemic in China (7, 8). Studies in other countries have also investigated the psychological impact of the COVID-19 pandemic on the general population (9–11) and students (12–16). The results of these studies confirmed that the pandemic had a severe psychological impact on people.

The current study mainly aims to investigate how a change in lifestyle affected mental health during the outbreak period. In this study, we define the 60-day Level 1 public health emergency response declared by Shanghai between January 24 and March 24 as the outbreak period. During the outbreak period, people spent most of their time being quarantined at home, which may increase mental health issues. Mental stressors may include changes in employment, reduced levels of physical activity (PA), a change in working environment, being unable to leave the house and interacting with the outside world, economic adversity due to loss of income, and fear of the COVID-19 pandemic.

The efficacy of exercise as a treatment approach for depression has been demonstrated in several studies. Previous studies have clarified dysregulated pathways as major factors in depression, which include neurotransmitter imbalances, dysregulated inflammatory pathways, HPA disturbances, neuroprogression, increased oxidative stress, and mitochondrial disturbances (17–23). Physical exercise can relieve depression by affecting the pathways mentioned above (24). Moreover, PA has been mentioned as a potential treatment for anxiety (25, 26). In the current study, we focused on how home confinement affects the mental health of workers and its relationship with PA.

As of November 12th 2021, a total of more than 7.1 billion vaccine doses have been administered globally, meanwhile, over 3 million newly confirmed cases were reported in the last 7 days (27). The data revealed vaccination alone is not almighty to beat COVID-19. Other prevention measurements including wearing face masks, keeping social distance and isolation are as crucial. Nie et al. (28). identified long-term home quarantine as one of major factors affecting mental health of Chinese residents and physical exercise was associated with improvement of mental health burden. Faulkner et al. (29). demonstrated that a negative change in exercise behavior during the COVID-19 restrictions was associated with poorer mental health of adults in the UK, Ireland, New Zealand and Australia. The strength of this study is that we provide a novel perspective for people under quarantine, that indoor and outdoor physical exercise is recommended and necessary to improve mental health status. In our study, time duration of home confinement is a key element. During the 60-day outbreak period, working from home became common. On the basis of days at work during the outbreak, we divided the participants into three groups (**Table 1**). We assumed people who spent different time on home confinement would perform differently on mental health and PA status.

TABLE 1 | Demographic characteristics of the participant population, $n = 2{,}409$ (n, %).

Age (y)	**37.7 ± 9.1**	**Gender**	
≤30	599 (24.9)	Male	955 (39.6)
31–40	933 (38.7)	Female	1,454 (60.4)
>40	877 (36.4)	**Education**	
Days at work during the outbreak Period (d)	20.5 ± 16.8	High school	214 (8.9)
≤10	853 (35.4)	Vocational	320 (13.3)
11–29	715 (29.7)	Undergraduate	1,579 (65.5)
30–60	841(34.9)	Graduate	296 (12.3)
Weight change	0.8 ± 2.0	**History of chronic diseases**	
N/A	365 (15.2)	Yes	346 (14.4)
weight unchanged	1,479 (61.4)	No	2,063 (85.6)
weight gained	795 (33)		
weight lost	135 (5.6)		

METHODS

Study Population

Employed individuals who underwent routine health checkups at Ruijin Hospital were recruited to complete an online questionnaire. A total of 2,580 participants completed the questionnaire, which yielded 2409 samples after data validation.

Data Collection

A standard questionnaire was designed to obtain participants' demographic information, the number of days they were working during the COVID-19 pandemic (in Shanghai), change in body weight, physical activity intensity, chronic disease history (hypertension, diabetes, coronary artery disease, thrombosis disease, chronic respiratory disease, pulmonary hypertension, liver cirrhosis, chronic kidney disease, chronic gastritis, tumor,

TABLE 2 | IPAQ-SF responses before and during the outbreak.

		During the outbreak	Before the outbreak	Δ(%)	*p* Value
All PA	MET values	1,720.29 ± 1,813.79	2,015.20 ± 2,100.60	294.91(17.1)	<0.001
Vigorous–intensity activities	Days/week	1.09 ± 1.80	1.26 ± 1.86	0.17 (15.6)	<0.001
	min/week	20.70 ± 32.20	24.30 ± 24.64	3.60 (17.4)	<0.001
	MET values	463.93 ± 1,016.53	543.85 ± 1,020.04	79.92 (17.2)	0.006
Moderate–intensity activities	Days/week	2.74 ± 2.64	2.77 ± 2.61	0.03 (1.1)	0.629
	min/week	45.43 ± 47.29	44.90 ± 45.15	0.53 (1.2)	0.692
	MET values	750.93 ± 1,098.53	714.50 ± 1,005.96	36.43 (5.1)	0.230
Walking	Days/week	2.87 ± 2.57	3.96 ± 2.59	1.09 (38.0)	<0.001
	min/week	38.85 ± 39.05	47.96 ± 41.80	9.11 (23.4)	<0.001
	MET values	505.43 ± 684.32	756.84 ± 816.94	251.41 (49.7)	<0.001
Sitting	Hours/day	6.13 ± 3.20	5.66 ± 3.15	0.47 (8.2)	<0.001

etc.), and the state of their mental health (depression and anxiety index).

Survey Questionnaires

With regard to data privacy and consent for participation, a consent file was obtained prior to completing the questionnaire. Before completing the survey, participants were made aware of their participation in this study. The survey was not anonymous. However, all data collected would only be used for research purposes.

Our team designed an online survey to assess changes in health during the COVID-19 outbreak. In our final survey, we included two questionnaires that evaluate mental health and one that evaluated PA—Patient Health Questionnaire (PHQ-9) (30), Generalized Anxiety Disorder Scale (GAD-7) (31) and International Physical Activity Questionnaire Short Form (IPAQ-SF) (32). Specifically, the participants were told to provide the answers to their IPAQ-SF before and during the outbreak. The entire questionnaire was in Chinese and was available online on March 26, 2020.

PHQ-9

The PHQ-9 is a self-reporting diagnostic tool for depression that contains nine items associated with depression-related symptoms (30). Each item is rated as 0 (not at all), 1 (for several days), 2 (at least half of the time), and 3 (nearly every day). A total score of 0–4 points indicates no depressive symptoms, a total score of 5–9 points indicates mild depression, a total score of 10–14 points indicates moderate depression, a total score of 15–19 points indicates severe depression, and a total score of 20–27 points indicates extremely severe depression. The PHQ-9 has been extensively validated and has satisfactory reliability (sensitivity, 0.77; specificity, 0.94) (33). This scale has also been widely used with Chinese populations and has demonstrated excellent psychometric properties (34).

GAD-7

The GAD-7 is a seven-item self-reporting scale used to measure generalized anxiety disorder (31). Each item is rated from 0 to 3, similar to PHQ-9 (as described above). Participants who scored $\geq$5 were considered to be suffering from anxiety. The validity and reliability of the GAD-7 scale in the general population has been confirmed in previous studies (35), and has been widely used in China. Good reliability and validity of the Chinese version of GAD-7 has been confirmed (36).

IPAQ-SF

Time data measured by min/week collected from the IPAQ-SF were categorized into different levels of exercise (vigorous, moderate, and walking). METs were matched with each level according to the official IPAQ guidelines: vigorous PA = 8.0 METs, moderate PA = 4.0 METs, and walking = 3.3 METs. According to the IPAQ scoring guide (available at www.ipaq.ki.se), we divided our participants into high, moderate, and low levels of PA. The Chinese version of IPAQ-SF was proved reliable (37).

Statistics

The results in **Table 2** were presented as mean ± SEM. Comparisons between the two groups were made using the Student *t* test. The positive rates of IPAQ-SF, PHQ-9, and GAD-7 among different working-day groups during the outbreak were compared through χ^2 tests. A *P* value lower than 0.05 was considered a statistically significant difference. Binary logistic regression models were used to evaluate the association between different factors with PHQ-9 and GAD-7. Statistical analyses were performed with GraphPad Prism 8 for macOS (Graph Pad Prism Software Inc., San Diego, CA, U.S.) and SPSS 25 (SPSS, Inc, Chicago, IL, U.S.).

RESULTS

Participant Characteristics

A total of 2,580 participants completed the online survey between March 26 and May 9, 2020, which yielded 2,409 valid samples. The mean age of respondents was 37.7 years (range: 20–88). 39.6% of the participants were male, and 77.8% possessed a high level of education (undergraduate and above). 14.4% of the participants had a history of chronic disease, 33% gained weight during the outbreak period, and 5.6% reported losing weight. We

TABLE 3 | Comparison on the positive rates of IPAQ-SF, PHQ-9, and GAD-7 among different working-day groups during the outbreak.

Surveys	30–60d	11–29d	0–10d	χ^2	*p*-value
PA level (High/Total)	199/841	155/715	266/853	21.298	<0.001
GAD-7 ≥5/Total	149/841	138/715	107/853	14.732	<0.001
PHQ-9 ≥5/Total	217/841	187/715	187/853	4.886	0.087

divided the entire data sample by the number of days worked at home during the outbreak period. Out of the 2,409 participants, 853 (35.4%) worked for <10 days, 715 (29.7%) worked between 11 and 29 days, and 841 people worked for more than 30 days.

Physical Activity Before and During the Outbreak Period

As shown in **Table 1**, the average weight change was positive, with 33% of the participants reporting weight gain during the outbreak. We compared the responses to the PA questionnaire (IPAQ-SF) recorded before and during the outbreak period, and the results are presented in **Table 2**.

Participants reported performing a total of 2015.20 MET-minutes/week of total PA before the outbreak period, and 1720.29 MET-minutes/week of total PA during the outbreak period ($p < 0.001$). The number of days/week and minutes/day of vigorous intensity PA during the outbreak decreased by 15.6% ($p < 0.001$) and 17.4% ($p < 0.001$), respectively. In addition, the MET values of vigorous-intensity PA were 17.2% lower than those before the outbreak period ($p = 0.006$). The number of days per week of moderate intensity PA decreased by 1.1% during the outbreak period ($p = 0.629$), whereas the amount of minutes/day of moderate intensity PA increased by 1.2% during the same period ($p = 0.692$). Additionally, the MET values of moderate intensity PA were 5.1% higher during the outbreak period ($p = 0.230$). The number of days/week of walking reduced by 38% during the outbreak period ($p < 0.001$). Likewise, the amount of minutes/day of walking reduced by 23.4% during the outbreak period ($p < 0.001$). Additionally, MET values of walking were also revealed to be 49.7% lower during the outbreak period ($p < 0.001$). Statistical analysis also revealed that the amount of hours/day of sitting increased by 8.2% during the outbreak period ($p < 0.001$).

PA Intensity, Depression, and Anxiety Proportions in Different Lengths of Home Confinement

We used the Chi-square test to further investigate the relationship between the length of time spent working during the outbreak period, PA levels, and mental health status (**Table 3**). We found PA levels ($p < 0.001$), GAD-7 score ($p < 0.001$), and PHQ-9 score ($p = 0.087$) to be associated with different working times during the outbreak period.

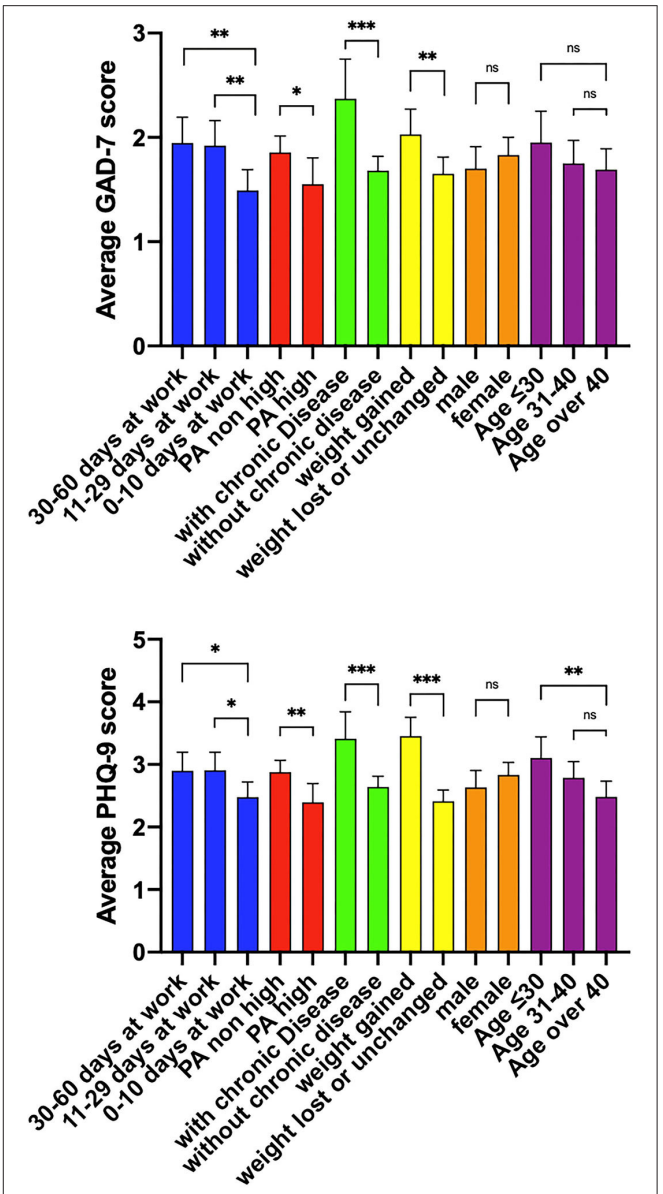

FIGURE 1 | Average GAD-7/PHQ-9 scores in different characteristic groups of participants. PA high: participants who had high level of physical activity. PA non-high: participants who had medium or low level of physical activity. According to the IPAQ scoring guide listed previously, Physical activity status of the participants were graded high, medium and low. In this article, medium and low levels of physical activity were combined as PA non-high. The other characteristic groups were described in **Table 1**. *p<0.05, **p<0.01, ***p<0.001, ns, not significant.

Average PHQ-9/GAD-7 Scores in Different Characteristic Groups of Participants

As shown in **Figure 1**, people who worked 30–60 days and 11–29 days during the outbreak period reported significantly higher average GAD-7 scores than those who worked for <10 days ($p < 0.01$). People who maintained a high level of PA intensity scored significantly lower than those who reported moderate and low

levels of PA intensity ($p < 0.05$). Participants with a history of chronic diseases scored notably higher than those without ($p < 0.001$). People who gained weight during the outbreak period also reported significantly higher scores than those who did not gain weight ($p < 0.01$). However, gender and age groups did not show any statistical significance on their performance on the GAD-7 scale.

In the case of PHQ-9 scores, people who went to work for 30–60 days and 11–29 days during the outbreak period reported significantly higher average GAD-7 scores than those who went to work for <10 days ($p < 0.05$). People who maintained a high level of PA intensity scored significantly lower than those who reported moderate or low levels of PA intensity ($p < 0.01$). Participants with a history of chronic diseases scored notably higher than those who did not ($p < 0.001$). People who gained weight during the outbreak period showed significantly higher scores than those who did not gain weight ($p < 0.001$). Similar to the GAD-7 results, gender differences in PHQ-9 performance were also minor. For the age groups, individuals younger than 30 years scored significantly higher than those aged >40 years ($p < 0.01$).

Binary Logistic Regression Analysis of PHQ-9 and GAD-7 Scores

Binary Regression Model for PHQ-9

As shown in **Table 4**, the relatively older participants tended to perform better in the PHQ-9 survey than the younger ones (OR 0.978, 95% CI 0.967–0.988), suggesting that age could be a protective factor. A higher PA level was also seen to be a protective factor (OR 0.755, 95% CI 0.603–0.944). Gaining weight during the outbreak (OR 1.754, 95% CI 1.466–2.217) and a history of chronic diseases (OR 1.711, 95% CI 1.312–2.233) were risk factors for depression.

Binary Regression Model for GAD-7

Similarly, gaining weight during the outbreak (OR 1.324, 95% CI 1.057–1.659) and a history of chronic diseases (OR 1.752, 95% CI 1.329–2.311) were risk factors for anxiety. Higher PA level was also seen to be a protective factor (OR 0.741, 95% CI, 0.568–0.967). Compared to participants who worked less than 10 days during the outbreak, participants who spent 11-29 days (OR 1.455, 95% CI 1.110–1.909) and more than 30 days at work (OR 1.619, 95% CI 1.227–2.316) were more likely to score over 5 in the GAD-7 survey, which indicates that going to work was a huge risk factor during the outbreak (**Table 4**).

DISCUSSION

Home confinement due to the current COVID-19 pandemic has dramatically impacted lifestyle activities globally, especially in terms of PA (38, 39). Overall, we found that differences in the length of home confinement during COVID-19 can have different levels of influence on mental health. Before the survey data was analyzed, we presumed that a longer time spent in quarantine might have had an adverse impact on mental health, and that not being able to socialize could be a significant source of psychological stress (40). Our presumption is supported by a study focusing on psychological distress during the SARS epidemic reported that symptoms of PTSD and depression increased by 28.9 and 31.2%, respectively. A longer duration of quarantine was associated with the increased prevalence of PTSD symptoms (41).

Interestingly, inconsistent with the previous studies mentioned above, our study showed that individuals who spent a longer time at home were more likely to have higher levels of PA and performed better in the PHQ-9 and GAD-7 surveys. The reasons behind this may include the following: going outdoors meant being exposed to more risk of contact with the virus than staying at home, and staying indoors would give people more time to spend on PA.

In this study, we found that the intensity of PA during the outbreak period was significantly lower than that before ($p < 0.001$, **Table 2**), and this finding was supported by a previous international study (42). The most significant change was in walking, which decreased by nearly 50% in MET value during the outbreak period. A 17.2% reduction in MET values of vigorous activity and 8.2% increase in hours of sitting were also notable. However, the intensity of moderate PA during and before the outbreak period were similar. According to the results of this study, the walking capacity was significantly reduced due to confinement. Hence, we encourage diversified indoor sports activities as an alternative. We also noted that regular PA may play an important role in relieving the symptoms of anxiety and depression. Although there is no evidence that PA can prevent the onset of depression, exercise can reduce the possibility of aggravating the symptoms in patients with mild depression (43) given that depression is commonly associated with low levels of PA. One study on data from over 4,000 adults showed that people with depression spent significantly less time doing light and moderate PA (44). In addition to depression, the protective effect of PA on generalized anxiety disorder has also been proven in another study. The odds of developing GAD was reduced by approximately 57% among older adults who met WHO PA guidelines (45). A cross-sectional study of 1.2 million people reported that regular PA has a positive effect on mental health (46).

According to previous studies, the 1-month prevalence of a major depressive disorder was 5.2% in a sample representing the general population (47). Accordingly, the cut-off PHQ-9 score was set at five in the current study. Based on our cut-off score, 591 participants out of 2,409 (24.5%) were considered to have mild depression or above. If we adjust the cut-off score to 10 points, 138 participants (5.7%) would be considered to have moderate or high levels of depression, consistent with the prevalence from the study mentioned above. Generalized anxiety disorder has an estimated prevalence in the general population of 1.6% to 6.2% (48–51). Among the 2,409 participants in the current study, 394 (16.4%) scored more than five points, and 81 (3.4%) scored more than 10 points in the GAD-7 survey. Previous studies showed that GAD-7 mean scores of the sample representing the general population ranged from 2.0 points (52) to 8.0 points (53). In our study, the mean scores of our samples was 1.8%.

Since the beginning of the 21st century, humankind have suffered subsequently from the SARS in 2003, H1N1 in 2009, MERS in 2012, Ebola virus disease (EVD) in 2014, and the new COVID-19 in 2019, five public health emergencies caused by

TABLE 4 | Regression results for the PHQ-9 and GAD-7 scores.

						95% Confidence interval for exp (B)	
	B	SE	Wald	Sig	Exp (B)	Lower bound	Upper bound
PHQ-9							
Age	−0.23	0.006	16.19	<0.001	0.978	0.967	0.988
Gaining weight	0.562	0.098	32.574	<0.001	1.754	1.446	2.127
History of chronic diseases	0.537	0.136	15.678	<0.001	1.711	1.312	2.233
High-level PA during outbreak	−0.282	0.114	6.071	0.014	0.755	0.603	0.944
GAD-7							
Gaining weight	0.281	0.115	5.955	0.015	1.324	1.057	1.659
History of chronic diseases	0.561	0.141	15.8	<0.001	1.752	1.329	2.311
High-level PA during outbreak	−0.300	0.136	4.868	0.027	0.741	0.568	0.967
Days at work							
0–10 days*			12.951	0.002			
11–29 days	0.375	0.138	7.359	0.007	1.455	1.11	1.909
30–60 days	0.482	0.141	11.587	0.001	1.619	1.227	2.136

*Parameter estimates for predictors in each logistic regression model. *means reference.*

infectious disease. Problem of mental health crisis has gained increasing attention. There's no doubt that eliminating the existence of the disease is the best way to avoid public mental health crisis (54). Sports was considered to be effective to promote mental health (55). Previous researchers have suggested various mechanisms of positive effect of physical activity on mental health (56, 57). What kind of types of physical activities are more accessible and practical for people especially under confinement? Future studies are needed to explain how to maintain physical activity during a global health crisis. To explore effectiveness and efficiency of physical activity to intervene impaired mental health, cross-sectional, multicenter studies of large sample sizes should be encouraged.

This study also showed that individuals who spent longer time at home during the outbreak period were more likely to have higher levels of PA, and they performed better in the PHQ-9 and GAD-7 surveys. A reasonable explanation for this interesting result could be as follows: At the initial stage of the COVID-19 epidemic, outdoor activity carried a higher risk of exposure to the virus. More people started working from home for a longer period of time, which gave them more time to exercise freely.

CONCLUSION

To our knowledge, our study is the first to focus on a unique demographic of people undergoing health checkups, a demographic that is characterized by a stable income and a relatively high level of education. This study provided valuable information to people suffering from home confinement. We found that home confinement during a pandemic is not detrimental to mental health provided that people engage in more PA indoors. Therefore, we encourage people who are being quarantined to spend more time doing physical exercise to reduce the risk of developing depression, generalized anxiety disorder, or any other potential mental health issues.

The present study has several limitations. First, the data collected were based on an online survey, which required the participants to assess their levels of PA prior to the pandemic. It was unrealistic to design a prospective study in response to the current pandemic. Second, the time frame for the current study was only 60 days. As the pandemic develops further, the relationships between the measures and various factors in the study might change. Future research should include larger population samples to further confirm the current findings.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ruijin Hospital Ethics Committee, Shanghai Jiao Tong University School of Medicine. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AL, JT, BW, GX, and XB: designed the study. AL, JT, BW, WZ, NW, and LL: designed the questionnaire. WZ, LW, WR, and CL: recruited participants and collected data. WZ, DX, HL, and GX: performed the statistical analysis. WZ: wrote the first draft. All authors revised, read, and approved the final manuscript.

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The Prevalence and Associated Factors of Depressive Symptoms Among Medical Students in Bangladesh During the COVID-19 Pandemic: A Cross-Sectional Pilot Study

Md. Abdullah Al Jubayer Biswas[1], M. Tasdik Hasan[2,3,4], Nora Samir[5], Sayma Islam Alin[6], Nusrat Homaira[5], Md. Zakiul Hassan[7], Mst Rabeya Khatun[8], Afifa Anjum[6,7], Sahadat Hossain[2,6], Kamrun Nahar Koly[7], Farhana Safa[9], Syeda Fatema Alam[10], Md. Abdur Rafi[11], Md. Abdullah al Osman Biswas[12], Farida Yasmin[13], Vivek Podder[13], Tonima Islam Trisa[7], Dewan Tasnia Azad[14], Rhedeya Nury Nodi[2], Fatema Ashraf[2,10], S. M. Quamrul Akther[10] and Helal Uddin Ahmed[15]*

[1] Department of Statistics, University of Dhaka, Dhaka, Bangladesh, [2] Public Health Foundation, Bangladesh (PHF, BD), Dhaka, Bangladesh, [3] Department of Public Health, State University of Bangladesh (SUB), Dhaka, Bangladesh, [4] Department of Primary Care and Mental Health, University of Liverpool, Liverpool, United Kingdom, [5] Discipline of Paediatrics, School of Women's and Children's Health, The University of New South Wales, Sydney, NSW, Australia, [6] Department of Public Health and Informatics, Jahangirnagar University, Dhaka, Bangladesh, [7] International Centre for Diarrheal Diseases Research, Bangladesh (icddr, b), Dhaka, Bangladesh, [8] Department of Biotechnology and Genetic Engineering, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh, [9] Department of Public Health, Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada, [10] Shaheed Suhrawardy Medical College Hospital, Dhaka, Bangladesh, [11] Rajshahi Medical College, Rajshahi, Bangladesh, [12] Sheikh Sayera Khatun Medical College, Gopalgonj, Bangladesh, [13] Tairunnessa Memorial Medical College and Hospital, Gazipur, Bangladesh, [14] Jashore Medical College, Jashore, Bangladesh, [15] National Institute of Mental Health, Dhaka, Bangladesh

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***Correspondence:**
Md. Abdullah Al Jubayer Biswas
jubayerbiswas@gmail.com

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Background: Whilst very limited studies have demonstrated a correlation between the COVID-19 pandemic and depressive symptoms amongst Bangladeshi medical students, the prevalence and associated factors of depressive symptoms as measured by the Patient Health Questionnaire (PHQ-9) remains widely unknown.

Objective: The study aimed to investigate the prevalence and factors associated with depression symptoms among Bangladeshi medical students during the COVID-19 pandemic lockdown period.

Method: In this web-based cross-sectional pilot study, medical students' data was collected using the Google Forms web survey platform after obtaining electronic informed consent. A total of 425 medical students were selected using a systematic sampling technique to accumulate depression symptoms and demographic and pandemic-related information. Depression was measured by a self-administered, validated English version of the Patient Health Questionnaire (PHQ-9) tool. The descriptive analysis utilized frequency and percentages, while the stepwise binary logistic regression analysis was performed to investigate the factors associated with depressive symptoms.

Result: Among 425 medical students, 62.3% were female, 97.4% unmarried. Almost 80.2% of medical students had mild to severe levels of depressive symptoms as characterized by PHQ-9. A significantly higher probability of depression was found amongst female students (adjusted OR = 1.8), those who struggled to stay away from social media (adjusted OR = 1.8), those who tried to be optimistic for maintaining better psychology (adjusted OR = 11.1), and those who always had a sleeping difficulty in the last 4 weeks (adjusted OR = 8.9).

Conclusion: A very high prevalence of depression symptoms among Bangladeshi medical students was found across the majority of socio-demographic variables. The alarming prevalence and associated factors of depression suggests the need for follow-intensity psychosocial interventions designed for medical students during the COVID-19 pandemic

Keywords: medical students, depressive symptoms, patient health questionnaire-(PHQ-9), COVID-19, Bangladesh

INTRODUCTION

As of December 23, 2021 the COVID-19 crisis has overwhelmed healthcare systems worldwide and resulted in over 5.3 million deaths and 273 million infections (1). The mental health and well-being of health care workers have been particularly impacted during the COVID-19 outbreak, with an increased prevalence of anxiety, fear, depression, and insomnia reported. Reasons for higher anxiety and depressive symptoms reported by health care workers during the pandemic include extended work shifts, higher risk of infection, lack of adequate personal protective equipment (PPE) and prolonged separation and isolation from families and friends (2). Medical students, in particular, are at risk of developing adverse mental health outcomes due to changes in teaching techniques, interruptions in academic curricula and clinical rotations, increased workload, and viral exposure during the COVID-19 epidemic (3–5). A meta-analysis found that the COVID-19 pandemic had a substantial adverse effect on the mental well-being of medical students (6). In addition, psychological reactions and depressive symptoms have been intensified in various other contexts due to COVID-19 pandemics (7, 8). During the COVID-19 pandemic in Brazil, 64.4% of medical students reported depressed symptoms using the Patient Health Questionnaire (PHQ-9), whereas, in India, it was 44.89% using the DASS-21 (5, 9).

Like the general population, medical students in Bangladesh have been demonstrated to suffer detrimental psychological impacts due to the COVID-19 epidemic (10, 11). A cross-sectional study during the COVID-19 pandemic reported that 49.9% of 425 Bangladeshi medical students had depressive symptoms measured by the Hospital Anxiety & Depression Scale (HADS) (10). However, there are limited data on prevalence and the associated factors of depressive symptoms using PHQ-9 during the COVID- 19 pandemic medical students. Additionally, it's unknown how the social isolation during lockdown periods in Bangladesh impacted the prevalence of depressive symptoms amongst Bangladeshi medical students. Also, in light of the long-term psychological effects of COVID-19, Bangladeshi medical students' depression status needs to be assessed so that an appropriate mitigation strategy may be devised in the future. Therefore, our study aimed to assess the prevalence and factors associated with depressive symptoms among medical students using PHQ tools during the COVID-19 pandemic lockdown period in Bangladesh. We also hypothesized that the prevalence of depression among Bangladeshi medical students would be the same regardless of their demographics or any other information about the epidemic. The findings of this study may help educational stakeholders understand medical students' mental status during health crises and plan targeted interventions to address such issues in the present pandemic and for future public health crises.

METHODOLOGY

Study Setting and Population

An online cross-sectional pilot survey was conducted between April 21, 2020, and May 10, 2020, to explore prevalence and factors associated with depressive symptoms among Bangladeshi medical students, coinciding with the 1st wave of the COVID-19 pandemic. All medical students who were Bangladeshi citizens, aged $\geq$18 years, currently enrolled in undergraduate medical program (MBBS) in any Bangladeshi medical college, residing in Bangladesh during the pandemic, had access to the social media platforms including Facebook, WhatsApp, Twitter or an e-mail account, and could read and understand English were eligible to participate.

Data Collection

We designed an online survey data collection tool with the declaration of anonymity and confidentiality using the Google Forms web survey platform to minimize human contact and adhere to the strict COVID-19 protocols. Initially, we recruited five volunteer medical students conveniently from five different medical colleges situated in different locations in Bangladesh, including Chittagong, Dhaka, Sylhet, Barisal, Rajshahi. The five volunteers developed a primary contact list of medical

students using their social media platforms, such as Facebook, WhatsApp, and Twitter. After finalizing the primary contact list, the study team selected medical students from the list and sent an invitation message with a link for the survey using given e-mails or social media profiles. The invitation letter explained the rationale, objectives, and nature of the project. Medical students who accepted the invitation provided their responses by browsing the link; otherwise, they were counted as non-response.

Depressive Symptoms Measure

A self-administered version of the Patient Health Questionnaire (PHQ-9), the PRIME-MD diagnostic instrument for measuring depression, was utilized to assess depression symptoms (12). An English version of nine items PHQ-9 depression module whose reliability and validity have been reported by multiple studies was designed on the Google Form platform (13). A four-point Likert scale layout was followed to create an online PHQ-9 section where each item of the PHQ-9 scale was scored from zero implied not problematic at all to three indicated extremely difficult. The global summation of the nine issues delineated the level of the severity of depression. Recommended cut off PHQ-9 scores for level of depression severity (12): minimal (score 0–4), mild (score 5–9), moderate (score 10–14), moderately severe (score 15–19), severe (score 20–27). Patient Health Questionnaires had good internal consistency (Cronbach's Alpha = 0.77), adequate split-half reliability ($r = 0.80$) in our data.

Demographic and Pandemic Related Information

The self-reported and structured demographic and pandemic related questionnaire had five sections: socio-demographic, tension related to COVID-19 infection, adherence with media, the strategy taken to maintain psychological health and difficulty in sleeping. Participants filled a brief section after the informed consent segment on demographic characteristics including age in year, gender, marital status, profession, monthly income, ever searching remedy for mental health. In the next susceptible to COVID-19 section, participants invited the questions related to tension about himself/herself and family members getting infected by COVID 19, hard to step ways from media. Also, to evaluate respondents' recreational activities, they were asked questions regarding leisure activities, time to spend on leisure activities, and struggling to stay away from media. Furthermore, the difficulty in sleeping cycles was assessed using questions related to sleeping disturbance faced in the last 4 weeks and the average sleep time during the previous 4 weeks.

Sample Size and Sampling Technique

We calculated sample size using a single population proportion formula and considering 74.4% mild to severe depression assessed by the Patient Health Questionnaire (PHQ-9) among medical students of Banaras Hindi University, Varanasi, Uttar Pradesh, India (14, 15). Considering a 95% confidence interval (CI), 5% absolute precision, 5% non-response rates, and a 1.27 design effect, a minimum sample of 390 was calculated. A systematic sampling technique was used where every third eligible medical student was selected and approached to participate in the study. The final contact list was used as a list-based sampling frame (16, 17). The detailed sampling strategy is shown in **Figure 1**.

Statistical Analysis

We conducted descriptive analyses using frequency, percentage, mean, and standard deviation (SD) depending on the variables' type. Depressive symptoms of the study participants were categorized using established cutoff and summarized using frequency and percentage (12). Cross-tabulation with Pearson's Chi-square was used to test the association of demographic and pandemic related variables with participants' severity of the depressive symptom. We executed a binary logistic regression analysis to explore the bivariable relationship between the respondent's depression symptoms and explanatory variables. We reported bivariable analysis output as the unadjusted odds ratio (UOR) with a 95% confidence interval. We utilized stepwise logistics regression with removal algorithm to identify the factors associated with depression and described as adjusted odds ratio (AOR) with 95 % confidence interval (14, 15) for multivariable analysis. We included variables in the final multivariable model, which were significant at the 5% significance level. Statistical significance of the association was considered for p-values <0.05. The analysis was performed using Stata software (Stata Corp. 2017. Stata Statistical Software: Release 13. College Station, TX: Stata Corp LP).

Ethical Consideration

The study received ethical approval from the Ethical Review Committee, Shaheed Suhrawardy Medical College, and Dhaka, Bangladesh (ShSMC/Ethical/2020/12). A concise outline of the study and information regarding ethics were provided on the google form's preliminary page. Confidentiality of the participants was strictly maintained by avoiding identifiable personal questions, and data was collected anonymously. The respondents were also informed about their voluntary participation and ending the survey at any time just by closing the web browser. Likewise, the consent field was kept as a mandatory field for starting the study. The study was carried out under the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) guideline (18). Furthermore, the study investigators monitored all procedures relevant to the study to ensure the proper ethical standards of the concerned national and institutional committees on human experimentation and the Helsinki Declaration of 1975, as revised in 2008.

RESULTS

The final contact list had 1,368 medical student contact information, and among them, 456 medical students were identified and sent the invitation. After excluding 31 responses due to duplicate response, lack of complete records, the data set of 425 responses were finalized for analysis. This study had a response rate of around 93.2%.

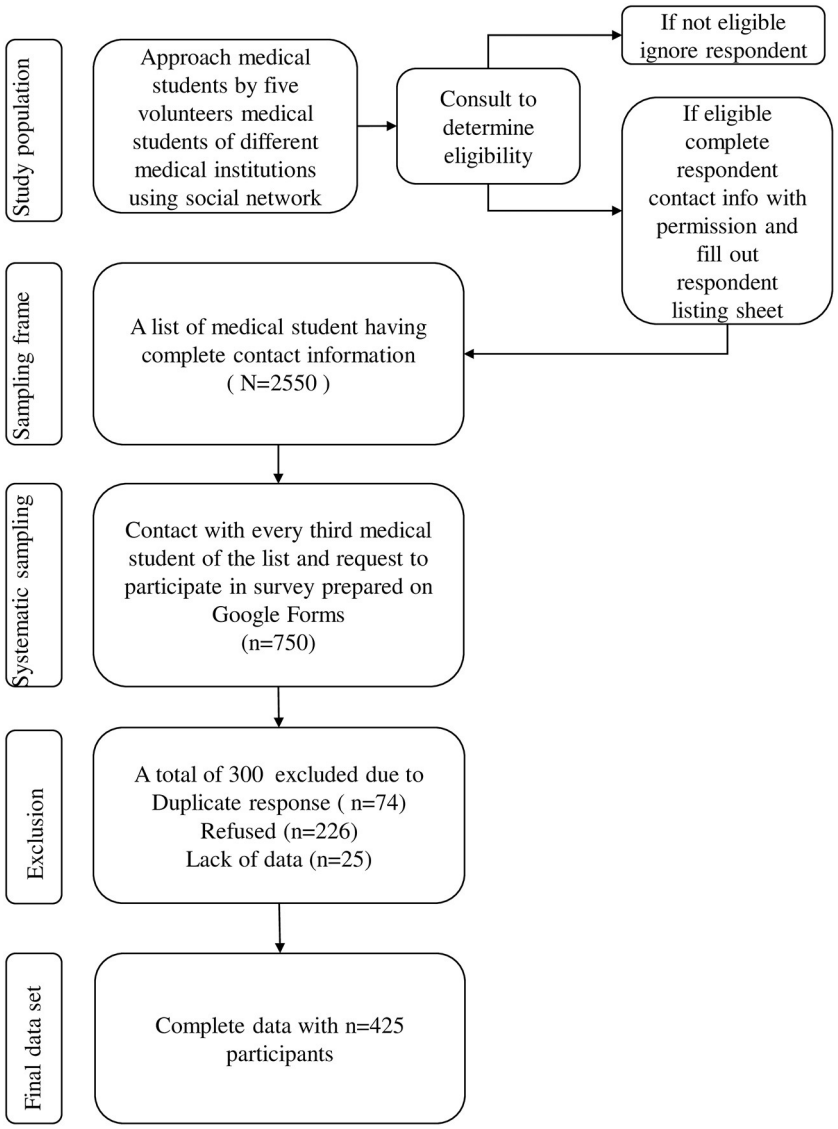

FIGURE 1 | Flow chart of sampling strategy.

Demographic and Pandemic Related Information

Among 425 medical students, 62.3% were female, and the mean age was 22 years with a standard deviation of 1.8 years. Almost all the students were fully engaged with the study (87.5%) and never sought treatment for their mental health issue (93.2%) (**Table 1**).

Prevalence of Depressive Symptoms Among Medical Student

Among all study participants, the average PHQ-9 score was 9.5 with a standard deviation of 5.4 and a range between zero to 26 (**Figure 2**). The prevalence of mild to severe depressive symptoms was 80.2% where it was high among females (83.8%) and among married students (90.9%). Likewise, the prevalence was decreased significantly with decreasing tension about the family member getting infected by COVID-19, ranging from 66.0 to 84.3%. Moreover, the significant highest prevalence was observed for the medical student who struggled to get away from social media (83.1%), always faced sleeping disturbances in the last 4 weeks (93.5%), then counters category (**Table 1**).

Associated Factors of Depressive Symptoms Among Medical Students

Table 2 shows the outcome of the bivariable and multivariable analyses. After controlling for other factors, the multivariable analysis found a higher probability of depression symptoms among female medical students (AOR = 1.8). Additionally, depressive symptoms remained almost similar among four successive categories of the respondents who had a sleeping disturbance in the last 4 weeks (Always vs. Never AOR = 8.9,

TABLE 1 | Prevalence of mild to severe depressive symptom among medical students, measured by PHQ-9, during COVID-19 pandemic following their demographic and pandemic related characteristics, 2020 Bangladesh.

Variables		Prevalence of depression		
	% (*n*)	% (row)	95% CI	*P*-value
Among all participants	100.0 (425)	80.2	(76.1, 83.9)	
Age in year	22.0 ± 1.8			
≤20	25.4 (108)	72.2	(63.0, 79.9)	
21–24	68.5 (291)	83.5	(78.8, 87.4)	0.038
≥25	6.1 (26)	76.9	(56.7, 89.4)	
Gender				
Male	37.7 (160)	74.4	(67.0, 80.6)	
Female	62.3 (265)	83.8	(78.8, 87.8)	0.018
Marital status				
Married	2.6 (11)	90.9	(53.5, 98.8)	0.368
Unmarried	97.4 (414)	79.9	(75.8, 83.5)	
Profession				
Part-time job	12.5 (53)	90.6	(79.1, 96.1)	0.044
Solely study	87.5 (372)	78.8	(74.3, 82.6)	
Ever seeking treatment for mental health issues				
Yes	6.8 (29)	89.7	(71.9, 96.7)	0.187
No	93.2 (396)	79.5	(75.3, 83.2)	
The tenseness of getting infected by COVID-19 about				
Himself/herself				
Severe	36.9 (157)	84.1	(77.4, 89.0)	
Moderate	43.5 (185)	79.5	(73.0, 85.0)	0.209
No/minimal	19.5 (83)	74.7	(64.2, 83.0)	
Family members				
Severe	64.2 (273)	84.3	(79.4, 77.8)	
Moderate	24.0 (102)	76.5	(67.2, 83.7)	0.006
No/minimal	11.8 (50)	66.0	(51.8, 77.8)	
Source of news				
Television news	68.5 (291)	80.8	(75.8, 84.9)	
Social media	18.8 (80)	86.3	(76.7, 92.3)	0.038
Newspaper	12.7 (54)	68.5	(54.9, 79.6)	
Struggling to get away from social media				
Yes	71.1 (302)	83.1	(78.4, 87.0)	0.020
No	28.9 (123)	73.2	(64.6, 80.3)	
The strategy took to maintain healthy psychology				
Yes	44.2 (188)	80.8	(74.6, 85.9)	
No	55.8 (237)	79.7	(74.0, 84.3)	0.760
Type of strategic strategy taken to maintain healthy psychology (Multiple responses)				
Involving leisure activities	55.3 (104)	80.8	(72.0, 87.4)	0.832
Spending quality of time with friends and family	29.3 (55)	87.3	(75.4, 93.9)	0.160
Maintaining COVID-19 instructions	21.8 (41)	73.2	(57.5, 84.6)	0.232
Practicing religion norms	21.3 (40)	80.0	(64.6, 89.7)	0.969
Optimistic thinking/positive outlook	17.6 (33)	96.9	(80.1, 99.5)	0.012
Maintaining physical activity	17.0 (32)	90.6	(74.2, 97.0)	0.125
Staying at home	7.5 (14)	71.4	(42.8, 89.3)	0.400
Avoiding COVID-9 new broadcast	2.1 (4)	80.0	(25.5, 97.9)	0.989
Difficulty in sleeping				
Having sleeping disorder in last 4 weeks				
Always	10.8 (46)	93.5	(81.4, 97.8)	
Often	14.8 (63)	92.1	(82.1, 96.6)	
Sometimes	24.5 (104)	87.5	(79.6, 92.6)	<0.001
Occasionally	22.8 (970)	86.6	(78.2, 92.1)	
Never	27.1 (115)	56.5	(47.3, 65.3)	

(Continued)

TABLE 1 | Continued

Variables		Prevalence of depression		
	% (*n*)	% (row)	95% CI	*P*-value
Average time of sleep in last 4 weeks				
<6 h	19.8 (84)	83.3	(73.7, 89.9)	
6–8 h	36.0 (153)	75.8	(68.4, 81.9)	0.226
More than 8 h	44.2 (188)	82.4	(76.3, 87.3)	

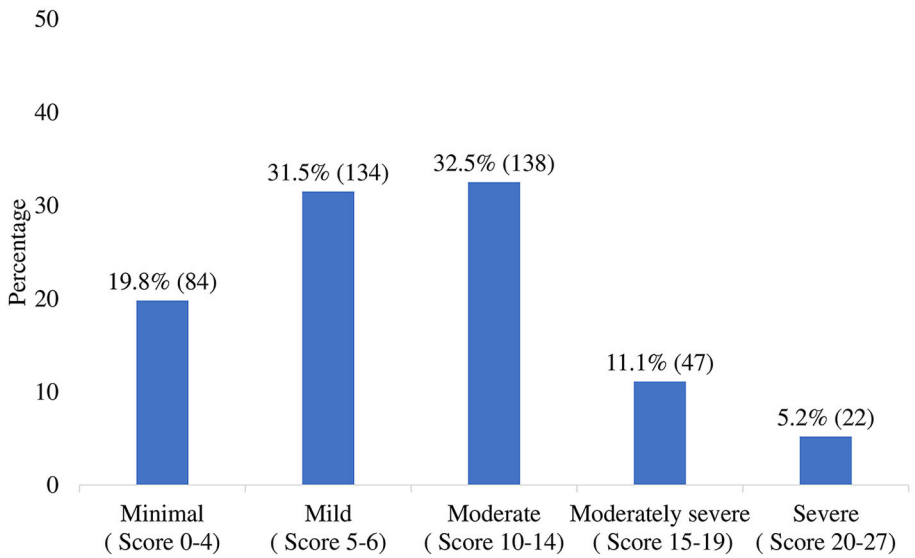

FIGURE 2 | Level of depression severity among medical students obtained by categorizing PHQ-9 score. The total PHQ-9 score was 4,038, with an average 9.5 ± 5.4 and a median 9.0.

95% CI: 2.6–31.4; Often vs. Never AOR = 7.9, 95% CI: 2.8–21.7; Sometimes vs. Never AOR = 5.6, 95% CI: 2.7–11.5; Occasionally vs. Never AOR = 5.0, 95% CI: 2.3–9.7). Also, students who maintained a positive outlook for keeping psychological health fit had a higher probability of being depressed during the COVID-19 pandemic (AOR = 11.1).

DISCUSSION

Our study aimed to determine the prevalence and factors associated with depressive symptoms among Bangladeshi medical students during the COVID-19 pandemic. The study findings revealed that the prevalence of mild to severe depressive symptoms was high in medical students, and factors such as gender, struggling to get away from social media, and having sleep disturbances in the preceding 4 weeks were significantly associated with depressive symptoms.

In our study, 80.2% of medical students had mild to severe levels of depressive symptoms, which was comparable to findings from Bangladesh (49.1%), India (74.6%) and Brazil (64.41%) but higher than those reported from Nepal (5.5%) and Iran (25.6%) (3, 3, 5, 10, 19, 20). The disparity in prevalence could be due to the usage of multiple measurement scales and countries contexts. Additionally, the tension associated with the possibility of infecting a family member with COVID-19, gender, adverse effects of COVID-19 and its perceived long-term health outcomes, discrimination against the frontline physicians and a tendency to get irritated more quickly than normal could all contribute to the high prevalence (10, 21). The study by Tasdik et al. reported depression symptoms in 38.9% of medical students, with 3.6, 14.5, and 20.8% being severe, moderate, and mild depression, respectively pre-COVID-19 era, which used PHQ-9 as the assessment tool. This highlights the overwhelming mental health burden experienced by the medical students during the pandemic (22).

Our study found that female medical students reported experiencing significantly more depressive symptoms than male students, comparable with earlier epidemiological studies (10, 23). Research on the disparity between women and men during the COVID-19 pandemic revealed that female students had higher COVID-19 pandemic risk perceptions than male students (23, 24). That research also estimated higher conscientiousness, neuroticism, tolerance to experiences, and tension to be higher in female university students (23). However, in comparison to results from a similar COVID-19 pandemic survey, it was found that gender did not significantly affect the medical students'

TABLE 2 | Logistic regression analysis of medical student who had depression for mild to severe level during COVID-19 pandemic, 2020 Bangladesh.

	Depression (mild to severe level)			
	Unadjusted OR (95% CI)	***P*-value**	**Adjusted OR (95% CI)**	***P*-value**
Age in year				
21–24	1.9 (1.2–3.3)	0.012	–	
≥25	1.3 (0.5–3.5)	0.628	–	
≤20	Reference			
Gender				
Female	1.8 (1.1–2.9)	0.019	1.8 (1.1–3.1)	0.032
Male	Reference		Reference	
Profession				
Parttime job	2.6 (1.0–6.7)	0.051	–	
Solely study	Reference			
The tenseness of getting infected by COVID-19 about family members				
Severe	2.8 (1.4–5.4)	0.003	–	–
Moderate	1.7 (0.8–3.5)	0.174	–	–
No/minimal	Reference			
Adherence with media				
Source of news				
Television news	2.9 (1.2–6.8)	0.016	–	–
Social media	1.9 (1.0–3.7)	0.046	–	–
Newspaper	Reference			
Struggling to get away from social media				
Yes	1.8 (1.1–3.0)	0.021	1.8 (1.0–3.1)	0.041
No	Reference		Reference	
Strategy took to maintain psychological health				
Type of strategic capture				
Optimistic thinking/positive outlook				
Yes	8.6 (1.2–63.8)	0.035	11.1 (1.3–93.5)	0.034
No	Reference		Reference	
Difficulty in sleeping				
Having a sleeping disorder in the last 4 weeks				
Always	11.0 (3.2–37.6)	<0.001	8.9 (2.5–31.4)	0.001
Often	8.9 (3.3–23.9)	<0.001	7.9 (2.8–21.7)	<0.001
Sometimes	5.4 (2.7–10.7)	<0.001	5.6 (2.7–11.5)	<0.001
Occasionally	5.0 (2.5–9.9)	<0.001	4.9 (2.3–9.8)	<0.001
Never	Reference		Reference	
Average time of sleep in the last 4 weeks				
6–8 h	0.6 (0.3–1.2)	0.180	–	
More than 8 h	0.9 (0.5–1.9)	0.858	–	
<6 h	Reference			

mental health (25). In light of our study, further investigation into understanding the kinds of social support that can help mitigate gender-specific mental health well-being issues among Bangladeshi medical students is essential.

Additionally, we also found that medical students who fail to disengage from social media during the COVID-19 pandemic tend to experience more frequent depressive symptoms. At the height of the COVID 19 pandemic, students were unable to leave their homes for fear of being infected or breaking government-imposed lock-down laws (26). Online platforms were initially used to learn about the virus and spread information, which resulted in a spike in mobile social media use (26). Maintaining social media use for an extended period may cause social, family, and/or occupational impairments, cyberchondria as well as mental health and well-being problems (26–28). A recent survey of 100 first-year medical students in India showed that time spent on social media for over 4 hours during lock-down rose from 1.1 to 47.72% (29). It was also found that social network use of >4 h is significantly correlated with mood variations, including feeling frustrated among medical students (29). Based

on our findings, we believe institutions and clinicians must work together to find ways to combat social media addiction among medical students and encourage healthy use of social media during the pandemic. In order to get a clearer understanding of how medical students should utilize social networking channels as helpful learning resources, further research is needed.

We also found that medical students who had a sleeping disorder in the last 4 weeks were more likely to have depressive symptoms, similar to a previous prospective longitudinal study conducted in India on 217 medical students (30). In that study, researchers found that medical students who had increased depression during the COVID-19 pandemic were 1.11 times more likely to have poor sleep quality (30). Because of travel limitations and lock-down precautions, medical students were dealing with reduced physical activity, changing living circumstances, and greater employment pressure (30). Sleep was adversely affected by these combinations, one of the key symptoms of seeking depression (30, 31). In addition, it may highlight the need for the medical community to provide further support to medical trainees at times of health crises such as the COVID-19 pandemic in order to prevent sleep disorders, burnout and associated downs-stream psychological effects.

Strength and Limitation

It was one of the first few studies to examine the prevalence and associated factors of depressive symptoms among medical students under lock-down scenarios, using a validated method for detecting depressive symptoms. To avoid sampling bias, we constructed a contact list of medical students based on the eligibility criteria, which also ensured representation of the population we wanted to study. However, our study has several limitations. Firstly, as we prepared a primary contact list based on five volunteer medical studnets social media networks, there might have been some selection bias in the list. Secondly, students without internet or social media accounts were excluded due to the online approach of the survey platform. As a result, our results were not generalisable to all Bangladeshi medical students. Thirdly, depressive symptoms were assessed only by self-report, which may not be consistent with professional mental health diagnoses. However, the questionnaire used has been validated for use in self-reported depressive symptoms (12). Fourthly, findings from this research do not give a comprehensive picture of COVID-19's long-term impact on depression symptoms, preventative measures, and coping techniques. Furthermore, future longitudinal studies are required to examine the ramifications of COVID-19 on the medical student's psychological well-being.

CONCLUSION

We conclude that during the worldwide pandemic of COVID-19, the prevalence of depressive symptoms was alarmingly high among Bangladeshi medical students, which indicates medical students were at high risk of developing depressive symptoms during the ongoing pandemic. Given that medical students are prone to developing depression during the COVID-19 pandemic, adequate mental health services focusing on depression for students might be considered by medical colleges. Besides, in times of infectious disease outbreaks like COVID-19, when mental health issues like depression symptoms impacts academic performance, physical health, psychological well-being, interventions targeted to improve mental health conditions in medical students are crucial.

DATA AVAILABILITY STATEMENT

The study's original contributions are provided in the article/supplementary material. Any further questions should be addressed to the corresponding author.

ETHICS STATEMENT

The study received ethical approval from the Ethical Review Committee, Shaheed Suhrawardy Medical College, and Dhaka, Bangladesh (ShSMC/Ethical/2020/12). A concise outline of the study and information regarding ethics were provided on the google form's preliminary page. Confidentiality of the participants was strictly maintained by avoiding identifiable personal questions, and data was collected anonymously. The respondents were also informed about their voluntary participation and ending the survey at any time just by closing the web browser. Likewise, the consent field was kept as a mandatory field for starting the study. The study was carried out under the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) guideline (Eysenbach, 2004). Furthermore, the study investigators monitored all procedures relevant to the study to ensure the proper ethical standards of the concerned national and institutional committees on human experimentation and the Helsinki Declaration of 1975, as revised in 2008. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MTH, SFA, MAR, VP, SMQA, and FA: conceptualization. MAAJB and MRK: data analysis. MTH, SFA, MAR, VP, DA, and RNN: investigation. MAAJB, MTH, and SH: methodology. MTH, FS, SFA, and SH: resources. SMQA and FA: supervision. MAAJB, SIA, MTH, and MRK: writing –original draft. MAAJB, MTH, NS, SIA, NH, MZH, SH, FY, MAaOB, FS, KNK, SFA, MAR, VP, TIT, RNN, DA, MRK, FA, SMQA, and HUA: writing –review and editing. All authors contributed to the article and approved the submitted version.

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The Prevalence of Psychological Distress and Its Relationship to Sleep Quality in Saudi Arabia's General Population During the COVID-19 Pandemic

Maha M. AlRasheed[1,2], Sinaa Al-Aqeel[1], Afnan M. Alkadir[1], Khulood Bin Shuqiran[1], Fowad Khurshid[1], Noura M. AlRasheed[3], Roua M. Al-kufeidy[4], Omar A. Alhaj[5], Haitham Jahrami[6,7] and Ahmed S. BaHammam[8,9]*

[1] Department of Clinical Pharmacy, College of Pharmacy, King Saud University, Riyadh, Saudi Arabia, [2] Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia, [3] General Administration of School Health, Ministry of Health, Riyadh, Saudi Arabia, [4] Department of Botany and Microbiology, Molecular Immunology, College of Science, King Saud University, Riyadh, Saudi Arabia, [5] Department of Nutrition, Faculty of Pharmacy and Medical Sciences, University of Petra, Amman, Jordan, [6] Ministry of Health, Manama, Bahrain, [7] College of Medicine and Medical Sciences, Arabian Gulf University, Manama, Bahrain, [8] Department of Medicine, College of Medicine, University Sleep Disorders Centre, King Saud University, Riyadh, Saudi Arabia, [9] The Strategic Technologies Program of the National Plan for Sciences and Technology and Innovation in the Kingdom of Saudi Arabia, Riyadh, Saudi Arabia

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***Correspondence:**
Maha M. AlRasheed
mahalrasheed@ksu.edu.sa

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Background: We aimed to examine the effect of the COVID-19 pandemic and associated mitigation measures on sleep quality and psychological distress in Saudi Arabia.

Methods: Subjective sleep quality over the preceding 30 days was measured using the Pittsburgh Sleep Quality Index (PSQI). In addition, Kessler Psychological Distress Scale (K10) was used to assess the psychological distress.

Results: The study included 836 participants. The median age was 28 years, 624 (74.64%) were females, and 158 (18.90%) were healthcare workers. Factors associated with poor sleep were recent changes in the sleep habits $p = 0.004$), anxiety or fear because of coronavirus news on social media $p = 0.02$), fear because there was no approved drug to treat COVID-19 $p = 0.03$), and unaware of the presence of chronic diseases $p = 0.03$). Female gender $p = 0.02$), fear or anxiety because of coronavirus news on social media $p = 0.04$), recent change in sleep habits (OR: 1.97 (1.15–3.39); $p = 0.01$), fear because there is no approved drug to treat COVID-19 $p = 0.001$), monthly income < 1000 SR $p = 0.01$), and isolation $p = 0.01$) were associated with distress. PSQI and K10 scores were significantly correlated $p < 0.001$).

Conclusion: Poor sleep and psychological distress are common during the COVID-19 outbreak in Saudi Arabia. Identifying factors associated with poor sleep and psychological distress would help develop specific intervention programs that enhance mental health and sleep quality during pandemics.

Keywords: PSQI score, K10 score, COVID-19, psychological distress, sleep quality

INTRODUCTION

The World Health Organization declaration (1) on March 11, 2020, classifying the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) disease as a global pandemic mandated governments worldwide to implement measures to mitigate virus spread. These procedures included lockdowns, quarantine, social distancing, and travel restrictions, all of which may reduce physical activity and exposure to daylight, adversely affecting the pace of time flow (2) and disrupting nighttime sleep (3, 4). These measures increase the risk of mental health problems. A rise in the prevalence of generalized anxiety disorders, post-traumatic distress, depression, and worsening of psychiatric symptoms has been reported in published systematic reviews (5–9) because of the pandemic. In addition, female gender, younger age, unemployment, educational level, insufficient knowledge of the disease, frequency of exposure to social media/disease-related news, and chronic/psychiatric illnesses have been implicated as risk factors for these disorders. A meta-analysis of studies up to July 5, 2020, identified 44 publications involving 54,231 participants from 13 countries, demonstrating a pooled global rate of 35.7% for sleep problems among the studied populations. Patients infected with SRS-CoV-2, commonly known as COVID-19, exhibited a higher rate of sleep problems of 74.8% compared to 36.0% in healthcare workers and 32.3% in the general population (10). Examples of reported sleep problems linked to the COVID-19 pandemic involve increased sleep duration and latency (11), worsening of sleep quality (11–16), decrease in the amount and regularity of sleep, and insomnia symptoms (13).

Gender has been demonstrated to play a major effect in the experience of sleep disruptions in previous research (17). A study of research, for example, discovered that females have a greater risk of insomnia than males. Matud and Garca (18) found that women had a greater frequency of mental health concerns than males. Furthermore, sleep loss leads women to be more anxious than males (19). During the COVID-19 epidemic, females experienced more psychological anguish than males (20). However, whether gender influences the association between sleep problems and mental health during the COVID-19 pandemic is unknown and warrants more investigation. As a result, we expected that gender would have an influence on the connection between sleep disruptions and mental health.

Saudi Arabia has implemented several mitigation measures such as curfew, self-quarantine for infected or symptomatic individuals and travelers arriving in Saudi Arabia, mandatory face masks, and restrictions on national and international journeys since the identification of the first case in March 2020 (21). Full and partial curfews were imposed from March 24 until June 20, 2020. Lockdown included schools, universities, and shops not selling basic stuff. While the published research on mental health and sleep quality and its association with COVID-19 might apply to Saudi Arabia, many country-specific social and economic variables could influence the rates of mental and sleep problems. Hence, local decision-makers need local data to plan preventive public health interventions during potential subsequent pandemics. Additionally, there is a need to identify risk factors associated with mental and sleep problems to prioritize preventive and treatment strategies targeting vulnerable groups (22).

During the COVID-19 epidemic, the current study looked at the incidence of sleep disruptions in different demographic categories of Saudi Arabians. Furthermore, the association between sleep disruptions and mental health status, as well as the factors that influence it, was investigated. The current study's findings will give vital information to medical personnel and the government regarding who would benefit the most from initiatives aimed at minimizing sleep disruptions and promoting mental health during the COVID-19 crisis.

METHODOLOGY

Study Design and Participants

A cross-sectional questionnaire-based study was conducted between May 8 and June 29, 2020. The study was conducted during the lockdown period in Saudi Arabia. The eligible study population included participants aged 18 years and older, capable of reading and understanding the questionnaire that was availed to participants in Arabic and English to select their preferred language and those living in Saudi Arabia during the study period. We excluded participants on sleep or psychiatric medications ($n = 76$). A convenience sampling technique was employed to recruit the participant according to availability and accessibility. The required sample size for the study was calculated using the Raosoft sample size calculator, employing a type I error margin of 5% and a confidence interval of 95%, power was set at 80% (23) and the population of Saudi Arabia estimated at 34,813,871 according to the United Nations database (24). An estimated sample size of 385 individuals was determined as adequate for the study. However, to increase power, the ultimately recruited population was 836.

This study was approved by the Institutional Review Board (IRB) of King Saud University Medical City (E-20-4869) and the IRB of the Ministry of Health (20-331E).

Survey Instruments

The principal investigator constructed a dedicated account for the online questionnaire using a Google Form. It collected information on (**Supplementary Table 1**):

a. Socio-demographic characteristics of the participants, including age, gender, marital status, work sector, family status, income, education, employment status, and region of residence.
b. The social interaction involved attitude and response to social events, measured with the desire to attend such events, attendance frequency, and involvement in the activities.
c. COVID-19 and associated disease data aimed to evaluate participants' personal experience with COVID-19 infection. The questions used to cover this item involved "the frequency of going out before the coronavirus pandemic, information about coronavirus and its ways of spreading, concerns about lack of approved drug to treat COVID-19, the effect of COVID-19-related news on social media on anxiety, and fear,

TABLE 1 | Socio-demographic of participants.

Variable	All participants ($n = 836$)
Age (Years)	28 (22–38)
Female	624 (74.64)%
Marital status	
Single	464 (55.5%)
Married	336 (40.19%)
Divorced/widow/separated	36 (4.31%)
Do you work in the healthcare sector? (Yes)	158 (18.9%)
Do you have children?	322 (38.52%)
How many members of your family live with you at home (including you)?	
One to two persons	103 (12.32%)
Three to five persons	270 (32.30%)
More than five persons	463 (55.38%)
Nationality	
Saudi	775 (92.7%)
Non-Saudi	61 (7.3%)
Educational level	
Middle school or lower, High school or Diploma	196 (23.44%)
Bachelor's degree or higher	640 (76.56%)
Job-status	
I do not work	159 (19.02%)
Employee	341 (40.79%)
Self-employed	22 (2.63%)
Student	314 (37.56%)
Monthly income	
I don't want to answer	315 (37.68%)
<1000 SR	136 (16.27%)
1000–2999 SR	81 (9.69%)
3000–5999 SR	44 (5.26%)
6000–9999 SR	57 (6.82%)
10000–30000 SR	171 (20.45%)
>30000	32 (3.83%)
Region of residence (Riyadh)	536 (64.11%)
Social interaction	
Loves and waits for social events	301 (36%)
Gets bored of social events and does not go there	162 (19.38%)
Hates social events and does not go there	54 (6.46%)
Neutral	319 (38.16%)
How often do you go out weekly before the coronavirus pandemic outside working hours?	
None	75 (8.97%)
Once a week	178 (21.29%)
Two to three times a week	325 (38.88%)
Four times or more	258 (30.86%)
I have good information about coronavirus and its ways of spreading	
Highly agree	733 (87.68%)
Agree	20 (2.39%)
Neutral	68 (8.13%)
Disagree	12 (1.44%)
Highly disagree	3 (0.36%)
I feel very afraid because there is no approved drug to treat COVID-19	
Highly agree	152 (18.18%)
Agree	296 (35.41%)
Neutral	200 (23.92%)
Disagree	148 (17.7%)
Highly disagree	40 (4.78%)
Coronavirus news on social media increases my anxiety and fear	
Highly agree	169 (20.22%)
Agree	271 (32.42%)
Neutral	176 (21.05%)
Disagree	173 (20.69%)
Highly disagree	47 (5.62%)
Isolated	84 (10.05%)
Do you have COVID-19?	
Yes	24 (2.87%)
No	745 (89.11%)
In the past	67 (8.01%)
Curfew hours during the past month	
Partial curfew 6 a.m.−3 p.m.	424 (50.72%)
Partial curfew 6 a.m.−8 p.m. Penalties for not wearing a face mask	409 (48.92%)
No curfew, Penalties for not wearing a face mask, refuse to be checked for temperature	3 (0.36%)
Pregnancy	19 (2.27%)
Are your sleep habits affected by special occasions as Ramadan or vacations? (Yes)	768 (91.87%)
Do you suffer from a chronic disease?	
No	671 (80.26%)
Yes	105 (12.56%)
I don't know	60 (7.18%)

Continuous data were expressed as median (25th−75th percentiles) and categorical data as numbers and percentages.

TABLE 2 | PSQI score component and K-10 score.

Variable	All participants ($n = 836$)
Subjective sleep quality	2 (2–3)
Sleep latency	1 (1–2)
Sleep duration	0 (0–1)
Habitual sleep efficiency	1 (0–3)
Sleep disturbance	1 (1–2)
Use of sleeping medication	0 (0–0)
Day time dysfunction	1 (0–2)
PSQI score	7 (6–10)
K-10 score	24 (18–31)

Continuous data were expressed as median and 25th−75th percentiles.

whether infected by COVID-19, suffering from a chronic disease, pregnant or how one's sleeping habits were affected by

special occasions such as the month of Ramadan or vacations." A recent meta-analysis showed that Ramadan and related behaviors influence sleep duration and daytime drowsiness. The average total sleep time for the entire population was 7.2 h at the start of the study, which fell by around 1 h throughout Ramadan. Ramadan fasting might affect daytime drowsiness, although the effect is minimal, as reflected by a recent meta-analysis that showed nearly a 1 point increase in the ESS score (25).

d. Over the preceding 30 days, subjective sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI) (26). The tool looks at seven areas: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, the use of sleep-promoting medication, and daytime dysfunction (26). Each component is scored on a four-point scale from 0 (no difficulty) to 3 (severe difficulty). The global score is calculated by adding each component's score, ranging from 0 to 21, with higher scores indicating lower sleep quality. It presents a cut-off point of PSQI ≤ 5 as good and PSQI >5 as poor sleep quality (26). We used the Arabic version of the PSQI got from MAPI Research Trust. The validity and reliability of the Arabic version have been demonstrated (27). The PSQI has a sensitivity of 89.6% and specificity of 86.5% for distinguishing good and poor sleepers, using a cut-off score of 5.
e. Kessler Psychological Distress Scale (K10) measures psychological distress based on ten questions assessing emotional states (28). It uses a 5-point scale ranging from "None of the time," which is assigned a score of 1, to "All of the time," assigned a score of 5. The maximum total score is 50, while the minimum is 10. A total score of <20 was considered not to represent stress of any level, while 20–24 represented mild stress, 25–29 moderate stress, and 30–50 represented severe stress (28). We used the Arabic version of K10 obtained from the Health Translation online library (29). The validity and reliability of the Arabic version have been demonstrated (30).

Procedure

The principal investigator posted an invitation on Twitter, WhatsApp, and Facebook. We reached isolated participants by sending invitations to special governmental facilities to be shared with them. Participants responded to the survey by scanning the Quick Response code (Q.R. code) on the questionnaire address or clicking on the appropriate link. Before taking part in the study, the participants gave their informed consent. There were no monetary or non-monetary incentives for time or responses; participation was voluntary.

Statistical Analysis

Data visualization and Shapiro-Wilk normality test was employed to evaluate the distribution of the continuous variables. Non-normally distributed continuous data were expressed as median (25th−75th percentiles) and compared using the Mann-Whitney U test. Categorical data were presented as numbers and percentages and compared by the Chi-square test or Fisher's exact test if the expected frequency was less than five.

The correlation between the K10 and PSQI scores was tested using the Spearman correlation test. Multivariable logistic regression analysis was used to identify risk factors associated with poor sleep and distress. Univariable logistic regression was performed for the individual variables, whereby those displaying a P-value <0.2 were included in a stepwise logistic regression analysis with a forward selection. A stay P-value of <0.05 was required to be included in the final regression model. Collinearity was tested using variance inflation factor (VIF), model calibration with the Hosmer-Lemeshow test, and discrimination with the area under the receiver operator curve. Negative binomial regression was used to identify factors associated with PSQI and K10 scores. We followed the same route for model selection as described for logistic regression analysis. Odds ratios (OR) and incidence rate ratios (IRR) were reported for the logistic and negative binomial regression models, respectively. Marginal analysis was performed after negative binomial regression to identify the K10 scores predicting PSQI scores. A generalized structural equation modeling was used to test the relationship between poor sleep and distress in the presence of other variables that could affect sleep. All statistical analyses were performed using STATA 16.1 (Stata Corp- College Station- TX- USA). A P-value of ≤ 0.05 was considered statistically significant.

RESULTS

Participants

One thousand three hundred fifty-four participants opened the survey; 913 completed it, and 441 did not. After excluding the participants on sleep or psychiatric medications, 836 were included. There were no differences in age ($p = 0.67$), gender ($p = 0.63$), marital status ($p = 0.70$), area of residence ($p = 0.56$), job-status ($p = 0.47$), education ($p = 0.92$) and nationality ($p = 0.15$) between respondents and non-respondents. However, non-respondents were more among healthcare professionals and had higher income ($p < 0.001$).

Socio-Demographics

We included 836 participants in our analysis. The median age was 28 years (25th−75th percentiles: 22–38), and 624 (74.6%) were females. Healthcare workers represented 18.9% of our participants ($n = 158$) and the majority were Saudis nationals ($n = 775$, 92.7%) and live in Riyadh ($n = 536$, 64.1%) (**Table 1**).

The socio-demographic data and the questionnaire responses were compared between participants with poor vs. good sleep and participants who had distress vs. those without distress in **Supplementary Table 1**.

PSQI and K10 Scores

The median PSQI score was 7 (6–10), and the median K10 score was 24 (18–31) (**Table 2**). The box plots of PSQI components in participants with good vs. poor sleep are presented in **Figure 1**. There was a significant difference in PSQI score between participants with poor vs. good sleep [8(6–10) vs. 4(3–4); $p <$

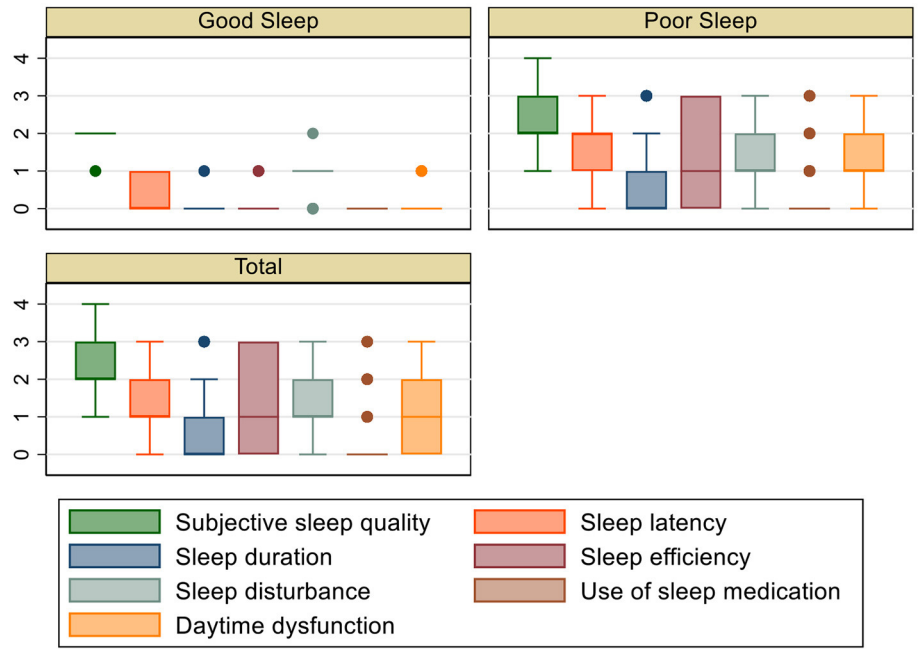

FIGURE 1 | Box plot of PSQI components in participants with good and poor sleep.

0.001] and between participants with distress vs. no distress [8(6–11) vs. 6(5–8); $p < 0.001$]. Participants with poor sleep had a higher K10 score compared to participants who had a good sleep [25(19–31) vs. 17(13–23); $p < 0.001$].

Factors Associated With Poor Sleep

Poor sleep was reported in 733 (87.7%) participants. Factors associated with poor sleep were recent changes in sleep habits due to special occasions such as Ramadan or vacations [(OR: 2.49(1.33–4.66); $p = 0.004$)], anxiety or fear because of coronavirus news on social media [2.13(1.10–4.11); $p = 0.02$], fear because there was no approved drug to treat COVID-19 [1.72(1.07–2.78); $p = 0.03$] and unawareness of the presence of chronic disease [9.15 (1.25–67.21); $p = 0.03$] (C-statistics: 0.65, Hosmer-Lemeshow $p = 0.97$). Recent changes in sleep habits, anxiety, fear because of coronavirus news on social media, chronic disease status, and hating social events were significantly associated with increased PSQI scores, while students had significantly lower PSQI scores (**Table 3**). Variables included in the multivariable logistic and negative binomial regressions are given in **Supplementary Table 2**.

Factors Associated With Distress

Distress was reported in 568 participants (67.9%). Female gender [OR: 1.54 (1.06–2.24); $p = 0.02$], living outside Riyadh (the capital) [OR: 1.74(1.23–2.48); $p = 0.002$], fear or anxiety because of coronavirus news on social media [OR: 1.64(1.02–2.65); $p = 0.04$], recent changes in sleep habits because of Ramadan or vacation [OR:1.97(1.15–3.39); $p = 0.01$], fear because there is no approved drug to treat coronavirus COVID-19 [OR:2.24(1.36–3.69); $p = 0.001$], monthly income of <SR 1000 [OR:2.07(1.22–3.5); $p = 0.01$], isolation [OR:2.08 (1.16–3.71); $p = 0.01$] and unaware of the presence of chronic disease [OR:2.53(1.19–5.4); $p = 0.02$] were associated with distress (C-statistics: 0.73, Hosmer-Lemeshow $p = 0.17$). Young age, students, and employees had lower K10 scores while getting bored or hating social events, fear of no available COVID-19 treatment, isolation, and feeling anxious or afraid of COVID-19 news on social media increased K10 score (**Table 4**). Variables included in the multivariable logistic and negative binomial regressions as given in **Supplementary Table 3**.

Relationship Between Sleep and Distress

PSQI and K10 scores had a significant positive correlation (Spearman rho = 0.41; $p < 0.001$) (**Figures 2A,B**). A K10 score of 21 points predicted poor sleep with a sensitivity of 64%, specificity of 72%, area under the curve of 0.73 (**Figure 3A**). The predicted PSQI scores according to the measured K10 score are shown in **Figure 3B**.

Distress was included in a generalized structural equation model to evaluate its relationship with poor sleep in the presence of other variables. Distress was significantly associated with poor sleep [coefficient: 0.15(0.10–0.20); $p < 0.001$]. Additionally, recent changes in sleep habits increased poor sleep by 8.4% ($p = 0.04$), while students had lower chances of experiencing poor sleep ($p = 0.01$). All distress categories affected sleep significantly moderate [coefficient: 0.12 (0.05–0.17); $p < 0.001$], high [0.16 (0.1–0.23); $p < 0.001$], very high [0.18(0.12–0.24); $p < 0.001$. Other factors presented in **Figure 4** were not significantly associated with poor sleep when distress was included in the model.

TABLE 3 | Factors associated with poor sleep and PSQI score.

	Factors associated with poor sleep		Factors associated with PSQI score	
	OR (95% CI)	***P***	**IRR (95% CI)**	***P***
Sleep habits affected by special occasions as Ramadan or vacations	2.49 (1.33–4.66)	0.004	1.19 (1.07–1.33)	0.001
Coronavirus news on social media increases my anxiety and fear (Highly agree)	2.13 (1.10–4.11)	0.02	1.05 (1.03–1.08)	<0.001
I have a chronic disease (I don't know)	9.15 (1.25–67.21)	0.03	1.05 (1.01–1.1)	0.02
I feel very afraid because there is no approved drug to treat COVID19 (Agree)	1.72 (1.07–2.78)	0.03	–	–
Hates social events and does not go there	–	–	1.17 (1.04–1.04)	0.01
Student	–	–	0.91 (0.84–0.98)	0.01

CI, confidence interval; IRR, incidence rate ratio; OR, odds ratio.

TABLE 4 | Factors associated with distress and K-10 score.

	Factors associated with distress		Factors associated with K-10 score	
	OR (95% CI)	***P***	**IRR (95% CI)**	***P***
Age	0.97 (0.96–0.99)	0.003	0.99 (0.98–0.99)	<0.001
Female	1.54 (1.06–2.24)	0.02	–	–
Student	0.63 (0.4–0.99)	0.047	0.88 (0.82–0.95)	0.001
Employee	–	–	0.9 (0.84–0.96)	0.001
I feel very afraid because there is no approved drug to treat COVID19 (Highly agree)	2.24 (1.36–3.69)	0.001	1.05 (1.02–1.07)	<0.001
Coronavirus news on social media increases my anxiety and fear	0.65 (0.45–0.95)	0.03		
Disagree		–	–	
Agree	1.64 (1.02–2.65)	–	1.13 (1.01–1.27)	0.04
Highly agree		0.04	1.26 (1.11–1.43)	<0.001
Sleep habits affected by special occasions as Ramadan or vacations	1.97 (1.15–3.39)	0.01	–	–
Living outside Riyadh	1.74 (1.23–2.48)	0.002	–	–
Monthly income <1000 SR	2.07 (1.22–3.5)	0.01	–	–
I have a chronic disease (I don't know)	2.53 (1.19–5.4)	0.02	–	–
Gets bored of social events and does not go there	–	–	1.12 (1.04–1.18)	0.002
Hates social events and does not go there	2.85 (1.27–6.4)	0.01	1.23 (1.12–1.35)	<0.001
Isolation	2.08 (1.16–3.71)	0.01	1.12 (1.04–1.21)	0.004

CI, confidence interval; IRR, incidence rate ratio; OR, odds ratio.

DISCUSSION

The current study found a high rate of sleep disturbances in the Saudi Arabia population during the COVID-19 lockdown, and that sleep disturbances increased the risk of mental health problems, particularly in front-line epidemic workers, people who were quarantined or isolated, young people. The findings emphasize the significance of interventions aimed at persons with sleep disorders in order to decrease mental health problems during a public health crisis. Vulnerable populations, in particular, should be continuously watched. The current findings can be used to establish mental health intervention policies during epidemic/pandemic situations.

An epidemic or pandemic such as the COVID-19 affects societies' physical and mental health (6, 7). During the COVID-19 outbreak, stress, anxiety, and depression increased, while sleep was similarly affected, as evidenced by various studies in different populations (4, 5, 8, 9, 11, 15, 16). Another study found that current or previous COVID-19 infection was associated with psychiatric disorders and loneliness (31). As a result, the objective of this study was to evaluate the factors that affected sleep quality and psychological distress in the Saudi population during the COVID-19 pandemic. Our study revealed that the prevalence of poor sleep was associated with recent changes in sleep habits, fear, and anxiety due to lack of approved drugs for treating the disease as well as an overflowing amount of COVID-19-related information on social media. Before COVID-19, medical residents in Saudi Arabia have a significant rate of poor sleep quality. The most mentioned sleep distractors were increased sleep latency and short sleep duration. Sleep deprivation was linked to on-call schedules and shift jobs. The 80-h weekly maximum for training programs should be adhered to, and wellness programs should be included in the curriculum (32). A similar trend was also reported in local studies that underlined deterioration in sleep quality and a high prevalence of sleep disorders during the spreading of the pandemic among physicians, quarantined

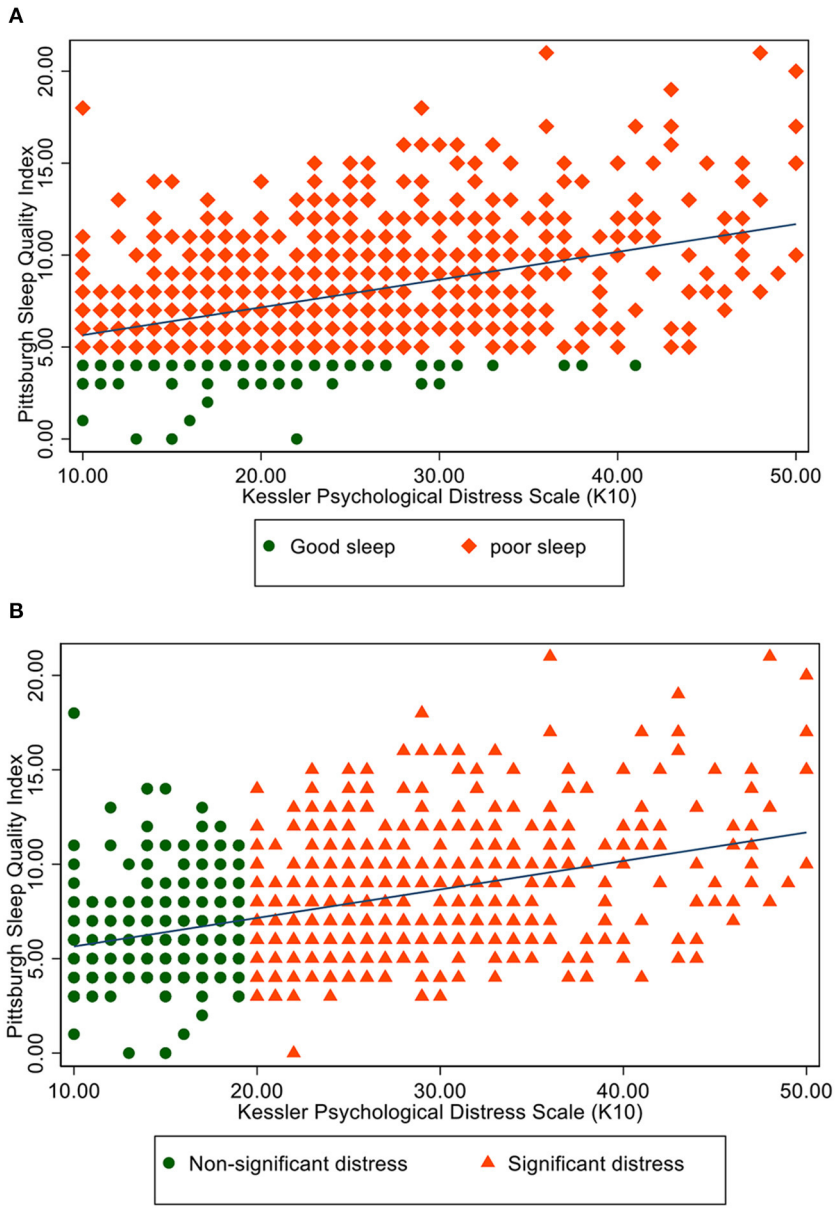

FIGURE 2 | (A) Scatter plot of PSQI and K-10 scores in patients with poor vs. good sleep. **(B)** Scatter plot of PSQI and K-10 scores between participants with significant and non-significant distress.

individuals, and the public (33–36). Other studies from different countries have highlighted the increased prevalence of sleep problems. For example, Casagrande et al. (37) reported a 57.1% prevalence of poor sleep quality among the Italian population during the pandemic (37). Similarly, in a web-based cross-sectional survey of 7,236 Chinese individuals, Huang and Zhao (38) indicated that about 18% of the participants reported symptoms of poor sleep quality during the disease outbreak (38). An Italian cross-sectional study observed a significant increase in the PSQI score during COVID-19 lockdown (39).

The overwhelming COVID-19 social media news and information created fear and confusion among the public (40). Another study of 521 Bangladeshi individuals found that fear of the COVID-19 disease significantly impacted sleep quality, with significantly higher COVID-19 dread, perceived stress, and subjective sleep quality (41). In addition, poor sleep quality has a detrimental impact on life satisfaction, health, and social and emotional domains (42).

Our study found psychological distress among 67.9% of our sample, with a median K10 score of 24 (18–31). This finding

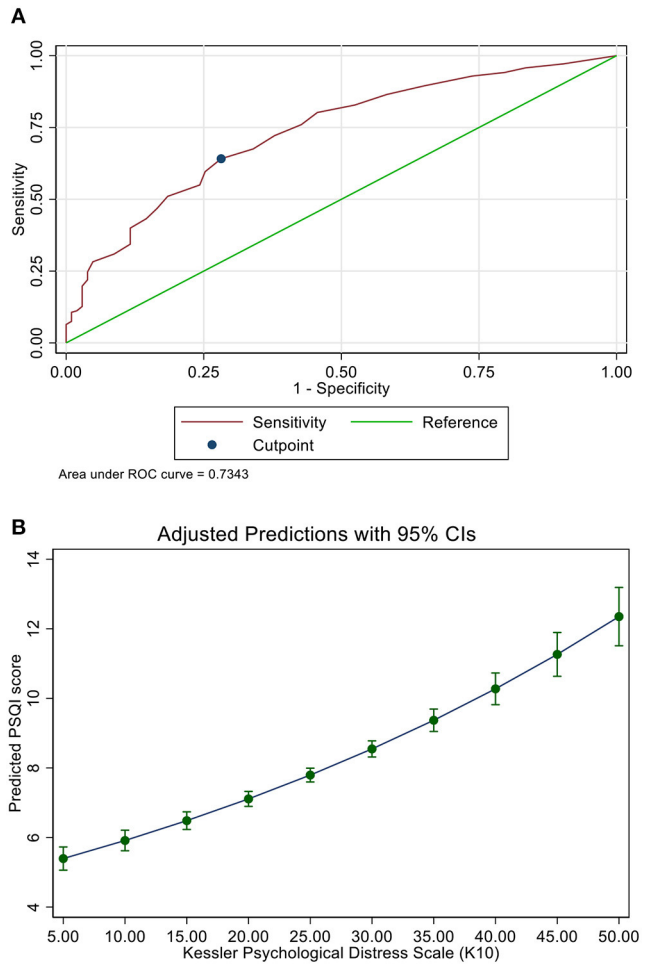

FIGURE 3 | (A) The receiver operator curve (ROC) for the cut-off point of K-10 score predicting poor sleep. **(B)** The predicted PSQI score according to the K-10 score.

is consistent with other studies that reported the increased prevalence of psychological distress during the pandemic (43–45). In some studies, the psychological distress related to pandemics has been associated with gender, whereby these trends among females appear to have remained constant or even become exasperated (46). Our study has also revealed a significant association of psychological distress with the female gender. These findings are comparable to the studies of Al-Hanawi et al. (45) and Alkhamees et al. (44), reporting similarly higher rates of distress among females during the pandemic (44, 45). The explanation for this might be that older individuals are better at managing their stress than younger ones because they better understand the epidemic. Another theory is that COVID-19 causes the most emotional anguish among younger individuals due to their high exposure to social media, which disseminates a significant quantity of information about the epidemic, some of which are important and some unsettling. Previous data from KSA supports this conclusion, demonstrating that internet addiction causes significant suffering among the young, particularly those at undergraduate college levels (45). In contrast, however, higher stress levels were linked to the disease in men than in women in some other studies, possibly pointing to ethnic or societal variations in such demographic-related analyses (47–49).

The COVID-19 epidemic expanded the use of electronic devices, particularly smartphones, as a method of reducing the negative consequences of social isolation and communicating with the rest of the world, all while preserving the necessity for social separation. As a result, the number of research documenting the negative impacts of excessive mobile device use on mental and physical health is continuously growing (50–54).

This study also revealed the sleep quality and psychological distress among healthcare workers during this outbreak of COVID-19. Previous national studies showed that healthcare workers are a vulnerable group susceptible to psychological distress (55, 56). Our results showed that almost 18% (n = 132) of the studied participants experienced poor sleep quality, and 16.9% reported psychological distress. Our findings concur with the recent data published from other countries. A recent analysis reported a 45.1% (95% CI: 37.2–53.1%) sleep disturbance and a higher total PSQI score of (9.83) in the Chinese healthcare workers during the pandemic (57).

Our study also observed a change in the prevalence of sleep quality and mental health among students. Findings indicate that 36.6% of students had poor sleep quality, while 40.5% experienced psychological distress. Comparable with our results, a recent study in Bangladesh reported that University students were mentally distressed and experiencing poor subjective sleep quality during the pandemic (58). Similar results were also revealed by Martinez-Lezaun et al. (59), who reported 70.7% of the University students showed worse sleep quality during the lockdown.

The recent COVID-19 pandemic has also triggered various economic crises that have resulted in psychological suffering among different groups of people in society. Accordingly, our study has shown significantly higher psychological distress among low-income categories. At the same time, a longitudinal study in the general Japanese population also reported severe psychological distress among those in the lower-income bracket compared to those in the higher category (60). A cross-national analysis from 62 countries found social isolation and loneliness adversely impact psychological wellbeing and its prediction of poor mental health of society (61) similar to our findings. A significant relationship was found in our study between sleep quality and psychological distress, as demonstrated by the significant positive correlation between PSQI scores and K10 scores. Similar findings were reported in different populations and risk groups (62, 63). Accordingly, it can be speculated that information linking sleep quality with psychological distress provides some important clues about the potential role of the

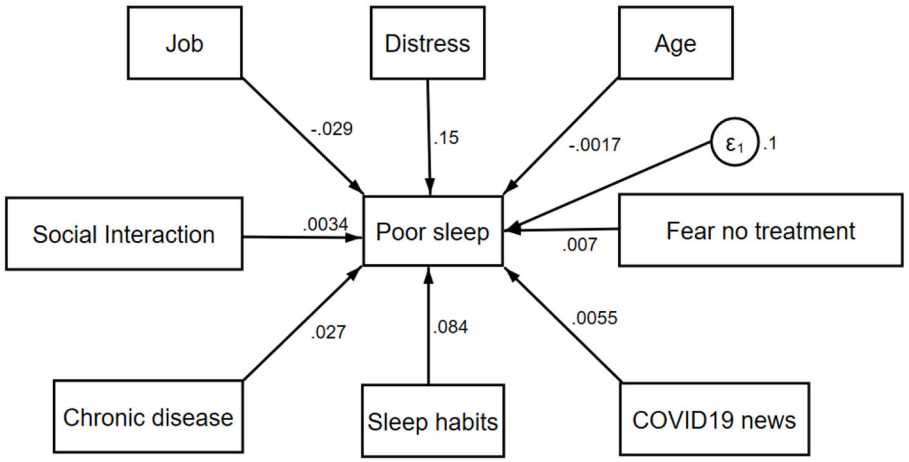

FIGURE 4 | Relationship between poor sleep and factors associated with it (Numbers on arrows indicate the effect magnitude of each variable on sleep, ε is the calculated error).

former in predicting the onset of psychological problems and depressive disorders.

There were limitations to the current study that must be noted. First, the data and results were derived from a cross-sectional design; hence it is difficult to make causal inferences. Also, since this is a cross-sectional survey that was done during the early stages of the COVID-19 epidemic in Saudi Arabia, long-term effects are not known. The data particularly captures the mental health state at that moment. Second, using a web-based survey procedure to conduct a study such as ours within the period of social distancing limits the generalizability of the results. Most of our participants were relatively young, which could be due to the distribution of the survey through social media. This observation could lead to an underestimation of the psychological effect of the pandemic. Third, reporting bias is possible due to the self-reported nature of the survey. Fourth, since the median PSQI score is relatively low, this could be a particular kind of selection bias. Those who have voluntarily responded could be more interested in the topic since being sleep-disturbed. The survey did not include data related to contact with COVID-19 patients, which could be the source of stress. Several other factors could have affected sleep and were not included in the survey. Longitudinal follow-up studies are advised to investigate the dynamic dynamics of people's mental health state during the pandemic. Finally, no specialist sleep assessment instruments were utilized, which resulted in the omission of data such as the severity of sleep disorders, limiting our knowledge of the observed sleep abnormalities.

CONCLUSION

Our survey results reveal a sizeable percentage of the Saudi population experienced poor sleep and psychological distress during the COVID-19 outbreak. Poor sleep was strongly associated with recent changes in sleep patterns, worry, or anxiety because of the lack of an authorized medication to treat coronavirus and the overabundance of information about COVID-19 on social media. In addition, distress was significantly correlated with female gender, low monthly income, and isolation, while sleep quality and psychological distress were interrelated.

DATA AVAILABILITY STATEMENT

Data are available upon reasonable requests to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board (IRB) of King Saud University Medical City (E-20-4869) and the IRB of the Ministry of Health (20-331E). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MA, SA-A, HJ, and AB: conceptualization, investigation, and methodology. MA: formal analysis. MA, AA, KB, and NA: data curation. MA, SA-A, HJ, AB, NA, and FK: writing—original draft preparation, writing—review, and editing. All authors read and agreed to the published version of the manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.809040/full#supplementary-material

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Does Mental Health Affect the Decision to Vaccinate Against SARS-CoV-2? A Cross-Sectional Nationwide Study Before the Vaccine Campaign

Julian Maciaszek[1], Marta Lenart-Bugla[1], Dorota Szcześniak[1], Paweł Gawłowski[2], Wojciech Borowicz[3], Błażej Misiak[1] and Joanna Rymaszewska[1]*

[1] Department of Psychiatry, Wroclaw Medical University, Wroclaw, Poland, [2] Department of Emergency Medical Service, Wroclaw Medical University, Wroclaw, Poland, [3] Department of Pediatric Infectious Diseases, Wroclaw Medical University, Wroclaw, Poland

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***Correspondence:**
Julian Maciaszek
julian.maciaszek@umed.wroc.pl

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The COVID-19 pandemic generated a sense of threat in the society, leading to social isolation and mental health deterioration. A great deal of hope for the development of herd immunity was placed in preventive vaccinations. The survey, performed before vaccine campaign between September 26-October 27, 2020, during the second wave of the SARS-CoV-2 pandemic in Poland with the Computer Assisted Web Interviews method. The study was partly community based and partly open to the public. Participants were invited to complete the survey using Google forms *via* social media (Facebook, WhatsApp). The survey was also distributed 54 times at the request of interested persons *via* e-mail. Total 1,043 questionnaires were assessed for eligibility and 41 were excluded (13 because of the age under 18, and 28 due to refusal to participate: non-response after sending questionnaire *via* e-mail). Finally 1,001 questionnaires were included to the study and statistical analysis was performed on the basis of the 1,001 responses. The questionnaire consisted of three parts: a sociodemographic survey, a questionnaire assessing the knowledge of the SARS-CoV-2 and the General Health Questionnaire-28. Participants also determined their attitude toward being vaccinated against SARS-CoV-2. The questionnaire was completed by a total of 1,001 participants: 243 people declared that they will not get vaccinated against SARS-CoV-2. Majority of people declaring the willingness to vaccinate were representatives of medical professions, suffering from chronic diseases, with higher values on the total GHQ-28 scale and the subscales: anxiety and insomnia, social dysfunction and somatic dysfunction. Loss of income, difficult access to health care, recognizing the restrictions as excessive and knowledge about COVID-19 were found as significant positive determinants of the reluctance to vaccinate. Greater readiness to vaccinate can be associated with greater certainty about its effectiveness and a hypothetical collectivist attitude. Experiencing anxiety and psychopathological symptoms

are risk factors for infection, but can also be conducive to reliance on information about vaccination presented in the media. Reluctance to vaccinate may result from greater awareness of the complexity of the disease, and thus less faith in the effectiveness of vaccines.

Keywords: COVID-19, SARS-CoV-2, anxiety, mental deterioration, vaccine decision-making

INTRODUCTION

Analyzes prepared by the WHO Collaborating Center for Infectious Disease Modeling predicted the effects of the SARS-CoV-2 pandemic at the level of the 1,918 influenza pandemic, killing 50 million people (1). The average mortality rate of SARS-CoV-2 is 2.2%, the Infection Fatality Rate (IFR) ranges from 0.3 to 0.6% (2, 3). To date, over 5 million people have died from COVID-19 worldwide (4). Due to reorganization of the health care system, a reduction in the total number of hospitalizations and planned procedures (5, 6), hospitalizations due to acute coronary syndromes (7, 8) and oncological operations (9) was observed. As a result of these changes, many countries have seen an increase in the number of deaths compared to previous years, also after taking into account those caused by COVID-19 (10). The introduced lockdowns also contributed to the severe economic crisis and an increase in the unemployment in most countries (11).

The COVID-19 pandemic generated a sense of threat in the society, modified lifestyles, leading to social isolation, and thus contributing to a reduction in the quality of life (12). In the course of the pandemic in the general public, symptoms of post-traumatic stress disorder and depression, as well as increased and anger were observed (13–15). In the previous study, analogous to the current one, conducted during the first wave of SARS-CoV-2 in Poland, over 50% of respondents showed at least mild psychopathological symptoms (16). A study by Babicki et al. (17) in the Polish population indicated an equally high prevalence of psychopathological symptoms also during the second wave of the pandemic. The impact of the pandemic on anxiety seems to be particularly important, as confirmed by the study conducted by Greenhawt et al. (18), based on approximately 5,000 respondents whose mean state anxiety score (S-anxiety) was significantly higher than mean trait anxiety score (T-anxiety), with both scores being significantly higher than the previously published standards. The meta-analysis by Bueno-Notivol et al. (19) indicates that the pooled prevalence of depressive symptoms in society during the COVID-19 pandemic is estimated at 25%—approximately seven times greater compared to the average prevalence of pre-pandemic depression, estimated at 3.44%. A study comparing the first and second waves of COVID-19 also confirmed the persistent negative impact of the pandemic on the quality and duration of sleep (20).

A great deal of hope for the development of herd immunity was placed in preventive vaccinations. So far, on November 4, 2021, 39% of the world's population was fully vaccinated against SARS-CoV-2. Individual countries differ significantly depending on the number of complete vaccinations, e.g., USA 57%, Israel 65%, Germany 66%, Poland 53% and Russia 33% (21).

So far, only individual studies examining the factors influencing the decision to vaccinate have been published. Due to the importance of the topic, this original survey is aimed to identify the relationship between the decision to vaccinate and demographic factors, mental health measured with the standardized GHQ-28 questionnaire and pandemic-related factors. We hypothesize that the presence of psychopathological symptoms, as well as the level of knowledge on SARS-CoV-2 determine the willingness to be vaccinated.

MATERIALS AND METHODS

The survey was performed from September 26, 2020 to October 27, 2020, during the second wave of the SARS-CoV-2 pandemic in Poland. At that time, there was a sharp increase in the number of reported positive test results and, due to the epidemiological situation, additional restrictions were introduced, such as the obligation to cover the mouth and nose in public spaces (22).

At the time of data collection, no SARS-CoV-2 vaccines were available and no reports of their efficacy were published. The questionnaires were obtained using the Computer Assisted Web Interviews (CAWI) method, which is currently one of the most popular and fastest growing survey methods. Thanks to the feeling of anonymity and the opportunity to participate in the survey at a time convenient for the respondent, it allows to collect more reliable data. The manuscript was formulated based on STROBE Statement—cross-sectional reporting checklist (23) and the protocol was described in the STROBE flow chart (**Figure 1**). A priori analysis performed using G* Power software (24) revealed that to detect a correlation with $r = 0.01$ and power of 0.95, the calculated sample size was 595. Due to the potential non-response, questionnaires were sent to more participants. The study was partly community based and partly open to the public. Participants were invited to complete the survey using Google forms *via* social media (Facebook, WhatsApp) and information about the survey was also posted on the website of the Department of Psychiatry of the Wroclaw Medical University. In the case of people willing to complete the survey who do not use social media, the survey was also distributed 54 times at the request of interested persons *via* e-mail. The questionnaire was fully anonymous, aimed at people aged 18 and over, and only fully completed questionnaires were analyzed. Total 1,043 questionnaires were assessed for eligibility and 41 were excluded (13 because of the age under 18, and 28 due to refusal to participate: non-response after sending questionnaire *via* e-mail). Finally 1,001 questionnaires were included to the study and statistical analysis was performed on the basis of the 1,001 responses.

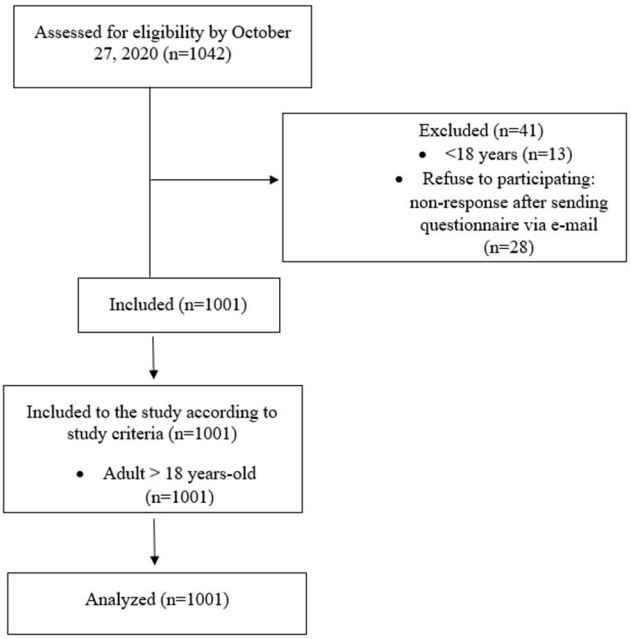

FIGURE 1 | STROBE flow chart.STROBE.

All participants gave their informed consent to participate in the survey. The study procedure was approved by the Ethics Committee of the Medical University of Wroclaw (Poland, no 188/2020) and performed in accordance with the principles of the Helsinki Declaration.

The study consisted of three parts: a sociodemographic survey, a questionnaire assessing the knowledge of the SARS-CoV-2 pandemic and the General Health Questionnaire-28 (GHQ-28). Participants also determined their attitude toward being vaccinated against SARS-CoV-2, choosing from the following responses: (a) "I will definitely not get vaccinated against SARS-CoV-2"; (b) "I would make a decision based on the ratio of vaccine efficacy to the observed side effects"; (c) "I will definitely get vaccinated against SARS-CoV-2".

The sociodemographic survey included questions about sex, age, place of residence, education, the presence of chronic diseases and the use of psychological or psychiatric care. This section also included questions about the impact of lockdown on income, access to medical care, frequency of tracking the epidemiological situation, main sources of knowledge about the SARS-CoV-2 pandemic, and assessment of the extent of the lockdown. The full sociodemographic survey is available in the **Supplementary Table S1**.

The original questionnaire of knowledge about COVID-19 included 10 questions, for each correct answer, participants could get one point. Question number 1 regarded the current definition of a pandemic, questions 2,3,4,6 concerned the virulence and course of SARS-CoV-2 infection, questions 5,7,8 concerned the measurable effects of the pandemic, and questions 9 and 10 regarded knowledge of personal protective equipment. The detailed questionnaire of knowledge about COVID-19 is available in the **Supplementary Table S2**.

The number of correct answers was included as the measure of knowledge (**Supplementary Table S2**). The Cronbach's alpha in the total sample was 0.716, indicating acceptable internal consistency. In our previous study, we presented the relationship between mental health and knowledge of SARS-CoV-2 (25).

The GHQ-28 is a questionnaire that assesses the prevalence of psychopathological symptoms in the general population. It consists of 28 questions divided into four categories of symptoms: severe depression (items 6, 19, 20, 21, 22, 23, 24), anxiety and insomnia (items 2, 7, 9, 13, 15, 17, 18), disorders of social functions (items 5, 10, 11, 25, 26, 27, 28) and somatic symptoms (items 1, 3, 4, 8, 12, 14, 16) (26, 27). The points range from 0 to 84 points, with a higher score indicates greater psychopathology in the mental picture. The cut-off point for clinical significance was set at 24 points, as described by Makowska and Merecz (27).

Only fully completed questionnaires were used for statistical analysis. The following procedure was used: anonymous responses received *via* Google Forms were identified by code numbers, checked for completeness and submitted for further analysis.

The Mann-Whitney U test or *t*-test, respectively, were used to compare participants for continuous values. The Shapiro-Wilk test was used to evaluate the normal distribution. The chi-square test was used to assess the differences between the groups in terms of categorical variables. Additionally, a binary logistic regression was performed. Reluctance to vaccinate against SARS-CoV-2 was defined as the dependent variable. The independent variables were the factors that significantly differentiated the anti-vaccination and pro-vaccination groups with respect to the bivariate comparison. Three models differing from the independent variables were created to determine the model with the highest value of Negelkere's R2 that most fully described the effect on the dependent variable. The higher Negelkere's R2 value, the greater the proportion of variance 'explained' by the regression model makes it a useful measure of the success of predicting a dependent variable from independent variables.

In the first step, we took into account the psychopathology described in the GHQ-28 subscales. Next, we added sociodemographic factors. Finally, we extended the previous models to include factors related to the pandemic, considering the level and source of knowledge about COVID-19, as well as the impact of lockdown and attitudes to the introduced restrictions.

The results were considered significant if the *p*-value was <0.05. All analyzes were performed in SPSS (IBM SPSS Statistics for Windows).

RESULTS

General Characteristics

In the current study, 1,001 responses were collected. Among the respondents, 243 people (24%) declared "I will definitely not get vaccinated against SARS-CoV-2", 574 people (57%) declared "I would make a decision based on the ratio of vaccine effectiveness to the observed side effects", and 184 people (18%) declared "I will definitely get vaccinated against SARS-CoV-2". **Table 1** presents the characteristics of the study group taking into account gender. Almost 75% of the respondents were women, the average age was 38 years (standard deviation [SD]: 14.6, range 18–83), 90%

TABLE 1 | General characteristics of total sample. *n* (%) or mean ± standard deviation.

	Total ***n* = 1001**	**Women** ***n* = 750 (74.85%)**	**Men** ***n* = 251 (25.15%)**	***p*-value**
Age, years	38.36 ± 14.62	38.17 ± 14.19	38.91 ± 15.82	0.867
Place of residence (urban)	901 (90.01%)	675 (90%)	226 (90.04%)	0.971
Education level (higher education)	759 (75.82%)	576 (76.80%)	183 (72.91%)	0.276
Occupation (medical profession)	479 (47.85%)	382 (50.93%)	97 (38.65%)	**0.031**
Chronic diseases (yes)	210 (20.98%)	167 (22.27%)	43 (17.13%)	0.225
Psychiatric or psychological care	172 (17.18%)	138 (18.40%)	34 (13.55%)	0.179
GHQ-28 positive scoring	394 (39.36%)	318 (42.40%)	76 (30.28%)	<0.000
GHQ-28—Total score	22.86 ± 12.9	23.72 ± 13.34	20.29 ± 11.04	0.692
GHQ-28—somatic symptoms	5.66 ± 3.8	6.01 ± 3.89	4.65 ± 3.28	**0.000**
GHQ-28—anxiety and insomnia	6.58 ± 4.7	6.95 ± 4.76	5.46 ± 4.18	0.105
GHQ-28—social dysfunction	7.66 ± 2.9	7.72 ± 3.01	7.46 ± 2.50	**0.019**
GHQ-28—severe depression	2.96 ± 3.8	3.04 ± 3.80	2.72 ± 3.57	0.168
Vaccination (anti-vaccination)	243 (24.28%)	182 (24.27%)	61 (24.30%)	0.645
Loss of income	277 (27.67%)	206 (27.47%)	71 (28.29%)	0.979
Difficulty in accessing heathcare	457 (45.65%)	357 (47.60%)	100 (39.84%)	**0.029**
Daily tracking of the epidemiological situation	424 (42.36%)	320 (42.67%)	104 (41.43%)	**0.000**
Opinion: the applied lockdown was excessive	348 (34.77%)	238 (31.73%)	110 (43.82%)	**0.020**
Mass media as main source of information	382 (38.16%)	345 (46.00%)	37 (14.74%)	**0.037**
Knowledge about SARS-CoV-2: number of correct answers	6.0 ± 2.1	5.85 ± 2.12	6.48 ± 2.12	**0.000**

Data expressed as n (%) or mean (SD). Significant effects ($p < 0.05$) are marked in bold.

lived in the city, almost 76% had higher education, almost 48% worked in the medical profession, 21% suffered from chronic somatic diseases and 17% received psychiatric or psychological care (**Table 1**). Using the GHQ-28 scale showed that 39% of all respondents obtained more than 24 points, which suggests the presence of clinically relevant psychopathological symptoms. The mean GHQ-total score was 22.86 (SD: 12.9 points, range: 1–75). Over 27% of respondents reported losing income as a result of the lockdown, and over 45% reported difficult access to healthcare during the pandemic. In the study sample, 42% monitored the epidemiological situation every day, over 34% described the previously introduced lockdown as excessive, and 38% indicated the mainstream media as the main source of knowledge about the COVID-19 pandemic. In the questionnaire of knowledge about COVID-19 the average score was 6.0 points (SD: 2.1, range: 0–10). Compared to men in the study group, women were significantly more likely to work in health care, had a higher severity of social dysfunction and somatic symptoms, more often than men indicated limited access to health care, more often indicated the daily monitoring of the epidemic situation and more often relied on the mass media as the main source of information about the pandemic. Men in the study group achieved significantly higher results in the COVID-19 questionnaire and significantly more often indicated an excessive range of introduced lockdowns.

Bivariate Comparisons

Table 2 shows the comparison of the two groups in terms of the declared willingness to vaccinate. The first group included people definitely reluctant to vaccination (anti-vaccination), the second group included the remaining people considering or already decided to vaccinate (pro-vaccination). The pro-vaccination attitude was significantly more often observed among representatives of medical professions and people with chronic diseases. People declaring the willingness to vaccinate obtained significantly higher values on the GHQ-28 scale, both in relation to the total results and the subscales: anxiety and insomnia, social dysfunction and somatic dysfunction. Nearly 33% of people reluctant to get vaccinated and over 41% of those willing to vaccinate experienced significant clinical psychopathological symptoms. Respondents from the pro-vaccination group significantly more often confirmed the daily monitoring of the epidemiological situation and more often indicated the mass media as the main source of information about the pandemic. Anti-vaccination groups significantly more often experienced loss of income, loss of access to health care, and more often considered the epidemiological restrictions to be excessive. People from the anti-vaccination group obtained a significantly higher number of correct answers in the COVID-19 knowledge test.

Logistic Regression Analysis

Table 3 shows the results of binary logistic regression. In the first model, taking into account the following GHQ-28 domains: somatic symptoms, anxiety and insomnia and social dysfunction, no factors significantly correlating with reluctance to vaccinate were found. The first model had a Negelkere's R2 coefficient of 0.015. The second model was extended over the first to include the occupation and chronic diseases. A significant negative correlation was found between the practice of a medical profession, the presence of chronic diseases and reluctance to vaccinate against SARS-CoV-2. The second model

TABLE 2 | Comparison of the two groups in terms of the declared willingness to vaccinate.

	Anti-vaccination, $n = 243$	Pro-vaccination, $n = 758$	*p*-value	*Z*-value	ES
Sex (female)	182 (74.90%)	569 (75.07%)	0.976	−0.030	0.000
Age, years	38.74 ± 13.12	38.24 ± 15.08	0.252	−1.146	0.001
Place of residence (urban)	211 (86.83%)	690 (91.03%)	0.058	1.890	0.004
Education level (higher education)	175 (72.02%)	584 (77.04%)	0.143	1.464	0.002
Occupation (medical profession)	92 (37.86%)	387 (51.06%)	**<0.001**	−3.581	0.013
Chronic diseases (yes)	36 (14.81%)	174 (22.96%)	**0.004**	2.866	0.008
Psychiatric or psychological care	36 (14.81%)	136 (17.94%)	0.225	1.213	0.001
GHQ-28 positive scoring	80 (32.92%)	314 (41.42%)	**0.018**	2.280	0.005
GHQ-28—Total score	21.00 ± 12.90	23.47 ± 12.82	**0.001**	3.233	**0.**010
GHQ-28—somatic symptoms	5.08 ± 3.81	5.86 ± 3.77	**<0.001**	3.362	0.011
GHQ-28—anxiety and insomnia	5.77 ± 4.81	6.84 ± 4.60	**<0.001**	3.748	0.014
GHQ-28—social dysfunction	7.38 ± 3.07	7.75 ± 2.83	**0.032**	2.148	0.005
GHQ-28—severe depression	2.77 ± 3.56	3.02 ± 3.81	0.117	1.567	0.002
Loss of income	87 (35.80%)	190 (25.07%)	**0.001**	−3.341	0.011
Difficulty in accessing heathcare	139 (57.20%)	318 (41.95%)	**<0.001**	−4.039	0.016
Daily tracking of the epidemiological situation	68 (27.98%)	356 (46.97%)	**<0.001**	5.288	0.028
Opinion: the applied lockdown was excessive	158 (65.02%)	190 (25.07%)	**<0.001**	−11.356	0.129
Mass media as main source of information	64 (26.34%)	318 (41.95%)	**<0.001**	3.011	0.009
Knowledge about SARS-CoV-2: number of correct answers	6.83 ± 2.15	5.76 ± 2.07	**<0.001**	−6.842	0.047

n (%) or mean ± standard deviation.
Data expressed as n (%) or mean (SD).
Significant differences ($p < 0.05$) were marked with bold characters.

had a Negelkere's R2 coefficient of 0.037. In the third model we added the following variables: loss of income, difficult access to health care, daily monitoring of the epidemiological situation, opinion: the applied restrictions were excessive, mass media as the main source of information, and knowledge about COVID-19: number of correct answers. A significant negative relationship was found between the results of anxiety and insomnia in the GHQ-28, the practice of a medical profession, daily monitoring of the epidemiological situation, the mass media as the main source of information and reluctance to vaccinate. The following factors were found as significant positive determinants of the reluctance to vaccinate: loss of income, difficult access to health care, finding the applied lockdown as excessive and knowledge about SARS-CoV-2: number of correct answers. The third model was characterized by a definitely higher Negelkere's R2 coefficient of 0.252 as compared to the previously described models and described the effect on the dependent variable most fully.

DISCUSSION

In this study we aimed to describe the factors influencing the decision to vaccinate against SARS-CoV-2. We observed a significantly lower severity of psychopathological symptoms measured with the GHQ-28 in people reluctant to get vaccinated compared to those considering vaccination, both in terms of the total score and all its subscales, including somatic symptoms, severe depression, social dysfunction, anxiety and insomnia. As a result of the use of binary logistic regression, it was shown that only the values in the anxiety and insomnia subscale, significantly negatively correlated with reluctance to vaccinate, turned out to be the inverse determinant of vaccination refusal.

Regarding the effect of socio-demographic variables on the decisions regarding vaccination we observed that pro-vaccination attitude was significantly more often present among medical professionals, respondents suffering from chronic diseases as well as among city dwellers and respondents with higher education level, for whom however, statistical significance was not achieved. In relation to pandemic related factors pro-vaccination attitude was more often observed among respondents who indicated daily monitoring of the epidemiological situation and more often chose the mass media as the main source of information about the pandemic. Anti-vaccination attitude was significantly more often observed in relation to the respondents who pointed to loss of income, loss of access to health care, and more often considered the epidemiological restrictions to be excessive—which factor had the highest effect size of 0.129 among bivariate variables. People from the anti-vaccination group obtained a significantly higher number of correct answers in the COVID-19 knowledge test and had the second highest effect size of 0.047.

In the survey, among more than 1,000 people, 24% of participants were willing to get vaccinated against SARS-CoV-2, 57% were unsure about vaccination and 18% were reluctant to be vaccinated. The obtained results indicate a clear polarization of the respondents in regard to the decision about vaccination. However, it is worth noting that during the distribution of the survey, reports from manufacturers detailing the efficacy and side effects of vaccines were not widely available. At that time, only the

TABLE 3 | Factors related to the non-vaccination against SARS-CoV-2 using binary logistic regression analysis.

Model (Negelkere's R2)	Variable	Beta	S.E.	*p*-value	VIF	O.R.	95% CI
Model 1	GHQ-28—somatic symptoms	−0.016	0.036	0.650	3.150	0.984	0.917–1.056
(0.015)	GHQ-28—anxiety and insomnia	−0.046	0.030	0.122	3.289	0.955	0.901–1.012
	GHQ-28—social dysfunction	0.013	0.035	0.706	1.741	1.013	0.946–1.085
Model 2	GHQ-28—somatic symptoms	0.001	0.037	0.984	3.209	1.001	0.931–1.075
(0.037)	GHQ-28—anxiety and insomnia	−0.053	0.030	0.080	3.300	0.948	0.894–1.006
	GHQ-28—social dysfunction	0.006	0.035	0.862	1.750	1.066	0.939–1.078
	Occupation (medical profession)	−0.450	0.180	0.012	1.007	0.638	0.448–0.907
	Chronic diseases (yes)	−0.572	0.205	0.005	1.020	0.564	0.378–0.843
Model 3	GHQ-28—social dysfunction	−0.034	0.038	0.360	1.772	0.966	0.898–1.040
(0.252)	GHQ-28—anxiety and insomnia	−0.071	0.033	0.032	3.356	0.932	0.873–0.944
	GHQ-28—somatic symptoms	0.060	0.040	0.131	3.262	1.062	0.982–1.147
	Occupation (medical profession)	−0.484	0.196	0.014	1.017	0.616	0.420–0.906
	Chronic diseases (yes)	−0.387	0.225	0.085	1.044	0.679	0.437–1.056
	Loss of income	0.359	0.177	0.043	1.027	1.431	1.012–2.025
	Difficulty in accessing health care	0.542	0.167	0.001	1.038	1.719	1.240–2.384
	Daily tracking of the epidemiological situation	−0.504	0.178	0.005	1.068	0.604	0.426–0.856
	Opinion: the applied lockdown was excessive	1.327	0.176	<0.001	1.240	3.769	2.670–5.321
	Mass media as main source of information	−0.401	0.180	0.026	1.054	0.669	0.471–0.952
	Knowledge about SARS-CoV-2: number of correct answers	0.135	0.042	0.001	1.155	1.145	1.054–1.244

Significant associations ($p < 0.05$) were marked with bold characters. In parentheses below Models are given Negelkere's R2 values measuring the proportion of variance 'explained' by the regression.

assumed mechanism of action of vaccines based on mRNA and viral vector technologies was known.

In a study by Salali and Uysal (28) 31% of the participants from Turkey and 14% from the UK were unsure whether to get the COVID-19 vaccine. In both countries, 3% of the participants refused to vaccinate. In an Italian study published in December 2020, more than three-quarters of respondents wanted the vaccine, 10% did not have a clear opinion, and only 5% said they did not want the vaccine, and 9% did not answer. Therefore, these data indicate significant differences between countries in terms of attitudes to vaccination against SARS-CoV-2 (29). Moreover, the results of our study, compared with studies from other countries carried out in the same period, indicate greater distrust of vaccines in Poland. At the time of writing this article, in autumn 2021, compared to the above-mentioned countries, Poland has a much smaller percentage of fully vaccinated people—53%, while in Turkey it is 58%, in UK 67% and in Italy 72% (21). This observation may support the statement that the initial attitude toward SARS-CoV-2 vaccination, which we examined, did not change much under the influence of a vaccination campaign lasting almost a year and may be of key importance in understanding the causes of reluctance to vaccinate.

Almost 40% of the study participants had a high GHQ-28 score, indicating the presence of clinically significant psychopathological symptoms. These results correspond to other studies assessing the psychological burden during the COVID-19 pandemic, which is significantly greater than before the pandemic period, and moreover, it did not decrease significantly with the duration of the pandemic (16, 17). The high level of psychopathological symptoms in the study group is all the more important due to the fact that it characterized people from pro-vaccination group. In turn, reluctance to vaccinate was inversely determined by anxiety and insomnia. These results are consistent with the study by Yigit et al. (30), in which it was observed that people with high levels of anxiety of COVID-19 infection were more likely to agree to vaccination. At this point, it is worth referring to the study, where the authors, in the context of previous epidemics, described the so-called "adaptive" level of anxiety, prompting people to act prophylactically (31). According to them, this anxiety is based on a balance between excessive anxiety leading to panic inadequate to the actual threat and a complete lack of anxiety leading to ignoring the recommended preventive actions. On the other hand, when discussing the increasing anxiety in society, one should bear in mind the chronic stress theory, according to which prolonged activation of the hypothalamic-pituitary-adrenal axis negatively affects the immune system and overall health, leading to increased susceptibility to other diseases, including diseases of cardiovascular system and cancer (32). A binary logistic regression model showed that knowledge of SARS-CoV-2 is a positive determinant of anti-vaccine attitudes, which is in line with Chinese findings that greater understanding of COVID-19 does not correlate with greater vaccination propensity (33). In the study, over 90% of students declared their willingness to be vaccinated against SARS-CoV-2, while over 50% presented insufficient knowledge about the preventive behavior and symptoms of this disease. The significant difference in knowledge about COVID-19 between the anti-vaccine and pro-vaccine groups, coupled with prior observation of a lower level of anxiety in the anti-vaccine group, may indicate a potential difference in assessing the risk of infection with the virus: those who are reluctant to vaccinate may perceive the risk as lower

compared to the pro-vaccine group. The sense of risk of SARS-CoV-2 varies from country to country. For example, according to the study from 2021 by Bowman et al. (34). 97% of Hong Kong respondents rated the symptoms of COVID-19 infection as serious or very serious, compared to only 20% in the UK. The higher sense of risk in Hong Kong was associated with a greater degree of hygiene and social distancing compared to the UK. In particular, almost 99% of Hong Kong respondents reported wearing a face mask, compared to 3% of the UK respondents. These results indicate the potential real impact of government policy and media information on the sense of threat and the degree of compliance with epidemiological recommendations.

The aforementioned different assessment of the risk of the SARS-CoV-2 pandemic is confirmed by the noted difference in the frequency of checking epidemiological reports in media, which may indicate emotional involvement in the course of the pandemic: belonging to the anti-vaccination group is negatively correlated with daily monitoring of the epidemiological situation. In our study, 42% of respondents monitored the epidemiological situation in the media on a daily basis. The result from the second wave of the pandemic may indicate a downward trend compared to the US study conducted during the first wave, in which 57% checked COVID-19-related news several times a day, and 84% at least once a day (34). On the one hand, this tendency can be explained by the habituation effect, and on the other hand, a greater awareness of the real risk of SARS-CoV-2, overestimated during the first wave. The obtained results show a correlation between less frequent news tracking and a lower level of anxiety. The relationship between emotional involvement and monitoring information about the epidemic is also confirmed by studies on the H1N1 (swine flu) virus epidemic, indicating a higher level of anxiety in response to greater exposure to media materials about the epidemic (35).

When analyzing the differences between groups in terms of knowledge about the pandemic, the impact of information sources on the decision to vaccinate should also be considered. Based on the binary logistic regression model, people reluctant to vaccinate against SARS-CoV-2 less frequently reported using the mass media as a source of information about the pandemic. Nekliudov et al. (36). emphasized the role of the mass media in the excessive escalation of fear related to the pandemic. On the other hand, it is worth remembering that apart from mainstream media, there are also portals where fake news and conspiracy theories are overrepresented (37). Therefore, an extended analysis of vaccination decisions in the context of infodemia is justified (38). Research indicates that 90.3% of North Americans and 61.9% of the rest of the world actively use the Internet (39). The data show that 75–80% of internet users look for health information on websites, and 70% of them say that this content influences their treatment (40). Unfortunately, the Internet still does not allow for reliable data verification, hence it is there that the fake news about pandemic and vaccines is most often spread. We can conclude that the decision to vaccinate against SARS-CoV-2 is made without verifying the information gathered by the online media (41). Interesting results were brought by the study by Salali and Uysal (28), which investigated the influence of conspiracy theories on the decision to vaccinate against SARS-CoV-2 in Great Britain and Turkey. It turned out that the belief that the pandemic started naturally had a significant impact on the pro-vaccination attitude. Another study of around 1,500 Jordanian students found higher levels of anxiety among those who believed in COVID-19 conspiracy theories compared with students who rejected them (42). A study performed by Pisl et al. (43) found that students experiencing a typical dissociative situations more often believed in conspiracy theories related to COVID-19. Believing in them might be understand as an unconscious tendency to lower the level of anxiety associated with the pandemic based on a mechanism similar to the phenomenon of dissociation. A strong long-term relationship between adherence to conspiracy theories and vaccine hesitancy (44, 45) as well as the negative impact of exposure to conspiracy theories on the willingness to vaccinate have been described (46). Bronstein et al. (47), using cutting-edge machine learning algorithms and psychometric network analysis, described a mechanism that takes into account the dependencies between tasks measuring reasoning biases, belief in conspiracy theories and reluctance to vaccinate. Reasoning biases, such as reduced data gathering related to the currently increasing tendency to stay in so-called "information bubbles" seems to be a modifiable factor leading to conspiracy believes and vaccine reluctance. It has been reported that the fear of losing a sense of control during a pandemic exacerbated the perceptions of persecution, then increased the sense of danger associated with vaccine and vaccination, and ultimately influenced the emergence of conspiracy theories. Finally reluctance to vaccinate was identified as a likely cause of belief in a conspiracy theory subverting the common assumption that the opposite causal relation exists. Unfortunately, our study did not assess belief in conspiracy theories, which should definitely be considered in further conclusions. We postulate that mental health and decision to vaccinate might be mediated by conspiracy believes regarding virus origins, vaccines and vaccination.

During the first wave of the pandemic, as in other European countries (48), the Polish government introduced the so-called total lockdown, consisting in an order to stay at home except for the necessity to meet basic life needs and go to work if it is not possible to perform it remotely (49). During the second wave, the Polish government introduced a partial lockdown, including the closure of restaurants, shopping malls, guesthouses and hotels, and recommendations for remote work were maintained (50). During the first two waves of the pandemic, wearing masks in public places, including open spaces were obligatory (51). Another explanation for such a low percentage of people willing to be vaccinated in our study may be the anti-vaccination movement in Poland. Its groups spread false information to the public, creating chaos and thus undermining confidence in the validity and safety of vaccinations. Such action causes divisions in the society and, as indicated by several authors, evokes a strong reluctance to vaccinate (52, 53).

Among the determinants of reluctance to vaccinate, the belief about excessive restrictions and the introduction of lockdown was the most important. Moreover, loss of access to healthcare and loss of income as a result of the pandemic also determined belonging to the anti-vaccine group. Such results indicate a

broader aspect of the decision to vaccinate in the context of the negative impact of lockdown on the lives of citizens. Attitude toward vaccination appears to have a potential relationship to the degree of trust in the government, which imposes economic constraints, and is also involved in vaccine distribution. This hypothesis is confirmed by Italian studies conducted by Prati (29), in which the lack of intention to receive a vaccine was associated with a lower level of worry and institutional trust.

The observed ineffectiveness of lockdowns in reducing the number of SARS-CoV-2 infections, while at the same time causing the emotional burden of social isolation and economic costs should prompt governments to consider changing their strategies, especially due to the aforementioned impact of public confidence in the willingness to vaccinate against SARS-CoV-2.

Experiencing limitations and changes in many important spheres of life can cause a reaction based on the so-called defense mechanisms, e.g., denial, which in the time of a pandemic is not only to reduce the risk of infection with the virus, but also to reduce the perceived anxiety. For example, according to Johnson, "ignoring happens when an individual consciously knows that a problem exists, but chooses not to confront it" (54). Hence, there is a potential explanation that people with less severe GHQ-28 psychopathological symptoms, who are also reluctant to vaccinate, may ignore the actual situation so as not to exacerbate their anxiety.

Our study found that health care workers were less in the anti-vaccine group. These results are consistent with the studies by Akarsu et al. (55), where greater susceptibility to vaccination was also observed among medical professions. The majority of people who considered COVID-19 a very serious disease was the elderly, the chronically ill, men, people with lower incomes and lower levels of education. Therefore, it is worth considering the different social attitudes presented by the respondents at this point. People from the anti-vaccine group, due to their high knowledge of SARS-CoV-2, awareness of a relatively low risk of contracting the disease at an earlier age, no burden of chronic diseases and a lower risk of infection resulting from much less frequent work in the health service, may characterize an individualistic attitude. Focusing on your own health and the consequences of long-term lockdown restrictions can lead to opposition to vaccination as well as decisions to be made against society as a whole. In contrast, pro-vaccination people may present a collectivist attitude, characterized by respecting the common good and responsibility for the safety of the community. Our results showed that this group largely included representatives of medical professions, the elderly and people with chronic diseases, especially at risk of severe COVID-19. In the future, therefore, it is worth considering social attitudes when researching attitudes and beliefs about vaccinations.

In our study, we did not ask directly about the reasons for the reluctance to take the vaccine. In a study from Turkey, the most common reasons for refusal were concerns about the side effects of COVID-19 vaccines, a lack of knowledge about vaccine effectiveness, and distrust of vaccines from abroad (29). Similarly, in the study by Szmyd et al. (56), the desire to get vaccinated as quickly as possible was associated with lower concerns about side effects of the vaccine.

LIMITATIONS

The strength of our study is the use of an original tool to assess the level of knowledge about COVID-19 along with the standardized GHQ-28 questionnaire to measure mental health and the assessment of sociodemographic and pandemic factors in the context of vaccination decisions. However, we do recognize some of its limitations. First, the conclusions should be generalized with caution due to the limited representativeness of the sample. We did not register the initial number of people asked to participate and we did not report the reasons for non-participation. It should also be noted that the study did not include questions about the duration of selected symptoms, hence the results relate more to short-term psychopathological episodes than to long-term mental states. It is inevitable that both the online distribution and the form of the online questionnaires themselves run the risk of bias in the responses, hence the strength of the evidence should be treated with caution. The sampling bias consists in over representing people with a special interest in the COVID-19 pandemic. As a result, our study over-represented representatives of the medical professions. Due to the online nature of the study an overrepresentation of young people and a lower representation of older people were observed. Moreover, we did not ask about the direct reason for the declared willingness or reluctance to vaccinate against SARS-CoV-2, which could provide relevant information about the motives of attitudes and decisions. Another limitation of our study was the lack of a questionnaire assessing the severity of psychotic-like experiences and a paranoid attitude, which, according to recent studies, may influence refusal of vaccination (57). It is worth noting that the GHQ-28 scale assesses the severity of symptoms such as depression and anxiety, however, it does not allow for an unequivocal psychiatric diagnosis, which should be based on a clinical examination taking into account the DSM-V or ICD-10 criteria. We also did not use other scales that would allow for the differential diagnosis of mental disorders. Finally, a significant limitation is the inability to establish a causal relationship between psychopathological symptoms, sociodemographic and pandemic factors, and between the decision to be vaccinated hence we discussed the potential impacts.

CONCLUSIONS

Initial attitude toward SARS-CoV-2 vaccination, which we examined, may be of key importance in understanding the causes of reluctance to vaccinate. The presented study shows a significant social polarization depending on the decision to vaccinate. Greater readiness to vaccinate can be understood in terms of greater confidence in its effectiveness when a person experiences anxiety and mental deterioration, is physically burdened, is older, or is at risk of infection by working in the healthcare sector. Such an attitude may also result from relying on pro-vaccination information presented in the mass media, but also from a hypothetical collectivist attitude, in which the good of society exceeds the individual good. On the other hand, reluctance to vaccinate can be seen as greater awareness of the complexity of the disease, and thus less faith in the

safety and effectiveness of vaccines. Such decisions may also be conditioned by the assessment of the pandemic situation as not so threatening and thus not causing strong symptoms of psychopathology. Resistance to vaccination is also associated with a loss of confidence in health care and the experience of loss of income, which may indicate a strict focus on one's own situation, which is explained by an individualistic attitude. More research is needed regarding the evaluation of paranoid attitudes, psychotic-like experiences and vaccination refusal. Moreover, in view of the prolonged pandemic and voluntary nature of vaccinations, longitudinal studies on representative samples are needed in order to make a reliable assessment of the long-term health and social consequences, and regarding factors contributing to vaccination decision.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the Medical University of Wroclaw (Poland, No. 188/2020). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JM, BM, DS, and JR: conceptualization. JM, BM, and DS: methodology. JM and BM: software. WB: validation and data curation. ML-B: formal analysis. PG: investigation. JR: resources, supervision, and funding acquisition. JM, PG, and DS: writing—original draft preparation. ML-B, BM, DS, and JR: writing—review and editing. WB and PG: visualization. JM: project administration. All authors have read and agreed to the published version of the manuscript.

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ORIGINAL RESEARCH
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The Psychological Impact of the Tertiary Hospital Reappraisal on Resident Doctors in the Post-pandemic Era: A Cross-sectional Study in Ningbo

Zhonghao Shao[1,2], Angyang Cao[1], Wenjun Luo[1], Yanling Zhou[1], Jianhua Wang[3], Yu Gui[1], Bin Gao[1], Zhipeng Xu[1], Binbin Zhu[1] and Zhiren Sheng[4]**

[1] Department of Anesthesiology, The Affiliated Hospital of Medical School of Ningbo University, Ningbo, China, [2] Department of Anesthesiology, Affiliated Hospital of Shaoxing University, Shaoxing, China, [3] Department of Radiology, The Affiliated Hospital of Medical School of Ningbo University, Ningbo, China, [4] Department of Nursing, The Affiliated Hospital of Medical School of Ningbo University, Ningbo, China

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Xenia Gonda, Semmelweis University, Hungary

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***Correspondence:**
Binbin Zhu
pingchi1983@126.com
Zhiren Sheng
498769997@qq.com

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Participants: Competent resident doctor were expected to help the patients, advance medical knowledge, and promote public health. The time and effort necessary for residents to devote to standarized training is extensive. Anxiety and depression can negatively affect professional development and work efficacy. The study aimed to assess the psychosocial effects of the hospital reappraisal during the post-pandemic era of COVID-19 and analyze potential risk factors leading to their symptoms of anxiety and depression.

Method: In March 2021, the "Questionnaire Star" electronic questionnaire system was used to collect data. A total of 96 resident doctors from the affiliated hospital of the medical school of Ningbo University were invited to complete the questionnaires.

Results: According to our study, the prevalence of symptoms of anxiety and depression in the resident doctors in the institution was 61.5 and 59.4%, respectively. The residents who were worried about clinical skills tend to have anxiety symptoms under online education (OR = 3.436, 95%CI: 1.122–10.526). Compared with participants who were assigned by other hospitals, social trainees (OR: 7.579, 95%CI: 1.747–32.885), and full-time masters (OR: 5.448, 95% CI: 1.586–18.722) were more likely to have anxiety symptoms. Participants without a labor contract (OR = 3.257, 95% CI: 1.052–10.101) had a high risk of depression symptoms. Participants who spent more time learning the details prepared for the tertiary hospital reappraisal were significantly more likely to develop anxiety and depressive symptoms.

Conclusion: This study suggested that the tertiary hospital reappraisal program has an impact on the high incidence of anxiety and depression of the young resident doctors during the post-pandemic era of the COVID-19 in Ningbo.

Keywords: post-pandemic, the tertiary hospital reappraisal, resident doctor, mental health, psychological problem

HIGHLIGHTS

- As far as we know, few researches aimed to study the effect of a hospital reappraisal program on stress and mental conditions. Our study focused on the issue during the post-pandemic era of the COVID-19 crisis, and we investigated the psychosocial problems of the young residents in Ningbo.
- The results of our study suggested that most of the resident doctors have high degrees of mental problems in our institution, which indicated more effective interventions and support are needed.
- The main risk factors of the residents' mental problems involved both the ramifications of the epidemic, and the impact of the tertiary hospital reappraisal.
- In addition, due to the effective control of the COVID-19, the psychological impact of the regional fluctuation of the pandemic on the trainees was not severe. Besides, Ningbo had been categorized as a low-risk area, so preventive measures such as travel restrictions or making fewer trips outside doesn't have a major impact on the psychological burden of the residents.

INTRODUCTION

Resident doctors are an integral part of clinical teams and are vital to patient care in various clinical settings. Residents progress annually with the advancement of their roles within patient-care teams and participation in increasingly complicated operative cases. These training years are characterized by long work hours and little time for family (1). Meanwhile, clinical residency training primarily emphasizes the development of medical knowledge and technical skills. Yet, non-technical skills (NTS) are also vital to successful clinical practice (2). The NTS include social skills, cognitive skills and personal resource skills, which also contains Managing stress and coping with fatigue (3). Consequently, NTS also contributes to resident doctors have an excellent and efficient performance in work. However, the high incidence of psychological problems is detrimental to doctors' performance and destroys their careers. The medical residency is recognized as a risk period for the development of psychological problems, such as anxiety and depression (4). Resident doctors report the highest rate of having a formally diagnosed mental health condition. This may be because they are in the vulnerable age group when psychiatric disorders start (5). Mounting evidence from many studies suggests that anxiety and depression may affect the daily work of residents and interfere with their non-technical abilities, especially in some stressful situations (5, 6). Studies have consistently shown high levels of anxiety amongst resident physicians (7). To deal with this situation, more measures have been made on a large scale to improve doctors' mental health and fitness (8).

During the COVID-19 pandemic, to quickly control the epidemic and save the lives of infected patients, Chinese doctors have been extremely busy working hard over the past 1 year and great efforts have been made to cope with the tremendous public health crisis (9). In terms of the dangerous epidemic situation, the young resident doctors have experienced varieties of mental health challenges, such as overwork, frustration, loneliness, and other stressors (10). Even the family members of medical staff tend to appear symptoms of anxiety and depression (11). China has responded to COVID-19 in time and efficiently, but the current evidence and published literature on previous epidemics suggest that mental health issues may arise in the post-pandemic era (12). The so-called post-epidemic era does not mean that the epidemic completely disappears and everything goes back to normal as we imagined before. Rather, it means that the epidemic rises and falls, can erupt in small scale at any time, and has a seasonal outbreak (13). Existing evidence indicates that a number of medical health care workers developed mood disorders, anxiety disorders, or posttraumatic stress disorder (PTSD) in the wake of the SARS outbreak in 2003 (14). Therefore, there is an immediate need to identify the long- term mental health consequences of the COVID-19 in the post-pandemic era.

The tertiary hospital reappraisal is a kind of healthcare assessment mechanism of the Chinese government for hospitals. The reappraisal is similar to hospital accreditation, which has been adopted internationally as a way and solution for healthcare quality improvement in hospitals (15). In China, tertiary hospital reappraisal means providing patients with better medical conditions, medical technology and medical services, therefore it also represents the strict evaluation conditions of a tertiary hospital (16). During the period of the reappraisal, the expert groups reviewed the relevant documents and regimens of the hospital, and conduct necessary assessments on the hospital staff. It was a huge challenge for our hospital, which requires the efforts of every doctor, including young residents. The main purpose of the appraisal is to check the quality of health care in different regions, tremendous materials are prepared by young staff for the assessment, and knowledge of the hospital's ability in management, clinical, teaching, and scientific research should be memorized comprehensively (17). This reappraisal extended the working hours of residents to a certain extent

In a word, the mental health of resident doctors should be protected with timely interventions and proper information feedback (18). So far, little attention has been paid to this issue. We conducted a cross-sectional survey to evaluate the psychological conditions of tertiary hospital resident doctors. This work aims to study the effect of a hospital reappraisal program on symptoms of anxiety and depression during the post-pandemic era of the COVID-19 crisis in Ningbo.

RESEARCH METHODS

Research Participants and Study Design

During the period from March 15, 2021 to March 19, 2021, we distributed online questionnaires to 96 resident doctors of the Affiliated Hospital of the medical school of Ningbo University. Subsequently, we received 96 responses accordingly with an effective recovery rate of 100%. At the beginning of the questionnaire, we informed participants that they would be signing the consent by default if they accomplished the survey. All of the residents were invited to voluntarily participate in the online survey. Ethics approval was obtained from the Clinical Ethics Committee of the Affiliated Hospital of the medical

school of Ningbo University, and the ethical serial number is KY20210318.

Study Methods

Survey Methods

To prevent the spread of COVID-19 through droplets or contact, we used an online-based survey program "Questionnaire Star" to collect data. The "Questionnaire Star" is an application dedicated to send electronic questionnaires. Researchers can design different options for each question for participants to choose, and they can use web page to answer (10). We explained the purpose, content, and detailed methods of the survey to participants before filling. The content of the questionnaire included general information, problems related to the standardized training, the impact of the tertiary hospital reappraisal and COVID-19 on resident doctors, the mental health of them and so on. All of the questionnaires are anonymous.

Measures of Dependent Variables

Anxiety Symptoms

We employed the Chinese version of GAD-7 to assess the anxiety symptoms of resident doctors. GAD-7 is a self-report questionnaire that screens and measures the severity of generalized anxiety disorder (19). Participants rated seven items according to the frequency of symptoms in the past 2 weeks on a 4-point scale from 0 (not at all) to 3(nearly every day). Total scores ranged from 0 to 21, with higher scores indicating greater severity of anxiety symptoms. A score of 0–4 has no anxiety, a score of 5–9 may have mild anxiety, a score of 10–13 may have moderate anxiety, and a score of 14–18 may have moderate to severe anxiety, 19-21 may have severe anxiety (20). The GAD-7 has been widely applied in China and good reliability and validity of GAD-7 have been confirmed (21). The presence of mild anxiety symptoms was defined as a total score of $\geq$5 points in the GAD-7 in this survey (21).

Depressive Symptoms

We employed the Chinese version of PHQ-9 to assess the depressive symptoms of the resident doctors. PHQ-9 is a 9-item self-report measure to assess the severity of depression (22). Participants rated each item in accordance with the frequency of symptoms over the past 2 weeks on a 4-point scale from 0 (not at all) to 3 (nearly every day). Total scores ranged from 0 to 27, with the highest scores indicating greater severity of depressive symptoms. A score of 0–4 has no depression, 5–9 may have mild depression, 10–14 may have severe depression, 15–19 may have moderate to severe depression, 20–27 may have severe depression. The PHQ-9 has been widely used in China and good reliability and validity of the Chinese version of PHQ-9 have been demonstrated (23). The mild depressive symptom was defined as a total score of $\geq$5 points in the PHQ-9 in this survey.

Participants Characteristics

We designed the characteristics of the participants on the questionnaire, including gender, grade, major, education background, marital status, whether they have obtained the medical practitioner qualification certificate, whether have signed a contract with a hospital, and so on.

The Source of Stress

In the questionnaire, we arranged the options about the source of pressure close to the participants. The questionnaires for the source of stress of participants were self-developed specifically for this study, as there were no suitable scales available for measuring factors related to resident doctors during the post-pandemic era of the COVID-19 crisis. Due to the author's identity as a resident doctor, the following situations were set up for other participants to choose from: (1) numerous examinations; (2) acquiring the knowledge required for the tertiary hospital reappraisal; (3) whether having signed a contract with a hospital; (4) income; (5) Project; (6) COVID-19-related events;(7) interpersonal relationship;(8) the loss of investment; (9) marriage; (10) others. These options contain common sources of stress, which can be supplemented by others to enrich the need of the survey.

Ways to Relieve Stress

In the questionnaire, we arranged the options about the ways to relieve stress close to the participants. The questionnaires for the ways to relieve the stress of participants were self-developed specifically for this study, as there were no suitable scales available for measuring factors related to resident doctors during the post-pandemic era of the COVID-19 crisis. The following situations were set up for other participants to choose from: (1) indulge in food; (2) take a rest; (3) take a walk; (4) work; (5) review lessons; (6) chat; (7) go to shopping; (8) drink; (9) sing; (10) travel; (11) play games; (12) Others. These options contain common ways to cope with stress, which can be supplemented by others to enrich the need of the survey.

Statistical Analysis

This statistical analysis adopted categorical variable statistics. The categorical variables were expressed as percentages, and then the chi-square test is performed to analyze whether there was statistical significance. The binary logistic regression analysis was used to analyze the data of the chi-square test $p \leq 0.05$ in the categorical variables. Model discrimination and calibration were evaluated using Hosmer–Lemeshow goodness-of-fit statistic. Two-sided $P < 0.05$ was considered statistically significant. These statistical tools included SPSS v25.0 (IBM) and "questionnaire star" to collect statistical data.

RESULT

Demographic Characteristics

Table 1 presents the characteristics of participants. A total of 96 resident doctors from the affiliated hospital of medical school of Ningbo University completed the questionnaire, of whom 51 (53.13%) were men and 45 (46.88%) were women. Among them, 39 resident doctors (40.63%) were from first grade, 23 doctors (23.96%) from second grade, and 34 doctors (35.42%) from third grade. The education level of respondents varied from junior college to master. The participants included a junior

TABLE 1 | Sample characteristics and univariate analysis of variables related to symptoms of anxiety and depression.

Variables	*n* (%)	Anxiety symptoms (GAD-7 score)		*P*	Depressive symptoms(PHQ-9 score)		*P*
		<5 (*n* = 37)	≥5 (*n* = 59)		<5 (*n* = 39)	≥5 (*n*= 5 7)	
Demographics Gender				**0.572**			**0.594**
Male	51 (53.1)	21 (56.8)	30 (50.8)		22 (56.4)	29 (50.9)	
Female	45 (46.9)	16 (43.2)	29 (49.2)		17 (43.6)	28 (49.1)	
Grade				0.838			0.737
First grade	39 (40.6)	14 (37.8)	25 (42.4)		14 (35.9)	25 (43.9)	
Second grade	23 (24.0)	10 (27.0)	13 (22.0)		10 (25.6)	13 (22.8)	
Third grade	34 (35.4)	13 (35.2)	21 (35.6)		15 (38.5)	19 (33.3)	
Educational background				0.627			0.649
Junior college	1 (1.0)	0 (0.0)	1 (1.7)		0 (0.0)	1 (1.8)	
Undergraduate	61 (63.5)	25 (67.6)	36 (61.0)		26 (66.7)	35 (61.4)	
Master	34 (35.4)	12 (32.4)	22 (37.3)		13 (33.3)	21 (36.8)	
Marital status				0.722			0.504
Spinsterhood	77 (80.2)	29 (78.4)	48 (81.4)		30 (77.0)	47 (82.5)	
Married	19 (19.8)	8 (21.6)	11 (18.6)		9 (23.0)	10 (17.5)	
Fertility circumstance				0.311			0.066
Yes	5 (5.2)	3 (8.1)	2 (3.4)		4 (10.3)	1 (1.8)	
No	91 (94.8)	34 (91.9)	57 (96.6)		35 (89.7)	56 (98.2)	
The type of the standardized training				0.039			0.087
Full-time master	36 (37.5)	8 (21.6)	28 (47.4)		10 (25.6)	26 (45.6)	
Social being	18 (18.8)	9 (24.3)	9 (15.2)		7 (17.9)	11 (19.2)	
Resident doctors assigned by other hospitals	42 (43.8)	20 (54.1)	22 (37.2)		22 (56.5)	20 (35.2)	
Whether have signed a contract with a hospital				0.014			0.004
Yes	60 (62.5)	28 (75.6)	32 (54.2)		26 (66.7)	30 (52.7)	
No	36 (37.5)	9 (24.4)	27 (45.8)		13 (33.3)	27 (47.3)	
Whether the weekly nucleic acid test occupied their leisure time				0.035			0.047
Yes	60 (62.5)	28 (75.6)	32 (54.2)		9 (25.6)	31 (54.4)	
No	36 (37.5)	9 (24.4)	27 (45.8)		29 (74.4)	26 (45.6)	
Whether had concerns about clinical skills under the online education				0.013			0.401
Yes	37 (38.5)	20 (54.0)	17 (28.8)		17 (43.5)	20 (35.0)	
No	59 (61.5)	17 (46.0)	42 (71.2)		22 (56.5)	37 (65.0)	
The time of acquiring knowledge required for the tertiary hospital reappraisal				0.005			0.003
<1 h	18 (18.6)	13 (35.1)	5 (8.5)		14 (35.8)	4 (7.0)	
1–2 h	27 (28.1)	11 (29.8)	16 (27.1)		11 (28.2)	16 (28.0)	
2–3 h	22 (22.9)	7 (18.9)	15 (25.5)		6 (15.5)	16 (28.0)	
>3 h	29 (30.2)	6 (16.2)	23 (38.9)		8 (20.5)	21 (37.0)	

The bold values indicate the P values for gender.

college student (1; 1.04%), undergraduate students (61; 63.54%), graduate students (34; 35.42%). Among the participants, 77 (80.21%) were unmarried and 19 (19.79%) were married.

Related Issues During Standardized Training for Residents

In terms of employment, 47 residents have signed contracts with the different hospitals, and the rest of the 49 residents are without labor contracts. Among the participants, 60 residents (62.5%) have obtained the medical practitioner qualification certificate, and the remaining 36 residents (37.5%) have not yet obtained it. The survey also showed that 60 residents (62.5%) took up their rest time due to weekly nucleic acid testing, while 36 (37.5%) did not change their work schedule. After the change of teaching mode due to the epidemic, 37 residents (38.5%) were concerned about the practical skills assessment, and the rest of 59 residents (61.5%) were not concerned. Regarding the time of acquiring knowledge required for the tertiary hospital

TABLE 2 | Multivariate logistic regression analysis of variables related to anxiety symptoms.

Variables	Depressive symptoms (PHQ-9 score ≥ 5)		
	P	OR	95%CI
Whether have signed a contract with a hospital	0.118	2.590	0.786–8.547
Whether have obtained the medical practitioner qualification certificate	0.979	1.017	0.258–3.623
Whether the weekly nucleic acid test occupied their leisure time	0.129	2.294	0.786–6.667
Whether had concerns about clinical skills under the online education	0.031	3.436	1.122–10.526
The time of acquiring knowledge required for the tertiary hospital reappraisal	0.005		
<1 h		Reference	
1–2 h	0.012	6.84	1.536–30.303
2–3 h	0.004	10.86	2.151–55.55
>4 h	0.000	19.231	3.937–90.909
The type of the standardized training	0.004		
Resident doctors assigned by other hospitals		Reference	
Social trainees	0.007	7.579	1.747–32.885
Full-time master	0.007	5.448	1.586–18.722

TABLE 3 | Multivariate logistic regression analysis of variables related to depressive symptoms.

Variables	Depressive symptoms (PHQ-9 score ≥ 5)		
	P	OR	95%CI
Whether have signed a contract with a hospital	0.041	3.257	1.052–10.101
Whether have obtained the medical practitioner qualification certificate	0.403	1.661	0.505–5.464
Whether the weekly nucleic acid test occupied their leisure time	0.248	1.841	0.193–1.529
			0.654–5.181
The time of acquiring knowledge required for the tertiary hospital reappraisa		0.005	
<1 h		Reference	
1–2 h	0.018	5.102	1.319–19.608
2–3 h	0.003	9.346	2.179–40.000
>4 h	0.002	9.174	2.315–37.037

reappraisal, 18 residents (18.6%) studied for <1 h, 27 residents (28.1%) studied for 1–2 h, 22 residents (22.9%) studied for 2–3 h, and 29 residents (30.2%) studied for more than 3 h.

Mental Health Status

Anxiety Symptoms

The questionnaire suggested that 59 (61.5%) resident doctors in this survey had anxiety-related symptoms. In the logistic regression analysis, several factors were independently associated with anxiety symptoms, such as whether they have obtained the medical practitioner qualification certificate, whether have signed a contract with a hospital, the type of the standardized training, weekly nucleic acid test, whether there is concern about the skill assessment under the online education, and the learning time of acquiring knowledge required for the tertiary hospital reappraisal. However, there was no obvious correlation in gender, educational background, marital status, and grade (**Table 2**).

Depressive Symptoms

The questionnaire suggested that 57 (59.4%) resident doctors in this survey had depression-related symptoms. In the logistic regression analysis, several factors were independently associated with depression symptoms, such as whether they have obtained the medical practitioner qualification certificate, whether have signed a contract with a hospital, weekly nucleic acid test, and the learning time of acquiring knowledge required for the tertiary hospital reappraisal. However, there was no obvious correlation in gender, educational background, marital status, grade, the nature of the standardized training, and whether there is concern about the skill assessment under the online education (**Table 3**).

Multivariate Logistic Regression Analysis of Factors Significantly Associated With Anxiety and Depression Symptoms

Anxiety Symptoms

From the above data, we have learned that 61.5% of the resident doctors have symptoms of anxiety and 59.4% of them have symptoms of depression. Multiple logistic regression analysis demonstrated that residents who were worried about clinical skills tend to have anxiety symptoms under online education (OR = 3.436, 95%CI: 1.122–10.526). From the data in **Table 2**, taking 0–1 h on the study as a reference, compared with 1–2 h (OR = 6.84, 95%CI: 1.536–30.303), 2–3 h (OR = 10.86, 95%CI: 2.151–55.55), and 4 h or more (OR = 19.231, 95%CI: 3.937–90.909), participants who spent more time learning about the acquiring knowledge required for the tertiary hospital reappraisal were significantly more likely to develop anxiety symptoms. Taking participants who assigned by other hospitals as a reference, social being (OR: 7.579, 95%CI: 1.747–32.885) and full-time masters (OR: 5.448, 95% CI: 1.586–18.722) were more likely to have anxiety symptoms.

Depressive Symptoms

From the data in **Table 3**, participants without a contract (OR = 3.257, 95% CI: 1.052–10.101) were significantly more likely to have depression symptoms. Regarding the learning of the acquiring knowledge required for the tertiary hospital reappraisal, taking 0–1 h on the study as a reference, compared with 1–2 h (OR = 5.102, 95%CI: 1.319–19.608), 2–3 h (OR = 9.346, 95%CI: 2.179–40.000), and 4 h or more (OR = 9.174, 95%CI: 2.315–37.037), participants who spent more time on learning were significantly more likely to develop depression symptoms.

DISCUSSION

As far as we know, resident doctors are a significant part of medical teams and undertake a mass of tedious work (24, 25). Anxiety and depression at work will not only affect their daily life, but also reduce work efficiency and even cause medical accidents (26). This cross-sectional psychological survey suggested that the tertiary hospital reappraisal program has an impact on the high incidence of anxiety and depression of the young resident doctors during the post-pandemic era of the COVID-19 in Ningbo. This study also obtained the factors affecting the psychological condition of the resident doctors in our hospital through a questionnaire and provided suggestions for mitigating the psychological consequences. According to our survey, the prevalence of symptoms of anxiety and depression in the resident doctors in our institution was 61.5 and 59.4%, respectively, which are much higher than the level of the general population in China (27). After controlling for confounders, the main factors affecting residents' mental health are as follows: the worried about clinical skills under the online education; the type of standardized training; whether has signed a labor contract with a hospital; the time of acquiring the knowledge required for the tertiary hospital reappraisal; various examinations; tedious work; low income and so on.

While previous studies mainly focus on the effect of COVID-19 on resident doctors (28, 29), according to the current situation, the regional fluctuation of the pandemic had less impact on the mental health of residents, which was beyond our expectations. The bigger impacts came from the ramifications of the COVID-19 crisis. There were several reasons for this phenomenon. At present, the pandemic in China has been well-controlled through unremitting efforts. The Chinese people have great confidence in the COVID-19 vaccine, and the coverage rate has observably increased (30). Medical supplies such as masks and protective suits are sufficient. Nevertheless, the lack of personal protective equipment (PPE) increased the anxiety of health workers in some countries (31). Furthermore, Chinese authorities adopted early stage integrated psychological crisis interventions following novel corona virus outbreak (32). Besides, the hospital has provided training on COVID-19 prevention for residents, and the impact of COVID-19 on their mental health is gradually diminishing. However, the prevalence of the COVID-19 has changed the way of education (33, 34), and online classes have become the main teaching method for resident doctors (35). In order to prevent the spread of the epidemic, our hospital had also chosen online education as the main teaching strategy to strengthen the training of residents. Doctors need theoretical knowledge as the basis, and they also need to have clinical practice capabilities. Online education may be more focused on the learning of theoretical knowledge, but the young resident doctors require communication and interaction with patients (36). The resources of online education are relatively limited. Compared with teaching in the hospital, online education can provide typical cases and operation specifications (37). However, online learning is helpless in practical training (38). The lack of rehearsal for future operational assessment increased the psychological problems of residents. The unexpected COVID-19 crisis has disorganized medical education, but this may be a seminal opportunity for medical education to develop in the long view (39). Following the COVID-19 pandemic, the revolution of medical education has accelerated. The medical career will put more emphasis on telemedicine, virtual education, and greater national and international cooperation in the future (40). Doctors should be prepared for these changes.

During the period of the tertiary hospital reappraisal, the trainees' spare time was occupied by different levels of transactional work: preparing materials of the daily quality control, arranging documents and photocopies of teaching activities, reciting the inspection-related information and taking part in the reappraisal simulation. This accreditation is beneficial to achieving universal quality health coverage (41), so the criteria of the assessment were very strict, which suggested the complexity of the accreditation (42). As a result of the reappraisal to the hospital staff necessary assessment, repeated exams with various contents increased the pressure on the residents. In addition, most of the residents were assigned by other hospitals, and they were requested to study the acquiring knowledge required for the tertiary hospital reappraisal just to cope with the accreditation. According to our study, the length of study time was positively correlated with the severity of anxiety and depression. In other words, residents who spent more time learning about the acquiring knowledge required for the tertiary hospital reappraisal were significantly more likely to develop the symptoms of anxiety and depression. Due to the need to prepare materials and documents of reappraisal, the working hours of the resident doctors were prolonged. Indeed, several studies have reported that occupational stress, such as excessive workload or working time, was closely related to anxiety and depression (43, 44). To solve the difficulty and accomplish the tasks of the tertiary hospital reappraisal, the hospital manager could encourage the residents to actively participate in the training and give appropriate rewards to the outstanding trainees to strengthen their enthusiasm (45).

Employment is the foundation of the people, and it will generate greater pressure and affect health without work. A large amount of evidence supported that young people are especially vulnerable to mental health problems when unemployed (46, 47). There is essentially no big difference between the type of training and whether have signed a contract with hospitals. They are both employment issues. After the three-years training, the trainees will face the pressure of finding a job competing with fresh graduates, which also caused their anxiety and depression. In addition, lower wages and high-intensity work aggravate the life and work pressure of residents (48). To alleviate the pressure of the trainees, the administrator could increase the rest time of the resident doctors by reasonably planning the work schedule of the trainees, so that the residents have more spare time to regulate their moods. Moreover, the income of trainees can be appropriately increased as overtime subsidies. The pressure of residents both comes from heavy work and frequent tests. In order to cultivate outstanding resident doctors and improve the quality of medical care in China, various assessments of trainees cannot be avoided. The hospital could start several

interventions with the aim to optimize the learning skills of trainees and exam preparation to prevent test anxiety, comprising lectures on mental health and study guidance (49). Therefore, the hospital administrators and health authorities could provide efficient interventions with addressing their psychological needs and formulate effective strategies to ameliorate resident doctors' mental health status (50). With the improvement of anxiety and depression problems of the residents, they can work with a more positive attitude to serve patients, which is also conducive to the development of Chinese medical treatment.

LIMITATIONS

The study has limitations. First of all, our research is a single-center study. We collected data based on the resident doctor of the affiliated hospital of the medical school of Ningbo University. The sample size is relatively small, and whether the results are applicable to other tertiary hospitals remains to be further studied. Nevertheless, if the study is clinically significant, it will be used to develop a multicenter project to demonstrate external validity. Secondly, this was a cross-sectional study designed after the outbreak of COVID-19, we're not able to confirm that whether the mental health of resident doctors was more serious by the pandemic with a direct comparison to pre-pandemic conditions. Also, our research was conducted using an anonymous online questionnaire due to the limited research conditions caused by the pandemic, which may have information bias. Finally, the study may be subject to selection bias and the results need to be interpreted with caution.

CONCLUSION

According to this cross-sectional survey, most of the resident doctors in our hospital had symptoms of anxiety and depression to varying degrees. The sources of anxiety and depression were similar. Despite of the fact that the regional fluctuation of the pandemic had minorless impact on the mental health of residents, the main sources of psychological burden for residents come from the reduced clinical skills training on account of the impact of COVID-19. Due to the lack of actual practical processes, resident doctors are worried about their practical abilities, yet time after working was spent on the preparation for the tertiary hospital reappraisal, which could accelerate mental problems. The purpose of this survey was to help residents to identify their mental status and think about what need to be done to address their problems prior to any potential mental health conditions developing. More detailed work is urgently needed to explore effective interventions, as well as how we can better understand the needs of resident doctors.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

ZSha and YZ performed the experiment. AC, WL, and BZ contributed significantly to analysis and manuscript preparation. ZShe performed the data analyses and wrote the manuscript. JW, YG, BG, ZX, ZShe, and BZ helped perform the analysis with constructive discussions. ZSha and AC contributed equally to this work. All authors contributed to the article and approved the submitted version.

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Resilience and Anxiety Among Healthcare Workers During the Spread of the SARS-CoV-2 Delta Variant: A Moderated Mediation Model

Ying Liu[1,2†], *Tianya Hou*[1†], *Hongjuan Gu*[2], *Jing Wen*[1], *Xiaoqin Shao*[1], *Yawei Xie*[1], *Wenxi Deng*[1] *and Wei Dong*[1*]

[1] *Faculty of Psychology, Navel Medical University, Shanghai, China,* [2] *Department of Nursing, Hunan Provincial Crops Hospital, Chinese People's Armed Police Force, Changsha, China*

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***Correspondence:**
Wei Dong
sophiedongwei@163.com

[†] These authors have contributed equally to this work and share first authorship

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Introduction: The B.1.617.2 (Delta) variant of SARS-COV-2 has caused a surge in COVID-19 cases worldwide, placing a great burden on the health care system under the zero-tolerance epidemic prevention policy in China. The present study aimed to investigate the prevalence of anxiety among health care workers during the spread of the SARS-CoV-2 Delta variant, and to discuss the mediating role of positive coping style between resilience and anxiety, and the moderating role of general self-efficacy.

Method: Connor-Davidson Resilience scale (CD-RISC), Generalized Anxiety Disorder Scale (GAD-7), General Self-efficacy Scale (GSES) and Simplified Coping Style Questionnaire (SCSQ) were used in this cross-sectional study among 390 healthcare workers in Jiangsu Province, China. Mackinnon's four-step procedure was applied to test the mediation effect, and Hayes PROCESS macro was conducted to examine the moderated mediation model.

Results: The prevalence of anxiety among Chinese healthcare workers during the spread of the SARS-CoV-2 Delta variant was 41.8%. Male, unmarried, childless and younger subjects reported higher levels of anxiety. Positive coping partially mediated the effect of resilience on anxiety among healthcare workers and the indirect effect was stronger with the increase of general self-efficacy.

Conclusions: Anxiety was prevalent among healthcare workers during the spread of SARS-CoV-2 Delta variant. This research sheds new light on the potential mechanism underlying the association between resilience and anxiety and provides new insight into the prevention of anxiety among healthcare workers during the spread of the SARS-CoV-2 Delta variant.

Keywords: resilience, anxiety, general self-efficacy, positive coping style, coronavirus disease 2019 (COVID-19), healthcare workers

INTRODUCTION

The outbreak of the Coronavirus Disease 2019 (COVID-19) as a public health emergency with international concern (1) had an unprecedented impact on the daily life of people all over the world, causing approximately 4.5 million deaths and 216 million infections worldwide (2). Also, the continuously mutating severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) strain posed a major challenge to the health care systems.

Although the spread of COVID-19 in China has been controlled to a certain extent, the risk of being infected has not subsided (3). Moreover, the B.1.617.2 (delta) variant has delivered a huge shock even to countries that have been mass vaccinated, because of its higher load and faster spread than SARS-CoV-2 (4). Therefore, the first local case in May (5), 1 month after the previous outbreak, has caused a considerable degree of panic (such as anxiety) in China. To control the spread of the outbreak, patients need to be quickly identified and isolated by scaling up nucleic acid tests, which places a huge burden on the healthcare system. It can be inferred that the work efficiency and quality of healthcare workers have become the key to control the epidemic. However, the fear of being infected or bringing the virus to family, lack of knowledge about the Coronavirus, high levels of work stress and workload and inadequate psychological support during the COVID-19 pandemic have made healthcare workers more vulnerable to develop psychological problems than other groups (6–8). A great many of studies conducted early during the outbreak showed a high level of depression, anxiety and insomnia among healthcare workers (9, 10), suggesting that greater attention should be paid to the mental health of healthcare workers. Among these symptoms, anxiety as the most prevalent mental disorders (11) is of particular concern to us because it can directly or indirectly cause cognitive deficits, reducing job performance by limiting working memory (12) or affecting cognitive flexibility and decision-making (13). Anxiety disorder is a mental health condition characterized by excessive fear, anxiety, or avoidance of perceived threats to the external environment or internal as well as the actual response is not equal to the actual risk (14). It is one of the most predominant mental disorders in the general population (11). A large web-based cross-sectional study conducted across China reported that the overall prevalence of general anxiety disorder (GAD) during the COVID-19 epidemic was 35.1%, and healthcare workers were at a higher risk of mental illnesses (15). Numbers of recent studies in the field of positive psychology have focused on anxiety disorders (16–18), and psychological resilience as an important component of positive psychology is also suggested to have a protective effect on anxiety (16).

Resilience refers to the capacity that allows people to successfully adapt and face adversity, traumatic and stressful events (19). The negative association between resilience and anxiety has been confirmed by multiple studies (20, 21). Moreover, an observational longitudinal cohort study conducted in individuals with multiple sclerosis over 12 months confirmed a significant longitudinal relationship between resilience and anxiety (22). When confronted with stressful life events, individuals with higher levels of resilience were less likely to experience anxiety and depression (23). A recent study reported the protective role of resilience components against mental problems including anxious symptoms among Italian healthcare workers during COVID-19 pandemic (24). Thus, we speculate that resilience may have a protective effect on anxiety of Chinese healthcare workers during the COVID-19 pandemic.

The Mediating Role of Coping Style

Despite the associations between resilience and anxiety having been well established, the underlying mechanisms behind this association have not been fully explained. Specifically, whether the association between resilience and anxiety among healthcare workers during the spread of the SARS-CoV-2 Delta variant is mediated by coping style has not been tested.

Coping is the cognitive and behavioral effort of individuals to consciously manage external or internal changes (25), which can be divided into two types according to the ways of coping with problems: positive coping and negative coping (26). Positive coping refers to solving problems in a direct and rational way such as focusing on the positive and changing behaviors to solve problems and seeking social support (27), while negative coping refers to dealing with problems through avoidance, withdrawal and denial (28). However, extant literature has already documented that positive coping is the dominant coping style among medical students or people facing COVID-19 (29–31), whereas multitudes of studies only investigated the impact of negative coping style (28, 32, 33). Therefore, the present study would focus on the effects of positive coping, and we will consider positive coping in our study.

The association between resilience and coping styles has attracted much attention. Similarly, a study conducted among Chinese soldiers found that resilience was a positive predictor of positive coping (34). A recent study reported the positive association between resilience and positive coping based on a sample of healthcare workers during the outbreak (21). According to the transactional stress model, coping plays an important role when individuals face adversity, and rapid response to stress is beneficial to prevent the generation of psychological disorders (35). Many empirical studies have reached the consensus that positive coping was a protective factor for anxiety, while negative coping may exacerbate this symptom (36, 37). In addition, a longitudinal study conducted in the United States showed that a lower level of positive coping among patients with post myocardial infarction was associated with a higher level of anxiety (38). Moreover, several studies provided robust evidence for the negative association between positive coping and anxiety among healthcare workers (39, 40). Therefore, it could be speculated that positive coping mediated the association between resilience and anxiety among healthcare workers.

To date, the association between resilience, coping style and anxiety has been widely investigated (41–43). However, some of these studies focused on patients rather than medical staff, and others used coping style as an independent variable or resilience as a moderator. To the best of our knowledge, the association between resilience and anxiety *via* positive coping

among health care workers during the COVID-19 outbreak has not been studied.

The Moderating Effect of General Self-Efficacy

Although resilience may affect anxiety indirectly through positive coping, not all people who are more inclined to use positive coping reported a lower level of anxiety since some studies reported no association between positive coping and anxiety (44). Therefore, it is necessary to explore the influencing factors of the association between positive coping and anxiety. Self-efficacy was defined as a belief in one's ability to handle complex or new tasks and cope with adversity, which exerted an impact on how people feel, think and behave (45). General self-efficacy is a generalized sense of self-efficacy, which refers to global confidence in one's ability to cope with a variety of different demands or new situations (46). In the light of the Integrative Conceptual Framework of coping process, individual's self-efficacy as a personal characteristic can interact with coping styles or coping skills to influence personal health and well-being (47), indicating the effect of coping skills on health differs at different levels of self-efficacy. Previous literature presented the interaction effect of coping style and self-efficacy on the treatment outcome among problem drinkers (48), suggesting the influence of coping style on health outcomes is not the same at different levels of self-efficacy. Brands and colleagues explored the influence of self-efficacy and negative coping on quality of life and found self-efficacy moderated the impact of emotion-oriented coping on health outcome. Specifically, the effect of negative coping on health outcome was attenuated with the increase of self-efficacy (49). Hence, we speculate that self-efficacy may moderate the effect of positive coping on anxiety among healthcare workers during the crisis.

The Present Study

The purpose of this study is to investigate the prevalence of anxiety among health care workers during the spread of the SARS-CoV-2 Delta variant, and to discuss the mediating role of positive coping style between resilience and anxiety, and the moderating role of general self-efficacy. Taken together, our study proposes a moderated mediation model that general self-efficacy moderates the indirect effect (positive coping–anxiety) of resilience on anxiety through positive coping style (see **Figure 1**) among healthcare workers during the COVID-19 pandemic.

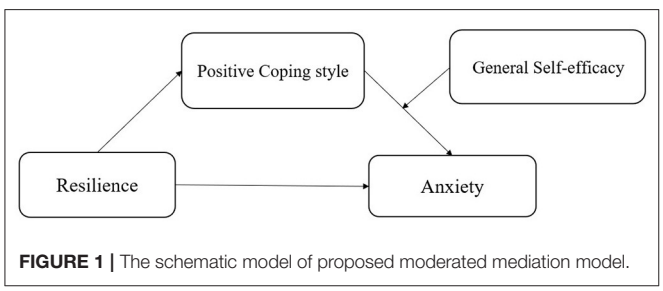

FIGURE 1 | The schematic model of proposed moderated mediation model.

METHODS

Participants and Procedures

The cross-sectional study was performed between May 14 and 25, 2021, during the spread of the SARS-CoV-2 Delta variant. A one-stage random cluster sampling technique was employed to recruit participants from a hospital in JiangSu Province. A total of 413 potential participants were contacted in the study. The inclusion criteria were as follows: (a) working in the hospital for at least 1 year, (b) no dyslexia or cognitive impairment, (c) age > 18 years. The exclusion criterion was set for respondents with psychiatric illnesses and those who did not respond seriously. Finally, 390 participants were included in the analysis, resulting in a valid response rate of 96.13% (390/413). The research project obtained an ethical approval from Suzhou Science & Technology Town Hospital (IRB201912002RI) before it was launched. All data were collected by conducting a self-administered questionnaire online. Prior to the online survey, informed consent online was given by all participants. Also, all participants were assured that their responses would be anonymous and confidential and that they were free to withdraw at any time without penalty.

Measures

Demographics Characteristics of Participants

Demographic information in this study included gender, age, educational level, professional title, marital status, and children situation. Age was divided into two groups (younger group and middle-age group). Educational level was categorized into two groups (college or lower, Master degree or above). Professional title was coded as a binary variable (junior title or no title, intermediate job title and senior title). Marital status was divided into married and unmarried (single, divorced, and widowed). Children situation was categorized into no child and having at least 1 child.

Measurement of Resilience

The Chinese version of Connor-Davidson Resilience scale (CD-RISC) (50) is a 25-item generic resilience instrument with three subscales: tenacity, strength, and optimism. Items were scored on a 5-point Likert scale ranging from 0 (never) to 4 (very often). A total score is calculated as the sum of all questions and ranged from 0 to 100, and the higher the score is, the higher the level of resilience is. The scale has been demonstrated good internal and external validity and widely employed in Chinese healthcare workers (51). In this study, the Cronbach's α coefficient of the scale was 0.968.

Measurement of Anxiety

The 7-item Generalized Anxiety Disorder Scale (GAD-7) was used to measured anxiety of patients during the last 2 weeks (52). The variables were scored on a four-point Likert scale with 0 indicating never,1 indicating several days, 2 indicating more than half the days, and 3 representing nearly every day. The total score was calculated as the sum of all items, with a total range of 0 to 21. The higher the total score is, the more severe the anxiety is. The cut-off point for identifying the symptoms of anxiety was 7 (53). The scale has been widely used in anxiety-related research and has high construct validity and reliability in Chinese population

(54, 55). In the present study, the Cronbach's α coefficient of the scale was 0.966.

Measurement of Positive Coping Style

Positive coping was measured by the positive coping subscale of Simplified Coping Style Questionnaire (SCSQ) (56). The SCSQ was an instrument widely used in China to reflect positive and negative responses when encountering stress (56). The positive coping subscale consists of 12 items (e.g., release through work, study or some other activities). The SCSQ was scored on a 4-point Likert scale ranging from 0 (do not take) to 3(often take). The positive coping subscale was calculated as the sum of all items. The total score of items represents the likelihood that the individual will adopt the corresponding coping style, with higher scores reflecting stronger coping style preferences (57). The scale has presented excellent psychometric properties and been widely used among healthcare workers (56), and the Cronbach's alpha of positive coping in this study was 0.947.

General Self-Efficacy

To assess general self-efficacy, we used the Chinese version of 10-item General Self-efficacy Scale (GSES) (58). Items were rated on a 4-pointed Likert scale ranging from 1 (not true at all) to 4 (exactly true), with a total score ranging from 10 to 40. Higher scores indicated higher levels of general self-efficacy. The scale has been found to have good reliability and validity among Chinese healthcare workers (58, 59). In this study, the Cronbach alpha coefficient for GSES was 0.954.

Statistical Analysis

SPSS 22.0 (IBM Corporation) was used for statistical analysis in this study. First of all, we conducted Harman single factor test to examine common method bias. Common method bias as a well-documented phenomenon observed in research based on self-reported measures is caused by the fact that the constructs are measured by the same methods (e.g., multiple-item scales in the same questionnaire), which might result in spurious effects because of measurement instruments (60). Then, an analysis of descriptive statistics was conducted to illustrate the demographic and other selected characteristics of the respondents. Independent *t*-test and one-way analysis of variance (ANOVA) were used to compare group differences in Anxiety. Secondly, Pearson correlation test was utilized to evaluate the bivariate correlations between interested variables. Thirdly, MacKinnon's four-step method (61) was applied to test the mediation effect in our research and four criteria need to be satisfied: (1) a significant association between the independent variable (resilience) and the dependent variable (anxiety); (2) a significant association between the independent variable (resilience) and the mediator (positive coping style); (3) a significant association between the mediator (positive coping style) and the dependent variable (anxiety) after controlling for the independent variable (resilience); (4) a significant coefficient for the indirect association between the independent variable (resilience) and the dependent variable (anxiety) *via* mediator (positive coping style). To examine the last condition, the bias-corrected percentile bootstrap method was used, obtaining the bias-corrected 95% confidence intervals with 5,000 bootstrapping iterations. If the interval range of 95% CI value does not contain 0, indicating that the mediating effect is significant. The mediation effect was analyzed by PROCESS version 3.0 macro for SPSS (Model 4), which is a free mediation and moderation software package published by Preacher and Hayes. Finally, the PROCESS macro (Model 14) was used to examine the moderated mediation effects. According to the foregoing, the effects were established if 95% bias-corrected bootstrap CI of the interaction does not contain zero. Then, Johnson-Neyman technique (62) was employed to plot the conditional effects and confidence bands at different values of general self-efficacy. In addition, gender, age, educational level, years of working, professional title, marital status, and children situation were entered into models as covariates and all continuous variables were standardized. In all data analysis, *p*-values of 0.05 or less ($p < 0.05$) were considered as statistical significance.

RESULTS

Common Method Bias Test

In this research, we used self-report approach to collect data, which may lead to common method bias problem (63). The Harman single factor test was employed to test common method bias (64). The KMO value was 0.95 ($p < 0.001$), indicating that the data in this study were suitable for exploratory factor analysis. After exploratory factor analysis, we found that the factors of eigenvalues >1 was 8 and the interpretation rate of the first factor was 37.42%, lower than the reference value of 40%. Therefore, the results showed that there was no serious common method bias problem in this research.

Demographic Characteristics and Anxiety

The sociodemographic characteristics and intergroup comparison of anxiety were displayed in **Table 1**. Among the 390 valid samples, the average age was 29.78 (±5.35) years old, and the average years of working was 7.84 (±5.73) years. Most of the participants were female [343(87.95%)], married [256(65.64%)], junior title [267 (68.46%)], aged below 30 years [249 (63.85%)], had at least one child [212 (54.36%)], had an educational level of college or lower.

The prevalence of anxiety among healthcare workers was 41.8%. There were no significant differences in the prevalence of anxiety among participants with different professional title and educational level. Of the total sample, males had higher levels of anxiety than females ($F = 7.51$, $P < 0.05$). Unmarried ($F = 5.59$, $P < 0.05$), childless ($F = 6.60$, $P < 0.05$) and younger group subjects ($F = 4.46$, $P < 0.05$) reported a higher level of anxiety.

Mean, Standard Deviations (SD), and Bivariate Correlation of all Study Variables

Table 2 shows the Pearson correlation coefficient among variables. Resilience was positively associated with positive coping style ($r = 0.70$, $P < 0.001$) and general self-efficacy ($r = 0.53$, $P < 0.001$). Also, positive coping was positively related to general self-efficacy ($r = 0.46$, $P < 0.001$). Besides, resilience ($r = -0.22$, $P < 0.001$) and positive coping style ($r = -0.32$,

$P < 0.001$) were negatively correlated with anxiety. However, general self-efficacy was not significantly related to anxiety ($P > 0.05$).

TABLE 1 | Demographic characteristics of respondents ($N = 390$) and group comparisons on anxiety.

	Respondents		Anxiety Scores		*F/t*	*p*-value
	n	%	*M*	SD		
Gender					7.51	0.01
Male	47	12.05	6.72	5.39		
Female	343	87.95	4.76	4.49		
Marital status					5.59	0.02
Unmarried	134	34.36	5.76	4.86		
Married	256	65.64	4.60	4.48		
Children situation					6.60	0.01
No child	178	45.64	5.65	4.77		
One child or more	212	54.36	4.45	4.47		
Professional title					2.53	0.11
Junior title	267	68.46	5.25	4.71		
Intermediate job title and senior title	123	31.54	4.45	4.46		
Age (29.78 ± 5.35)					4.46	0.04
Younger group (≤30)	249	63.85	5.37	4.83		
Middle-aged group (>30)	141	36.15	4.34	4.22		
Educational level					1.71	0.19
College or lower	360	92.31	5.09	4.70		
Master degree or above	30	7.69	3.93	3.83		

TABLE 2 | Pearson's correlation among resilience, self-efficacy, coping style and anxiety ($N = 390$).

	Mean (SD)	1	2	3
1. Resilience (CD-RISC)	63.28 (14.83)	1.00		
2. Positive coping style (SCSQ)	24.65 (6.07)	0.70***		
3. General self-efficacy (GSES)	25.96 (5.90)	0.53***	0.46***	
4. Anxiety (GAD-7)	5.00 (4.64)	−0.22***	−0.32***	−0.07

****P < 0.001.*

Mediating Effect of Positive Coping Style

After finding an internal links among resilience, anxiety, and positive coping style, the research examined the potential mediating role of positive coping style between resilience and anxiety. We used Mackinnon's four-step procedure to examine the mediation effect (see **Table 3**), which follows: above all, resilience was significantly correlated with anxiety ($\beta = -0.250$, $P < 0.001$) (see Model 1). Secondly, resilience was significantly associated with positive coping style ($\beta = 0.742$, $P < 0.001$) (see Model 2). Next, positive coping style was significantly related to anxiety when controlling for resilience (β =-0.286, $P < 0.001$) (see Model 3). Finally, the indirect effect of resilience on anxiety *via* positive coping style was significant (ab =-0.213, SE = 0.050, 95% CI = [−0.312, −0.117]). The mediation effect of positive coping style accounted for 85.31% of the total effect. The 95% CI did not contain zero, suggesting the indirect association between resilience and anxiety *via* positive coping style. In conclusion, mediation effect met all four conditions and positive coping style mediated the relation between resilience and anxiety among healthcare workers during the outbreak of COVID-19.

Moderating Effect of Self-Efficacy

The study hypothesized that general self-efficacy might moderate the indirect effect (the second stage of the mediation pathway: positive coping-anxiety) of resilience on anxiety. The results of conditional process analysis in **Table 4** showed the interaction of positive coping style and general self-efficacy had a significant effect on anxiety ($\beta = -0.183$, $P < 0.001$), indicating the association between positive coping style and anxiety was moderated by general self-efficacy. Therefore, the moderated mediation effect was established since the indirect pathway was moderated by general self-efficacy (65).

The conditional indirect effect of resilience on anxiety *via* positive coping style at different values of general self-efficacy (1 SD below the mean, mean, and 1 SD above the mean) is also showed in **Table 4**. The indirect effect of positive coping style at 1 SD above the mean [$\beta = -0.361$, 95% CI (−0.478, −0.248)] was stronger than 1 SD below the mean [$\beta = -0.090$, 95% CI (−0.195, 0.013)]. As shown in **Figure 2** by Johnson-Neyman technique (62), general self-efficacy would moderate the indirect effect of resilience on anxiety *via* positive coping when the standard scores of general self-efficacy were higher than −0.8982, in which the 95% CI did not contain zero.

TABLE 3 | Mediation analysis ($N = 390$).

	Model 1 (Anxiety)		Model 2 (Positive coping)		Model 3 (Anxiety)			Indirect effect of positive coping style			
	β	*t*	*β*	*t*	*β*	*t*		Indirect effect	SE	LLCI	ULCI
Resilience	−0.250***	−4.889	0.742***	18.906	−0.037	−0.529	Positive coping	−0.213	0.050	−0.311	−0.117
Positive coping					−0.286***	−4.415					
R^2_{adj}	0.099***		0.490***		0.142***						
F(df)	5.966		52.452		7.909						
P	0.001		0.001		0.001						

All models are adjusted for gender, marital status, age, children situation, educational level, and professional title.
****P < 0.001.*

TABLE 4 | Conditional process analysis ($N = 390$).

	β	SE	LLCI	ULCI
Dependent variable model (outcome: anxiety)				
Resilience	−0.121	0.071	−0.261	0.020
Positive coping style	−0.306***	0.064	−0.431	−0.181
Self-efficacy	0.179**	0.056	0.070	0.289
Positive coping style * Self-efficacy	−0.183***	0.038	−0.258	−0.109
	β	Boot SE	Boot LLCI	Boot ULCI
Conditional indirect effect analysis				
1 SD below the mean	−0.090	0.052	−0.195	0.013
Mean	−0.225	0.049	−0.325	−0.129
1 SD above the mean	−0.361	0.058	−0.478	−0.248
Index of moderated mediation	−0.136	0.025	−0.184	−0.085

All models are adjusted for gender, marital status, age, children situation, educational level, and professional title.
****P < 0.001, **P < 0.01.*

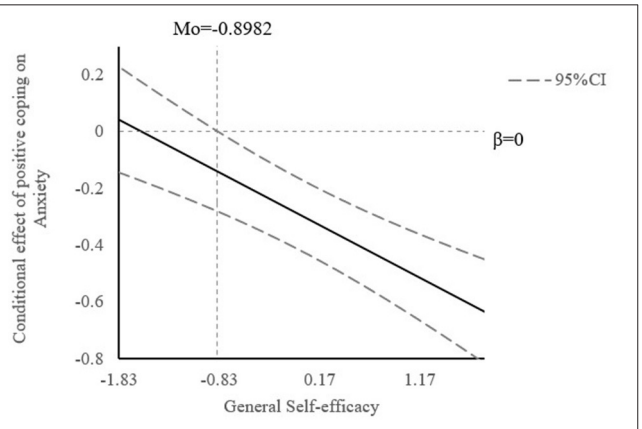

FIGURE 2 | The conditional effect of positive coping on anxiety at the value of general self-efficacy.

DISCUSSION

This study aimed to assess the prevalence of anxiety symptoms among healthcare workers 20 months during the spread of the SARS-CoV-2 Delta variant, and to discuss the mediating role of positive coping style in the association of resilience with anxiety, and the moderating role of general self-efficacy. As far as we know, this is the first research to investigate the association between resilience and anxiety *via* positive coping and the moderating role of general self-efficacy.

The results showed that the overall prevalence of anxiety among Chinese healthcare workers during the spread of the SARS-CoV-2 Delta variant was 41.8%, which is higher than the prevalence of 35.1% reported in a large-scale epidemiological survey conducted among Chinese during the COVID-19 pandemic (15). This is also higher than the prevalence of 25% among healthcare workers during the peak period of COVID-19 reported in a meta-analysis (66). These suggest that, under the circumstance of the COVID-19 pandemic the constantly mutating virus, makes healthcare workers even more likely to be anxious in comparison to the peak of the epidemic.

The demographic variables showed that male subjects had higher levels of anxiety than females, which is inconsistent with previous findings (67–69). This might be explained by several reasons. First, different samples and questionnaires were used among these studies, which resulted in certain differences. In addition, the cluster sampling method adopted in this study resulted in a large difference in the number of men (only 47) and women. This could be attributed to the fact that most nursing staff were female (70). The results also presented that unmarried, childless, and younger subjects reported a higher level of anxiety, which is in line with some published findings (69, 71, 72). These results may be due to the fact that medical workers with these characteristics tend to undertake more workload and frontline duties. Also, their professional experience and decision-making authority are lower than those of senior medical staff (69, 73).

The Mediating Role of Positive Coping

As expected, the results of MacKinnon's four-step method presented that the mediation effect accounted for 85.31% of the total effect, which indicated the effect of resilience on anxiety was largely through positive coping among healthcare workers during the spread of the SARS-CoV-2 Delta variant. This is consistent with the findings from previous literature (35, 74), which documented the mediating role of resilience in the association between resilience and health outcomes. Zhao et al. (35) found that resilience was correlated with positive coping, and coping style mediated the association between resilience and depressive symptoms. Chen (74) also proved that coping styles played a mediating role in the association between resilience and subjective well-being. The results could also be explained by the theory of psychological stress and coping developed by Lazarus et al., which claims that coping is a key mediator of stressful person-environment relations and their immediate and long-range outcomes (75). Therefore, appropriate coping styles play an important role in preventing individuals in stressful situations from developing short-term or long-term negative emotions. An individual with a higher level of resilience is more likely to develop positive coping strategies (76), which could further protect against anxiety disorders. Hence, positive coping, as a direct and rational way, could be a good mediator between the resilience and anxiety of medical staff under the COVID-19 pandemic, indicating resilience can have an impact on anxiety through positive coping.

The Moderating Role of General Self-Efficacy

In the moderated mediation analysis, the coefficient of the interaction term between self-efficacy and coping is significant, suggesting the moderating effect of self-efficacy on the indirect association between resilience and anxiety through positive coping among healthcare workers during the spread of the SARS-CoV-2 Delta variant since self-efficacy moderated the second

stage of the mediation pathway. The result is in line with the Integrative Conceptual Framework of coping process (47) and previous studies (48, 49), reporting the impact of coping on health outcomes differs at different levels of self-efficacy. Practically speaking, healthcare workers with a higher level of general self-efficacy showed a stronger association between resilience and anxiety *via* positive coping. As shown in the Johnson-Neyman technique, the association between resilience and anxiety through positive coping was weakened with the decrease of general self-efficacy. Specifically, when the standard score of general self-efficacy dropped to below −0.8496, the indirect mediation effect was not significant any more. This result could be explained by the theory of self-efficacy developed by Bandura (77). General self-efficacy will determine whether an individual takes coping measures and how much an effort he or she will make. People with a higher sense of self-efficacy are more confident to face problems, while those with a lower sense of self-efficacy will avoid or follow the crowd rather than resisting pressure (78). Hence, healthcare workers with a lower sense of general self-efficacy are more likely to feel anxious even if they adopt a positive coping style.

Implications

Our results have profound implications for the prevention of anxiety. The findings highlight the protective role of resilience and potential value of positive coping against anxiety among healthcare workers during the spread of the SARS-CoV-2 Delta variant. Programs combining resilience-building interventions [e.g., adopting a proactive orientation to solve problems, being flexible and adaptive (79)] and positive coping skills training [e.g., relaxation training, positive thinking, and problem solving (80)] should be designed and special attentions should be paid to healthcare workers with a higher sense of self-efficacy during the crisis.

Limitations and Contributions

Some limitations should be recognized. First of all, this survey used a cross-sectional design, which leads to the inability to infer causality. Longitudinal studies could be carried out in the later study to further verify the moderated mediation model. Secondly, the cluster sampling method used in this study contributed to a high proportion of women compared to men. The reason for this phenomenon might be explained by the fact some medical positions, such as nurses, are mostly occupied by women, and other studies have shown similar limitations (71, 81). Thirdly, the information about occupation was not collected in our study, which might influence the results and the generalization of the findings. Fourthly, all data were collected through online self-report, which resulted in self-reported biases. Further study could collect information from multiple informants. Fifthly, all subjects came from a hospital in Jiangsu Province and there were only 390 subjects, which limited the generalization of the findings. Follow-up studies could recruit subjects from multiple hospitals in multiple provinces and cities. Finally, anxiety could be affected by numerous factors, the pathway identified in this study was just a part of them. Future studies could construct a more integrated model to explore the influential factors of anxiety.

As far as we know, this is the first study to assess the association between resilience and anxiety *via* positive coping among healthcare workers during the spread of the SARS-CoV-2 Delta variant, and to assess the moderating role of general self-efficacy, which would give insight into how resilience affects anxiety. From a practical point of view, this study plays an important role in maintaining the mental health of healthcare worker during the spread of the SARS-CoV-2 Delta variant.

CONCLUSION

In summary, this study presented the protective effect of resilience on anxiety among healthcare workers during the spread of the SARS-CoV-2 Delta variant. Besides, positive coping could be one of the pathways through which resilience affects anxiety. Furthermore, the effect of resilience on anxiety *via* positive coping is enhanced with the increase of general self-efficacy.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Naval Medical University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

YL and TH contributed to the writing of this article and the statistical analysis. WDo led the whole study including carrying out this study and putting forward the study. HG, JW, XS, YX, and WDe contributed to the data collection and statistical analysis. All authors contributed to editing the manuscript and have approved the final manuscript.

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Mental Health Differences in Healthcare Workers Exposed to Different Risks During the Coronavirus Disease 2019 Pandemic

*Yihui Zhang[1], Da Li[2], Xuan Ouyang[1], Hanping Bai[3], Linlin Zhao[1], Yongyan Shi[1] and Liwen Tan[1]**

[1] Department of Psychiatry, National Clinical Research Center for Mental Disorders, China National Technology Institute on Mental Disorders, The Second Xiangya Hospital of Central South University, Changsha, China, [2] Institute of Anthropology, East China Normal University, Shanghai, China, [3] Department of Psychiatry, Renmin Hospital of Wuhan University, Wuhan, China

Background: The coronavirus disease 2019 (COVID-19) pandemic has caused a significant impact on the physical and mental health of healthcare workers. This study assessed the psychological status of healthcare workers who were exposed to different risk-levels in China and explored the factors that affected their mental health.

Methods: Demographic, occupational characteristics, and mental health measurements were collected from 810 workers in 41 hospitals in China, through online questionnaires from February 11 to March 3, 2020. The degree of symptoms for fatigue, anxiety, and insomnia were assessed using the Chinese versions of the Fatigue Severity Scale, 7-item Generalized Anxiety Disorder Scale, and Insomnia Severity Index, respectively. Binary logistic regression analysis was performed to identify factors associated with mental health symptoms.

Results: All 810 participants completed the relevant questionnaires without missing data. The prevalence of fatigue, anxiety, and insomnia symptoms was 74.3, 73.7, and 61.7%, respectively. Nurses, women, and workers exposed to high-risk areas were more likely to report mental health problems ($P < 0.05$). After controlling for confounders, exposure to high-risk areas was independently associated with increased symptoms of fatigue, anxiety, and insomnia (fatigue among high-risk areas: OR, 3.87; 95% CI, 2.26–6.61; $P < 0.001$; anxiety among high-risk areas: OR, 2.66; 95% CI, 1.58–4.51; $P < 0.001$; insomnia among high-risk areas: OR, 2.83; 95% CI, 1.68–4.79, $P < 0.001$).

Conclusion: The study demonstrated significant differences in psychological symptoms among healthcare workers exposed to different levels of risk, and those in high-risk areas were more vulnerable to experiencing mental health symptoms. These findings emphasize the importance of giving due attention to healthcare workers, especially women, nurses, and those working in high-risk settings during the COVID-19 pandemic.

Keywords: COVID-19, mental health, different risks, healthcare workers, China

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***Correspondence:**
Liwen Tan
tanliwen@csu.edu.cn

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INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has had devastating effects worldwide. Globally, as of October 29, 2021, there were 245,373,039 confirmed cases of COVID-19, including 4,979,421 deaths, reported to the WHO (1). As of October 29, 2021, there were 97,080 confirmed cases on the Chinese mainland, according to data from the National Health Commission (2).

The experience of previous pandemics has demonstrated that, in addition to the direct damage to physical functioning of the affected, emerging virus outbreaks also negatively impact mental health, particularly that of healthcare workers (3–5). The World Psychiatric Association has repeatedly issued statements calling attention to the mental health of healthcare workers (6). Previous studies on severe acute respiratory syndrome (SARS), Ebola, Middle East respiratory syndrome, and influenza A (H1N1) pandemic have revealed that public health emergencies significantly increase the workload of healthcare workers who face higher mortality rates and greater risks of infection than other communities due to the nature of their work; these factors can contribute to psychological problems among healthcare workers (7–10). Similarly, since the outbreak of COVID-19, studies on medical mental health have revealed that medical staff were particularly prone to anxiety (11, 12) and insomnia (13) at the early stage of the epidemic, with a higher prevalence of insomnia (14).

As per the experiences from previous pandemics, the exposure risks experienced by each healthcare worker vary, which may lead to differences in working hours, stress, and ultimately, differences in their mental health (15).

Over the course of the COVID-19 pandemic, the World Psychiatric Association has highlighted the different risks of exposure to healthcare workers (6). However, previous studies mostly investigated mental health problems of medical staff using regional or individual hospitals (13, 16) and did not analyze the mental health status of workers with different exposure risks in the early pandemic.

Therefore, we collected information on healthcare workers (doctors and nurses) who were exposed to varying levels of risk in China to explore the factors affecting their mental health in the early stage of COVID-19. Participants from different hospitals in Wuhan, Hubei province, and cities in other provinces were enrolled in this survey to analyze potential risk factors associated with symptoms such as fatigue, anxiety, and insomnia by quantifying the extent of these symptoms in participants and comparing differences in exposure to different levels of risk. The purpose of this study was to assess the psychological health of healthcare workers who were exposed to various risks in China, which may also serve as an effective evidence to guide the improvement of mental health of healthcare workers in various risk areas.

MATERIALS AND METHODS

Participants and Procedures

This study is part of an investigation into mental health symptoms, associated risk factors, and relevant coping methods among healthcare workers across the country during the peak of COVID-19 in China. The 810 participants comprised staff (including 239 [29.5%] doctors and 571 [70.5%] nurses) from 41 hospitals during the early pandemic. Since Wuhan was the hardest-hit region, we sampled more hospitals in Wuhan, accounting for approximately three-quarter of the total sample size. This study was approved by the Clinical Research Ethics Committee of the Second Xiangya Hospital of Central South University.

The specific procedures were as follows. The survey was conducted on "Questionnaire Star," a well-known online survey platform in China, from February 11 to March 3, 2020. The investigators distributed the link to the online questionnaire to workgroups at different hospitals through WeChat, spreading through a snowball sampling procedure (implying that each respondent was able to forward the link to another person). With informed consent, healthcare workers who received the link volunteered to participate in the study and could withdraw from the survey at any time. The online survey was anonymous and could only be completed once on the same device.

Measures

Demographic and Occupational Characteristics Data

Demographic information mainly included gender (male or female) and age (18–25, 26–30, 31–40, 41–50, or 51–60). Occupational characteristics data primarily included occupation type (doctor or nurse), technical title (junior, intermediate, or senior), type of hospital (secondary or tertiary), location (Wuhan, Hubei province outside Wuhan, or other cities outside Hubei province), designated hospitals (yes or no), current position (fever clinic, mild ward, intensive care unit, medical technology, or logistics), and exposure risk (low, medium, or high). For evaluating exposure risk levels, participants were asked to answer four questions related to exposure risk. First, they were asked to state the risk level of their local area (selected by themselves after consulting the local government announcement), and the following questions were set considering the different opportunities for medical staff to come into contact with patients: whether the protective materials at their posts were sufficient; whether they were in a front-line position; and what level of exposure risk did they think individuals have at work? These questions more clearly instruct participants to identify their individual exposure risk level, rather than simply filling in the risk level for their location.

Fatigue, Anxiety, and Insomnia Symptoms

Previous studies have revealed that in the early stages of the outbreak, medical staff are prone to fatigue, anxiety, insomnia, and other acute symptoms, whereas depression is relatively insignificant (11–13). To reduce the efforts for answering questions and assess the mental health status of healthcare workers more efficiently and quickly, we assessed symptoms of fatigue, anxiety, and insomnia using the Chinese version of the standardized measurement tools (17–19). It includes three scales. First, the Fatigue Severity Scale (FSS) is used to assess fatigue symptoms and consists of nine items with a total score ranging from 0 to 63, with 36 or more being subjective fatigue (17). Second, the Generalized Anxiety Disorder-7 (GAD-7) assesses

the severity of anxiety over the past 2 weeks, which contains seven items with a total score ranging 0–21 (18). The relationship between total scores and severity was as follows: normal (0–4), mild (5–9), moderate (10–14), and severe (15–21) anxiety. Lastly, the Insomnia Severity Index (ISI), a self-report tool that assesses the intensity of insomnia during the previous 2 weeks, contains seven items with a total score ranging 0–28 (19). The corresponding relationship between the total score and severity of insomnia was normal (0–7), mild (8–14), moderate (15–21), and severe (22–28) insomnia.

Statistical Analysis

SPSS statistical software (version 26.0; IBM Corp) was used for data analysis. The ranked data are shown as numbers and percentages, calculated from the scores of each level for symptoms of fatigue, anxiety, and insomnia. To assess the intensity of each symptom between two or more groups, the non-parametric Mann–Whitney *U*-test and Kruskal–Wallis test were used. Binary logistic regression analysis was used to identify potential risk factors for fatigue, anxiety, and insomnia symptoms in participants, and the associations between risk factors and outcomes were presented as odds ratios (ORs) and 95% confidence intervals (CIs), after controlling for confounders such as gender, age, occupation type, technical title, type of hospital, location, departments, designated hospital, current position, and exposure risk. Statistical significance was set at $P < 0.05$.

RESULTS

In the study, 810 healthcare professionals completed the survey, of whom 239 (29.5%) were doctors and 571 (70.5%) were nurses. Among the respondents, 577 (71.2%) were exposed to high-risk areas, 163 (20.1%) were exposed to medium-risk areas, and 70 (8.6%) were exposed to low-risk areas. The primary distribution of the respondents across gender, age, job title, affiliated hospital, and risk area was as follows: women (662 [81.7%]), 26–40 years old (505 [62.4%]), junior technical title (422 [52.1%]), working in a tertiary hospital (537 [66.3%]), working in a designated hospital (622 [76.8%]), and belonging to medium or high-risk areas (740 [91.3%]; **Table 1**).

The severity categories of fatigue, anxiety, and insomnia were measured in the total cohort and subgroups. Most of the participants had subjective fatigue (602 [74.3%]), anxiety (597 [73.7%]), and insomnia symptoms (500 [61.7%]). Compared with physicians, nurses were more likely to report severe symptoms of anxiety (86 [15.1] vs. 30 [12.6], $P = 0.024$) and insomnia (42 [7.4] vs. 12 [5.0], $P = 0.001$). Compared with men, women were more likely to report fatigue (505 [76.3%] vs. 97 [65.5%], $P = 0.007$), severe anxiety (97 [14.7%] vs. 19 [12.8%], $P = 0.021$), and moderate insomnia (123 [18.6%] vs. 17 [11.5%], $P = 0.006$). The healthcare workers who reported exposure to high-risk areas were more likely to experience fatigue, severe anxiety, and severe insomnia than those exposed to medium- and low-risk areas (fatigue: 462 [80.1%] vs. 106 [65.0%], and 34 [48.6%], $P < 0.001$; severe anxiety: 102 [17.7%] vs. 11 [6.7%], and 3 [4.3%], $P < 0.001$; and severe insomnia: 47 [8.1%] vs. 5 [3.1%], and 2 [2.9%], $P < 0.001$). Compared with those working in non-designated hospitals, participants working in COVID-19 designated hospitals were more likely to report symptoms of fatigue (476 [76.5%] vs. 126 [67.0%], $P = 0.009$) and severe insomnia (47 [7.6%] vs. 7 [3.7%], $P < 0.001$). Compared with healthcare workers in "Hubei outside Wuhan" and "outside Hubei," healthcare workers in Wuhan were more likely to report symptoms of fatigue (472 [76.7%] vs. 36 [58.1%], and 94 [70.7%], $P < 0.001$), anxiety (94 [15.3%] vs. 10 [16.1%], and 12 [9.0%], $P < 0.001$), and insomnia (94 [15.3%] vs. 10 [16.1%], and 12 [9.0%], $P < 0.001$; **Tables 2.1**, **2.2**).

For all participants, the median (IQR) scores on the FSS, the GAD-7, and the ISI scales were 44.0 (35.0–53.0), 7.0 (4.0–12.0), and 9.0 (5.0–14.0), respectively. Similarly, nurses, women, individuals exposed to high-risk areas, and those working in COVID-19 designated hospitals in Wuhan had higher scores on all scales. Specifically, among all participants, nurses scored higher than doctors on fatigue (46.0 [36.0–54.0] vs. 42.0 [33.0–48.0], $P < 0.001$), anxiety (7.0 [5.0–12.0] vs. 7.0 [4.0–11.0], $P = 0.004$), and insomnia (10.0 [6.0–15.0] vs. 8.0 [4.0–13.0], $P < 0.001$) symptom scales. Women were more likely than men to report high scores for fatigue (45.0 [36.0–54.0] vs. 40.0 [30.3–49.0], $P < 0.001$), anxiety (7.0 [5.0–12.0] vs. 6.0 [2.0–10.0], $P = 0.001$), and insomnia (10.0 [6.0–15.0] vs. 8.0 [3.0–13.0], $P = 0.001$) symptom scales (**Table 3.1**). Compared with those exposed to medium- and low-risk areas, participants who were exposed to high-risk areas reported higher scores in the three scales (fatigue: 46.0 [38.0–55.0] vs. 40.0 [31.0–51.0], 35.0 [26.8–43.0]; anxiety: 8.0 [5.0–13.0] vs. 6.0 [3.0–9.0], 5.0 [1.0–7.0]; and insomnia: 10.0 [6.0–15.0] vs. 8.0 [4.0–12.0], 6.0 [1.8–9.0]; $P < 0.001$). Moreover, participants working in a designated hospital reported higher scores than those working in a non-designated hospital (fatigue: 42.0 [32.0–49.0] vs. 45.0 [36.0–54.0], $P < 0.001$; anxiety: 7.0 [5.0–12.0] vs. 6.0 [2.0–11.0], $P = 0.001$; and insomnia: 10.0 [6.0–15.0] vs. 8.0 [3.3–12.0], $P < 0.001$). Similarly, compared to the participants in other cities of Hubei province (other than Wuhan) and other provinces, those in Wuhan reported higher scores in the three scales (fatigue: 45.0 [36.0–54.0] vs. 37.5 [27.5–47.3] and 43.0 [34.0–49.0], $P < 0.001$; anxiety: 7.0 [5.0–12.0] vs. 5.5 [2.0–9.3] and 6.0 [3.5–11.0], $P = 0.001$; and insomnia: 10.0 [6.0–15.0] vs. 8.0 [4.0–11.3] and 8.0 [4.0–13.0], $P = 0.002$; **Table 3.2**).

After controlling for confounding factors, binary logistic regression analysis revealed that nurses and women were more susceptible to fatigue (fatigue among nurses: OR, 0.54; 95% CI, 0.32–0.91; $P = 0.022$; fatigue among women: OR, 1.83, 95% CI, 1.07–3.14, $P = 0.028$). Compared with working in a secondary hospital, working in a tertiary hospital was associated with increased anxiety symptoms (OR, 1.45; 95% CI, 1.03–2.05; $P = 0.032$). Exposure to medium-risk areas was associated with increased anxiety symptoms than exposure to low-risk areas (OR, 1.91; 95% Cl, 1.06–3.45; $P = 0.031$). Compared with working in a non-designated hospital, working in a COVID-19 designated hospitals was associated with increased symptoms of insomnia (OR, 1.37; 95% CI, 0.95–1.97, $P = 0.090$). Exposure to high-risk areas was associated with increased fatigue, anxiety, and insomnia symptoms (fatigue: OR, 3.87; 95% CI, 2.26–6.61;

TABLE 1 | Demographic and occupational characteristics of participants.

Characteristic	Total (%)	Occupation		Exposure risk		
		Physician	Nurse	Low	Medium	High
	810 (100.0)	239 (29.5)	571 (70.5)	70 (8.6)	163 (20.1)	577 (71.2)
Gender						
Male	148 (18.3)	129 (54.0)	19 (3.3)	25 (35.7)	27 (16.6)	96 (16.6)
Female	662 (81.7)	110 (46.0)	552 (96.7)	45 (64.3)	136 (83.4)	481 (83.4)
Ages (years)						
18–25	119 (14.7)	7 (2.9)	112 (19.6)	8 (11.4)	18 (11)	93 (16.1)
26–30	217 (26.8)	26 (10.9)	191 (33.5)	14 (20.0)	41 (25.2)	162 (28.1)
31–40	288 (35.6)	116 (48.5)	172 (30.1)	27 (38.6)	69 (42.3)	192 (33.3)
41–50	149 (18.4)	72 (30.1)	77 (13.5)	16 (22.9)	30 (18.4)	103 (17.9)
51–60	37 (4.6)	18 (7.5)	19 (3.3)	5 (7.1)	5 (3.1)	27 (4.7)
Technical title						
Junior	422 (52.1)	56 (23.4)	366 (64.1)	30 (42.9)	69 (42.3)	323 (56.0)
Intermediate	315 (38.9)	125 (52.3)	190 (33.3)	28 (40.0)	78 (47.9)	209 (36.2)
Senior	73 (9.0)	58 (24.3)	15 (2.6)	12 (17.1)	16 (9.8)	45 (7.8)
Type of hospital						
Secondary	273 (33.7)	100 (41.8)	173 (30.3)	31 (44.3)	69 (42.3)	173 (30.0)
Tertiary	537 (66.3)	139 (58.2)	398 (69.7)	39 (55.7)	94 (57.7)	404 (70.0)
Location						
Wuhan	615 (75.9)	129 (54.0)	486 (85.1)	45 (64.3)	104 (63.8)	466 (80.8)
Hubei province	62 (7.7)	21 (8.8)	41 (7.2)	7 (10.0)	14 (8.6)	41 (7.1)
Outside	133 (16.4)	89 (37.2)	44 (7.7)	18 (25.7)	45 (27.6)	70 (12.1)
Designated hospitals						
Yes	622 (76.8)	147 (61.5)	475 (83.2)	44 (62.9)	113 (69.3)	465 (80.6)
No	188 (23.2)	92 (38.5)	96 (16.8)	26 (37.1)	50 (30.7)	112 (19.4)
Current position						
Fever clinic	64 (7.9)	25 (10.5)	39 (6.8)	4 (5.7)	10 (6.1)	50 (8.7)
Mild ward	358 (44.2)	87 (36.4)	271 (47.5)	43 (61.4)	74 (45.4)	241 (41.8)
Intensive care unit	247 (30.5)	27 (11.3)	220 (38.5)	5 (7.1)	29 (17.8)	213 (36.9)
Medical technology	102 (12.6)	85 (35.6)	17 (3.0)	12 (17.1)	37 (22.7)	53 (9.2)
Logistics department	39 (4.8)	15 (6.3)	24 (4.2)	6 (8.6)	13 (8.0)	20 (3.5)

$P < 0.001$; anxiety: OR, 2.66; 95% CI, 1.58–4.51; $P < 0.001$; and insomnia: OR, 2.83; 95% CI, 1.68–4.792; $P < 0.001$; **Table 4**).

DISCUSSION

This study assessed the mental health of healthcare workers exposed to different risks in the early stages of the COVID-19 pandemic and analyzed the risk factors. In 2022, the global pandemic and the epidemic in China have once again reached a severe state, and the results of our study may strengthen the government's early attention to the mental health of medical staff and provide more perspectives and evidence for psychological prevention and intervening measure of healthcare workers. In this survey, a total of 810 healthcare professionals who were exposed to different risks in China received and completed all questions in the online questionnaire. All participants were divided into three groups based on their exposure risk: low-risk areas (70), medium-risk areas (163), and high-risk areas (577), and interregional differences were compared. Our results showed that most of the participants had mental health concerns, with symptoms of fatigue (74.3%), anxiety (73.7%), and insomnia (61.7%). In addition, nurses, women, those working in tertiary hospitals, in COVID-19 designated hospitals, in Wuhan, and those exposed to medium-and high-risk areas were more likely to exhibit symptoms pointing to mental health concerns. In all aspects of interest, exposure to high-risk areas was an independent risk factor for poor mental health.

Thus, the results of this study highlight that more attention should be given to the mental health of healthcare workers who reported exposure to high-risk environments.

This study indicated that a significant proportion of healthcare workers had fatigue symptoms, but the rate was significantly higher than in one study of frontline nurses in Wuhan that reported 35.06% of respondents having fatigue (20). Moreover, a previous study conducted early in the SARS outbreak in Taiwan, China, showed that 77.4% of respondents reported anxiety and worry, 52.3% experienced sleep problems, and obvious anxiety symptoms were more prominent in the initial

TABLE 2.1 | Severity categories of fatigue, anxiety, and insomnia measurements in total cohort and subgroups.

Severity category	Total, No (%)	Occupation		Z	*P*	Gender		Z	*P*	Ages (years)					H	*P*
		Physician	Nurse			Male	Female			18–25	26–30	31–40	41–50	51–60		
FSS																
No.fatigue	208 (25.7)	69 (28.9)	139 (24.3)	−1.344	0.179	51 (34.5)	157 (23.7)	−2.703	0.007	24 (20.2)	48 (22.1)	75 (26.0)	49 (32.9)	12 (32.4)	5.178	0.270
Fatigue	602 (74.3)	170 (71.1)	432 (75.7)			97 (65.5)	505 (76.3)			95 (79.8)	169 (77.9)	213 (74.0)	100 (67.1)	25 (67.6)		
GAD-7																
Normal	213 (26.3)	76 (31.8)	137 (24)	−2.257	0.024	49 (33.1)	164 (24.8)	−2.303	0.021	30 (25.2)	47 (21.7)	88 (30.6)	41 (27.5)	7 (18.9)	7.315	0.120
Mild	311 (38.4)	89 (37.2)	222 (38.9)			58 (39.2)	253 (38.2)			48 (40.3)	86 (39.6)	109 (37.8)	59 (39.6)	9 (24.3)		
Moderate	170 (21.0)	44 (18.4)	126 (22.1)			22 (14.9)	148 (22.4)			21 (17.6)	48 (22.1)	56 (19.4)	31 (20.8)	14 (37.8)		
Severe	116 (14.3)	30 (12.6)	86 (15.1)			19 (12.8)	97 (14.7)			20 (16.8)	36 (16.6)	35 (12.2)	18 (12.1)	7 (18.9)		
ISI																
Normal	310 (38.3)	111 (46.4)	199 (34.9)	−3.273	0.001	72 (48.6)	238 (36)	−2.727	0.006	47 (39.5)	76 (35)	116 (40.3)	58 (38.9)	13 (35.1)	4.974	0.290
Mild	306 (37.7)	84 (35.1)	222 (38.9)			49 (33.1)	257 (38.8)			45 (37.8)	85 (39.2)	107 (37.2)	58 (38.9)	11 (29.7)		
Moderate	140 (17.3)	32 (13.4)	108 (18.9)			17 (11.5)	123 (18.6)			21 (17.6)	42 (19.4)	48 (16.7)	21 (14.1)	8 (21.6)		
Severe	54 (6.7)	12 (5.0)	42 (7.4)			10 (6.8)	44 (6.6)			6 (5)	14 (6.5)	17 (5.9)	12 (8.1)	5 (13.5)		

FSS, fatigue severity scale; GAD-7, 7-item generalized anxiety disorder; ISI, 7-item insomnia severity index.

TABLE 2.2 | Severity Categories of Fatigue, Anxiety, and Insomnia Measurements in Subgroups.

Severity category	Exposure risk			H	*P*	Designated hospitals		Z	*P*	Location			H	*P*
	Low	Medium	High			Yes	No			Wuhan	Hubei province	Outside Hubei		
FSS														
No.fatigue	36 (51.4)	57 (35.0)	115 (19.9)	52.478	0.000	146 (23.5)	62 (33.0)	−2.613	0.009	143 (23.3)	26 (41.9)	39 (29.3)	19.653	0.000
Fatigue	34 (48.6)	106 (65.0)	462 (80.1)			476 (76.5)	126 (67.0)			472 (76.7)	36 (58.1)	94 (70.7)		
GAD-7														
Normal	33 (47.1)	50 (30.7)	130 (22.5)	49.875	0.000	152 (24.4)	61 (32.4)	−1.569	0.117	152 (24.7)	19 (30.6)	42 (31.6)	13.726	0.001
Mild	23 (32.9)	76 (46.6)	212 (36.7)			246 (39.5)	65 (34.6)			235 (38.2)	23 (37.1)	53 (39.8)		
Moderate	11 (15.7)	26 (16.0)	133 (23.1)			134 (21.5)	36 (19.1)			134 (21.8)	10 (16.1)	26 (19.5)		
Severe	3 (4.3)	11 (6.7)	102 (17.7)			90 (14.5)	26 (13.8)			94 (15.3)	10 (16.1)	12 (9.0)		
ISI														
Normal	43 (61.4)	79 (48.5)	188 (32.6)	44.507	0.000	220 (35.4)	90 (47.9)	−3.657	0.000	220 (35.8)	30 (48.4)	60 (45.1)	12.130	0.002
Mild	19 (27.1)	61 (37.4)	226 (39.2)			237 (38.1)	69 (36.7)			231 (37.6)	25 (40.3)	50 (37.6)		
Moderate	6 (8.6)	18 (11.0)	116 (20.1)			118 (19.0)	22 (11.7)			115 (18.7)	6 (9.7)	19 (14.3)		
Severe	2 (2.9)	5 (3.1)	47 (8.1)			47 (7.6)	7 (3.7)			49 (8.0)	1 (1.6)	4 (3.0)		

FSS, fatigue severity scale; GAD-7, 7-item generalized anxiety disorder; ISI, 7-item insomnia severity index.

TABLE 3.1 | Scores of fatigue, anxiety, and insomnia measurements in total cohort and subgroups.

Scale	Total score median (IQR)	Occupation (IQR)		Z	P	Gender (IQR)		Z	P	Ages (years) (IQR)					H	P
		Physician	Nurse			Male	Female			18–25	26–30	31–40	41–50	51–60		
FSS (fatigue)	44.0 (35.0–53.0)	42.0 (33.0–48.0)	46.0 (36.0–54.0)	−3.909	0.000	40.0 (30.3–49.0)	45.0 (36.0–54.0)	−3.633	0.000	43.0 (37.0–54.0)	47.0 (37.0–54.0)	43.0 (35.0–50.8)	44.0 (31.0–55.0)	49.0 (23.0–57.0)	5.178	0.270
GAD-7 (anxiety)	7.0 (4.0–12.0)	7.0 (4.0–11.0)	7.0 (5.0–12.0)	−2.846	0.004	6.0 (2.0–10.0)	7 (5.0–12.0)	−3.287	0.001	7.0 (4.0–10.0)	7.0 (5.0–12.0)	7.0 (4.0–11.0)	7.0 (4.0–12.0)	11.0 (4.5–17.0)	7.315	0.120
ISI (insomnia)	9.0 (5.0–14.0)	8.0 (4.0–13.0)	10.0 (6.0–15.0)	−3.958	0.000	8.0 (3.0–13.0)	10.0 (6.0–15.0)	−3.375	0.001	10.0 (6.0–14.0)	10.0 (6.0–15.0)	9.0 (5.0–14.0)	8.0 (4.0–14.0)	11.0 (5.0–17.0)	4.974	0.290

FSS, fatigue severity scale; GAD-7, 7-item generalized anxiety disorder; ISI, 7-item insomnia severity index.

TABLE 3.2 | Scores of fatigue, anxiety, and insomnia measurements in subgroups.

Scale	Exposure risk			H	P	Designated hospitals		Z	P	Location			H	P
	Low	Medium	High			Yes	No			Wuhan	Hubei province	Outside Hubei		
FSS (fatigue)	35.0 (26.8–43.0)	40.0 (31.0–51.0)	46.0 (38.0–55.0)	52.478	0.000	45.0 (36.0–54.0)	42.0 (32.0–49.0)	−3.825	0.000	45.0 (36.0–54.0)	37.5 (27.5–47.3)	43.0 (34.0–49.0)	19.653	0.000
GAD-7 (anxiety)	5.0 (1.0–7.0)	6.0 (3.0–9.0)	8.0 (5.0–13.0)	49.875	0.000	7.0 (5.0–12.0)	6.0 (2.0–11.0)	−3.226	0.001	7.0 (5.0–12.0)	5.5 (2.0–9.3)	6.0 (3.5–11.0)	13.726	0.001
ISI (insomnia)	6.0 (1.8–9.0)	8.0 (4.0–12.0)	10.0 (6.0–15.0)	44.507	0.000	10.0 (6.0–15.0)	8.0 (3.3–12.0)	−4.155	0.000	10.0 (6.0–15.0)	8.0 (4.0–11.3)	8.0 (4.0–13.0)	12.13	0.002

FSS, fatigue severity scale; GAD-7, 7-item generalized anxiety disorder; ISI, 7-item insomnia severity index.

TABLE 4 | Risk factors for mental health symptoms identified by binary logistic regression.

Variable	No. of symptomatic cases/ No. of total cases (%)	Adjusted OR (95%CI)	*P*-value[a]
FSS, fatigue symptoms	629/859 (73.2)		
Occupation			
Physician	170/239 (71.1)	Reference	
Nurse	432/571 (75.7)	0.54 (0.32–0.91)	0.022
Gender			
Male	97/148 (65.5)	Reference	
Female	505/662 (76.3)	1.83 (1.07–3.14)	0.028
Exposure risk			
Low	34/70 (48.6)	Reference	
Medium	106/163 (65.0)	1.73 (0.96–3.12)	0.068
High	462/577 (80.1)	3.87 (2.26–6.61)	0.000
GAD-7, anxiety symptoms	621/859 (72.3)		
Occupation			
Physician	163/239 (68.2)	Reference	
Nurse	434/571 (76.0)	0.98 (0.6–1.6)	0.927
Gender			
Male	99/148 (66.9)	Reference	
Female	498/662 (75.2)	1.22 (0.73–2.06)	0.444
Type of hospital			
Secondary	188/273 (68.9)	Reference	
Tertiary	414/537 (77.1)	1.45 (1.03–2.05)	0.032
Exposure risk			
low	37/70 (52.9)	Reference	
Medium	113/163 (69.3)	1.91 (1.06–3.45)	0.031
High	447/577 (77.5)	2.66 (1.58–4.51)	0.000
ISI, insomnia symptoms	519/859 (60.4)		
Occupation			
Physician	128/239 (53.6)	Reference	
Nurse	372/571 (65.1)	1.1 (0.7–1.72)	0.689
Gender			
Male	76/148 (51.4)	Reference	
Female	424/662 (64.0)	1.42 (0.88–2.29)	0.149
Designated hospitals			
Yes	402/622 (64.6)	1.37 (0.95–1.97)	
No	98/188 (52.1)	Reference	0.090
Exposure risk			
Low	27/70 (38.6)	Reference	
Medium	84/163 (51.5)	1.55 (0.87–2.77)	0.140
High	389/577 (67.4)	2.83 (1.68–4.79)	0.000

FSS, fatigue severity scale; GAD-7, 7-item generalized anxiety disorder; ISI, 7-item insomnia severity index; OR, odds ratio.

[a] *P-value for each category vs. the reference.*

stage (7). Therefore, the results of our study are consistent with those of previous studies. However, compared with studies among healthcare workers during the COVID-19 pandemic in China and Italy, our study showed higher rates of anxiety (13, 21–23). Furthermore, the percentage of healthcare workers with insomnia in our study was higher than the pooled prevalence of sleep disorders in Chinese healthcare professionals during the COVID-19 pandemic, which was ∼45.1% (24). In the early pandemic period, longer working hours, a lack of protective equipment and supplies (25), and quarantine of self from family by healthcare workers significantly increased their perceived level of risk and psychological stress, which may exacerbate their daytime fatigue and affect mood and sleep patterns (14, 26, 27). In addition, the reasons why our study observed a higher rate of fatigue, anxiety, and insomnia may be due to differences in sample sources and sampling time. In this study, 71.2% of the participants worked in high-risk environments and may experience more work-related stress. Moreover, we discovered some differences in mental health between doctors and nurses, with nurses being more likely to experience fatigue, anxiety, and insomnia symptoms in the early pandemic period. Similarly, studies from other countries have revealed that the mental health burden on healthcare workers during the COVID-19 pandemic is significantly higher among nurses than doctors, owing to a greater exposure to both patients' and families' suffering and distress (28, 29).

More importantly, this survey showed that there were considerable disparities in the prevalence of fatigue, anxiety, and insomnia symptoms among healthcare professionals of different genders, with women scoring significantly higher than men. Similar results were also reported in a recent study of gender differences in mental health among healthcare workers during the COVID-19 pandemic (30). Moreover, it was consistent with earlier studies on healthcare professionals and the general public in the early stages of the SARS (7, 31) and COVID-19 pandemic (32, 33). Epidemiological studies have revealed that the lifetime prevalence of anxiety disorders is ∼1.5-times higher in women than in men (34, 35), and adult women had significantly higher rates of insomnia reported (36–38). These differences may be influenced by many physiological factors, such as sex chromosome genes, sex hormones, and the activity of the hypothalamic-pituitary-adrenal axis (39, 40). Additionally, under significant stress, women tend to adopt more emotion-centered coping styles, such as complaint, avoidance, and self-blame, which are associated with increased symptoms of anxiety and insomnia (34).

What makes the study more remarkable is that it discovered that health care professionals at different exposure risks had different rates of mental health symptoms, with those in high-risk areas more likely to experience fatigue, anxiety, and insomnia. Moreover, it is an independent risk factor for poor mental health. Studies in China, Poland, Italy, Switzerland, and other countries during the COVID-19 pandemic have also revealed that front-line workers, especially those in high-risk areas, such as the intensive care unit, the infectious diseases unit, and the emergency departments, were at a much higher risk of anxiety, insomnia, and depressive symptoms than second-line workers (15, 41–43). This result may be due to the following reasons. First, the workload of front-line staff is overwhelming, especially during the outbreak of COVID-19, and the number of infections has increased sharply, and staff are more prone to fatigue symptoms, anxiety, and other psychological problems (44–47). Second, with regard to psychological aspects, compared

with the staff in low-risk areas, the staff exposed to the high-risk setting and having a direct contact with a significant number of infected people, may have greater concerns about exposure to infection coupled with the patient's negative emotions, protective material shortage, lack of contact with family, and guilt from not being able to save each patient, leading to a significant increase in the psychological pressure of frontline staff (20, 26). Research has revealed that psychological stress is directly related to mental health problems such as anxiety and insomnia, and the greater the psychological stress, the higher the likelihood of these symptoms (45, 48, 49). The European Psychiatric Association also issued a statement highlighting the necessity of paying attention to psychological problems and early intervention among frontline workers (50). In addition, our study suggests that governments can allocate the number of mental health workers and the corresponding treatment model according to the level of exposure risk to more accurately maintain the mental health of healthcare workers and achieve a more effective use of resources.

Study Limitations

This study had some limitations. First, our study focused on risk factors affecting the mental health of healthcare workers and lacked analysis of protective factors during the pandemic. Recent research has argued that resilience, emotion regulation, and social support may play a protective role in healthcare workers during the pandemic, and these protective factors may be operating to grant healthcare workers the necessary resilience in facing the enormous challenges posed by the pandemic (51). Second, the study was cross-sectional, reflecting only the mental health of healthcare professionals at that point in time, and could not reflect causality. Third, all data were collected through self-reported questionnaires, which may have increased the recall bias. Moreover, a convenience sampling method was adopted to recruit participants, which may limit the representativeness of the samples and the generality of the research results to some extent. Finally, our survey did not consider respondents' prior mental and physical conditions, which may have had some impact on their reported results.

In conclusion, the study of healthcare workers revealed a significant prevalence of fatigue, anxiety, and insomnia, especially among women during the COVID-19 pandemic. The survey results also demonstrated significant differences in psychological symptoms among healthcare workers exposed to different levels of risk, in which those in high-risk areas are more vulnerable to experiencing mental health symptoms. These findings remind us to pay more attention to healthcare workers, especially women and nurses, and those working in high-risk settings during the COVID-19 pandemic, while providing them with more support, including medical material support, personnel support, family support, and as early as possible to carry on psychological intervention, to maintain their mental health.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Clinical Research Ethics Committee of the Second Xiangya Hospital of Central South University. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

LT, HB, DL, and XO contributed to the study concept and design. LZ and YS acquired and collected the data. YZ analyzed the data and drafted the manuscript. All authors read and approved the final manuscript.

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Factors Associated With Experiences of Fear, Anxiety, Depression, and Changes in Sleep Pattern During the COVID-19 Pandemic Among Adults in Nigeria: A Cross-Sectional Study

Morenike Oluwatoyin Folayan[1,2], Olanrewaju Ibigbami[3], Brandon Brown[1,4], Maha El Tantawi[1,5], Nourhan M. Aly[1,5], Oliver C. Ezechi[1,6], Giuliana Florencia Abeldaño[1,7], Eshrat Ara[1,8], Martin Amogre Ayanore[1,9], Passent Ellakany[1,10], Balgis Gaffar[1,11], Nuraldeen Maher Al-Khanati[1,12], Ifeoma Idigbe[1,6], Mohammed Jafer[1,13], Abeedha Tu-Allah Khan[1,14], Zumama Khalid[1,14], Folake Barakat Lawal[1,15], Joanne Lusher[1,16], Ntombifuthi P. Nzimande[1,17], Bamidele Olubukola Popoola[1,18], Mir Faeq Ali Quadri[1,19], Mark Roque[1,20], Ala'a B. Al-Tammemi[1,21], Muhammad Abrar Yousaf[1,22], Jorma I. Virtanen[1,23], Roberto Ariel Abeldaño Zuñiga[1,24], Nicaise Ndembi[1,25], John N. Nkengasong[1,25] and Annie Lu Nguyen[1,26]*

[1] Mental Health and Wellness Study Group, Ile-Ife, Nigeria, [2] Department of Child Dental Health, Obafemi Awolowo University, Ile-Ife, Nigeria, [3] Department of Mental Health, Obafemi Awolowo University, Ile-Ife, Nigeria, [4] Department of Social Medicine, Population and Public Health, Riverside School of Medicine, University of California, Riverside, Riverside, CA, United States, [5] Department of Pediatric Dentistry and Dental Public Health, Faculty of Dentistry, Alexandria University, Alexandria, Egypt, [6] Department of Clinical Sciences, Nigerian Institute of Medical Research, Lagos, Nigeria, [7] School of Medicine, University of Sierra Sur, Oaxaca, Mexico, [8] Government College for Women, Srinagar, India, [9] Department of Health Policy Planning and Management, School of Public Health, University of Health and Allied Sciences, Ho, Ghana, [10] Department of Substitutive Dental Sciences, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia, [11] Department of Preventive Dental Sciences, College of Dentistry, Imam Abdulrahman bin Faisal University, Dammam, Saudi Arabia, [12] Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Syrian Private University, Damascus, Syria, [13] Department of Preventive Dental Sciences, Saudi Arabia Department of Health Promotion, Faculty of Health, Medicine and Life Sciences, Jazan University, Maastricht University, Maastricht, Netherlands, [14] Department of Health Sciences, University of Genova, Genova, Italy, [15] Department of Periodontology and Community Dentistry, University of Ibadan and University College Hospital, Ibadan, Nigeria, [16] Director of People and Member of the Provost's Group, Regent's University, London, United Kingdom, [17] Department of Economic and Social Geography, University of Szeged, Szeged, Hungary, [18] Department of Child Oral Health, University of Ibadan, Ibadan, Nigeria, [19] Department of Preventive Dental Sciences, Division of Dental Public Health, College of Dentistry, Jazan University, Jizan, Saudi Arabia, [20] Department of Maternity and Childhood Nursing, College of Nursing, Taibah University, Medina, Saudi Arabia, [21] Migration Health Division, International Organization for Migration (IOM), The UN Migration Agency, Amman, Jordan, [22] Institute of Zoology, University of the Punjab, Lahore, Pakistan, [23] Faculty of Medicine, University of Turku, Turku, Finland, [24] Postgraduate Department, University of Sierra Sur, Oaxaca, Mexico, [25] Africa Centres for Disese Control and Preventon, African Union Commission, Addis Ababa, Ethiopia, [26] Department of Family Medicine, Keck School of Medicine, University of Southern California, Los Angeles, CA, United States

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Edited by:
Xenia Gonda,
Semmelweis University, Hungary

Reviewed by:
Tomasz M. Gondek,
Private Practitioner, Wrocław, Poland
Sarah Bjedov,
University Hospital Centre Zagreb, Croatia

***Correspondence:**
Morenike Oluwatoyin Folayan
toyinukpong@yahoo.co.uk

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Background: Multiple facets of the pandemic can be a source of fear, depression, anxiety and can cause changes in sleep patterns. The aim of this study was to identify health profiles and the COVID-19 pandemic related factors associated with fear, depression, anxiety and changes in sleep pattern in adults in Nigeria.

Methods: The data for this analysis was extracted from a cross-sectional online survey that collected information about mental health and well-ness from a convenience sample of adults 18 years and above resident in Nigeria from July to December 2020. Study

participants were asked to complete an anonymous, closed-ended online questionnaire that solicited information on sociodemographic profile, health profiles (high, moderate and low COVID-19 infection risk profile) including HIV status, COVID-19 status, and self-reported experiences of fear, anxiety, depression and changes in sleep patterns.

Results: In total, 4,439 participants with mean age of 38.3 (±11.6) years responded to the survey. Factors associated with higher odds of having COVID-19 related fear were health risk ($p < 0.05$); living with HIV (AOR: 3.88; 95% CI: 3.22–4.69); having COVID-19 symptoms but not tested (AOR: 1.61; 95% CI: 1.30–1.99); having a friend who tested positive to COVID-19 (AOR: 1.28; 95% CI: 1.07–1.53) and knowing someone who died from COVID-19 (AOR: 1.43; 95% CI: 1.24–1.65). The odds of feeling anxious was significantly higher for those with moderate or low health risk profile ($p < 0.05$); living with HIV (AOR: 1.64; 95% CI: 1.32–2.04); had a friend who tested positive for COVID-19 (AOR: 1.35; 95% CI: 1.08–1.68) or knew someone who died from COVID-19 (AOR: 1.53; 95% CI: 1.28–1.84). The odds of feeling depressed was significantly higher for those with health risk profile ($p < 0.05$); living with HIV (AOR: 2.49; 95% CI: 1.89–3.28); and respondents who had COVID-19 symptoms but had not taken a test (AOR: 1.41; 95% CI: 1.02–1.94). Factors associated with higher odds of having sleep pattern changes were having moderate and low health risk profiles ($p < 0.05$).

Conclusion: The study findings suggest that the pandemic may cause fear, anxiety, depression and changes in sleep patterns differently for people with different health profile, HIV status and COVID-19 status.

Keywords: SARS-CoV-2, mental health, HIV, COVID-19, Nigeria, mental distress

INTRODUCTION

For many individuals, the COVID-19 pandemic has been a source of fear, depression, and anxiety; all of which can lead to changes in sleep quality and patterns. Multiple facets and characteristics of the pandemic can be attributed to these outcomes. Concerns about mortality and morbidity associated with the COVID-19, scarcity of financial resources, and uncertainty about time of recovery from associated financial hardships are partly to blame (1). Patients with COVID-19 also fear abandonment, feelings of isolation and psychological sufferings (1). Some may fear infecting friends and family members, otherwise known as contamination fear (2–4). The fear of the unknown appears to be a core component of anxiety that accompanies situations that are unpredictable and uncontrollable (5, 6). Fear of these threats is often learned, irrespective of the probability of its occurrence, and results from the inability to tolerate uncertainty (7). The intolerance of uncertainty is also related to depressive symptomatology, and the fear of COVID-19 may explain part of the relation (8).

The COVID-19 pandemic is associated with up to a seven times higher prevalence of depression (9) and over 25% mental deterioration in some populations (10, 11). Persons with prior history of mental health disorders had higher rates of depression during the pandemic (12). Depressive symptoms were associated with testing positive for COVID-19 or having COVID-19 symptoms, exposure to social media, poor social support, unemployment, uncertainty about the future of jobs, and careers and economic crisis, especially for students (9). As with fear, depression is associated with anxiety (13, 14). The prevalence of anxiety during the COVID-19 pandemic is higher than 30% (15); and anxiety is higher in people with poor health (16). Anxiety disorder may lead to dysfunctional arousal that in turn results in persistent sleep-wake difficulties such as insomnia and hypersomnia (17, 18). Sleep disturbance is also a diagnostic symptom for generalized anxiety disorder (19), with young people being the worse-affected (20).

Though the prevalence of sleep problems, fear, anxiety and depression increased during the pandemic (21, 22), the impact may, however, differ between populations (23, 24). Fear, anxiety, depression and sleep disorder may be lower in the general population than it is in populations living with co-morbidities. Understanding the association between negative emotions and sleep pattern during the COVID-19 pandemic is important. However, research in this field is scarce (20). We hypothesize that respondent's COVID-19 related status would be associated with the experience of fear, depression, anxiety and changes in sleep pattern during the pandemic; that more people living with HIV will experience fear, anxiety, depression and sleep disorder; and

Abbreviations: AOR, Adjusted Odds Ratio; CI, Confidence Interval; COVID-19, Corona Virus Infectious Disease – 2019; HIV, Human Immunodeficiency Virus; PTSD, Post Traumatic Stress Disorder; SARS-CoV-2, Severe Acute Respiratory Syndrome Corona Virus Type 2.

that more people with fear, anxiety, depression and sleep disorder will use COVID-19 preventive measures.

The consolidation of contextual fear, depression, anxiety and avoidance of the shock evoke negative emotions and trigger alterations in sleep characteristics (25). Despite this, there is a little known about the aspects of the pandemic crisis that trigger negative emotions. One of the aims of this study was to identify COVID-19 pandemic related factors such as COVID-19 test positivity status, history of COVID-19 symptoms, and contact/relation with persons who have COVID-19, and their association with fear, depression, anxiety, and changes in sleep pattern. We also identified the association between fear, depression, anxiety, and changes in sleep pattern and the COVID-19 status. Finally, we determined if living with HIV was associated with the experience of fear, depression, anxiety, and changes in sleep pattern.

METHODS

Study Design and Study Participants

This was a sub-analysis data from an international cross-sectional study on the impact of COVID-19 on the mental health and wellness of adults using an online multi-country survey. Data were collected from a convenient sample of adults 18 years and above from July to December 2020. The study methodology had been reported in detail in prior studies (26, 27).

Study Instrument

The survey used a questionnaire, which was initially developed for a study that targeted a specific population in the United States and was consequently adapted and validated for use by a global audience (28). The questionnaire underwent four iterative processes content validation. The overall content validity index of the survey was 0.83. The responses collected for content validation were excluded from the final analysis. The study was approved by the Human Research Ethics Committee at the Institute of Public Health of the Obafemi Awolowo University Ile-Ife, Nigeria (HREC No: IPHOAU/12/1557). Participants received no incentive for taking part in the study.

Recruitment of the Study Participants

A call for collaboration for this study was made on Research gate. The 45 collaborators engaged through the public call were required to distribute their unique survey links to networks within and outside their countries and communities to ensure maximum representation and geographic spread. There were none data collectors recruited from Nigeria. The study participants were recruited through respondent-driven sampling. These links were posted on social media groups (Facebook, Twitter, and Instagram) and sent via WhatsApp or email to eligible participants in each collaborators' networks. The study participants were further asked to disseminate the links to those in their own networks using snowball sampling to facilitate further recruitment. The survey link was also posted on social media groups (Facebook, Twitter, and Instagram, WhatsApp) and network email lists.

Data Collection

Study participants were asked to complete an anonymous, closed-ended questionnaire to learn about how the COVID-19 pandemic has affected the people's mental health and psychological wellbeing. The questionnaire also enquired about respondents' sociodemographic profile, health profile, and various aspects of pandemic-related stress. The questionnaire was preceded by a brief introduction explaining the purpose of the study, and assuring participants of their voluntary participation, and confidentiality of their data. The questionnaire took an average of 11 min to complete and was administered in English. Each participant could only complete a single questionnaire through IP address restrictions, though they could edit their answers freely until they chose to submit. For the current analyses, we included only respondents who self-reported as residing in Nigeria. We also identified and removed survey responses that were completed below 7 min—the minimum time for filling the questionnaire by people familiar with the questionnaire in the pilot stage ($n = 77$); and those with incomplete data on fear, anxiety, depression and sleep disorder ($n = 32$).

Explanatory Variables

Sociodemographic Variables

The section on sociodemographic profile had questions on country of residence, age (in years), sex at birth, highest level of education attained (none, primary, secondary and tertiary) and employment status (retired, student, employed, and unemployed).

Health Profile

The section on health profile required respondents to select any of the 23 medical conditions listed that they experienced in addition to other health conditions not listed. These medical conditions put individuals at high risk for severe COVID-19 disease (pneumonia, diabetes, cancer, heart condition), those that might put people at moderate risk for severe COVID-19 disease (hepatitis, hypertension, neurological problems, neuropathy, respiratory problems, stroke, depression) and those conditions associated with low risk for severe COVID-19 disease (herpes, shingles and other sexually transmitted infections, dermatologic problems, migraines, arthritis, broken bones, hearing loss and vision loss) (29). As part of the list, participants were also asked about their HIV status. A tick on a checkbox on the list of health conditions was an indication that the individual had the health condition. All respondents were categorized as either having the health condition (indicated by a tick of the checkbox) or not having the health condition (indicated by not ticking the checkbox).

COVID-19 Status

Respondents were asked if they had tested positive for COVID-19, had COVID-19 symptoms but did not test, had a close friend who tested positive for COVID-19, or knew someone who died from COVID-19. Response choices for these items were "yes" or "no".

TABLE 1 | Factors associated with COVID-19 status by adults in Nigeria ($N = 4,439$).

Variables	Total $N = 4,439$ *n* (%)	COVID-19 positive			Had COVID-19 symptoms but no test			Friend tested positive to COVID-19			Knew someone who died of COVID-19		
		No $N = 4,329$ *n* (%)	Yes $N = 110$ *n* (%)	*P*-value	No $N = 3,973$ *n* (%)	Yes $N = 466$ *n* (%)	*P*-value	No $N = 3,724$ *n* (%)	Yes $N = 715$ *n* (%)	*P*-value	No $N = 3,072$ *n* (%)	Yes $N = 1,367$ *n* (%)	*P*-value
Age Mean (SD) in years	38.30 (11.63)	38.31 (11.59)	39.58 (12.72)	0.256	38.77 (11.71)	34.64 (10.15)	<0.001	38.11 (11.82)	39.55 (10.45)	0.002	37.16 (11.38)	40.99 (11.72)	<0.001
Sex													
Male	2,076 (46.8)	2,020 (97.3)	56 (2.7)	0.386	1,829 (88.1)	247 (11.9)	0.004	1,716 (82.7)	360 (17.3)	0.036	1,358 (65.4)	718 (34.6)	<0.001
Female	2,363 (53.2)	2,309 (97.7)	54 (2.3)		2,144 (90.7)	219 (9.3)		2,008 (85.0)	355 (15.0)		1,714 (72.5)	649 (27.5)	
Level of education													
No formal education	48 (1.1)	46 (95.8)	2 (4.2)	0.689	42 (87.5)	6 (12.5)	0.764	43 (89.6)	5 (10.4)	<0.001	37 (77.1)	11 (22.9)	<0.001
Primary	84 (1.9)	82 (97.6)	2 (2.4)		76 (90.5)	8 (9.5)		77 (91.7)	7 (8.3)		66 (78.6)	18 (21.4)	
Secondary	715 (16.1)	701 (98.0)	14 (2.0)		633 (88.5)	82 (11.5)		664 (92.9)	51 (7.1)		604 (84.5)	111 (15.5)	
College/university	3,592 (80.9)	3,500 (97.4)	92 (2.6)		3,222 (89.7)	370 (10.3)		2,940 (81.8)	652 (18.2)		2,365 (65.8)	1,227 (34.2)	
Employment status													
Current status													
Retired	122 (2.7)	118 (96.7)	4 (3.3)	0.163	117 (95.9)	5 (4.1)	0.002	112 (91.8)	10 (8.2)	<0.001	77 (63.1)	45 (36.9)	<0.001
Student	495 (11.2)	489 (98.8)	6 (1.2)		425 (85.9)	70 (14.1)		456 (92.1)	39 (7.9)		398 (80.4)	97 (19.6)	
Employed	3,131 (70.5)	3,045 (97.3)	86 (2.7)		2,822 (90.1)	309 (9.9)		2,517 (80.4)	614 (19.6)		2,053 (65.6)	1,078 (34.4)	
Unemployed	691 (15.6)	677 (98.0)	14 (2.0)		609 (88.1)	82 (11.9)		639 (92.5)	52 (7.5)		544 (78.7)	147 (21.3)	
Medical health profile													
High risk													
No	4,272 (96.2)	4,171 (97.6)	101 (2.4)	0.014	3,828 (89.6)	444 (10.4)	0.250	3,593 (84.1)	679 (15.9)	0.051	2,977 (69.7)	1,295 (30.3)	<0.001
Yes	167 (3.8)	158 (94.6)	9 (5.4)		145 (86.8)	22 (13.2)		131 (78.4)	36 (21.6)		95 (56.9)	72 (43.1)	
Moderate risk													
No	3,742 (84.3)	3,657 (97.7)	85 (2.3)	0.040	3,376 (90.2)	366 (9.8)	<0.001	3,166 (84.6)	576 (15.4)	0.003	2,647 (70.7)	1,095 (29.3)	<0.001
Yes	697 (15.7)	672 (96.4)	25 (3.6)		597 (85.7)	100 (14.3)		558 (80.1)	139 (19.9)		425 (61.0)	272 (39.0)	
Low risk													
No	3,986 (89.8)	3,895 (97.7)	91 (2.3)	0.013	3,596 (90.2)	390 (9.8)	<0.001	3,359 (84.3)	627 (15.7)	0.043	2,797 (70.2)	1,189 (29.8)	<0.001
Yes	453 (10.2)	434 (95.8)	19 (4.2)		377 (83.2)	76 (16.8)		365 (80.6)	88 (19.4)		275 (60.7)	178 (39.3)	
HIV Status													
Living with HIV	912 (20.5)	904 (99.1)	8 (0.9)	<0.001	819 (89.8)	93 (10.2)	0.740	830 (91.0)	82 (9.0)	<0.001	740 (81.1)	172 (18.9)	<0.001
Not living with HIV	3,527 (79.5)	3,425 (97.1)	102 (2.9)		3,154 (89.4)	373 (10.6)		2,894 (82.1)	633 (17.9)		2,332 (66.1)	1,195 (33.9)	
COVID 19 related fear													
Fear of getting infected													
No	2,189 (49.3)	2,108 (96.3)	81 (3.7)	<0.001	1,998 (91.3)	191 (8.7)	<0.001	1,858 (84.9)	331 (15.1)	0.078	1,565 (71.5)	624 (28.5)	0.001
Yes	2,250 (50.7)	2,221 (98.7)	29 (1.3)		1,975 (87.8)	275 (\12.2)		1,866 (82.9)	384 (17.1)		1,507 (67.0)	743 (33.0)	

(Continued)

TABLE 1 | Continued

Variables	Total *N* = 4,439 *n* (%)	COVID-19 positive			Had COVID-19 symptoms but no test			Friend tested positive to COVID-19			Knew someone who died of COVID-19		
		No *N* = 4,329 *n* (%)	Yes *N* = 110 *n* (%)	*P*-value	No *N* = 3,973 *n* (%)	Yes *N* = 466 *n* (%)	*P*-value	No *N* = 3,724 *n* (%)	Yes *N* = 715 *n* (%)	*P*-value	No *N* = 3,072 *n* (%)	Yes *N* = 1,367 *n* (%)	*P*-value
Fear of infecting someone else													
No	3,936 (88.7)	3,857 (98.0)	79 (2.0)	<0.001	3,599 (91.4)	337 (8.6)	<0.001	3,379 (85.8)	557 (14.2)	<0.001	2,794 (71.0)	1,142 (29.0)	<0.001
Yes	503 (11.3)	472 (93.8)	31 (6.2)		374 (74.4)	129 (25.6)		345 (68.6)	158 (31.4)		278 (55.3)	225 (44.7)	
Anxiety													
No	3,693 (83.2)	3,608 (97.7)	85 (2.3)	0.093	3,333 (90.3)	360 (9.7)	<0.001	3,140 (85.0)	553 (15.0)	<0.001	2,624 (71.1)	1,069 (28.9)	<0.001
Yes	746 (16.8)	721 (96.6)	25 (3.4)		640 (85.8)	106 (14.2)		584 (78.3)	162 (21.7)		448 (60.1)	298 (39.9)	
Depression													
No	4,050 (91.2)	3,953 (97.6)	97 (2.4)	0.251	3,653 (90.2)	397 (9.8)	<0.001	3,398 (83.9)	652 (16.1)	0.961	2,785 (68.8)	1,265 (31.2)	0.041
Yes	389 (8.8)	376 (96.7)	13 (3.3)		320 (92.3)	69 (17.7)		326 (83.8)	63 (16.2)		287 (73.8)	102 (26.2)	
Changes in sleep pattern													
No	3,432 (77.3)	3,347 (97.5)	85 (2.5)	0.992	3,093 (90.1)	339 (9.9)	0.013	2,894 (84.3)	538 (15.7)	0.149	2,396 (69.8)	1,036 (30.2)	0.105
Yes	1,007 (22.7)	982 (97.5)	25 (2.5)		880 (87.4)	127 (12.6)		830 (82.4)	177 (17.6)		676 (67.1)	331 (32.9)	

Outcome Variables

Fear, Anxiety and Depression

Respondents were asked to indicate if they had experienced fear, anxiety and depression during the pandemic by checking a response box. The questions were adapted from the Pandemic Stress Index (30).

Changes in Sleep Pattern

Respondents were asked to indicate if they had experienced changes in sleep patterns (sleeping more, sleeping less, or no changes) during the pandemic. Each respondent was required to check a response box that indicated if they had experienced any of these conditions. The questions were adapted from the Pandemic Stress Index (30). The responses were dichotomised to change (sleeping more, sleeping less) and no change in sleep pattern.

Data Analysis

Data were downloaded from Survey Monkey® as SPSS file version 23.0 (IBM Corp., Armonk, N.Y., USA), cleaned and prepared for analysis. T- test and chi square tests were used to assess the relationship between COVID-19 status (testing positive, suspected but not tested, friend testing positive and knowing someone who died of COVID-19) on one hand, and health profile, HIV status, fear, anxiety, depression, and changes in sleep pattern on the other hand. Also, the associations between the explanatory variables and the outcome variables were determined by conducting logistic regression analysis using four models: one for each outcome variable. The covariates for the study were the sociodemographic profile (age, sex, educational level, and employment status). Adjusted odds ratios, 95% confidence intervals (CIs) and *p*-values were calculated. Significance was set at 5%.

RESULTS

The mean age of the 4,439 respondents living in Nigeria was 38.3 years (SD = 11.6) ranging from 18 years to 85 years. **Table 1** highlights the demographic profile of respondents. More than half of the respondents were females (53.2%), the majority had college/university education (80.9%) and were employed (70.5%). Also, 110 (2.5%) respondents tested positive for COVID-19, 466 (10.5%) had COVID-19 symptoms but did not take a test, 715 (16.1%) had a friend who had tested positive to COVID-19, and 1,367 (30.8%) knew someone who died of COVID-19. The majority (52.9%) expressed fear in response to the pandemic—fear of getting infected (50.7%) or fear of infecting someone (11.3%). Moreover, 746 (16.8%) felt anxious, 389 (8.8%) felt depressed and 1,007 (22.7%) experienced changes in their sleep pattern.

Significantly more respondents with high ($p = 0.014$), moderate ($p = 0.040$) and low ($p = 0.013$) medical risks tested positive for COVID-19. Also, significantly more people not living with HIV than people living with HIV (PLHIV) had a positive SARS-CoV-2 test result ($p < 0.001$). In addition, significantly more people who had no fear of getting infected with COVID-19

TABLE 2 | Logistic regression analysis for factors associated with anxiety, depression and sleep changes during the COVID-19 pandemic by adults in Nigeria ($N = 4,439$).

Variables	Fear		Anxiety		Depression		Sleep changes	
	AOR (95% CI)	*P*-value	AOR (95% CI)	*P*-value	AOR (95% CI)	*P*-value	AOR (95% CI)	*P*-value
Age	1.00 (0.99–1.01)	0.965	1.00 (0.99–1.01)	0.892	0.95 (0.94–0.96)	<0.001	0.99 (0.98–0.99)	<0.001
Sex								
Male (ref: Not male)	1.15 (1.01–1.30)	0.030	0.77 (0.65–0.91)	0.002	0.90 (0.71–1.14)	0.389	0.82 (0.71–0.95)	0.007
Level of education								
No formal education	1.00	–	1.00	–	1.00	–	1.00	–
Primary	0.80 (0.31–2.04)	0.634	0.98 (0.68–2.08)	0.960	0.30 (0.11–0.79)	0.015	0.99 (0.30–3.31)	0.984
Secondary	0.67 (0.30–1.46)	0.315	0.46 (0.24–0.87)	0.017	0.49 (0.23–1.05)	0.066	1.47 (0.55–3.90)	0.442
College/university	0.56 (0.26–1.22)	0.146	0.43 (0.23–0.80)	0.008	0.48 (0.23–1.02)	0.057	1.39 (0.53–3.66)	0.504
Employment status								
Employed (ref: Not employed)	1.25 (1.08–1.46)	0.003	1.18 (0.97–1.43)	0.109	0.82 (0.64–1.06)	0.134	0.79 (0.67–0.94)	0.008
Health profile								
High risk (ref: No high risk)	1.69 (1.17–2.45)	0.005	1.40 (0.97–2.03)	0.075	1.66 (1.03–2.69)	0.038	1.25 (0.86–1.50)	0.245
Moderate risk (ref: No moderate risk)	1.61 (1.34–1.93)	<0.001	2.61 (2.15–3.18)	<0.001	7.88 (6.14–10.10)	<0.001	1.57 (1.29–1.92)	<0.001
Low risk (ref: No low risk)	1.16 (0.94–1.44)	0.160	1.50 (1.18–1.90)	0.001	1.50 (1.09–2.07)	0.013	1.86 (1.50–2.32)	<0.001
HIV status								
Living with HIV (ref: Not living with HIV)	3.88 (3.22–4.69)	<0.001	1.64 (1.32–2.04)	<0.001	2.49 (1.89–3.28)	<0.001	0.30 (0.23–0.39)	<0.001
COVID-19 status								
Tested COVID-19 positive								
Yes (ref: No)	0.56 (0.37–0.85)	0.006	1.01 (0.62–1.65)	0.966	1.41 (0.73–2.72)	0.300	0.78 (0.49–1.26)	0.309
Had COVID-19 symptoms but no test								
Yes (ref: No)	1.61 (1.30–1.99)	<0.001	1.28 (0.99–1.64)	0.059	1.41 (1.02–1.94)	0.038	1.15 (0.92–1.45)	0.226
Friend tested positive to COVID-19								
Yes (ref: No)	1.28 (1.07–1.53)	0.008	1.35 (1.08–1.68)	0.007	1.06 (0.76–1.49)	0.726	1.06 (0.86–1.30)	0.579
Knew someone who died of COVID-19								
Yes (ref: No)	1.43 (1.24–1.65)	<0.001	1.53 (1.28–1.84)	<0.001	0.79 (0.60–1.04)	0.089	1.05 (0.89–1.24)	0.551
Nagelkerke R^2	0.123		0.096		0.209		0.076	
Omnibus test of model coefficients	430.34	<0.001	261.12	<0.001	436.05	<0.001	227.29	<0.001
Hosmer and Lemeshow goodness of fit test	6.515	0.590	13.26	0.103	24.11	0.002	8.72	0.367

AOR, adjusted odds ratio; CI, confidence interval.

($p < 0.001$) and those who had the fear of infecting other persons ($p < 0.001$) tested COVID-19 positive.

Significantly more respondents who had COVID-19 symptoms but did not test were younger ($p < 0.001$), were males ($p = 0.004$), students ($p = 0.002$), had moderate ($p < 0.001$) and low ($p < 0.001$) health risks, had fear of getting infected ($p < 0.001$) and infecting someone else ($p < 0.001$), felt anxious ($p < 0.001$), depressed ($p < 0.001$) and had changes in sleep pattern ($p = 0.013$).

Significantly more respondents who had a friend who tested positive to COVID-19 were older ($p = 0.002$), males ($p = 0.036$), had college/university education ($p < 0.001$), were employed ($p < 0.001$), had moderate ($p = 0.003$) or low ($p = 0.043$) health risk, were not living with HIV ($p < 0.001$) and had the fear of infecting someone else ($p < 0.001$) and felt anxious ($p < 0.001$).

Significantly more respondents who knew someone who died of COVID-19 were older ($P < 0.001$), males ($p < 0.001$), had college/university education ($p < 0.001$), were retirees ($p < 0.001$), had mild, moderate or high health risk profiles ($p < 0.001$), were not living with HIV ($p < 0.001$), had the fear of getting infected ($p = 0.001$) or infecting others ($p < 0.001$), felt anxious ($p < 0.001$) and did not feel depressed ($p = 0.041$).

Table 2 highlights the factors associated with COVID-19 related fear, anxiety, depression and changes in sleep pattern. The *p*-values of the omnibus tests of model coefficients for the four models indicate that the models outperformed the null models. The goodness of fit tests also indicated that the models were robust except the model to determine the factors associated with depression.

The factors associated with significantly higher odds of having COVID-19 related fear were being a male (AOR: 1.15; 95% CI: 1.01–1.30); being employed (AOR: 1.25; 95% CI: 1.08–1.46); having high (AOR: 1.69; 95% CI: 1.17–2.45) and moderate (AOR: 1.61; 95% CI: 1.34–1.93) health risk; living with HIV (AOR:

3.88; 95% CI: 3.22–4.69); having COVID-19 symptoms but not yet tested (AOR: 1.61; 95% CI: 1.30–1.99); having a friend who tested positive to COVID-19 (AOR: 1.28; 95% CI: 1.07–1.53) and knowing someone who died from COVID-19 (AOR: 1.43; 95% CI: 1.24–1.65). Having tested positive to COVID-19 was associated with significantly lower odds of experiencing fear (AOR: 0.56; 95% CI: 0.37–0.85).

Also, respondents had significantly higher odds of feeling anxious when they had moderate (AOR: 2.61; 95% CI: 2.15–3.18) or low (AOR: 1.50; 95% CI: 1.18–1.90) health risk profile; living with HIV (AOR: 1.64; 95% CI: 1.32–2.04); had a friend who tested positive for COVID-19 (AOR: 1.35; 95% CI: 1.08–1.68) or knew someone who died from COVID-19 (AOR: 1.53; 95% CI: 1.28–1.84). The odds of feeling anxious were significantly lower for respondents who were males (AOR: 0.77; 95% CI: 0.69–0.91); and those with secondary (AOR: 0.46; 95% CI: 0.24–0.87) or college/university (AOR: 0.43; 95% CI: 1.25–4.39) education when compared with those that had no formal education. Respondents who had significantly higher odds of feeling depressed had high (AOR: 1.66; 95% CI: 1.03–2.69), moderate (AOR: 7.88; 95% CI: 6.14–10.10) and low (AOR: 1.50; 95% CI: 1.09–2.07) health risks; living with HIV (AOR: 2.49; 95% CI: 1.89–3.28); and respondents who had COVID-19 symptoms but had not taken a test (AOR: 1.41; 95% CI: 1.02–1.94). The odds of feeling depressed were significantly lower for respondents who were older (AOR: 0.95; 95% CI: 0.94–0.96); and who had primary school education (AOR: 0.03; 95% CI: 0.11–0.79) when compared with those that had no formal education.

Factors associated with significantly higher odds of having sleep pattern changes were having moderate (AOR: 1.57; 95% CI: 1.29–1.92) or low (AOR: 1.86; 95% CI: 1.50–2.32) health risk profiles. Factors associated with significantly lower odds of having sleep pattern changes were being older (AOR: 0.99; 95% CI: 0.98–0.99); being a male (AOR: 0.82; 95% CI: 0.71–0.95); employed (AOR: 0.79; 95% CI: 0.67–0.94); and living with HIV (AOR: 0.30; 95% CI: 0.23–0.39).

DISCUSSION

The study identified COVID-19 related factors associated with the experience of fear, depression, anxiety and changes in sleep pattern during the pandemic. First, we identified that respondents who had COVID-19 symptoms but not yet tested, who had a friend who tested positive and who knew someone who died from COVID-19 had higher odds of being afraid while those who had tested positive to COVID-19 had lower odds of experiencing fear. Anxiety was higher for persons who had a friend who tested positive for COVID-19 and who knew someone who died from COVID-19. Those who had COVID-19 symptoms but had not taken a test had higher odds of being depressed. Second, respondents with low and moderate health risks had higher odds of feeling depressed, anxious or having changes in sleep pattern during the pandemic while those with moderate and high health risk profiles had higher odds of having fears (fear of contracting infection or infecting others). Third, PLHIV had higher odds of having fears, feeling anxious or depressed than people not living with HIV. They also had lower odds of changes in sleep patterns than people not living with HIV. Fourth, males had higher odds of having COVID-19 related fears, and lower odds of having anxiety and changes in sleep patterns; older respondents had lower odds of feeling depressed and having changes in sleep patterns; those with secondary or college/university education had lower odds of feeling anxious, while those with primary school education had lower odds of feeling depressed than respondents without formal education.

The study provides evidence that the experience of fear, depression, anxiety, and changes in sleep patterns differ between different populations. We observed that some populations that had higher odds of being afraid and higher odds of having being anxious (having moderate and low health risk for COVID-19, PLHIV, having a friend tested positive to COVID-19, knowing someone who died from COVID-19); higher odds of being depressed (having high, moderate and low health risk for COVID-19) and higher odds of having changes in sleep patterns (having moderate and low health risk for COVID-19). Others had higher odds of being afraid but lower odds of having anxiety (males) and changes in sleep patterns (being employed, PLHIV). The complex relationship between fear, anxiety, depression, and changes in sleep patterns was reflected in the results we report about PLHIV. PLHIV had higher odds of having fears and feeling anxious or depressed, but lower odds of changes in sleep patterns.

Also, our study findings that respondents who had COVID-19 symptoms but not yet tested, who had a friend who tested positive and who knew someone who died from COVID-19 was associated with higher odds for fear and anxiety is an indication for identifying individuals with this profile and providing psychological support to them. Their fears and anxiety may be related with concerns about they themselves likely testing COVID-19 positive, the stigma associated with this status (31) and the concerns with being quarantined (32). Their fears and anxiety may also be due to concerns with the attendant consequences of testing positive (2) such as facing stigma (33), boredom, frustration, inadequate supplies, inadequate information, and financial loss while in quarantine or isolation (2). Quarantine and isolation are also associated with anger, confusion, and post-traumatic stress symptoms (2). Positive public messaging about COVID-19 positive status may also go a long way to ameliorates these concerns about COVID-19 that triggers negative emotions.

These associations suggest that there may be various factors that mediate and/or moderate the relationship between fear, depression, anxiety and changes in sleep patterns. One of these factors may be age: we observed that respondents who are older had lower odds of feeling depressed or having changes in sleeping patterns. Aging is associated with an intrinsic reduction in susceptibility to depression (34) though people with chronic illness are more likely to be depressed (34–41) and have changes in sleep pattern due to physiological alterations (42, 43). People with high health risks are usually

older (44–47). Our study findings indicated that those with high, moderate, and low health risk profiles had higher odds of reporting depression, anxiety and changes in sleep pattern corroborating prior findings (34–43). Populations with health concerns during the COVID-19 pandemic may however, have heightened concerns due to their susceptibility to infection and the absence of known therapies and vaccines. This may explain the high risk for depression, anxiety and changes in sleep pattern. On the other hand, this profile may have changed with the increased access to COVID-19 vaccines. The possibility of these changes may need to be explored in future studies.

Gender may act as a mediator and/or moderator of the relationship between fear, anxiety, and changes in sleep patterns. Though females were previously reported to be more likely to have fears (48), we observed in our study that males had higher odds of reporting fears. However, like a prior study, males had lower odds of reporting anxiety (49). We also observed that men had lower odds of changes in sleep patterns similar to prior studies that indicated that males had better sleep quality even during the pandemic (50, 51). This change in gender related association with fears during the pandemic may be related with men's concern about possible loss of income and the ability to provide the basic needs of the family. Although the International Labor Organization had stated that the pandemic had a greater impact on women than men in developed economies (52) this may not be the case for developing economies where men are responsible for securing food and life expenses and as such, may have greater concerns about losing their jobs due to COVID-19. Nigeria is a patriarchal society where men are the bread winners (53–55). With the loss of jobs and diminished income resulting from the pandemic (56–58), the affected male breadwinners may have fears. In the absence of welfare and social security packages during this pandemic for residents in Nigeria, there is a risk for an increase in health problems such as hypertension, high blood sugar and other metabolic disorders (59). This risk may be ameliorated by the lower risk for anxiety and sleep changes. This does not eliminate the possible need for palliative care for employees in Nigeria to absorb the economic shock they face because of the pandemic and reduce its impact on their quality of life.

Educational status is another possible mediator and/or moderator for anxiety and depression. Those with secondary education and above had lower odds of feeling anxious and those who had primary school education had lower odds of having depression than those without formal education. Prior studies indicated lower risk of depression and anxiety as the educational level improves (60, 61), while other evidence suggested no significant effect of educational level on anxiety (62). Like previous studies, we found that higher educational status was associated with lower odds of anxiety and depression during the pandemic. This finding may be because educated individuals may be more aware of modes of COVID-19 transmission and its consequences (63). Also, higher educational status may also be associated with better opportunities for employment, being male, lower risk for losing a job and thus, lower risk of experiencing anxiety and depression during the pandemic. This hypothesis needs to be tested further.

One of the strengths of this study is the large sample providing adequate study power. The data was also collected using validated tools and this strengthened the validity of the study findings. The data included information on the health status of respondents, which is relevant as differences in sickness status could influence anxiety, depression, and sleep pattern. The study has a few limitations despite its strengths. The self-reporting of fear, depression, anxiety, and HIV status is associated with high risk of social desirability and central tendency bias (64); and self-report may be more sensitive to identifying non-depressed, non-anxious and HIV negative individuals (65, 66). Also, we had an imbalance between participants on educational level, with comparably larger number of respondents with tertiary education which does not reflect the educational status of Nigeria. In addition, the study can only be generalized to those with internet access who could respond to the questionnaire; and it could not measure changes in the respondents' answers at different time points and phases of the pandemic as we know that the pandemic changed over time.

CONCLUSION

Various factors were identified to be significantly associated with experiencing fear, anxiety, depression and change in sleep patterns among the participants during the pandemic. The study findings suggest that the pandemic may have had significant impact on the psychological wellbeing and daily living of individuals. Capacity building and training on how to deal and cope with stressful events and to enhance individuals' resilience are of paramount importance during large-scale crisis like the current pandemic. Besides, our study findings open avenues for further longitudinal assessment of the impact of COVID-19 pandemic on various life domains, considering the dynamic nature of the crisis and human behavior.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Research Ethics Committee at the Institute of Public Health of the Obafemi Awolowo University Ile-Ife, Nigeria. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

The project was conceptualized by MF. The data for the research was collected by MF, II, FL, and BP. The data analysis was conducted by OI. All authors contributed to the article, read, and approved the submitted version.

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Modeling Rumor Diffusion Process With the Consideration of Individual Heterogeneity: Take the Imported Food Safety Issue as an Example During the COVID-19 Pandemic

Tinggui Chen[1,2], *Jingtao Rong*[1], *Jianjun Yang*[3] *and Guodong Cong*[4]*

[1] School of Statistics and Mathematics, Zhejiang Gongshang University, Hangzhou, China, [2] Academy of Zhejiang Culture Industry Innovation & Development, Hangzhou, China, [3] Department of Computer Science and Information Systems, University of North Georgia, Oakwood, GA, United States, [4] School of Tourism and Urban-Rural Planning, Zhejiang Gongshang University, Hangzhou, China

At present, rumors appear frequently in social platforms. The rumor diffusion will cause a great impact on the network order and the stability of the society. So it's necessary to study the diffusion process and develop the rumor control strategies. This article integrates three heterogeneous factors into the SEIR model and designs an individual state transition mode at first. Secondly, based on the influencing factors such as the trust degree among individuals, an individual information interaction mode is constructed. Finally, an improved SEIR model named SEIR-OM model is established, and the diffusion process of rumors are simulated and analyzed. The results show that: (1) when the average value of the interest correlation is greater, the information content deviation is lower, but the rumor diffusion range will be wider. (2) The increase of the average network degree intensifies influence of rumors, but its impact on the diffusion has a peak. (3) Adopting strategies in advance can effectively reduce the influence of rumors. In addition, the government should enforce rumor-refuting strategies right after the event. Also, the number of rumor-refuting individuals must be paid attention to. Finally, the article verifies the rationality and effectiveness of the SEIR-OM model through the real case.

Keywords: individual heterogeneity, rumor diffusion, SEIR-OM model, rumor control, COVID-19 pandemic

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***Correspondence:**
Guodong Cong
cgd@mail.zjgsu.edu.cn

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INTRODUCTION

With the rapid development of Internet information technology, information diffusion has become more and more convenient. However, due to malicious tampering and other reasons, information will continue to be alienated in the diffusion process, which will increase its complexity and redundancy. While receiving a large amount of information, netizens cannot verify its authenticity and accuracy. This provides an opportunity for the large-scale rumor diffusion. At this time, if the hot information related to the national economy and people's livelihood is tampered with and not controlled in time, it will easily breed public anxiety, panic and other emotions, which will bring great economic impact to individuals, society or the country, and even threaten the harmony and stability of society. For example, when COVID-19 broke out at the end of 2019, rumors that "masks

cannot prevent viruses" diffuse on social platforms in many countries, thus many people failed to take correct epidemic prevention measures in time, causing the widespread diffusion of COVID-19 in many countries, which greatly affected the social and economic development in the world. As a result, analyzing the rumor formation, diffusion and its control strategy has an important theoretical and practical significance.

Scholars have conducted a lot of research on the diffusion and control of rumors and have achieved some results. At present, the research on rumors is mainly divided into two categories: (1) A qualitative analysis of the diffusion process of rumors from the phenomenon itself, mainly to study its causes and counter measures. However, most of these studies lack specific empirical investigations and quantitative methods, and their conclusions are subjective; (2) Use evolutionary game theory, communication dynamics and other related methods to construct mathematical models, and use mathematical derivation or computer simulation to achieve inter-group interactive simulation of information diffusion, and observe the results to explore the rules of rumor diffusion and counter measures.

However, most of these models simulate the diffusion process of rumors, but rarely consider the formation of rumors and psychological influence factors. Based on this, this article integrates the individual's diffusion willingness, the individual's forgetting degree, and the intensity of government punishment into the SEIR model, and designs a state transition mode at first. Secondly, it considers the individual's decision-making behavior in the process of rumor generation and diffusion, and establishes information interaction mode among individuals. Finally, an improved SEIR model named SEIR-OM model is established. Also, rumor generation and diffusion process are simulated and analyzed from two aspects: model parameter setting and rumor control strategy.

The structure of the article is organized as follows: section Literature Review is a literature review. Section Research Framework builds a SEIR-OM model. Section Model Construction simulates the rumor evolution process through simulation experiments, and studies the influences of model parameters and different rumor control strategies on the rumor evolution. Section Simulation Experiment validates the SEIR-OM model with the real case from the imported food safety issue during the COVID-19 Pandemic. Section Empirical Analysis makes the conclusions and prospects for future work.

LITERATURE REVIEW

This section reviews the relevant literature from two aspects: rumor diffusion and control.

With regard to the research on the rumor diffusion, most of the existing literature uses infectious disease models and evolutionary game models to analyze their diffusing process: (1) the first aspect is the research on the dynamics of rumor diffusion based on the infectious disease model. For instance, Zhang and Zhu (1) studied two kinds of rumor diffusing dynamics with quadratic relationship by establishing the I2S2R model, and concluded that the diffusing intensity of second rumors depended on the diffusing intensity of initial rumors. In addition, based on the SIR model, Huang and Jin (2) divided the immunized population into two categories: those who accepted rumors but were not interested in diffusing them, and those who did not believe rumors, and analyzed two strategies through numerical simulation: random immunization and target immunization. The results showed that the application of random or directed immunity could effectively prevent the diffusion of rumors while reducing the credibility of rumors. Jiang and Yan (3) proposed a piecewise SIR model to quantify the diffusing speed, scale and influence of online information. The simulation results showed that there was no proportional relationship between the sustained influence of a message and the number of diffusers. Zhou et al. (4) analyzed the influence of network topology on rumor diffusion based on SIR model. The mean field analysis showed that the number of infected nodes depended on the network topology. Moreno et al. (5) studied the dynamic process of rumor evolution in homogeneous network and scale-free network. The results showed that when rumor diffused in the latter, the number of people who did not diffuse rumor in the final state had nothing to do with the degree of the source of infection, but was closely related to the probability of infection. Zhang et al. (6) considered the influence of the attractiveness of information itself on the diffusion, and based on this, they proposed a rumor diffusion model based on the diffusion ability. Most of the above-mentioned literatures have added more diverse individual states on the basis of classic infectious disease models. However, since the individual interaction mechanism in the process of rumor diffusion is not considered, most studies still use fixed reception probability to describe the process of individuals receiving external information. (2) The second aspect is to use the evolutionary game model to describe the game decision-making process of individuals facing rumors. For instance, Fernández-Domingos et al. (7) established a prisoner's dilemma game model, and analyzed the behavior of each node in the topology during network information diffusion. This study showed that in small-scale networks, choosing cooperation was the optimal strategy of nodes. On the contrary, for large-scale networks, choosing non-cooperation was the optimal strategy. Furthermore, by using three real social network datasets, Li et al. (8) found that increasing the judgment ability of individuals could curb the diffusion of rumor effectively. Moreover, there existed some optimal risk coefficients and punishment fractions that could help more people refuse to diffuse rumor. Mojgan et al. (9) proposed an evolutionary game model to analyze the diffusion process of rumors in social networks. The model studied the factors affecting people's decision-making, such as social anxiety, and conducted sensitivity analysis experiments to illustrate the impact of different factors on the process of rumor propagation. The analysis showed that people's attitude toward rumor/anti-rumor had a significant impact on rumor diffusion. In addition, factors such as social anxiety and rumor intensity also accelerated the rumor diffusion. Most of the above-mentioned documents have studied the diffusion process of rumors among individuals on the Internet, but rarely studied the process of their formation, which cannot fully reflect the large-scale diffusion process of

rumors from its initiation, and from weak to strong of the whole evolution. However, the research on the formation mechanism of rumors can effectively reduce the generation of rumors, which is very important for rumor control. Therefore, it is necessary to study the formation mechanism of rumors.

In addition, regarding the research on rumor control, the methods used in the existing literature mainly include controlling high-influence nodes, controlling key connecting edges, and diffusing refuting information. The details are as follows: (1) Control high-influence nodes. This type of method aims to find nodes that contribute to the rumor diffusion, and then delete such nodes to reduce the influence of rumors. Some typical literature is as follows: based on a variety of complex network metrics of network centrality, e.g., centrality of degree, intermediate, proximity, etc., Comin et al. (10) analyzed three communication mechanisms and provided an effective method of hairstyle communication sources. Inspired by the idea of gravity formula, Ma et al. (11) took the *k*-shell value of the node as its mass and the shortest path length between the two nodes as the distance, proposed the gravity centrality method to determine the high influence node, and compared it with other centrality indexes. (2) Control key connecting edges. This type of method aims to find the edges that play key nodes in information dissemination and delete them to reduce the rumor diffusion. Some typical literature is as follows: Pallis (12) deleted *k* edges from the original network to diffuse rumors as little as possible, and explained which edge should be deleted depended on the eigenvalues of the network adjacency matrix. Yuan et al. (13) proposed a fine-grained heuristic algorithm to solve the rumor propagation minimization problem. The experiment showed that the heuristics based on betweenness and out-degree were orders of magnitude faster than the greedy algorithm in terms of running time. (3) Diffusing refuting information. This type of method diffuses information that is contrary to the content of the rumors, so that as many nodes as possible are not deceived by the rumors. Some typical literature is as follows: Zhang et al. (14) presented an in-depth analysis of the function of official rumor-refuting information (ORI) in suppressing and quashing rumors. They determined the influencing factors and constructed a competition model. The simulation results also indicated that government credibility and the release time of ORI played a critical role in controlling rumors. Zhang and Xu (15) presented a simple model to describe the interplay between rumors and rumor-refuting information based on biomathematics theory. By drawing from differential equations, a theoretical analysis reveals that this model exhibited three dynamic cases: extinction of rumors, extinction of rumor-refuting information and coexistence. Also, they studied the stability of the equilibrium points of three cases, found that stable condition of equilibrium point, and showed unstable case of model. Most of the above-mentioned literature studies the effects of different rumor control strategies adopted after the occurrence of hot events, but few literature explores the role of rumor prevention strategies adopted before the occurrence. However, proactive prevention strategy is also an important part of rumor control strategy, so it is necessary to study it.

To sum up, the academies have conducted a certain depth of research on the diffusion and control of rumors, but there are still deficiencies. Based on this, in section Model Construction, this article first designs a state transition mode based on SEIR model. At the same time, considering the rumor generating factors such as information tampering and individual heterogeneity factors such as personal reputation, an information interaction mode is constructed. Finally, SEIR-OM model is constructed by fusing state transition mode and information interaction mode. In addition, this article also divides the rumor control strategy into proactive strategy and reactive rumor refutation strategy, and analyzes their effects through simulation experiments.

RESEARCH FRAMEWORK

This article integrates the individual's diffusion willingness, the individual's forgetting degree, and the intensity of government punishment into the SEIR model, and designs the state transition mode at first. Secondly, it refers to the trust theory and information asymmetry theory, considers the main factors affecting information interaction among individuals, and establishes information interaction mode. Finally, an improved SEIR model named SEIR-OM model is constructed, and its formation and diffusing process are simulated and analyzed from two aspects: model parameter setting and rumor control strategy. The framework of the article is shown in **Figure 1**.

MODEL CONSTRUCTION

Classic SEIR Model

SEIR model is a classical infectious disease dynamics model, which is often used in the medical field to simulate the transmission process of infectious diseases (16, 17) and predict the development trend of epidemic situation (18, 19).

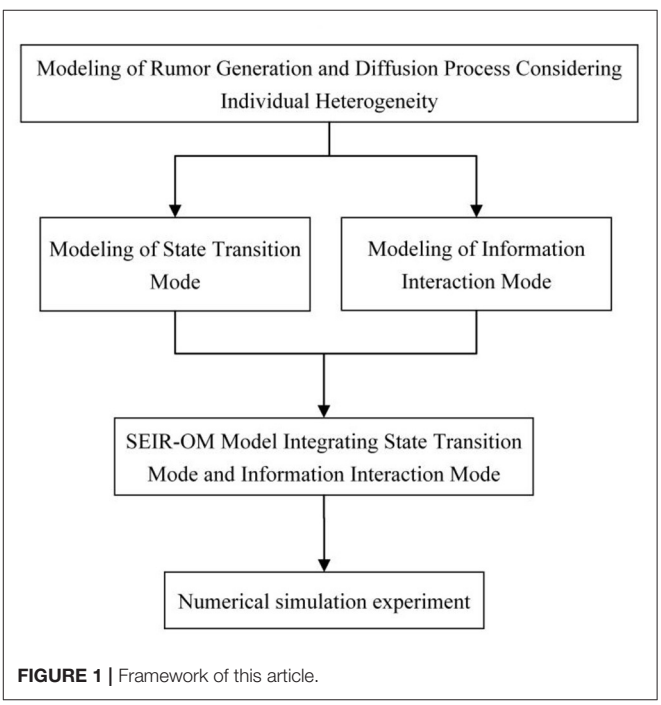

FIGURE 1 | Framework of this article.

The dissemination of public opinion information needs go through the process of germination, development, outbreak and finally decline, which is highly similar to the whole process of the development of infectious diseases. Therefore, in the existing research on information dissemination, a considerable proportion of studies uses SEIR model to analyze information dissemination.

The classic SEIR model divides individuals into four categories according to their different states in the diffusion process, namely: uninformed individual S, silent individual E, communication individual I, and immune individual R. Among them, uninformed individuals represent those who have not received information, corresponding to those who do not know the public opinion information in reality, and the initial states of most individuals are uninformed states; silent individuals represent those who have received information but have not diffused to uninformed ones; communication individuals represent those who receive information and diffuse information to other ones; immune individuals represent those referring to individuals who are no longer interested in information related to the event, which are the final states of individuals.

Moreover, the classic SEIR model has four assumptions: (1) The number of individuals always remains a constant, i.e., S+E+I+R=N (N is a constant); (2) Uninformed individuals turn into the silent after receiving information from the communication individual. Therefore, at $t + 1$, the number of newly-added silent ones is proportional to the number of communication ones at time t, and its proportional coefficient α is defined as the reception coefficient; (3) The number of newly-added silent ones at $t + 1$ is proportional to the total number of silent ones at time t, and its proportional coefficient σ is defined as the diffusing coefficient; (4) The communication individuals turn into immune ones after losing interest in the event-related information. Therefore, at time $t + 1$, the number of newly immunized individuals is proportional to the number of communication ones at time t, and the proportional coefficient ρ is defined as the immune coefficient. Based on the above four assumptions, the differential equations of the SEIR model are shown in formula (1):

$$\begin{cases} \frac{dS(t)}{dt} = -\alpha I(t)S(t) \\ \frac{dE(t)}{dt} = \alpha I(t)S(t) - \sigma E(t) \\ \frac{dI(t)}{dt} = \sigma E(t) - \rho I(t) \\ \frac{dR(t)}{dt} = \rho I(t) \end{cases} \quad (1)$$

Figure 2 is a schematic diagram of the classic SEIR model:

SEIR model uses fixed probability to describe the individual state transition process and information interaction process in the process of rumor propagation, ignoring the influence of individual heterogeneity factors on the process of rumor propagation. Based on this, next section will improve the classic SEIR model and construct the SEIR-OM model.

SEIR-OM Model Construction

In this section, the construction process of SEIR-OM model will be described in detail. The parameters and variables involved in the model are shown in **Tables 1**, **2**.

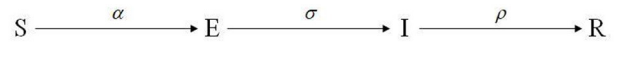

FIGURE 2 | Classic SEIR model.

State Transition Mode

The SEIR model uses a fixed probability to describe the transition of an individual's state, without considering the heterogeneity of the individual, so it cannot explain the internal mechanism of the individual's state transition. Based on this, the individual state transition mode of the SEIR model is improved here, and two factors describing individual heterogeneity are introduced, namely: individual's diffusion willingness and the individual's forgetting degree, which are used as the conditions for individual state transition.

(1) Individual's diffusion willingness. Diffusion willingness refers to "the sending intensity of sender's personal consciousness" (20), which is used to determine whether the individual diffuses the information to the outside world. It is important to determine whether the information can be diffused on a large scale in social networks. Generally, the factors that affect the one's diffusion willingness include two aspects: one is the degree of interest correlation between the individual and the event, which refers to the degree of influence of the occurrence and development of an event on a certain aspect of the person's interests (21), e.g., the occurrence of public health emergencies will damage the personal interests of local residents. The higher interest correlation of the individual to the event indicates the stronger willingness to diffuse relevant information; the other is accumulated gains due to external feedback after the information diffusion. If other individuals receive the information diffused by this individual, this individual's diffusion gains will increase, and his willingness to diffuse the information will be stronger. However, if other individuals reject the information diffused by the individual, his/her diffusion gains will decrease, and the corresponding diffusion willingness is also weaker. Therefore, the individual's diffusion willingness W_i is described by formula (2) (22):

$$W_i(t) = (b_{it} - 1)e^{1-m_{it}} + (1 - p) \quad (2)$$

where $b_{it} = b_{i(t-1)} + 0.1v_{it}$. Because each individual has a difference in the degree of interest correlation to a certain event, we assume that b_{i0} obeys a normal distribution with a mean value of μ_b and a variance of b^2, and is mapped to the interval [0,1]. $m_{i0} = 1$, when other individuals receive the information sent by individual i, and m_i is increased by 1.

(2) Individual's forgetting degree. Individual's attention to hot events will decay over time. Ebbinghaus research found that the failing of people's memory is fast at first and then slower. Considering that the degree of interest between individuals and the event will affect their attention to the event, referring to the Ebbinghaus forgetting curve equation, the individual forgetting degree F_i is described by the formula (3):

$$F_i(t) = 1 - e^{-\frac{t}{b_{it}}} \quad (3)$$

TABLE 1 | Involved parameters in the model.

Parameter	Description	Value
w	Diffusion threshold (refers to the critical value of information diffusion to the outside world)	[0,1]
f	Forgetting threshold (refers to the critical value of forgetting events)	[1,+∞)
b_{it}	Degree of interest correlation between individual i and public opinion events at time t	[0,1]
μ_b	Mean value of the degree of interest correlation between all individuals and public opinion events	[0,1]
s_b	Standard deviation of interest correlation between all individuals and public opinion events	[0,+∞)
c_i	Trust threshold of individual i (refers to the threshold at which the individual chooses to trust other individuals)	[0,1]
μ_c	Mean value of the trust thresholds of all individuals	[0,1]
p	Government punishment on rumors	[0,1]
m_{it}	Accumulated gain due to external feedback after the information diffusion	[0,+∞]
v_{it}	Amount of information received by individual i at time t	[0,+∞]
N	Total number of individuals in the network	(0,+∞)
s_{ij}	Shortest path between individual i and j	[0,+∞]
k_i	Number of neighbors of individual i	[0,+∞]
n_{ij}	Number of common neighbors of individuals i and j	[0,+∞]
d_{1i}	Subject deviation of the information content between mastered by individual i and original information	[0,2]
d_{2i}	Predicate deviation of the information content between mastered by individual i and original information	[0,2]
d_{3i}	Object deviation of the information content between mastered by individual i and original information	[0,2]
d_{4i}	Attribute deviation of the information content between mastered by individual i and original information	[0,2]
d_{5i}	Adverbial deviation of the information content between mastered by individual i and original information	[0,2]
s_{1i}	Deviation between the subject of the information content transmitted by individual i and that of the original information content	[0,2]
s_{2i}	Deviation between the predicate of the information content transmitted by individual i and that of the original information content	[0,2]
s_{3i}	Deviation between the object of the information content transmitted by individual i and that of the original information content	[0,2]
s_{4i}	Deviation between the attribute of the information content transmitted by individual i and that of the original information content	[0,2]
s_{5i}	Deviation between the adverbial of the information content transmitted by individual i and that of the original information content	[0,2]

TABLE 2 | Involved variables in the model.

Variable	Description	Value
W_i	Individual i's diffusion willingness	[0,1]
F_i	Individual i's forgetting degree	[0,1]
D_i	The set of deviations between the information content mastered by individual i and the original information content	
S_i	The set of deviations between the information content diffused by individual i and the original information content	
I_i	Social influence of individual i	[0,1]
R_{ij}	Strength of the relationship between individuals i and j	[0,1]
C_{ij}	The trust degree of individual i to individual j	[0,1]
K_i	Knowledge reserve of individual i	[0,1]
Σ_i	The degree of confusion of external information received by individual i in past information interactions	[0,1]
G_i	Individual i's mastery of event-related information	[0,1]
Δ_i	Individual i's tampered intensity with information content	[0,1]

Similar to the classical SEIR model, SEIR-OM model also divides individuals into four categories: uninformed individuals S, silent individuals E, communication individuals I, and immune individuals R. They also have the same meaning as the classical SEIR model.

In the individual state transition mode, the state transition rules are set as follows: when an uninformed person interacts with a communication one, the uninformed individual will transform into a silent one or a communication one according to his diffusion willingness. When the silent individual's diffusion willingness is greater than or equal to the diffusion threshold w, it turns into a communication one. When a communication individual's willingness is less than the diffusing threshold w and >0, he/she turns into a silent individual. If the individual's diffusion willingness is <0 or the forgetting degree is greater than forgetting threshold f, he/she turns into an immune one. The individual state transition rule is shown in **Figure 3**.

Note that although uninformed individuals and immune individuals do not participate in information dissemination, there are some differences between them. The uninformed individual means that the initial state of most individuals is uninformed state. After receiving the information, the state of the uninformed individual will change. On the contrary, the silent individual means that the final state of most individuals is silent state, and it will not change again. Also, the silent individuals will disconnect from other individuals.

Information Interaction Mode

The large-scale rumor diffusion is inseparable from the information interaction among individuals, and the information interaction process includes two stages, namely: the receiving stage and the diffusion stage of information. Existing studies mostly use SEIR model and evolutionary game model to describe this process. However, the SEIR model describes this process

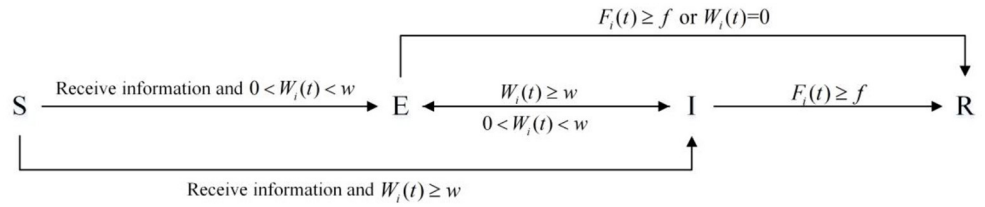

FIGURE 3 | Individual state transition rule.

through fixed reception probabilities and diffusion probabilities, ignoring the influence of individual heterogeneity factors on the information interaction process. While in the evolutionary game model, individuals choose whether to receive and diffuse information only based on the diffusion benefits. In addition, both the SEIR model and the evolutionary game model only describe the diffusion process after rumors are generated, and do not consider the rumor generation mechanism. Based on this, an information interaction mode is designed here to reflect the process of rumor generation and information interaction.

Information Content Deviation

Different people have different positions and opinions on the same public opinion event, and there are situations in the network where individuals distort and fabricate real information to gain attention. Therefore, in the process of information diffusion, information deviation is often caused, and a variety of different content of information coexist. In order to differentiate the information content mastered by different people and describe the difference between them and the original information content, the information content deviation set is established according to the Chinese sentence structure here.

In the Chinese context, a sentence is mainly composed of five parts, namely: subject, predicate, object, attributive, and adverbial. Therefore, the information content deviation set in the article is also composed of these five parts. Set the deviation set of the information grasped by the individual and the original information $D_i = < d_{1i}, d_{2i}, d_{3i}, d_{4i}, d_{5i} >$; the deviation set of the information content diffused by the individual and the original information $S_i = < s_{1i}, s_{2i}, s_{3i}, s_{4i}, s_{5i} >$. Among them, d_{1i}, d_{2i}, d_{3i}, d_{4i}, d_{5i}, s_{1i}, s_{2i}, s_{3i}, s_{4i}, s_{5i} are all described by values mapped to the interval [0,2]. d_{1i}, d_{2i}, d_{3i}, d_{4i}, d_{5i}, s_{1i}, s_{2i}, s_{3i}, s_{4i}, s_{5i} <1 means negative deviation, d_{1i}, d_{2i}, d_{3i}, d_{4i}, d_{5i}, s_{1i}, s_{2i}, s_{3i}, s_{4i}, s_{5i} <1 means positive deviation, d_{1i}, d_{2i}, d_{3i}, d_{4i}, d_{5i}, s_{1i}, s_{2i}, s_{3i}, s_{4i}, $s_{5i} = 1$ means it is consistent with the original information.

Factors Affecting Information Interaction Among Individuals

This section quantifies the two factors that affect the information interaction between people: one is the degree of trust between individuals and the other is the individual's mastery degree of event-related information.

(1) The degree of trust between individuals. Existing research on trust theory (23–25) generally believes that "trust is the premise of information exchange between individuals and the cornerstone of social networks. If there is no interpersonal trust, social networks will collapse." Taking the convenience of social networks into account, it can make two netizens who are not related in real life communicate, but the degree of mutual understanding of the interactive dual is not high. This leads to the fact that netizens in social networks can only determine whether to trust each other through their social influence and the strength of the relationship between netizens. Based on this, the degree of trust between individuals is determined by the individual's social influence and the strength of the relationship between them.

(1) Individual's social influence. A person's social influence refers to his/her ability to influence other ones' behaviors in a social network, and reflects the importance of an individual in the network. In complex network theory, tightness can be used as a measure of node centrality, which is defined as the average shortest path from a node to other reachable nodes. Generally, the higher the tightness is, the more important the node is. Therefore, the individual's tightness formula in the complex network is used to calculate the individual's social influence I_i, as shown in formula (4):

$$I_i = \frac{N-1}{\sum_j s_{ij}} \tag{4}$$

(2) Strength of relationships among individuals. In reality, people tend to trust their close friends more and trust the information they convey. Therefore, the strength of the relationship between individuals will have an impact on information diffusion, i.e., the closer the relationship between individuals is, the higher the degree of mutual trust is. Here, the concept of individual embedding degree (26), i.e., the number of common neighbor individuals that two individuals have in the network, is used to describe the strength of the relationship between these two individuals, as shown in formula (5):

$$R_{ij} = \begin{cases} \dfrac{n_{ij}}{(k_i - 1) + (k_j - 1)} & k_i, k_j \neq 1 \\ 1 & k_i = k_j = 1 \end{cases} \tag{5}$$

where k_i-1 represents the number of neighbors remaining for individual i except for individual j. (k_i-1) + (k_j-1) represents the maximum number of common neighbor individuals that may exist between individuals i and j. In addition, the premise of setting the interaction between two entities is that they have a direct connection in the network. Therefore, when $k_i = k_j = 1$, it means that individuals i and j are each other's exclusive

neighbors, and the relationship between the two is the strongest, i.e., $R_{ij} = 1$.

In summary, the calculation of the trust degree C_{ij} of individual i to individual j is shown in formula (6):

$$C_{ij} = I_i * R_{ij} \tag{6}$$

(2) The individual's mastery of event-related information. In social networks, only a small number of people can grasp more comprehensive information, while the vast majority only grasp part of the information and make behavioral decisions based on the limited information they have. This is called information asymmetry. The phenomenon of information asymmetry is an important driving force for the rumor diffusion (27). At present, the development of the Internet has made information acquisition more and more convenient, and the asymmetry of information between individuals will be weakened. However, at the same time, it will aggravate the level of information confusion in social networks. This is because the unique free speech space of the Internet allows any information to be diffused on a large scale in a short period of time, but it costs longer time to verify the information authenticity. Therefore, although the public have more opportunities and channels to obtain information, they cannot accurately judge the authenticity of the information, which further strengthens the asymmetry of individuals in terms of information accuracy. Based on this, this article introduces the individual knowledge reserve (28) and the degree of confusion in external information (29) to describe the individual's mastery of event-related information.

(1) Individual knowledge reserves. Because most individuals do not know the true situation of public opinion events, they can only judge whether to accept external information based on their own past experience and relevant knowledge. For example, during the outbreak of COVID-19, it was widely diffused on the Internet that dual yellow oral liquid could prevent virus infection. In fact, dual yellow oral liquid cannot prevent COVID-19 virus. However, due to the lack of knowledge of pathology and virology, the public chose to believe this information, which once triggered a panic buying wave. Based on this, the individual knowledge reserve K_i is assumed to follow a Poisson distribution with a mean value of λ to reflect the phenomenon that only a small number of individuals in the network have a relatively professional knowledge reserve.

(2) The degree of confusion in external information. After the diffusion of information, individuals gradually are aware of information with different contents. A large amount of redundant information will interfere with their judgment of the authenticity and accuracy of the information, so that there is a greater probability of accepting rumors or rejecting real information. Here, the degree of confusion in external information Σ_i is calculated by formula (7), as follows:

$$\Sigma_i(t) = \frac{1}{5}\sum_{j=1}^{5}\left(\sqrt{\sum_{l=1}^{n_i}(d_{jl}(t) - \sum d_{jl}(t)/n_i\ )/(n_i - 1)}\right) \tag{7}$$

In summary, the individual's mastery of event-related information G_i is described by formula (8).

$$G_i = K_i * \Sigma_i \tag{8}$$

Information Interaction Mechanism

When the information receiver has a high degree of trust in the communication individual, he/she will accept the information sent by the communication one. In addition, the communication ones are divided into ordinary communication individual O and malicious communication individual M according to diffuse intention. Among them, the ordinary communication individual diffuse information that he/she believes to be true to uninformed ones, who will not tamper or process the information in the processing of information diffusion. The malicious communication ones tamper and process the information for gaining attention and increasing influence, and diffuse processed information to others. Since the information receiving mechanism of all individuals is the same, and the information diffusion mechanism of different communication individuals is different, the information reception mechanism of the individual must be set first, and then the information diffusion mechanism of the general and the malicious communication individual must be set separately.

(1) Individual information reception mechanism

When a communication individual sends information to neighbors, the recipient of the information compares the communication individual's trust level with his/her own trust threshold at first. If the former's reputation is greater than the trust threshold, the information will be accepted by the information recipient, and vice versa. After receiving the information, the information recipient updates the content that he/she believes to be true according to his/her mastery of the event-related information. The specific reception mechanism is as follows:

When $C_{ij} \geq c_i$

$$\begin{aligned} d_{1i}(t+1) &= d_{1i}(t) + G_i(s_{1j}(t) - d_{1i}(t)) \\ d_{2i}(t+1) &= d_{2i}(t) + G_i(s_{2j}(t) - d_{2i}(t)) \\ d_{3i}(t+1) &= d_{3i}(t) + G_i(s_{3j}(t) - d_{3i}(t)) \\ d_{4i}(t+1) &= d_{4i}(t) + G_i(s_{4j}(t) - d_{4i}(t)) \\ d_{5i}(t+1) &= d_{5i}(t) + G_i(s_{5j}(t) - d_{5i}(t)) \\ d_i(t+1) &= \langle d_{1i}(t+1), d_{2i}(t+1), d_{3i}(t+1), d_{4i}(t+1), d_{5i}(t+1)\rangle \end{aligned} \tag{9}$$

When $C_{ij} < c_i$

$$d_i(t+1) = d_i(t) = \langle d_{1i}(t), d_{2i}(t), d_{3i}(t), d_{4i}(t), d_{5i}(t)\rangle \tag{10}$$

(2) Information diffusion mechanism of ordinary communication individuals

Generally speaking, while diffusing information to the outside world, ordinary communication individuals will directly diffuse the information they believe to be true to other individuals, i.e.,

$$\begin{aligned} s_i(t+1) = d_i(t+1) = \langle & d_{1i}(t+1), \\ & d_{2i}(t+1), d_{3i}(t+1), d_{4i}(t+1), d_{5i}(t+1)\rangle \end{aligned} \tag{11}$$

(3) Information diffusion mechanism of malicious communication individuals

Before diffusing information externally, malicious communication individuals will tamper with the information they believe to be true to a certain extent, and diffuse the tampered information to others. The degree of tampering will increase with the increase of the gain from the feedback of the tampered information, and decrease with the increase of the punishment of rumors. Therefore, the formula for calculating the tampered intensity Δ_i is as follows:

$$\Delta_i(t) = \ln(e^{1-p} - \frac{1}{m_{it}}) \tag{12}$$

Information diffusion mechanism of malicious communication individuals is as follows:

$$\begin{aligned} s_{1i}(t+1) &= d_{1i}(t+1) * (1 + (-1)^{\beta}\Delta_i(t+1)) \\ s_{2i}(t+1) &= d_{2i}(t+1) * (1 + (-1)^{\beta}\Delta_i(t+1)) \\ s_{3i}(t+1) &= d_{3i}(t+1) * (1 + (-1)^{\beta}\Delta_i(t+1)) \\ s_{4i}(t+1) &= d_{4i}(t+1) * (1 + (-1)^{\beta}\Delta_i(t+1)) \\ s_{5i}(t+1) &= d_{5i}(t+1) * (1 + (-1)^{\beta}\Delta_i(t+1)) \\ s_i(t+1) &= \langle s_{1i}(t+1), s_{2i}(t+1), s_{3i}(t+1), s_{4i}(t+1), s_{5i}(t+1) \rangle \end{aligned} \tag{13}$$

where β is a random number of either 0 or 1.

Framework and Simulation Steps of SEIR-OM Model

Based on the Barabási-Albert scale-free network (BA network) (30, 31), the Monte Carlo simulation method based on multi-agent is used to simulate the SEIR-OM model. Its construction process is shown in **Figure 4**.

Compared with the classical SEIR model, the state transition mode in SEIR-OM model can more reasonably and carefully describe the psychological mechanism of individual state transition. The information interaction mode in SEIR-OM model can not only distinguish different information contents, but also reflect the individual's psychological decision before receiving (transmitting) information.

The specific process of the formation and diffusion of rumors is as follows:

(1) At the initial moment, a certain number of malicious communication individuals and general communication individuals are randomly generated, and their initial diffusion willingness and the forgetting degree of public opinion events are generated according to formulas (1) and (2), respectively.

(2) At any time, the communication individual i randomly selects its neighbor individual j as the object of information interaction. If the trust degree of i is greater than or equal to the trust threshold of j, information interaction is carried out according to the state of j. Generally, there are the following two situations: (1) If j is an uninformed individual, he/she will fully accept the information diffused by i, form the initial diffusion willingness and the initial forgetting degree, and transform it into a communication individual or a silent individual according to the initial diffusion willingness. (2) When j is a silent individual or a communication individual, the communication individuals i and j exchange information according to the formulas (9–13). If the trust degree of the communication individual i is less than the trust threshold of j, they will not exchange information.

(3) At any time, after all communication individuals have completed their outward communication, they update

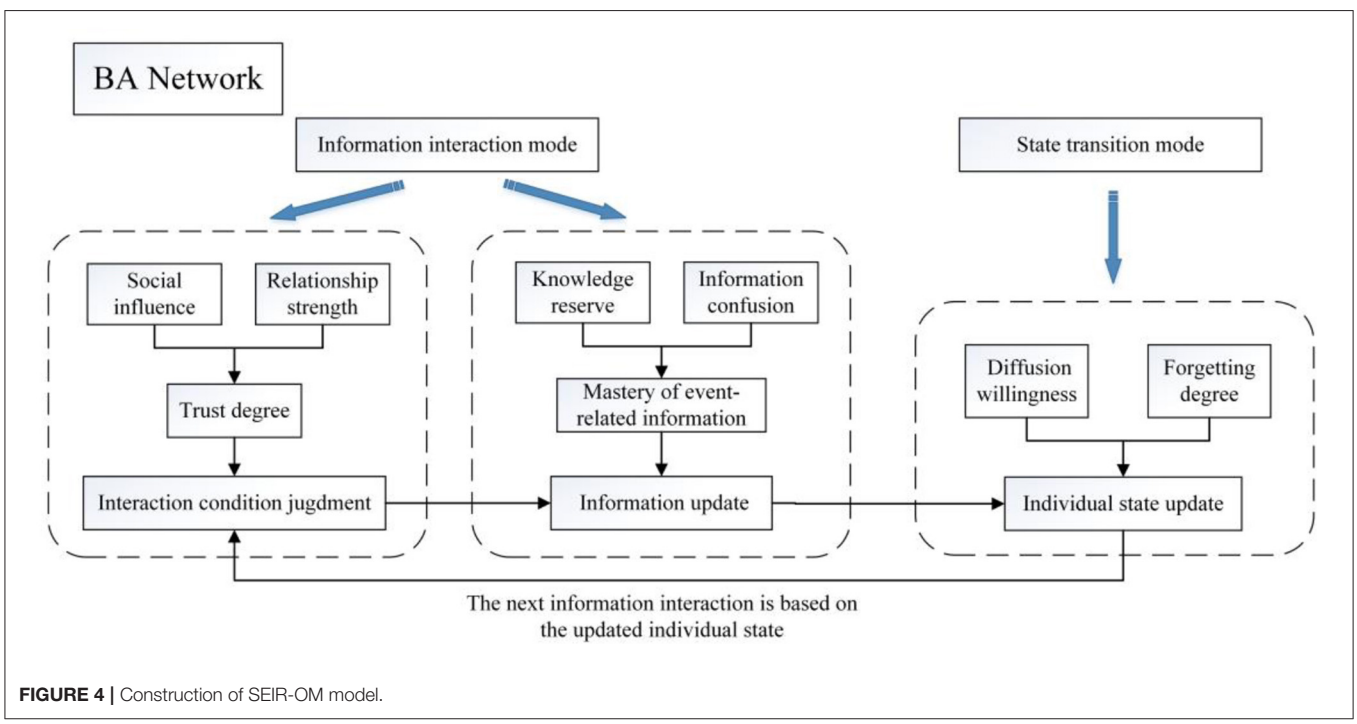

FIGURE 4 | Construction of SEIR-OM model.

the individual's diffusion willingness, forgetting degree, and individual state in the network.

(4) Determine whether the end condition is met. The conditions for ending the interaction are set as follows:

$$\frac{\sum_{i=1}^{N} v_i(t)}{N} \leq 0.1 \tag{14}$$

(5) If the interaction end condition is not satisfied, repeat steps (2)–(4) until formula (14) is satisfied, and the interaction process ends. The specific process is shown in **Figure 5**.

SIMULATION EXPERIMENT

This section uses the Monte Carlo simulation method based on multi-agent system to explore the influences of model parameters on the process of rumor diffusion and the implementation effects of different rumor control strategies. The simulation network is constructed with BA network, and the individual scale in the network is set to 300.

The Influence of Model Parameters on the Process of Rumor Diffusion

This section starts with the model parameters and analyzes its influence on the diffusion process of rumors. There are 2 comparison indicators used in the analysis:

(1) Entire network information content deviation: it refers to the average value of the deviation between the information content in the network and the actual information content. Here, the deviation $dev_i(t)$ between the information content diffused by the individual i and the real information content is set. The calculation is shown in formula (15), and the calculation of the deviation of the entire network information content deviation is shown in formula (16).

$$dev_i(t) = \frac{\sqrt{\sum_{x=1}^{5} (s_{xi}(t) - 1)^2}}{5} \tag{15}$$

$$Deviation(t) = \frac{\sum_{i=1}^{N} dev_i(t)}{N} \tag{16}$$

(2) Rumor diffusion range: it refers to the proportion of individuals holding rumors in the network to the total number of individuals on the network. Here, information with content deviation >0.5 is identified as a rumor, and the calculation is shown in formula (17). Based on this, the calculation of the rumor diffusion range is shown in formula (18):

$$d_i(t) \leftarrow \begin{cases} \text{rumor if } dev_i(t) \geq 0.5 \\ \text{truth if } dev_i(t) < 0.5 \end{cases} \tag{17}$$

$$Breath(t) = \frac{\sum \text{rumor}}{N} \tag{18}$$

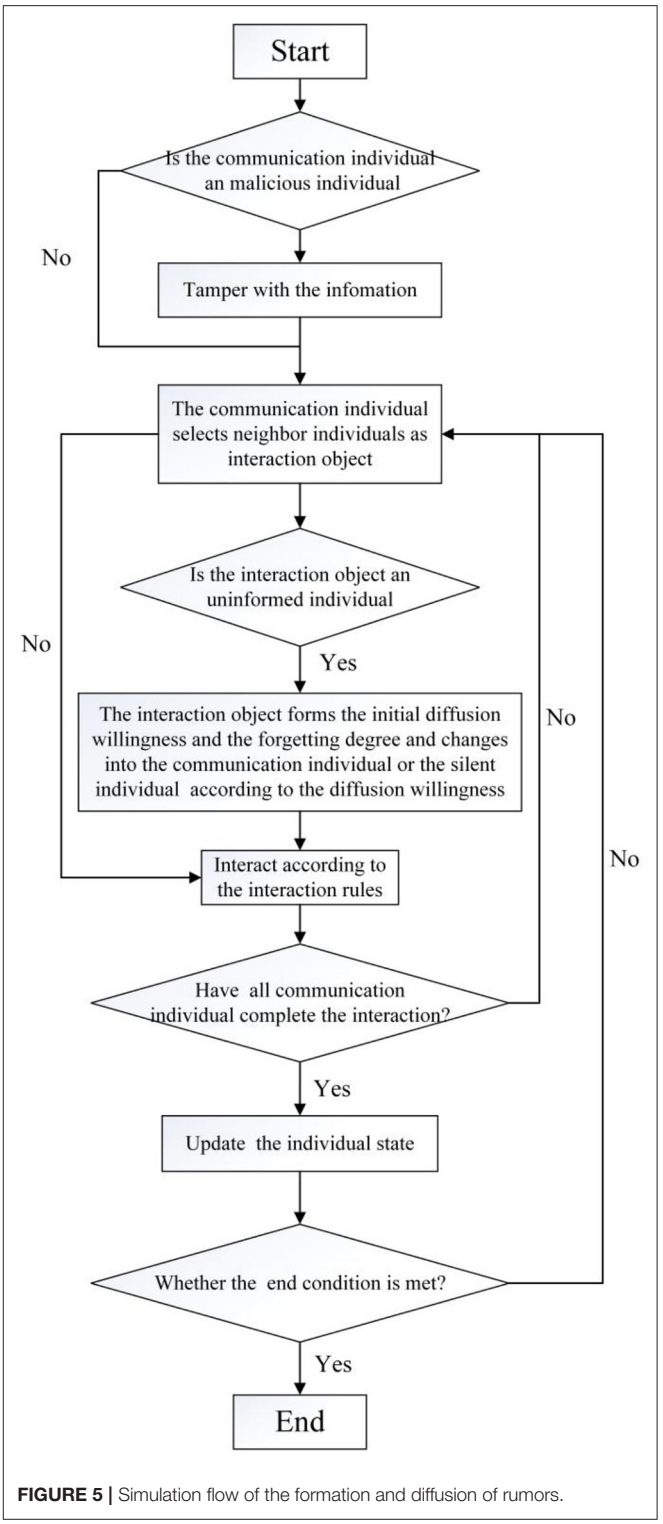

FIGURE 5 | Simulation flow of the formation and diffusion of rumors.

The Impact of μ_b on Rumor Evolution Process

The mean value of the degree of interest correlation between all individuals and public opinion events μ_b will affect the

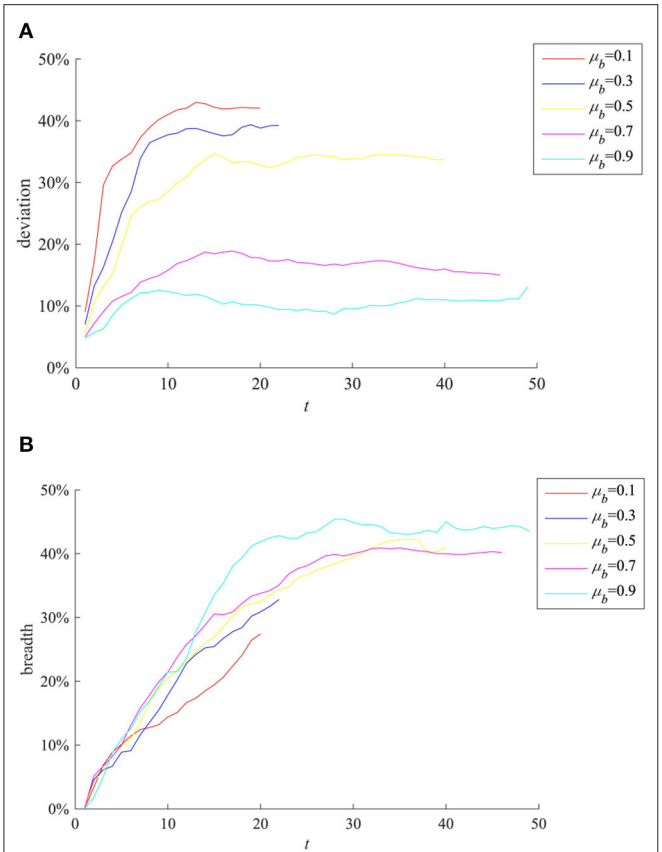

FIGURE 6 | The impact of μ_b on rumor evolution process. **(A)** Entire network information content deviation. **(B)** Rumor diffusion range.

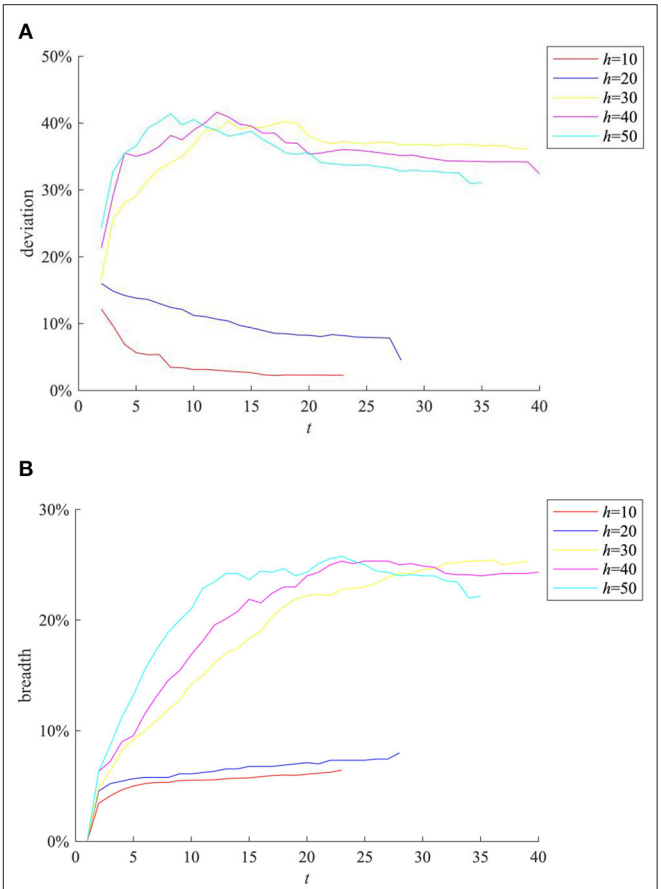

FIGURE 7 | The impact of network structure on rumor evolution process. **(A)** Entire network information content deviation. **(B)** Rumor diffusion range.

individual's attention to the event, and thus have an impact on the diffusion of event-related information. Here take μ_b as 0.1, 0.3, 0.5, 0.7, and 0.9, respectively, for comparison. The results are shown in **Figure 6**.

It can be seen from **Figure 6A** that as μ_b increases, the entire network information content deviation decreases. This shows that when the event is related to the interests of most individuals, they are more concerned about the authenticity of the information and more cautious about the information sent by the outside world, so that the entire network information content deviation of the entire network is lower. It can be seen from **Figure 6B** that as μ_b is larger, the rumor costs longer time to diffuse and its diffusion range is wider. This shows that individuals are more concerned about the incident and have a stronger willingness to forward information related to their own interests, and protect their own interests by expanding the influence of the incident, which also provides opportunities for the rumor diffusion and makes more widespread.

The Impact of Network Structure on Rumor Evolution Process

Social networks provide channels for information diffusion. If the network structure changes, the strength of relationships among individuals will change accordingly, which will affect the reception and diffusion of information. In order to study the influences of different network structures on the process of rumor diffusion, this section changes the value of h ($h \in [0,N]$) (Note that the BA network used in the simulation experiment is based on an interconnected network, after the introduction of several new nodes. The new nodes will be connected to h existing nodes). Our experiments generate BA networks of different structures, and compare the rumor diffusion under different network structures, then the results are as shown in **Figure 7**.

It can be seen from **Figures 7A,B** that when $h = 20$, the information content deviation of the entire network and the rumor diffusion range are higher than the case of $h = 10$. When $h = 30$, the information content deviation of the entire network exceeds 30%, and the rumor diffusion range also exceeds 20%. It can be seen that the increase of h can promote the rumor diffusion. This is mainly because when h is small, the average degree of network nodes is low, and the connection between individuals is weak, which makes the information diffusion channel blocked, resulting in small rumor diffusion range. With the increase of h, the average network degree of nodes increases, the connection among individuals is strengthened, and the information interactions among

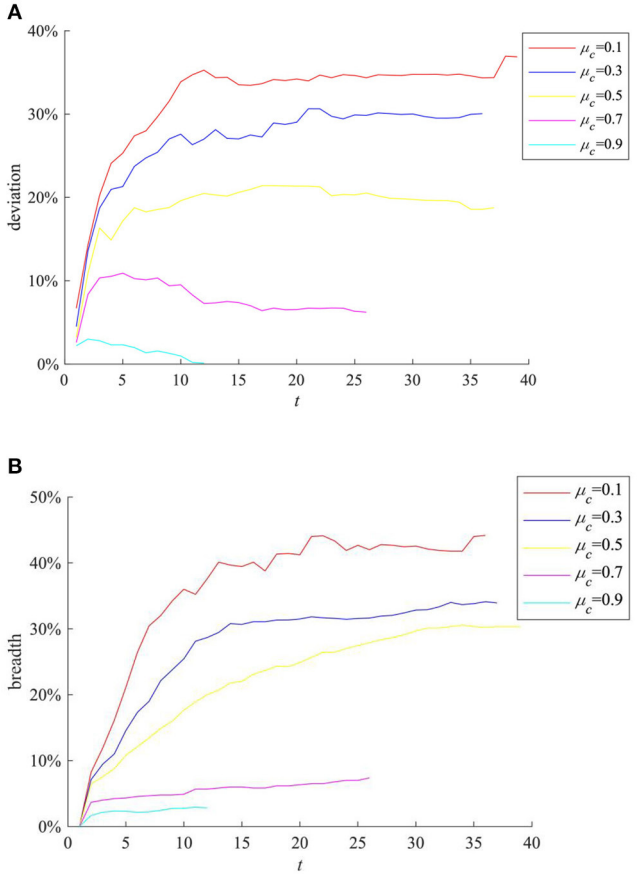

FIGURE 8 | The impact of μ_c on rumor evolution process. **(A)** Information content deviation. **(B)** Rumor diffusion range.

individuals become more frequent, which creates conditions for the rumor diffusion. However, it is easy to find that when $h \geq 30$, the increase of h no longer expands the entire network information content deviation of the entire network and the rumor diffusion range, indicating that the average network degree of nodes has a peak in the influence of rumor diffusion range.

The Impact of μ_c on Rumor Evolution Process

The trust threshold reflects the cautious of an individual treating external information, and its value will affect his/her reception of external information. Here we select the cases where the mean value of individual trust threshold $\mu_c(\mu_c = \sum (c_i)/N)$ is 0.1, 0.3, 0.5, 0.7, 0.9, respectively, for comparison, and the results are shown in **Figure 8**.

It can be seen from **Figures 8A,B** that with the increase of μ_c, the entire network information content deviation and the rumor diffusion range gradually decrease. This is because the increase in the average trust threshold means that the information recipients generally reduce their trust in the network, and they are increasingly inclined to refuse to information from the outside world, resulting in more obstacles for information diffusion, making it impossible for further diffusion.

TABLE 3 | Rumor control strategy classification.

Classification	Time	Measure
Proactive prevention strategy	Before the occurrence of public opinion incidents	Popularize relevant knowledge and improve the public's ability to discern rumors; establish a punishment mechanism to punish the communicator of rumors.
Reactive rumor-refuting strategy	After the occurrence of public opinion incidents	Organize some individuals to refute rumors

Analysis of Rumor Control Strategy

In this section, according to the time and means of implementing the rumor control strategies, they are divided into proactive prevention and reactive rumor refuting ones, as shown in **Table 3**. Among them, the prevention strategy refers to the preventive strategy taken before the occurrence of public opinion incidents. The reactive strategy refers to the refuting strategy taken after the occurrence of the rumors. Here, the effects of the two types of strategies are compared and analyzed through simulation experiments.

The current academic research on rumor control mainly focuses on how to reduce the impact of rumors, and rarely considers the negative impact of rumor control strategies, which leads to insufficient network activity. Currently, the social network has become an important channel for the media to release information, the public to obtain information, and the public to seek appeals. Insufficient network activity will prevent the important information from being diffused, and it will not satisfy the public's right to know public events. Based on this, the number of individuals participating in information interaction at different time moments is calculated as a measure of network activity to reflect the changes in network activity under different control strategies, so as to more comprehensively compare and analyze the positive and negative effects of different rumor control strategies.

Proactive Prevention Strategy

According to the different implementation methods of the strategy, the proactive prevention strategy is further divided into the knowledge popularization strategy and the punishment and restriction strategy.

(1) Knowledge popularization strategy

The knowledge popularization strategy refers to the one to restrict rumor diffusion by popularizing relevant knowledge in the field to individuals before the occurrence of public opinion events in a certain field. Here, the average knowledge reserves of network individuals reflect the implementation of the knowledge popularization strategy. They are set to follow the Poisson distribution with the mean λ of 1, 2, 3, 4, and 5, respectively, and the rumor diffusion when individuals have different levels of

knowledge reserves is compared. The results are shown in **Figure 9**.

It can be seen from **Figures 9A,B** that with the increase of λ, the higher level of individual knowledge reserves in the network represents the greater probability of the authentic identification information and greater possibility of rejecting rumors, reducing the scale of information content deviation and rumor diffusion range. It can be seen that adopting knowledge popularization strategies can effectively reduce the influence of rumors. In addition, it can be seen from **Figure 9C** that with the increase of λ, the peak value of network activity decreases, but its descend range is smaller. This is because when individual knowledge reserves are small, the public knows less about the causes and consequences of public events. In order to satisfy their own curiosity, they often trigger large-scale discussions on the Internet. However, with the increase of individual knowledge reserves, individuals can reason and derive the causes and consequences of events based on their own knowledge, which reduces the discussion on the network, and decreases network activity.

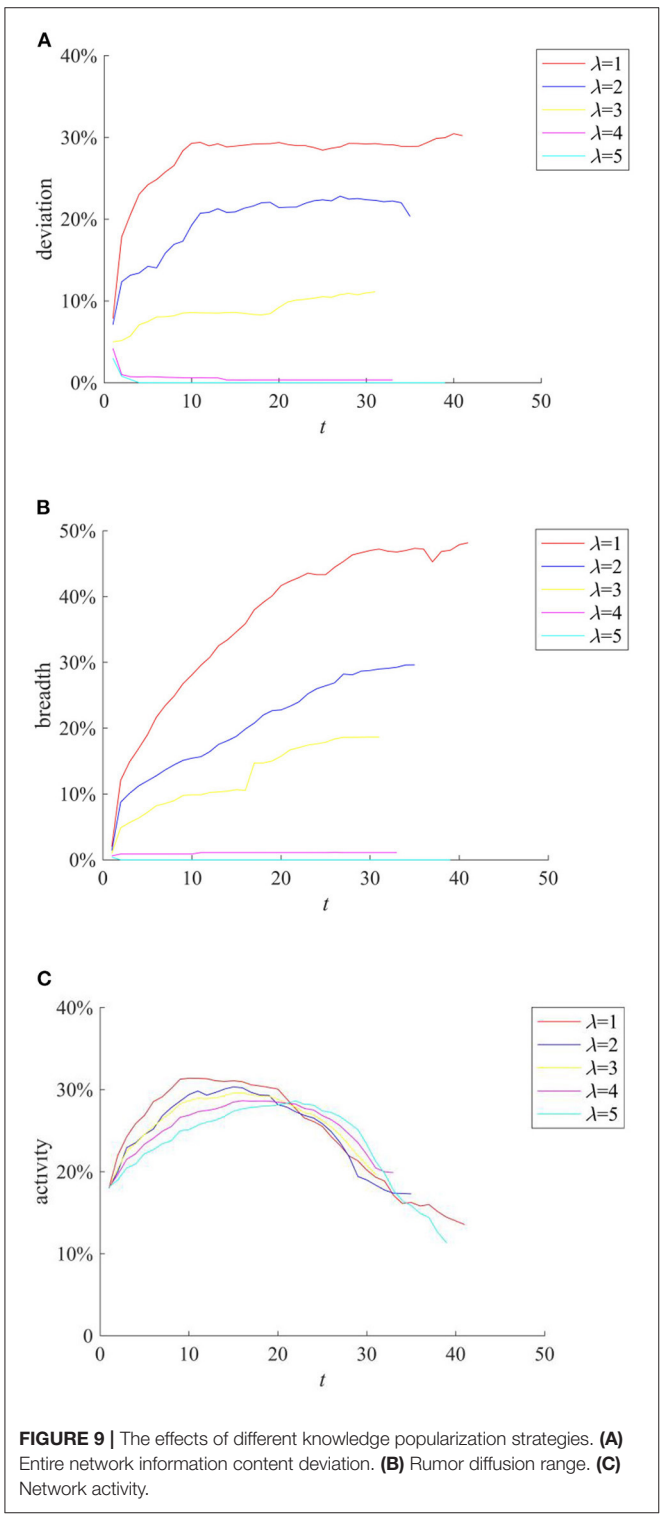

FIGURE 9 | The effects of different knowledge popularization strategies. **(A)** Entire network information content deviation. **(B)** Rumor diffusion range. **(C)** Network activity.

(2) Punishment and restriction strategy

Punishment and restriction strategy refers to the establishment of online code of conduct and punishment mechanism before the occurrence of public opinion incidents to restrict the individual behavior and rumor diffusion. Here we compare the rumor diffusion when the government punishment is 0.1, 0.3, 0.5, 0.7, and 0.9. The results are shown in **Figure 10**.

It can be seen from **Figures 10A–C** that as the punishment p increases, the entire network information content deviation range, the rumor diffusion, and the network activity decrease accordingly. In addition, when $p = 0.1$, the information content deviation has decreased, but it is close to the situation when there is no punitive measures. When p is equal to 0.5, 0.7, and 0.9, respectively, although the information content deviation and the rumor diffusion range are very low, the network activity is insufficient. In contrast, when $p = 0.3$, while avoiding low network activity, the entire network information content deviation and the rumor diffusion range are well-controlled.

(3) Analysis of combined proactive strategies

After analyzing the above two proactive strategies separately, this section analyzes the different combined effects of the two strategies. Here, set p equal to 0.1, 0.3, 0.5, 0.7, 0.9, and λ equal to 1,2 3, 4, and then combine p and λ with different values to form different strategy combinations, and compare the effects of different strategy combinations at $t = 1$, 15, 30, and 45. The results are shown in **Figures 11–13**.

It can be seen from **Figures 11–13** that with the increase of p and λ, the entire network information content deviation, the rumor diffusion range, and the network activity are continuously reduced. In addition, when λ is fixed, with the increase of p, the information content deviation, network activity and the rumor diffusion will be significantly reduced. When p is fixed, with the increase of λ, the decrease in network activity will be smaller, and the rumor diffusion range will be slightly reduced. Although the information content deviation of the entire network is greatly reduced, the rate of decrease is relatively slow. It can be seen that the rumor control effect of the punishment and restriction strategy is better than that of the knowledge popularization one, but its restraining influence on the

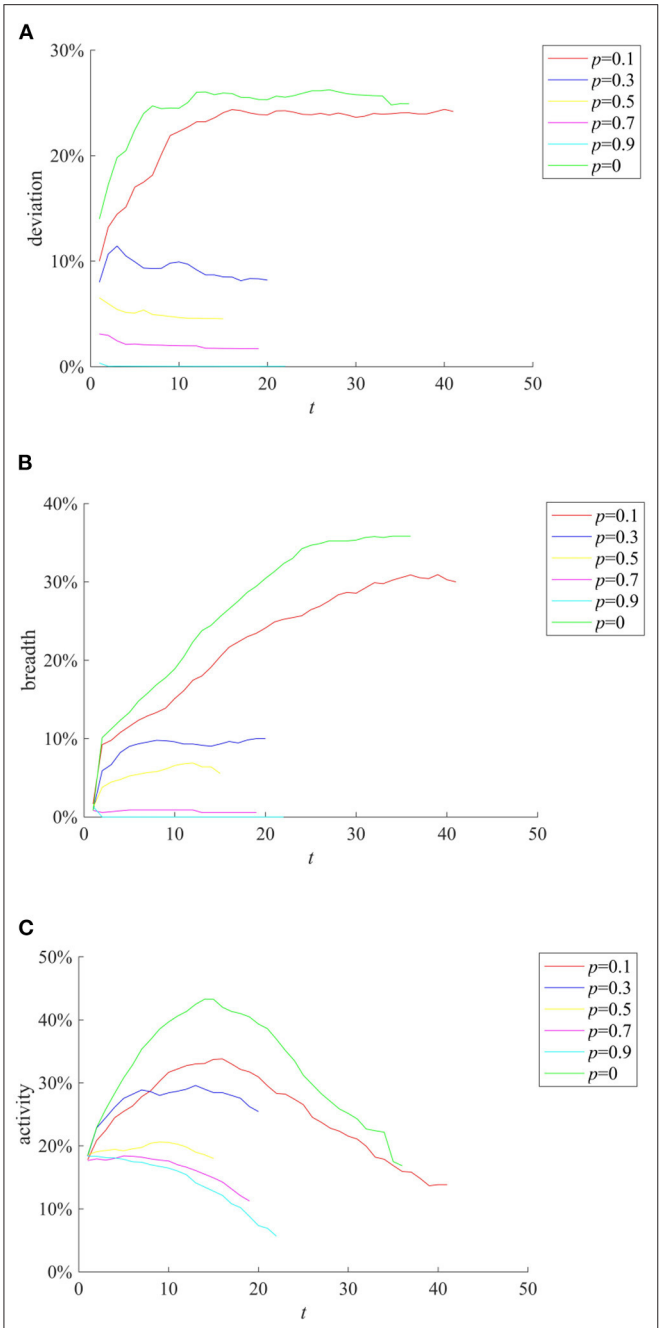

FIGURE 10 | The effects of different punishment and restriction strategies. **(A)** Entire network information content deviation. **(B)** Rumor diffusion range. **(C)** Network activity.

network activity is also far greater than that of the knowledge popularization strategy.

Reactive Strategy

After the rumors are formed, it is necessary to adopt a strategy of dispelling the rumors to suppress the rumor diffusion. In general, the basic idea of the rumor rejection strategy is as

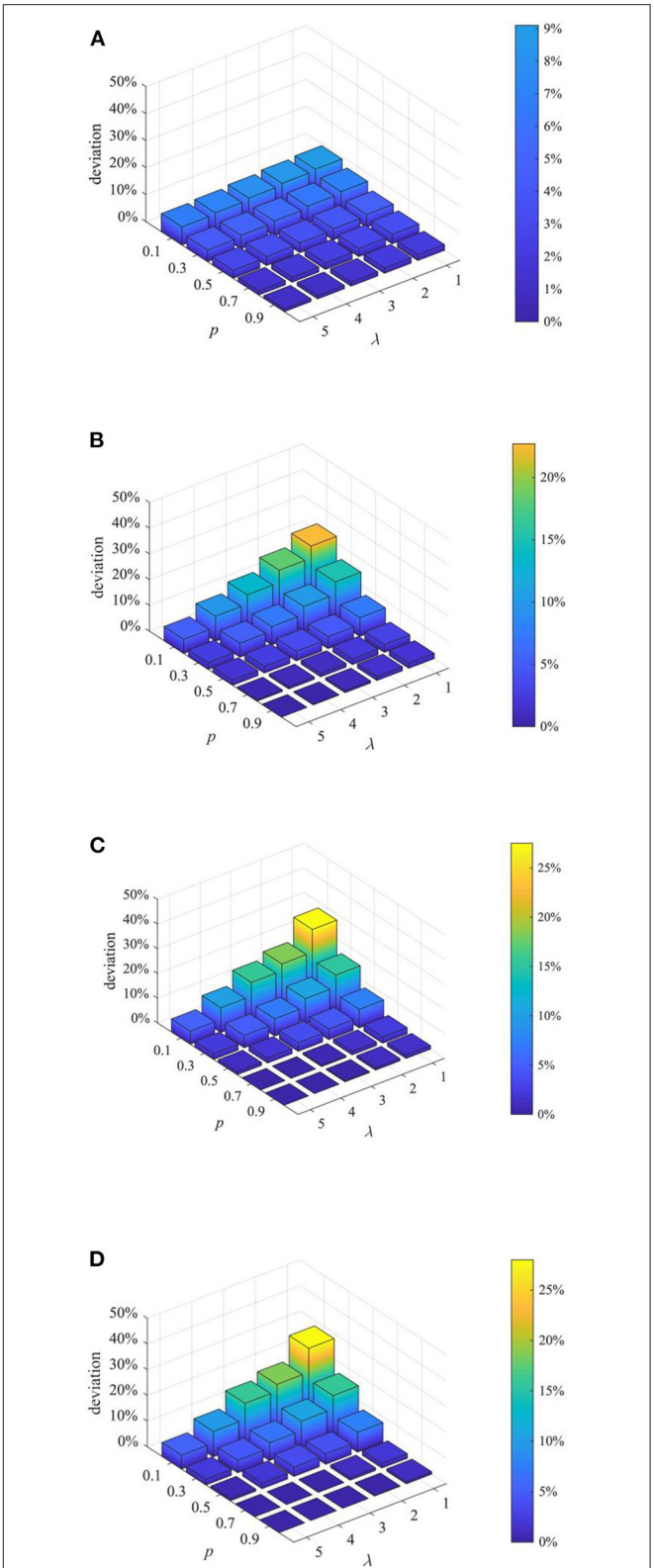

FIGURE 11 | The entire network information content deviation under different strategy combinations. **(A)** $t = 1$. **(B)** $t = 15$. **(C)** $t = 30$. **(D)** $t = 45$.

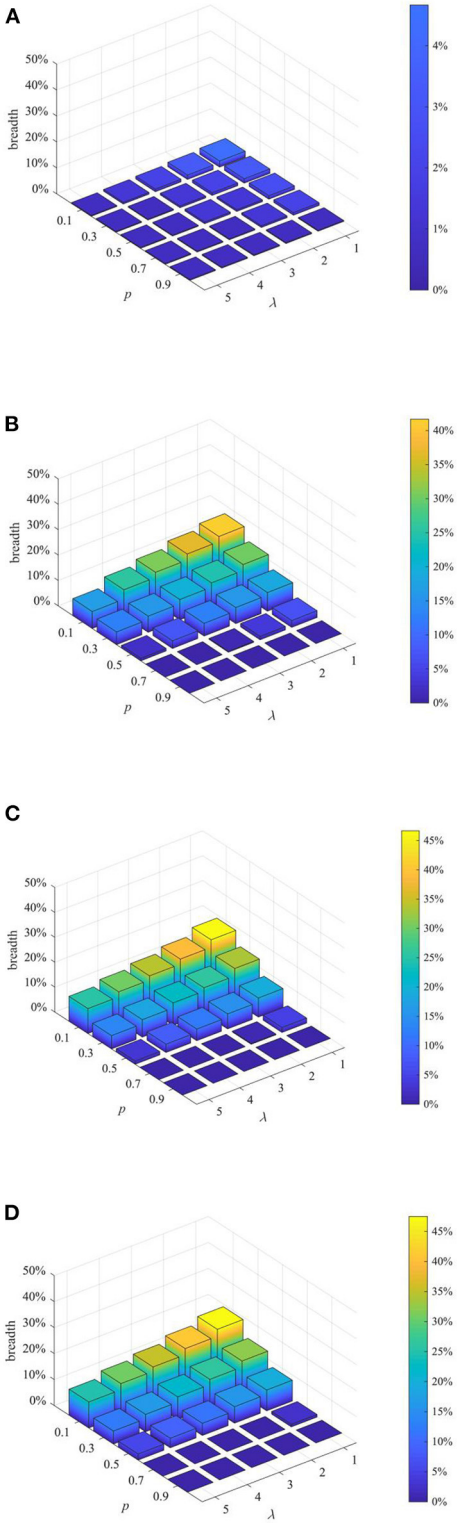

FIGURE 12 | Rumor diffusion range under different strategy combinations. **(A)** $t = 1$. **(B)** $t = 15$. **(C)** $t = 30$. **(D)** $t = 45$.

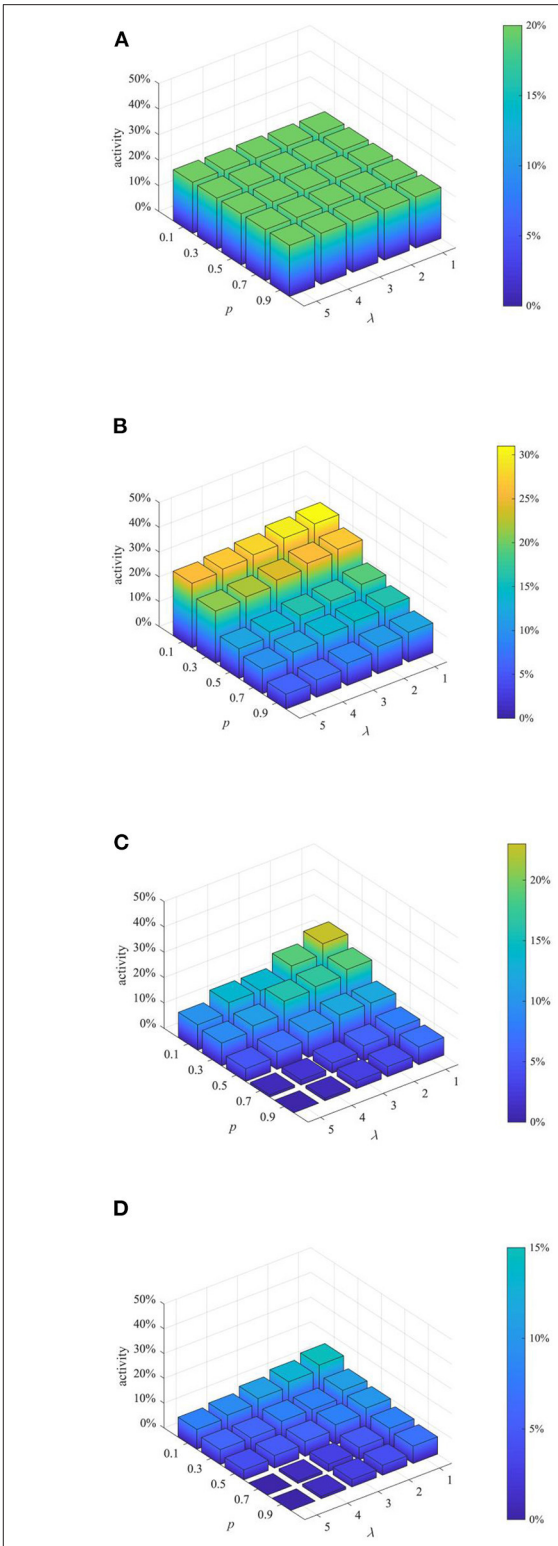

FIGURE 13 | Network activity under different strategy combinations. **(A)** $t = 1$. **(B)** $t = 15$. **(C)** $t = 30$. **(D)** $t = 45$.

follows: when the rumors diffuse to a certain extent, a certain number of nodes are randomly selected as the rumor-refuting individuals, which will diffuse real information to other nodes at a certain frequency, and finally achieve the effect of suppressing the rumors.

Here, we first compare the influence of the time moment on the effect of rumor refuting strategy. **Figure 14** compares the implementation effects of selecting the same number of network nodes as rumor-refuting individuals when the rumors diffusion range reaches 3, 6, 9, 12, and 15%, and disseminating rumors at the same frequency.

It can be seen from **Figure 14** that there are significant differences between the entire network information content deviation and the rumor diffusion range under the rumor refuting strategy. After adopting rumor-refuting strategy, the entire network information content deviation and the rumor diffusion range immediately changed from a rapid rise to a rapid decline. It can be seen from **Figures 14A–C** that when the rumor diffusion range reaches 3 or 6%, the rumor refuting strategy can quickly reduce the influence of rumors in a short period of time, purify relevant network information content, and finally make the rumors almost disappear. Although adopting a strategy to refute rumors when the scale of rumor diffusion range reaches 9, 12, and 15% can also greatly reduce the impact of rumors, as the time moment of the strategy is postponed, the rumors have formed a certain scale and the difficulty of refuting rumors has increased. The final effect of the strategy gradually deteriorated. In addition, the adoption of rumor refuting strategy has greatly increased network activity, and has caused a new round of useful discussions on public opinion events. To sum up, after a public opinion incident occurs, the government should adopt a rumor-refuting strategy as soon as possible to minimize the impact of rumors.

In addition, during the implementation of the rumor-refuting strategy, the time interval of rumor-refuting (the time interval between two adjacent rumor-refuting behaviors) and the number of individuals that refute the rumors (the individuals that refute the rumors point to other individuals who diffuse the true information content) will affect the ultimate effect of the rumor-refuting strategy. **Figure 15** compares the implementation effects of selecting 10, 20, 30, 40, and 50 network nodes as individuals to dispel rumors when the rumor diffusion reaches 10%. **Figure 16** compares the implementation effect of selecting the same number of network nodes as the rumor-refuting individuals and diffusing the rumor-refuting information at intervals of 1, 2, 3, 4, and 5 when the rumor diffusion reaches 10%.

It can be seen from **Figures 15A,B** that with the increase of the number of rumor-refuting individuals, the scale of entire network information content deviation and rumor diffusion range has dropped significantly. In addition, it can be seen from **Figures 16A,B** that the shorter the time interval of refuting rumors, the more effective the rumor-refuting strategy will be. Moreover, from **Figures 15C**, **16C**, it can be seen that the increase in the number of rumor-refuting individuals and the expansion of the time interval for rumor-refuting have significantly improved network activity.

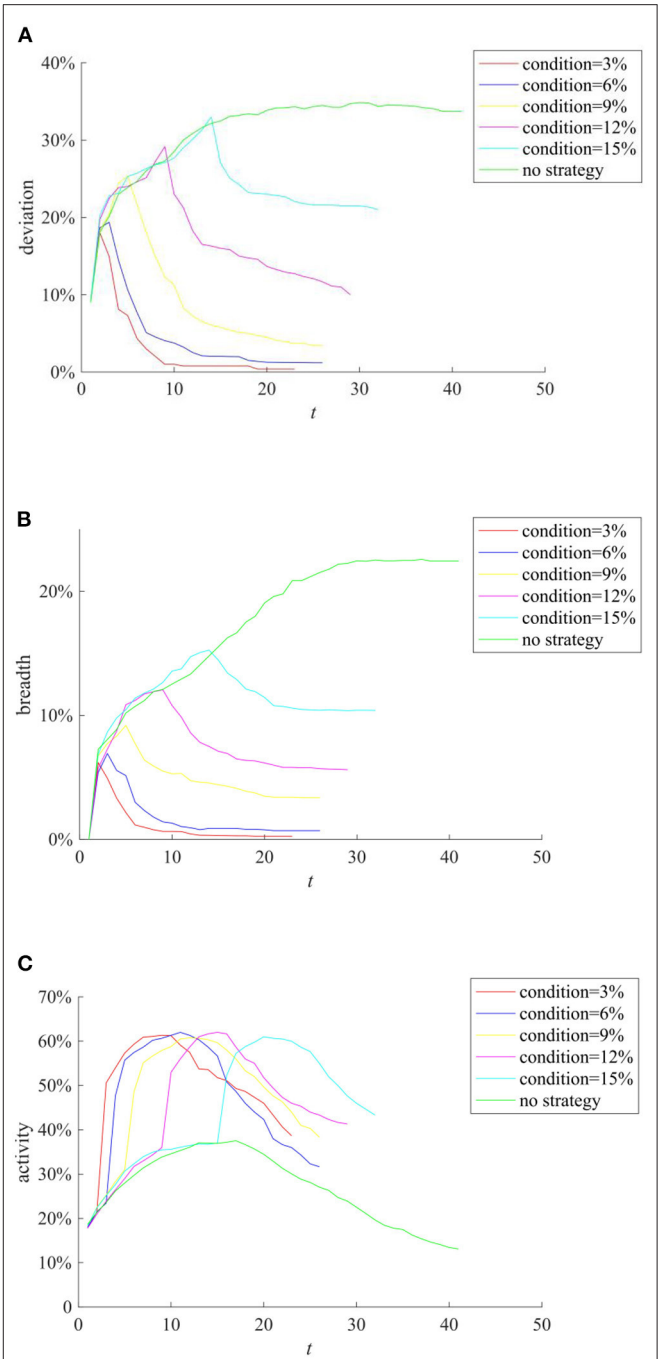

FIGURE 14 | The influence of the time moment on the effect of rumor refuting strategy. **(A)** Entire network information content deviation. **(B)** Rumor diffusion range. **(C)** Network activity.

Furthermore, considering the urgency and necessity of rumor control, it is necessary to find out the most critical factors in the process of refuting rumors. Based on this, a combined analysis of the number of rumor-refuting individuals and the time interval of rumor-refuting is conducted. Here, the numbers of rumor-refuting individuals are 10, 20, 30, 40, 50, and the time intervals

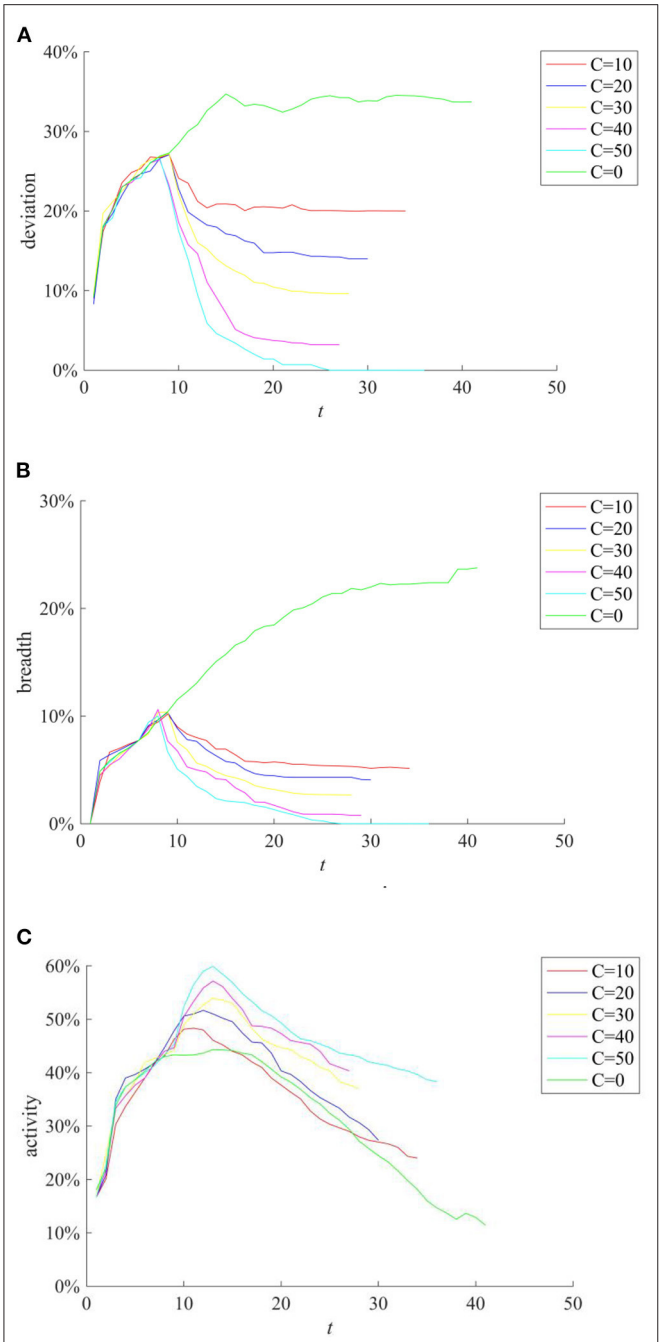

FIGURE 15 | The effect of rumor-refuting strategies based on different rumor-refuting individuals. **(A)** Information content deviation. **(B)** Rumor diffusion range. **(C)** Network activity.

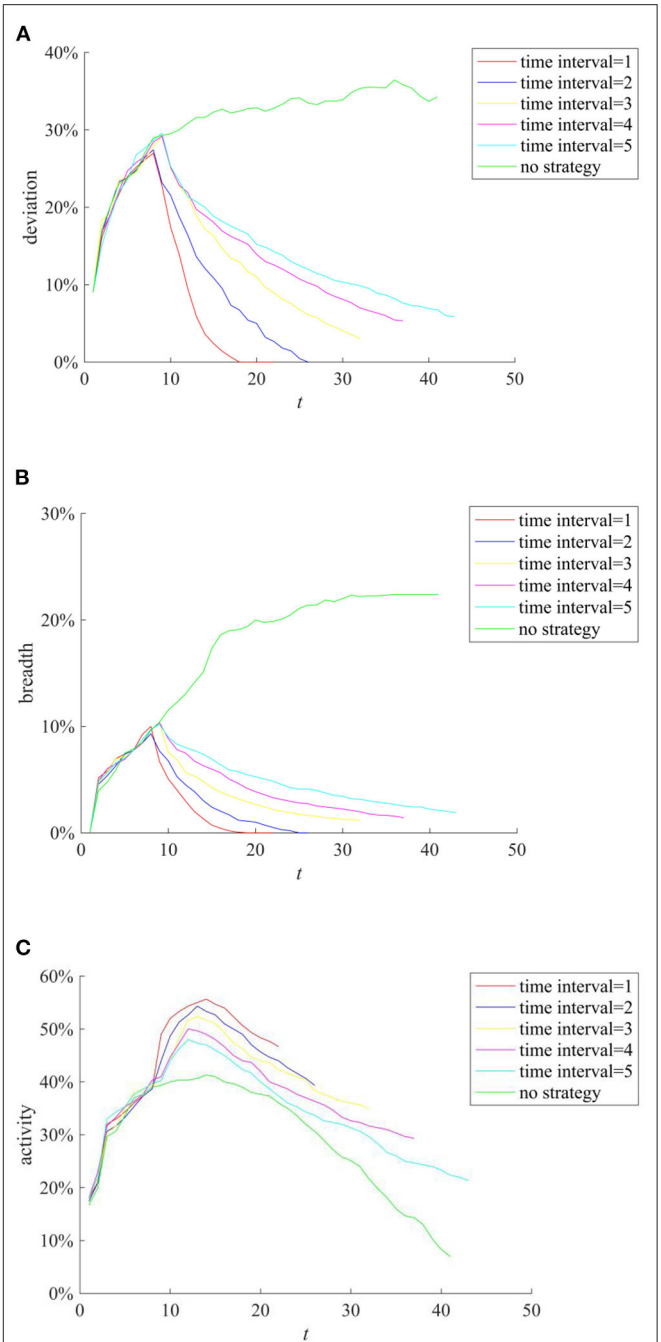

FIGURE 16 | The effect of rumor-refuting strategies based on different rumor time refuting interval. **(A)** Entire network information content deviation. **(B)** Rumor diffusion range. **(C)** Network activity.

of rumor-refuting are 1, 2, 3, 4, 5, and then combine in pairs to form 25 different strategies. The implementation effects of the combination at $t = 1$, 15, 30, and 45 are compared, and the results are shown in **Figures 17–19**.

As can be seen from **Figures 17–19**, when the time interval of rumor-refuting is fixed, as the number of refuting rumor individuals increases, the entire network information content deviation decreases rapidly, the rumor diffusion range is significantly reduced, and the network activity increases significantly. On the other hand, when the number of refuting rumors remains the same as the time changes, the reduction of the time

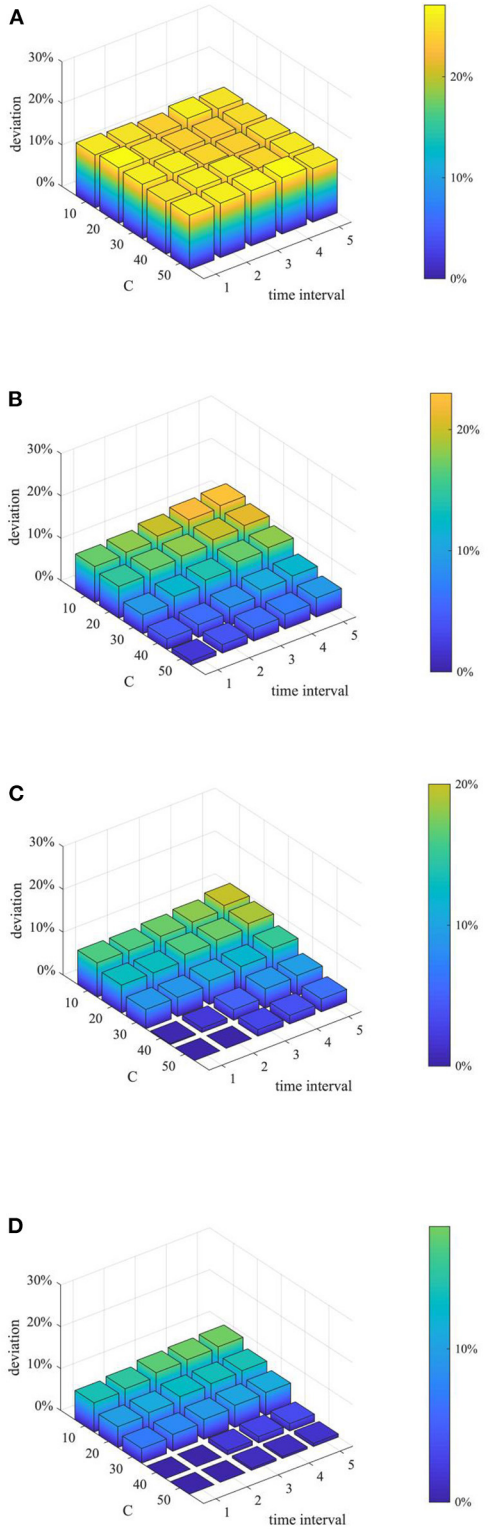

FIGURE 17 | Entire network information content deviation based on different combination. **(A)** $t = 10$. **(B)** $t = 20$. **(C)** $t = 30$. **(D)** $t = 40$.

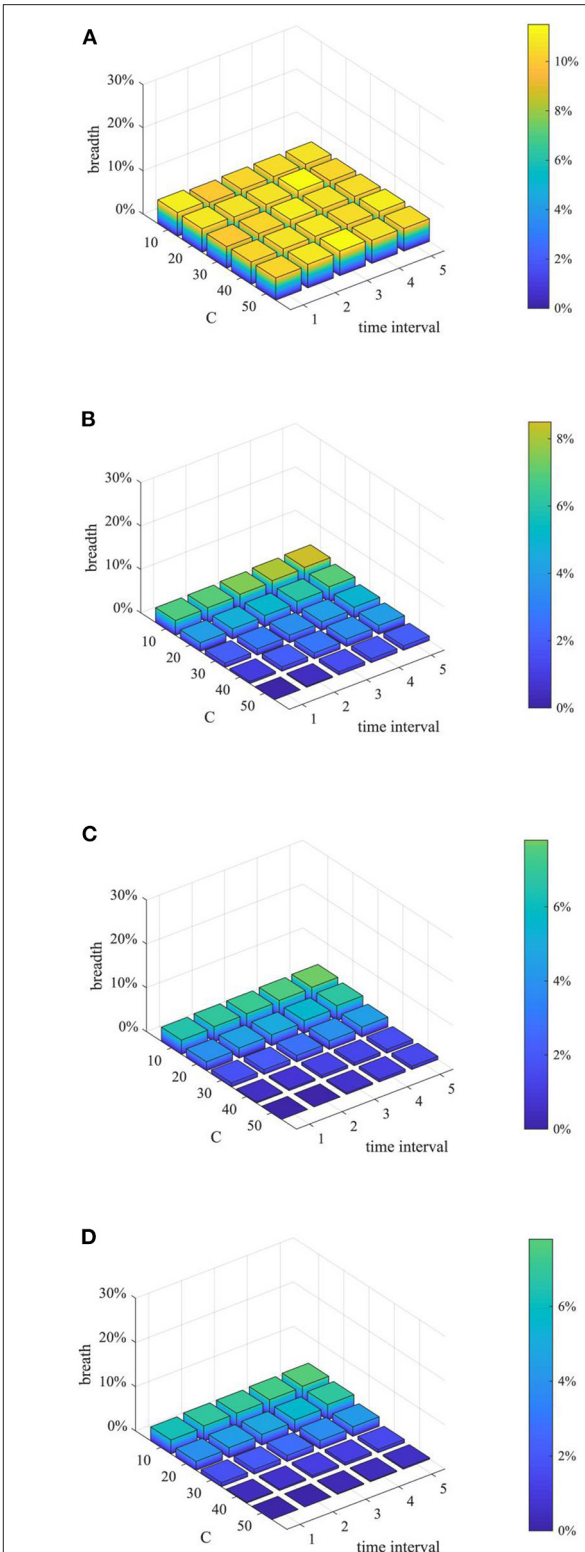

FIGURE 18 | Rumor diffusion range based on different combination. **(A)** $t = 10$. **(B)** $t = 20$. **(C)** $t = 30$. **(D)** $t = 40$.

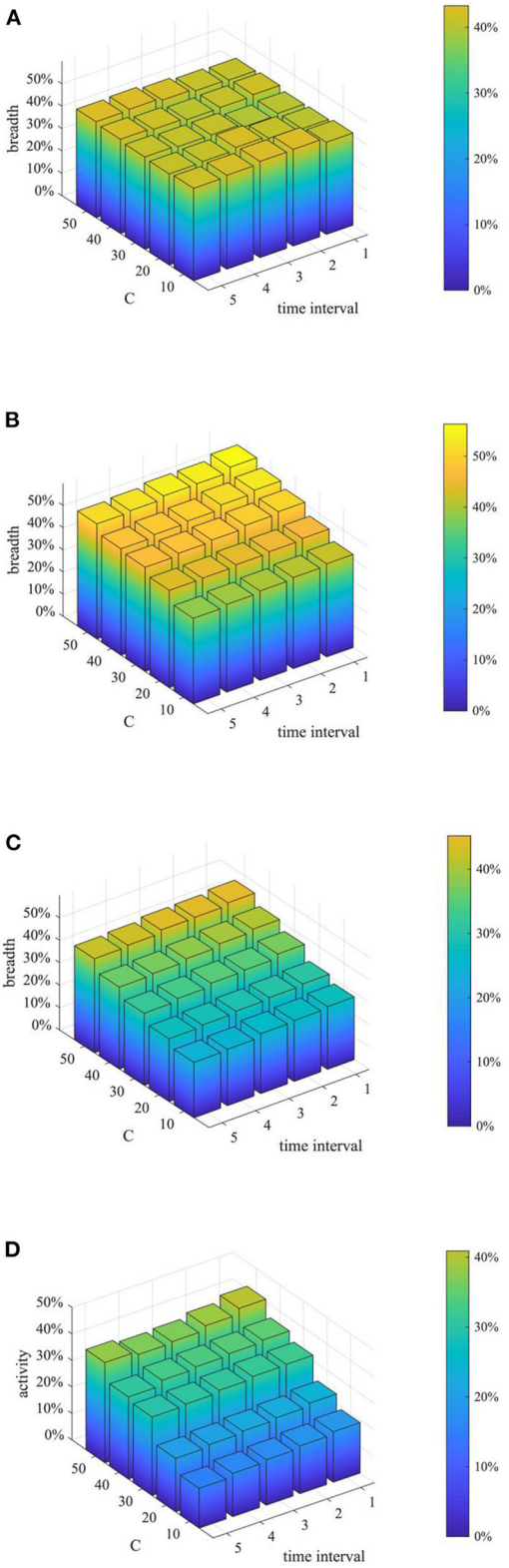

FIGURE 19 | Network activity based on different combination. **(A)** $t = 10$. **(B)** $t = 20$. **(C)** $t = 30$. **(D)** $t = 40$.

interval of rumor-refuting can speed up the decline of entire network information content deviation and rumor diffusion range, but it has little effect on the final information content deviation and the rumor diffusion range, and it has no obvious effect on the improvement of network activity. This shows that when adopting a rumor-refuting strategy, more attention should be paid to the number of rumor-refuting individuals.

Analysis and Discussion

In this section, some simulation results and findings are given firstly. Subsequently, the limitations of our study are also discussed.

Simulation Results and Findings

Through simulation experiments, the influence of model parameters on the evolution of rumors is analyzed, and the following conclusions are obtained:

(1) The higher average value of the interest correlation between individuals and the event that caused the rumors represents the lower deviation between the network information content and the real information content, and the larger scale of the rumor diffusion range.

(2) Increasing the average network degree of nodes can expand the influence of rumors, but its influence on the rumor diffusion range has a peak.

(3) The higher average trust threshold of all individuals in the network represents the lower entire network information content deviation, and the smaller scale of the rumor diffusion range.

In addition, according to the implementation effects of different rumor control strategies, the following conclusions are obtained:

(1) Before a public opinion incident occurs, adopting a knowledge popularization strategy and a punishment and restriction strategy for the public can effectively minimize the information content deviation and the rumor diffusion range after the public opinion incident occurs. Besides, the rumor control effect of the punishment and restriction strategy is better than that of the knowledge popularization strategy, but its inhibitory effect on network activity is far greater than that of the knowledge popularization strategy.

(2) After a public opinion incident occurs, the government should adopt a strategy of refuting rumors as soon as possible to minimize the impact of rumors. Moreover, when adopting a rumor-refuting strategy, more attention should be paid to the number of rumor-refuting individuals.

Limitations

In this study, there are still some shortcomings in simulation analysis as follows: the BA network constructed in the simulation analysis does not consider the growth of nodes in the diffusion of sudden hot events at the initial moment. Therefore, the network structure needs to be further optimized in the follow-up.

EMPIRICAL ANALYSIS

This section selects "Imported Food Safety Issue during the COVID-19 Pandemic" (hereinafter referred to as "Imported Food Safety") as an example to verify the effectiveness of the SEIR-OM model.

After the outbreak of COVID-19, in order to prevent the import of the virus from abroad, General Administration of Customs People's Republic of China (GACC) has strengthened the testing of imported food. In June 2020, the COVID-19 was detected on the surface of the imported salmon cutting board at the Xinfadi Seafood Wholesale Market in Beijing, which quickly caused panic among Chinese residents, leading to intense discussions on imported food safety issue. Since then, GACC has repeatedly detected positive samples of COVID-19 virus nucleic acid on the outer packaging of imported food or on the surface of the food, which has caused heated discussions on many occasions.

In order to analyze the diffusion of rumors in the "Imported Food Safety" incident, two incidents with a large amount of topic discussion are selected as the analysis objects based on the topic search on the Weibo platform. Firstly, the COVID-19 was detected on the surface of the imported salmon cutting board at the Xinfadi Seafood Wholesale Market in Beijing. Discussions on this incident were mainly focused on June 12, 2020–June 22, 2020. Secondly, the COVID-19 was detected on the surface of the imported cherry in Wuxi, Jiangsu Province in China on January 22, 2021. Discussions on this incident mainly focused on January 22, 2021–February 8, 2021. There are discussions about these two incidents on the Internet, such as "Eating imported food will get COVID-19" and "Eating imported food is dangerous." In response to these remarks, many Chinese official media continues to quote expert opinions to clarify and refute rumors.

The relevant Weibo data is crawled through python, and a total of 41,351 data is obtained. The schematic diagram of the data is shown in **Figure 20**.

After obtaining and preprocessing the data, it is necessary to identify the content of the comments. Here, we first establish two corpus sets including rumors and truths related to "Imported Food Safety," and then use JIEBA (32) word segmentation algorithm and word2vec algorithm to calculate the similarity between the review content and the two corpora sets one by one. If the similarities between the review content and the two corpora sets are low, it will be recognized as an irrelevant comment. If a comment is more similar to the rumor text set than the real content corpus set, it will be recognized as a rumor, otherwise it will be recognized as a truth. After removing irrelevant comments, there are 20,502 pieces of data in the two cases. Although the amount of data here is limited, according to the six-degree separation theory (33) in interpersonal relationships, the statistical results of these user data can reflect the universality of Weibo user behavior to a large extent. The data information involved in the case analysis is shown in **Table 4**.

In order to verify the validity of the SEIR-OM model constructed in this article, the existing evolutionary game model is introduced and compared with SEIR-OM model. We make the following three assumptions about the evolutionary game model: (1) The individuals in the network are divided into uninformed individuals and informed individuals according to their states. (2) Only the game behavior between informed individuals and uninformed individuals is discussed in the model. (3) There are malicious individuals in the network. The rules of game gains in the model are set as follows: (1) When an informed individual chooses to diffuse information, if the uninformed individual receives the information, the informed individual will get a higher gain a ($a > 1$), and the uninformed individual's gain is equal to 1; (2) When an informed individual chooses to diffuse information, if the uninformed individual does not receive the information, the informed individual's gain will be damaged and become -1, and uninformed individual's gain will be 0; (3) When the informed individual does not diffuse information, the gains of both parties are 0; (4) If malicious individuals successfully diffuse rumors to uninformed individuals, they can obtain excess gains; (5) Individuals who diffuse rumors will be punished by the government, and their gains will decrease by g. According to the above rules, the gain matrix of the evolutionary game model is shown in **Table 5**.

In addition, the individual strategy update rules in the evolutionary game model are as follows: individual i randomly selects a neighbor individual j, and imitates the strategy of j with a certain probability, as shown in formula (19).

$$W(S_i \leftarrow S_j) = \frac{P_j - P_i}{\max(k_i, k_j)H} \tag{19}$$

where S_i and S_j are the strategies adopted by i and j; P_i and P_j are the cumulative gains of i and j after the game; k_i, k_j are the degrees of i and j; H is the maximum difference in the game gains between individuals.

Since the evolutionary game model cannot reflect the difference of information content, i.e., it cannot calculate the deviation degree of information content, the comparison content of different models only includes the rumor diffusion range and network activity. In order to make the simulation environment closer to the real situation of the two incidents, some parameters in the two models will be adjusted according to the data of different time periods: (1) According to the Pareto principle (34), 20% of the people in society will produce 80% impact, and malicious individuals play a major role in the rumor diffusion. Therefore, the proportion of malicious individuals in the two models is set to be 20%; (2) The Chinese government takes a strong management measures on online rumors, so the intensity of government punishment p is set to 0.5 in the SEIR-OM model, and the government punishment g in the evolutionary game model is set to 0.5, too; (3) On June 14, 2020, when the deviation of the online information content of the "COVID-19 was detected on the surface of the imported salmon cutting board in Beijing" reached more than 10%, the official media refuted the rumor for the first time. Therefore, in response to this incident, when the entire network information content deviation is >10%, the government adopts a rumor-refuting strategy. Similarly, for the "the COVID-19 was detected on the surface of the imported cherry in Wuxi, Jiangsu," it is set that when the

	A	B	C	D	E	F	G	H
1	Topic	Publisher ID	Publish Time	Weibo	Commenter	Comment Time	Comment	Like
2	#COVID-19 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	MT-04	2020/6/13 0:17	Ever since the outbreak of the epidemic abroad, I have had this concern. I think imported foods are inedible and may become infected if we eat them	141
3	#COVID-20 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Laster00	2020/6/13 0:17	This is terrible! If we eat these salmon, we'll get infected	46
4	#COVID-21 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	imyourjoy_	2020/6/13 0:17	Please don't eat the salmon! The salmon has the novel coronavirus	39
5	#COVID-22 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Vancoshan	2020/6/13 0:18	Other imported foods also need to be tested. It's too dangerous	32
6	#COVID-23 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Serendipity_	2020/6/13 0:18	I think all the imported things carry virus	32
7	#COVID-24 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	leerphen	2020/6/13 0:18	Fortunately,I was poor,poor saved my life,ha ha ha	19
8	#COVID-25 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	LouieJung	2020/6/14 0:18	It's terrible. The salmon carry the virus	11
9	#COVID-26 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Jmile-H	2020/6/15 0:18	I don't think it's a problem even if I eat it	1
10	#COVID-27 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Katerince	2020/6/13 0:19	I immediately threw away the salmon that I hadn't eaten at home	4
11	#COVID-28 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Tsooo	2020/6/13 0:19	Is salmon the source of infection?	1
12	#COVID-29 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	bololo_	2020/6/13 0:19	It seems that salmon can't be eaten recently.	1
13	#COVID-30 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	cwd918123	2020/6/13 0:19	I just had salmon yesterday. I'm so worried.	1
14	#COVID-31 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	momery668	2020/6/13 0:19	Imported food can spread virus! The government should take measures quickly!	3
15	#COVID-32 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	yipinshutang	2020/6/14 0:20	Fortunately, I don't like salmon.	2
16	#COVID-33 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	kappafiy	2020/6/15 0:20	The government should stop importing seafood	12
17	#COVID-34 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	201912220v	2020/6/16 0:20	Please don't eat imported seafood. It's too dangerous.	1
18	#COVID-35 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Luuvy	2020/6/17 0:20	Is there any problem with other seafood?	2

FIGURE 20 | Schematic diagram of the data.

TABLE 4 | Relevant data.

Case	Time	Comments	Users	Duration
COVID-19 was detected on the surface of the imported salmon cutting board at the Xinfadi Seafood Wholesale Market in Beijing	From June 12, 2020 to June 22, 2020	8,275	5,601	10 days
COVID-19 was detected on the surface of the imported cherry in Wuxi	From January 22, 2021 to February 8, 2021	12,227	9,134	9 days

TABLE 5 | Gain matrix of the evolutionary game model.

				Uninformed individual	
				Receive	Not receive
Informed individual	General individual	Truth	Diffuse	(a,1)	(−1,0)
			Not diffuse	(0,0)	(0,0)
		Rumor	Diffuse	(a-g,1)	(−1,0)
			Not diffuse	(0,0)	(0,0)
	Malicious individual	Truth	Diffuse	(a,1)	(−1,0)
			Not diffuse	(0,0)	(0,0)
		Rumor	diffuse	(a+d-g,1)	(−1,0)
			Not diffuse	(0,0)	(0,0)

entire network information content deviation is >3%, the government adopts a rumor-refuting strategy; (4) As experts keep responding to the doubts about the safety of imported foods, the public's knowledge reserves going up. Therefore, it is assumed that the individual knowledge reserves in the SEIR-OM model obey the Poisson distribution with the mean λ is 1 and 3 in the two time periods, respectively; (5) In these two incidents, the government's time interval for rumor-refuting was 5 and 2 days, respectively. Therefore, the government's rumor-refuting time interval in the SEIR-OM model was set to 5 and 2 days, respectively; (6) Because the difficulty of diffusing rumors after the government has refuted the rumors will increase, the excess gain of malicious individuals diffusing false information will decreases. As a result, the excess gain of malicious individuals diffusing false information in the evolutionary game model before the government refuting the rumors is assumed to be 0.7, and becomes 0.3 after the government refuting the rumors. In addition, the other parameters of the SEIR-OM model are set as: $\mu_b = 0.9$, $\mu_c = 0.5$. The other parameters in the evolutionary game model are set as: $a = 0.12$, $H = 5$. It is assumed that the number of simulation network nodes of the two models is both 500.

SEIR-OM model and the evolutionary game model are used to simulate the changes in the rumor diffusion in the two incidents here, and the two change curves are compared with the actual curves shown in **Figure 21**. In this figure, the blue line represents the rumor diffusion curve simulated by the SEIR-OM model, the red line represents rumor diffusion curve simulated by the evolutionary game model, and the yellow line represents the rumor diffusion curve based on real data. In addition, the Root Mean Square Error (RMSE) is used

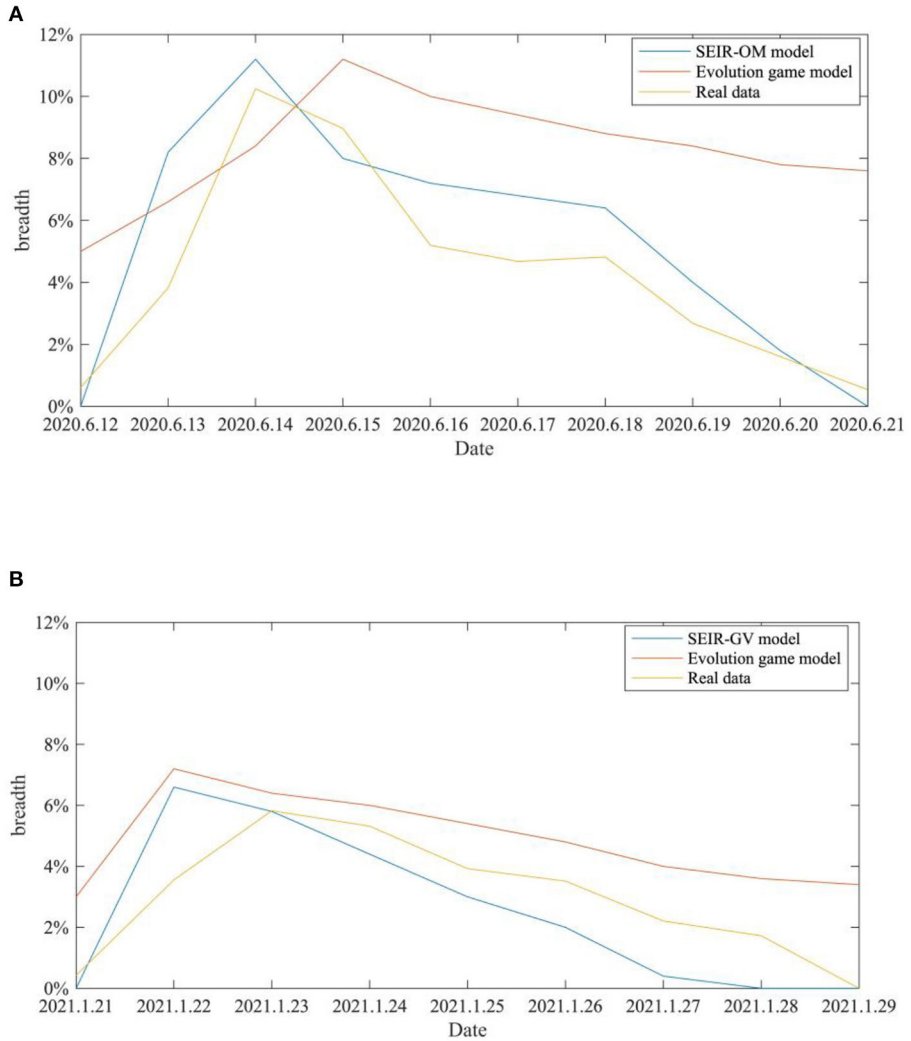

FIGURE 21 | Comparison of the rumor diffusion ranges in two events. **(A)** COVID-19 was detected on the surface of the imported salmon cutting board in Beijing. **(B)** COVID-19 was detected on the surface of the imported cherry in Wuxi.

here to accurately reflect the error between the variation curve of the rumor diffusion range simulated by SEIR-OM model, evolutionary game model and the real data. The results are shown in **Table 6**.

It can be seen from **Figures 21A,B** that the rumor diffusion curves simulated by the two models both show an upward trend before the government adopts the intervention strategy, and the curve simulated by the SEIR-OM model rises faster. After the government adopts the intervention strategy, the curve simulated by the evolutionary game model shows a gentle downward trend. In contrast, the curve simulated by the SEIR-OM model declines faster, and the change trend is similar to the real curve. According to **Table 6**, in terms of rumor diffusion, the error of the simulation results of the SEIR-OM model in the two incidents is smaller than that of the evolutionary game model, and the simulated curve is closer to the real curve, indicating that the SEIR-OM model is closer to real situation in terms of rumor diffusion.

TABLE 6 | RMSE of rumor diffusion scale.

Event / Model	COVID-19 was detected on the surface of the imported salmon cutting board in Beijing	COVID-19 was detected on the surface of the imported cherry in Wuxi
SEIR-OM model	0.0186	0.0435
evolutionary game model	0.0467	0.0683

In addition, the SEIR-OM model and the evolutionary game model are used to simulate the changes in network activity in the two events and compare with the real

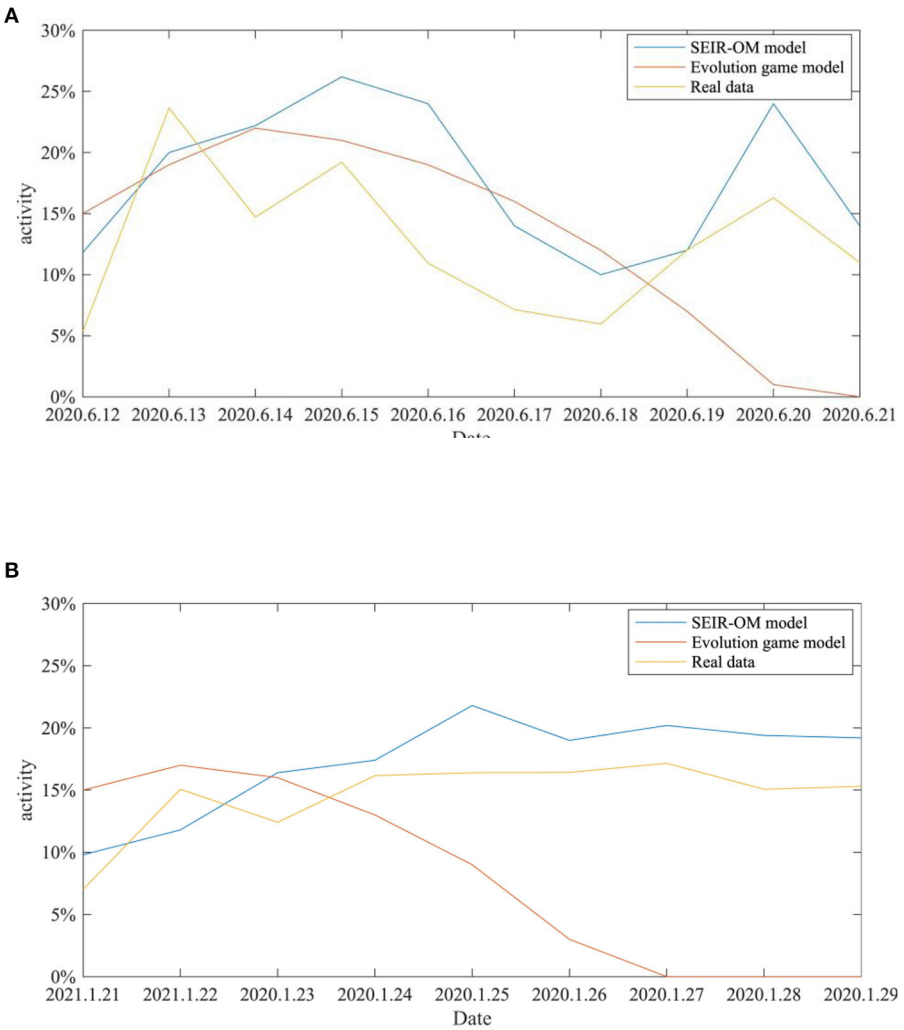

FIGURE 22 | Comparison of the network activities in the two incidents. **(A)** COVID-19 was detected on the surface of the imported salmon cutting board in Beijing. **(B)** COVID-19 was detected on the surface of the imported cherry in Wuxi.

situation shown in **Figure 22**. In this figure, the blue line represents the network activity curve simulated by the SEIR-OM model, the red line represents the network activity curve simulated by the evolutionary game model, and the yellow line represents the network activity curve drawn based on real data. In addition, the RMSE is used here to accurately reflect the error between the network activity curve simulated by the SEIR-OM model and the evolutionary game model and the real curve. The results are shown in **Table 7**.

TABLE 7 | RMSE of network activity.

Event / Model	COVID-19 was detected on the surface of the imported salmon cutting board in Beijing	COVID-19 was detected on the surface of the imported cherry in Wuxi
SEIR-OM model	0.068	0.0647
Evolutionary game model	0.0855	0.0832

From **Figures 22A,B**, it can be seen that the network activity curves of the two events simulated by the evolutionary game model both show an upward trend, and then a downward trend after the government adopts an intervention strategy, and the rate of decline keeps accelerating. In contrast, due to the different frequency of government refuting rumors, the two curves simulated by the SEIR-OM model have certain differences. The simulated network activity curve for the "COVID-19 was detected on the surface of the imported salmon cutting board in Beijing" event has two peaks, while the simulated network activity for the other incident remained stable at about 20% after the government frequently refuted rumors. After comparing the actual curve,

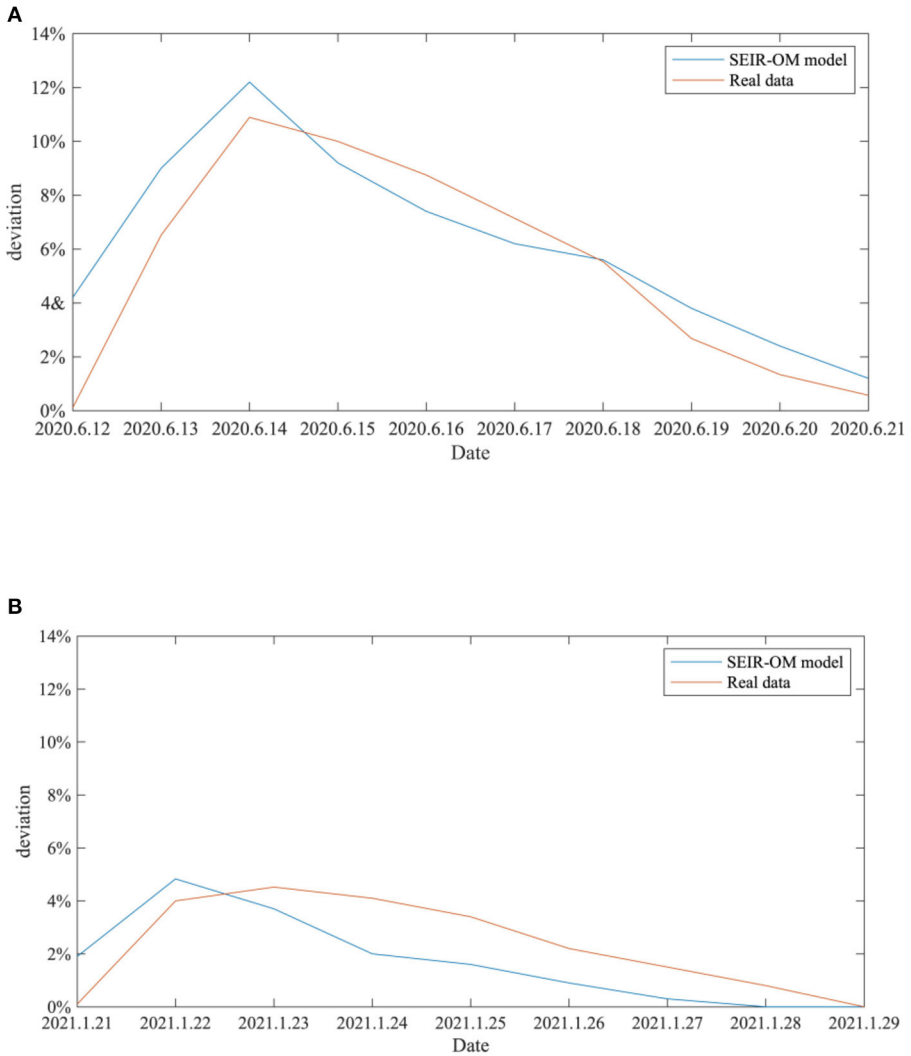

FIGURE 23 | Comparison of entire network information content deviations in two events. **(A)** COVID-19 was detected on the surface of the imported salmon cutting board in Beijing. **(B)** COVID-19 was detected on the surface of the imported cherry in Wuxi.

it is easy to find that the curve simulated by the SEIR-OM model is closer to the actual curve, indicating that the SEIR-OM model is closer to the real situation in terms of network activity.

In addition, in order to reflect the effectiveness of the SEIR-OM model in terms of entire network information content deviation, this curve simulated by the SEIR-OM model is compared with the actual curve, and the result is shown in **Figure 23**. In **Figure 23**, the blue line represents the information content deviation curve simulated by the SEIR-OM model, and the red line represents the information content deviation curve drawn based on real data.

It can be seen from **Figure 23** that in terms of entire network information content deviation, although the curve simulated by the SEIR-OM model is different from the real data curve, the trend of the two is similar. Therefore, it shows that SEIR-OM model performs well in the entire network information content deviation.

CONCLUSIONS

This article integrates individual heterogeneity factors into the SEIR model, and designs an individual state transition mode at first. Subsequently, based on trust theory and information asymmetry theory, it establishes an individual information interaction mode, and constructs an improved SEIR model named SEIR-OM model. Then the diffusion process of rumors and the implementation effects of different rumor control strategies are simulated and analyzed. Finally, the article verifies the rationality and effectiveness of the SEIR-OM model through

the real case from the imported food safety issue during the COVID-19 Pandemic.

However, this article still has the following shortcomings, which need further study:

(1) The BA network constructed in the article only considers the exit of the interconnection among nodes, but does not consider the growth of nodes in the diffusion of sudden hot events at the initial moment. Therefore, the network structure needs to be further optimized in the follow-up.

(2) Rumors in the constructed model are transmitted through random pairwise information interaction between the Internet and the people. In reality, a netizen can send the information to a designated person, or send it in groups to his friends or strangers. Therefore, it is necessary to consider a variety of forms of private information transmission on the Internet, such as group sending, and directional sending.

DATA AVAILABILITY STATEMENT

The data used to support the findings of this study are available from the corresponding author upon request.

AUTHOR CONTRIBUTIONS

TC described the proposed framework and wrote the whole manuscript. JR implemented the simulation experiments. JY collected data. GC revised the manuscript. All authors read and approved the final manuscript.

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Well-Being at Home During Forced Quarantine Amid the COVID-19 Pandemic

Elzbieta Krajewska-Kułak[1], Agnieszka Kułak-Bejda[2], Wojciech Kułak[3], Grzegorz Bejda[4], Cecylia Łukaszuk[1], Napoleon Waszkiewicz[2], Mateusz Cybulski[1], Andrzej Guzowski[1], Joanna Fiłon[1], Paulina Aniśko[5] and Magda Popławska[6]*

[1] Department of Integrated Medical Care, Medical University of Białystok, Białystok, Poland, [2] Department of Psychiatry, Medical University of Białystok, Białystok, Poland, [3] Department of Pediatric Rehabilitation and Center of Early Support for Handicapped Children "Give a Chance", Medical University of Białystok, Białystok, Poland, [4] The School of Medical Science in Białystok, Białystok, Poland, [5] Doctoral School, Medical University of Białystok, Białystok, Poland, [6] Students' Scientific Society, Department of Integrated Medical Care, Medical University of Białystok, Białystok, Poland

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Xenia Gonda, Semmelweis University, Hungary

Reviewed by:
Francesco Chirico, Catholic University of the Sacred Heart, Italy
Anna Vittoria Mattioli, University of Modena and Reggio Emilia, Italy

***Correspondence:**
Agnieszka Kułak-Bejda
agnieszka.kulak.bejda@gmail.com

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Introduction: People recently or currently in forced quarantine or isolation at home have shown high levels of depression and symptoms of generalized anxiety.

Aim of the Study: To assess the impact of the COVID-19 pandemic on certain aspects of people's day-to-day functioning.

Materials and Methods: The study involved using an online diagnostic survey including a proprietary questionnaire, the DASS 21, and the Liebowitz Social Anxiety Scale.

Results: Information about the pandemic in Poland and around the world was systematically obtained by 48.8 and 27.4% of respondents, respectively (N = 1,312). Whereas, 75.6% of respondents declared having knowledge about the number of infected people in Poland, only 28.7% declared having such knowledge about infections worldwide. Most often, respondents had obtained information online (65.9%). According to 45.7% of respondents, infection with COVID-19 is a major threat, and not enough has been done to reduce its spread in Poland (66.7%) or worldwide (56.1%). Respondents considered social distancing (68.3%), quarantining people arriving from abroad (63.4%), and wearing protective masks and/or gloves (60.4%) to be the most effective actions for combatting the pandemic. Most often, in compulsory quarantines, respondents surfed the Internet (48.8%) and experienced a lack of energy or fatigue (40.2%) and anxiety (54.9%). The severity of anxiety (mean = 4.6 points), stress (7.5 points), and depression (7.3 points) were within normal ranges, and the respondents could generally be included in the group showing mildly severe social phobia (57.9 points).

Conclusions: Most respondents considered infection with COVID-19 to be a major threat and feared another quarantine. During quarantine, respondents most often experienced fatigue, a lack of energy, nervousness, anxiety, anger, and sadness. Despite demonstrating anxiety, stress, and depression with severity in the normal range,

respondents showed no statistically significant correlation between severity and age, gender, place of residence, or level of education. Although they also showed mildly severe social phobia, only gender, not age, place of residence, or level of education, showed a statistically significant correlation with its severity.

Keywords: pandemic, COVID-19, quarantine, anxiety, stress, depression

INTRODUCTION

Contemporary recommendations for forced isolation during epidemics follow the centuries-old tradition of protecting people from serious infectious diseases (1). Today, however, awareness of the dire consequences of isolating large numbers of people in quarantine means that such measures are taken only in the most serious of situations. Isolation due to epidemics indeed presents several challenges, including a diminished sense of control that can promote a sense of fear, largely because quarantine and social isolation restrict people's mobility, social interaction, and range of daily activities.

During the current pandemic, to limit the spread of COVID-19 infection worldwide, quarantine strategies have been introduced the world over, including short- and mid-term blockades, curfews, the cancellation of planned social events, the restriction of social gatherings and sport activities, the introduction of travel bans, and airspace and border closures (1–4). However, because most societies have never experienced such restrictions, people have associated the introduction of quarantines with the restriction of freedoms and imprisonment and even treated them as a form of punishment and condemnation. After all, social isolation is a form of quarantine with a recommendation not only to stay at home but also to avoid social contact outside the home, which implies separation from family, friends, and wider social networks, as well as disengagement from social activities (5–7).

Literature on people in quarantine conducted before the COVID-19 pandemic is rather sparse and most often concerns the SARS-CoV-1, MERS, Ebola, and influenza epidemics (8). In response, research on the scale and severity of emotional distress, including symptoms of depression and anxiety, in various countries remains necessary, especially to identify groups at a clinically severe risk of those symptoms. Indeed, staying in forced quarantine or home isolation is associated with several stressors that risk emotional problems, including severe symptoms of depression and/or generalized anxiety, insomnia, burnout syndrome (BOS), and post-traumatic stress disorders (PTSD) (9–14). In addition, people recently or currently in forced quarantine or isolation at home have shown relatively high levels of depression and symptoms of generalized anxiety, as well as a significantly higher severity of suicidal ideation and/or thoughts of self-harm than people not in quarantine (9). Beyond that, Logie and Turan (15) have shown that people diagnosed with COVID-19 may also experience rejection and stigmatization, which may most severely affect individuals who face discrimination daily (e.g., people of low socioeconomic status, refugees, immigrants, and minorities).

According to Chirico et al. (16), lockdown measures effectively curbing COVID-19 related new infections and deaths and overburden on the healthcare system. However, these measures are difficult to be maintained for a long time for economic reasons. This has an important implication because COVID-19 may exacerbate social inequities. Indeed, countries, where economic inequity is prevalent may be disadvantaged in the fight against the COVID-19 pandemic because the lockdown measures are unsustainable for a longer time.

Brooks et al. (9) have confirmed that people in quarantine or isolation at home may also sense a serious threat to their health and life, as well as worry that they may infect other people. Quarantine and isolation at home may also be associated with boredom, frustration due to the lack of personal freedom, and a sense of separation from the rest of the world, including loved ones. In addition, people in quarantine depend on the help of others to meet their basic needs, even in acquiring food, and awareness of such dependence can generate strong negative emotions that may increase if appropriate support from others is not received (9). Moreover, similarly to Logie and Turan (15), Brooks et al. (9) emphasized that people in quarantine or isolation may experience stigmatization and rejection from their immediate social environments, further intensifying their negative emotions.

In the study reported here, we decided to assess how the COVID-19 pandemic has influenced certain aspects of people's day-to-day functioning.

MATERIALS AND METHODS

All respondents were Poles. Inclusion criteria: age over 18 years, staying at forced 14 days quarantine amid the COVID-19 pandemic. Exclusion criteria: age below 18 years, no staying at forced 14 days quarantine amid the COVID-19 pandemic.

The study group comprised ($N = 1{,}312$) people, including 88.4% women and 11.6% men. The respondents' age ranged from 19 to 79 years; the mean age was 57.3 ± 19.1 years. Eighty-four percent of the respondents lived in the city, and 16% in the countryside. Forty-seven percent of the respondents had higher education, secondary - 37.2%, bachelor's - 6.7, and 8.5% during their studies, and 0.6% of people had primary education.

The study used a diagnostic survey using an Internet platform over 26 days (from January 3, 2021, to June 28, 2021). The questionnaire was anonymous. All data obtained during the study will be generalized and used in a scientific study. Participation in the study was voluntary. Entering the survey was

tantamount to agreeing to fill in the survey. Respondents had the right to resign at any time, regardless of the survey stage.

The questionnaire consisted of an in-house questionnaire, the Depression Anxiety and stress scale (DASS-21), and The Leibowitz Social Anxiety Scale—LSAS.

The Bioethics Committee approved the study of the Medical University of Bialystok-APK.002.33.2021.

Lovibond and Lovibond developed the used version of the Depression Anxiety and stress scale (DASS-21) scale in 1995 (16–18);[1] it consisted of 21 items into three groups of 7 articles each: depression, anxiety, and stress. The tool applies to the last seven days. The respondents assessed individual items on a scale from 0 to 3 points, where 0- never, 1 - sometimes, 2 - often, and 3 - always / almost always. In case of depression - normal this 0–9 point, mild this 10–13 point, moderate this 14–20 point, severe this 21–27, extremely severe this 28+. In case of anxiety - normal this 0–7 point, mild this 8–9 point, moderate this 10–14 point, severe this 15–19, extremely severe this 20+. In case of stress - normal this 0–14 point, mild this 15–18 point, moderate this 19–25 point, severe this 26–33, extremely severe this 34+.

The Leibowitz Social Anxiety Scale (LSAS) allowed assessing the severity of social phobia symptoms and their impact on everyday functioning (19). The respondent must read the descriptions of all the situations presented in the table. Each case answers two questions: "how much anxiety or fear do I experience in this situation" and "how much am I willing to avoid such a situation." For fear/drug questions - 0 is none, 1 - mild, 2 - moderate, 3 - strong; in the case of avoiding situations - 0 - never, 1- sometimes, 2- often, and 3- always (16). The scoring scale: 0–29 No social anxiety; 30–49 Mild social anxiety; 50–64 Moderate social anxiety; 65–79 Marked social anxiety; 80–94 Severe social anxiety; >95 Very severe social anxiety.

Statistical Analysis

All statistical analysis was performed with Statistica PL 13.0. Results are presented as mean values ± SD. Non-parametric Wilcoxon test was applied to compare differences. Spearman's analysis was used to measure the dependence age, sex, place residence, education, and the severity of depression, stress, and anxiety symptoms in the DASS 21 scale. The critical level for all tests of significance was $p < 0.05$.

RESULTS

Information on the COVID-19 pandemic in Poland was systematically interested in 48.8% of respondents. In turn, 27.4% of respondents were systematically interested in information about the world's coronavirus pandemic.

Almost 76% of respondents declared knowing the number of infected people in Poland, only 28.7% declared having such knowledge about infections worldwide. Most often, respondents had obtained information online (65.9%).

According to 45.7% of respondents, infection with COVID-19 is a major threat, and not enough has been done to reduce its spread in Poland (66.7%) or worldwide (56.1%).

Fifty percent of respondents reported the probability of infection with the COVID-19.

Almost 67% of Poland respondents reported that not enough had been done to protect the country against the coronavirus epidemic. Nearly 20% of respondents expressed the opposite opinion. Respondents considered social distancing (68.3%), quarantining people arriving from abroad (63.4%), and wearing protective masks and/or gloves (60.4%) to be the most effective actions for combatting the pandemic.

Almost a half (48.8%) of respondents preferred Internet surfing (42.7%), mobilizing and trying to do everything to protect themselves from infection, watching movies (39.6%), or reading (33.5%). **Table 1** presents other indications.

The respondents declared that they most often spent between 8 and 12 h in front of the TV. The respondents often felt fatigue (40.2%), nervousness (39.6%), depression (37.2%), irritability (37.2%), or difficulty sleeping (32.9%). Details are presented in **Table 2**.

The quarantine evoked the following various emotions in the respondents: anxiety (54.9%), exhaustion (46.3%), anger (39.6%), and sadness (38.4%).

The severity of anxiety (mean = 4.6 points), stress (7.5 points), and depression (7.3 points) was within normal ranges, and the respondents could generally be included in the group showing mildly severe social phobia (57.9 points). The detailed results are presented in **Table 3**.

No significant relationship between age, sex, place of residence, and education and the severity of depression, stress, and anxiety symptoms in the DASS 21 test was found.

Almost half (45.1%) of the respondents had no social phobia on the LSAS scale. Mild social phobia had 16.5% of respondents, moderate phobia – 17.1%, severe social phobia – 9.9%, and very severe – 11.4% of respondents. The results are presented in **Table 4**.

No significant relationship between the severity of social phobia and age, place of residence, and education was found. The only positive correlation between the severity of social phobia and gender ($R = 0.16904$; $p = 0.0304$) was found.

DISCUSSION

Due to the COVID-19 pandemic, sudden and severe restrictions influenced many people's mental health in the world. The quarantined people had to deal with stressful living conditions without prior preparation (20, 21). Each crisis or disaster pandemic carries a high risk of diminished wellbeing and individuals and societies as a whole (5, 22–24).

Hamer et Baran (22) conducted a study four times in 2020 (in March, April, at the turn of May and June, and in December) the CAWI (Computer-Assisted Web Interview) on a sample of 1,098 people aged 18 and over. They demonstrated a relatively high level of nervousness at the beginning of the pandemic in April. At the turn of May and June, a significant decrease was the lowest

[1]Available online at: https://www.healthfocuspsychology.com.au/tools/dass-21/ (cited 29.12.2021).

TABLE 1 | Methods of the behavior of respondents in a situation of forced quarantine*.

Behavior of respondents	Very often	Often	Rarely	No
Asking for advice and help from other people what to do in order not to get infected	2.4%	12.2%	36.6%	48.8%
Mobilizing and trying to do everything to protect yourself from infection	36.0%	42.7%	11.0%	10.4%
Reaching for alcohol, cigarettes, other psychoactive substances so as not to think about it	1.2%	7.3%	20.7%	70.7%
Consoling myself with the thought that it could be even worse, and for now, I am healthy	11.6%	48.2%	20.1%	20.1%
Giving up, not knowing what to do, not knowing what would happen - so I did nothing	4.9%	7.9%	23.2%	64%
Taking sedatives so as not to think about it	0.6%	3.0%	12.2%	84.1%
Praying for help from God	10.4%	23.2%	22%	44.5%
Watching movies	18.3%	39.6%	25%	17.1%
Reading	21.3%	33,5%	28.7%	16.5%
Cleaning	10.4%	29.9%	42.1%	17.7%
Watching TV	13.4%	29,9%	27.4%	29.3%
Internet surfing	33.5%	48.8%	13.4%	4.3%
Learning	15.2%	31.7%	28.7%	24.4%
Writing a thesis / doctoral / other scientific thesis	9.8%	7.9%	13.4%	68,9%
Taking care of the various distractions and moods	25.6%	47.6%	17.1%	9.8%

Possibility of multiple answers.

TABLE 2 | Complaints occurring in respondents during their stay in forced quarantine.

Complaints	Very often	Often	Rarely	No
Headaches	11.6%	20.7%	33.5%	34.1%
Stomach pain	2.4%	8.5%	39.0%	50.0%
Dizziness	6.1%	9.8%	28.0%	56.1%
Difficulty falling asleep	23.2%	32.9%	17.1%	26.8%
Nervousness	19.5%	39.6%	26.8%	14.0%
Depression	26.2%	37.2%	25.0%	11.6%
Fatigue	28.0%	40.2%	21.3%	10.4%
Irritation	18.9%	37.2%	31.1%	12.8%

compared to the remaining months, then increased again to the level from April in December.

In a study from China (24), most respondents spent 20–24 h a day (84.7%) at home. In a study by Huang and Zhao (21), in a group of 603 randomly selected respondents, 264 people spent more than 3 h each day tracking information about the virus and the epidemic.

Information about the pandemic in Poland and around the world was systematically obtained by 48.8 and 27.4% of respondents, respectively ($N = 328$). The respondents most often obtained information about the pandemic from the Internet (65.9%) and television (22%).

The COVID-19 pandemic is a potent stressor affecting the functioning of many countries and aggravates social stress (9).

According to 40.9% of respondents, COVID-19 is a grave threat to Poles' lives in the present study. The probability of developing the coronavirus was most often determined by fifty percent of the respondents.

In the literature (25–34) quarantine may reveal mental health problems in people who did not before. Symptoms of post-traumatic stress and emotional exhaustion are also described.

The scientific publications show that in about 33% of people in isolation, their mental wellbeing worsened, and the severity of these symptoms was individual.

The pandemic clinical picture's most typical and common feature is an acute stress disorder. According to Heitzman (34), it is a prolonged anxiety reaction and the inability to break away from trauma's constant experience.

In a study from India, 12.5% of respondents reported sleep problems and, 37.8% had thoughts related to the possibility of COVID-19 infection. Furthermore, over 80% of respondents felt the need for mental support from the health care system (3).

The respondents reported mainly fatigue, nervousness, depression, and irritability in the current study.

Our results are similar to Pierce et al. (35) in the United Kingdom. The prevalence of clinically significant mental distress levels in the population increased from 18.9% in 2018–2019 to 27.3% in April 2020, 1 month after the UK economy closed. The increases were most significant among people aged 18–34, women living with young preschool children, and working before the epidemic.

TABLE 3 | Assessment of the respondents with the DASS 21 test.

Answer	Never	Sometimes	Often	Always
Stress				
I found it hard to wind down	17.1%	45.7%	1.8%	35.4%
I tended to over-react to situations	23.2%)	39.0%	6.1%	31.7%
I felt that I was using a lot of nervous energy	33.5%	34.1%	6.1%	26.2%
I found myself getting agitated	28.0%	48.8%	3.7%	19.5%
I found it difficult to relax	18.9%	47.6%	5.5%	28.0%
I was intolerant of anything that kept me from getting on with what I was doing	36.0%	39.6%	4.9%	19.5%
I felt that I was rather touchy	34.8%	46.3%	5.5%	13.4%
Mean 7.5 ± 2.5 points				
Anxiety				
I was aware of dryness of my mouth	46.3%	36.0%	3.0%	14.6%
I experienced breathing difficulty(eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	56.7%	29.9%	1.8%	11.6%
I experienced trembling (e.g., in the hands)	67.7%	23.2%	3.0%	6.1%
I was worried about situations in which I might panic and make a fool of myself	45.7%	33.5%	4.9%	15.9%
I felt I was close to panic	58.5%	27.4%	3.7%	10.4%
I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	50.6%	36.0%	3.7%	9.8%
I felt scared without any good reason	43.3%	38.4%	3.7%	14.6%
Mean 4.6.± 1.5 points				
Depression				
I could not seem to experience any positive feeling at all	25.0%	45.7%	1.2%	28.0%
I found difficulty to work up	14.6%	40.9%	10.4%	34.1%
I felt that I had nothing to look forward to	45.1%	29.9%	7.3%	17.7%
I felt down-hearted and blue	10.4%	43.3%	11.0%	35.4%
I was unable to become enthusiastic about anything	28.7%	51.2%	4.9%	15.2%
I felt I was not worth much as a person	43.9%	32.9%	5.5%	17.7%
I felt that life was meaningless	54.3%	25.0%	4.3%	6.5%
Mean 7.3 ± 2.4 points				

In China, the impact of quarantine on the mental state, level of anxiety, depression, and stress during the initial stage of the COVID-19 outbreak in a group of 1,210 people was assessed by Wang et al. (36). More than half (53.8%) of respondents rated the psychological impact of the COVID-19 pandemic on wellbeing as moderate or severe; 16.5% of respondents had severe depression, and 28.8% had severe anxiety symptoms. Women and students had higher levels of stress, anxiety, and depression. Lower levels of stress, anxiety, and depression positively correlated with accurate health information about the COVID-19 epidemic.

In a large study group of 52,730 respondents from 36 provinces of China, Qiu et al. (37) evaluated the impact of stress amid COVID-19. Moderate stress was found in 29% of respondents, while 5% had severe stress intensity. Women had more severe stress than men. Furthermore, the subjects aged 18–30 and over 60 and higher education levels had greater stress intensity.

Another Chinese study of 600 general population during national quarantine (25) demonstrated that women had 3.01 times higher risk of anxiety than men. Respondents over 40 years of age had a lower risk of anxiety than people under 40. The risk of depression depended on the level of education.

Similar findings were reported (29) in a 603 randomly selected respondents study. Generalized anxiety had 34% of participants, and depressive disorders - in 18.1%-were more often observed respondents 35 years of age.

In an online survey from India, Roy et al. (3) assessed the level of anxiety and level of knowledge about the course of COVID-19 using. More than 80% of surveyed had a high level of anxiety. On the other hand, most of the respondents had a moderate level of knowledge about COVID-19 and a high level of knowledge about prevention.

In the current study, the severity of anxiety, stress, and depression was within normal ranges, and the respondents could be included in the group showing mildly severe social phobia (57.9 points). In addition, most respondents considered quarantine of people coming from abroad (63.4%), and cancellation of all mass events (59.1%) as the most effective actions in the fight against the spread of the coronavirus in Poland. Also, the respondents indicated keeping a safe distance between people in public space (68.3%), protective masks and gloves when leaving the house (60.4%), frequent washing of hands with soap (59.8%), the use of special disinfectants (57.3%) and avoiding public transport (43.3%).

TABLE 4 | Assessment of social anxiety in respondents using the Leibowitz scale.

Questions	How much you experience anxiety or fear in this situation?				How willing you are to avoid this situation?			
	None	Mild	Moderate	Severe	Never	Occasionally	Often	Usually
Using a telephone in public	42.1%	35.4%	7.1%	5.5%	24.4%	36.0%	29.3%	10.4%
Participating in small groups	65.9%	25.6%	8.5%	0	54.3%	32.3%	11.0%	2.4%
Eating in public places	51.2%	29.3%	11.0%	8.5%	47.0%	28.0%	15.9%	9.1%
Drinking with others in public places.	55.5%	25.0%	11.6%	7.9%	42.7%	28.0%	14.6%	14.6%
Talking to people in authority	20.1%	35.4%	32.9%	11.6%	27.4%	37.8%	25.0%	9.8%
Acting, performing or giving a talk in front of an audience	12.8%	23.2%	32.9%	31.1%	17.7%	28.0%	30.5%	23.8%
Going to a party	42.7%	31.7%	16.5%	9.1%	39.0%	36.0%	14.0%	11.0%
Working while being observed	16.5%	39.0%	30.5%	14.0%	25.0%	37.8%	25.6%	11.6%
Writing while being observed	28.0%	40.9%	20.1%	11.0%	29.9%	39.6%	20.1%	10.4%
Calling someone you don't know very well	20.7%	38.4%	25.6%	15.2%	22.0%	40.2%	23.8%	14.0%
Talking with people you don't know very well	25.6%	36.6%	26.2%	11.6%	26.2%	44.5%	20.1%	9.1%
Meeting strangers	27.4%	39.0%	22.6%	11.0%	38.4%	34.1%	18.3%	9.1%
Urinating in a public bathroom	33.5%	26.8%	21.3%	18.3%	34.1%	22.6%	20.7%	22.6%
Entering a room when others are already seated	29.3%	36.6%	21.3%	12.8%	36.0%	32.9%	20.7%	10.4%
Being the center of attention	26.2%	28.0%	26.2%	19.5%	26.8%	29.9%	25.6%	17.7%
Speaking up at a meeting.	18.3%	25.0%	26.8%	29.9%	18.3%	31.1%	24.4%	26.2%
Taking a test	23.8%	32.9%	32.9%	10.4%	31.7%	38.4%	23.2%	6.7%
Expressing a disagreement or disapproval to people you don't know very well	22.0%	39.6%	30.5%	7.9%	23.8%	35.4%	27.4%	13.4%
Looking at people you don't know very well in the eyes	30.5%	39.0%	20.7%	9.8%	31.7%	36.6%	20.7%	11.0%
Giving a report to a group	15.2%	23.2%	36.0%	25.6%	20.7%	29.9%	28.0%	21.3%
Trying to pick up someone	19.5%	32.3%	28.7%	19.5%	28.0%	26.8%	20.1%	25.0%
Returning goods to a store	25.6%	31.7%	23.2%	19.5%	27.4%	22.6%	20.1%	29.9%
Giving a party	31.7%	36.0%	23.8%	8.5%	36.0%	37.8%	18.3%	7.9%
Resisting a high pressure salesperson	29.3%	36.6%	22.6%	11.5%	28.7%	32.9%	17.1%	21.3%

In the present study, very common ways of behaving in a situation of forced quarantine were surfing the Internet (48.8%), mobilizing and trying to do everything to protect yourself from infection (42.7%), watching movies (39.6%), or reading (33.5%).

Heitzman (34) noted that people who test positive for the coronavirus, who are sick or quarantined, and their families would develop acute stress disorder symptoms (308.3, DSM-5) of the nature of distress.

In some countries, expert guidance was published at the pandemic's start. For example, the Korean Neuropsychiatric Association has published guidelines based on the assumption that quarantine induced by the COVID-19 epidemic may cause severe psychological effects in acute stress disorder, depression, post-traumatic stress disorder (PTSD), insomnia, irritability, and emotional exhaustion. The guidelines mention groups that are particularly vulnerable to the psychological consequences of quarantine. Experts include parents caring for children, young children, people quarantined after contact with COVID-19, doctors dealing with infected patients (38).

A study from Brazil (20), on 1,468 volunteers via an online survey, demonstrated that people who had to work outside live with an older adult have at least one common comorbid disease experienced more significant psychological discomfort and distress during the pandemic. Conversely, children's presence protected the subjects from depression.

It is impossible to compare the data to the norms as there are no standards for measuring quarantine response. Therefore, there is a need to understand the role of behavioral and psychosocial factors in predicting mental health in people in confinement and social isolation. Heitzman (34) notes that not everyone confronted with the pandemic will reveal post-traumatic psychiatric symptoms and will need psychological help and support from others. In the available works on the topics mentioned above, it was emphasized:

- the need for special care for vulnerable groups when planning preventive psychological interventions during the COVID-19 epidemic (37)
- the need to raise awareness of the psychological consequences of this COVID-19 pandemic and to intensify preventive measures to avoid long-term consequences (3)
- the need to support groups such as young people, the elderly, women, and migrants through the healthcare system, improving telemedicine and interventions during quarantine to prevent long-term consequences in the form of mental disorders (36)

- the need to identify the weakest people who may need the most help from health care systems, which seems particularly important as the human resources of psychologists or psychiatrists are limited and should be wisely (based on reliable parameters) used to fight the consequences of the COVID-19 pandemic (20)
- the need for the state to maintain access to assistance in the event of domestic violence, but also to prioritize the availability of childcare (36)
- that obtaining and relying on reliable information about an epidemic may reduce the intensity of the anxiety response, which is expected in the situation (38)
- when planning prophylaxis and interventions, one of at least six groups should be considered—healthcare professionals, people who have direct contact with patients, patients who refuse treatment, and people susceptible to infection (39).

It is well known that women were more likely to suffer from psychological stress than men. Females are more than twice as likely as males to be afflicted by mood disorders (40). This sex disparity indicates a potential role for gonadal hormones in the etiology of anxiety and depressive disorders. Women often experience anxiety, and depression during times of hormonal flux, such as puberty, menopause, perimenstrual and post-partum periods (41). According to Bucciarelli et al. (42), study gender represents a potential modifying factor in cardiovascular disease and depression and COVID-19 short- and long-term outcomes, particularly in cases involving long-term COVID complications. Results from emerging studies indicate that the COVID-19 pandemic affected male and female populations differently. Women seem to experience less severe short-term complications but suffer worse long-term COVID complications, including depression, reduced physical activity, and deteriorating lifestyle habits, all of which may impact cardiovascular risk. Mass-quarantine, self-quarantine, and isolation are associated with depression, anger, and chronic stress. The stressor factors suggested included longer quarantine duration, frustration, boredom, inadequate supplies, inadequate information, financial loss, and stigma (43).

Our current study has some potential limitations. First, the study group was too small to generalize the results to the entire population of people in Poland. Secondly, there was an overrepresentation of women in the studied subgroups. Hence the results should be verified in an equally numerous group of men. Nevertheless, despite these limitations, this study's results may provide a starting point for further research into the problems arising from quarantine.

CONCLUSIONS

1. Most respondents considered infection with COVID-19 to be a significant threat and feared another quarantine.
2. During quarantine, respondents most often experienced fatigue, a lack of energy, nervousness, anxiety, anger, and sadness.
3. Respondents demonstrated anxiety, stress, and depression severity in the normal range.
4. Respondents showed mildly severe social phobia.
5. Due to their frequent occurrence of anxiety disorders and depression, it is worth educating people on recognizing them to seek professional help in time (a psychologist, psychotherapist, or psychiatrist). It is important to disseminate the most important advice and tips of mental health experts during a pandemic among the public. TV and social media channels that fuel a spiral of anxiety and stress should be limited. Information should be sought from reliable sources. We have to try as much as possible to keep the current, personal way of spending time and the rhythm of the day. Do not give up on favorite activities and interests.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Bioethics Committee of the Medical University of Białystok-APK.002.33.2021. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

EK-K and AK-B designed the study and wrote the protocol. EK-K, AK-B, WK, GB, CŁ, NW, MC, AG, JF, PA, and MP data collection. WK undertook the statistical analysis. EK-K, AK-B, and GB wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

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One Year Facing COVID. Systematic Evaluation of Risk Factors Associated With Mental Distress Among Hospital Workers in Italy

Matteo Bonzini[1,2*], *Anna Comotti*[1], *Alice Fattori*[1], *Filippo Cantù*[2], *Elisa Colombo*[3], *Valentina Tombola*[3], *Eralda Myslymi*[2], *Michele Gatti*[2], *Giulia Stucchi*[1], *Carlo Nava*[1], *Lorenzo Bordini*[1], *Luciano Riboldi*[1] *and Paolo Brambilla*[2,3*]

[1] Occupational Medicine Unit, IRCCS Maggiore Policlinico Hospital Foundation, Milan, Italy, [2] School of Medicine, University of Milan, Milan, Italy, [3] Psychiatric Unit, IRCCS Maggiore Policlinico Hospital Foundation, Milan, Italy

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***Correspondence:**
Matteo Bonzini
matteo.bonzini@unimi.it
Paolo Brambilla
paolobrambilla.ter@gmail.com

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Introduction: Italy was the first Western country affected by the COVID-19 pandemic that still constitutes a severe challenge for healthcare workers (HCWs), with a deep impact on their mental health. Several studies confirmed that a considerable proportion of HCW developed adverse psychological impairment (PsI). To focus on preventive and rehabilitation measures, it is fundamental to identify individual and occupational risk factors. We systematically assessed possible PsI among all employees in a large university hospital in Italy, using validated psychometric scales in the context of occupational health surveillance.

Methods: In the period of July 2020 to July 2021, we enrolled 990 HCWs. For each subject, the psychological wellbeing was screened in two steps. The first-level questionnaire collected gender, age, occupational role, personal and occupational COVID-19 exposure, general psychological discomfort (GHQ-12), post-traumatic stress symptoms (IES-R), and anxiety (GAD-7). Workers showing PsI (i.e., test scores above the cutoff in at least one among GHQ-12, IES-R, and GAD-7) have been further investigated by the second-level questionnaire (psycho-diagnostic) composed by PHQ-9, DES-II, and SCL-90 scales. If the second-level showed clinically relevant symptoms, then we offered individual specialist treatment (third level).

Results: Three hundred sixteen workers (32%) presented signs of PsI at the first-level screening questionnaire. Women, nurses, and subjects engaged in the COVID-19 area and with an infected family member showed significantly higher PsI risk. PsI prevalence was strongly associated with the pandemic trend in the region but sensibly decreased after January 2021, when almost all workers received the vaccination. A proportion of subjects with PsI presented clinically relevant symptoms (second-level screening) on PHQ-9 (35%), DES (20%), and SCL-90 (28%). These symptoms were associated neither to direct working experience with patients with COVID-19 nor to COVID-19 experience in the family and seemed not to be influenced by the pandemic waves or workers vaccination.

Conclusions: The evaluation of psychological wellbeing of all hospital workers, directly or indirectly exposed to pandemic consequences, constitutes a unique condition to detect individual, occupational, and non-occupational risk factors for PsI in situations of high stress and/or disasters, as well as variables associated with symptom chronicization.

Keywords: healthcare workers, mental health, risk factors, psychological impairment, COVID-19 vaccine

BACKGROUND AND AIMS

Italy was the first Western country to be affected by the COVID-19 pandemic since February 2020, when the exponential rise of cases required a national lockdown and imposed a rapidly increasing extraordinary amount of work on the healthcare system in terms of critical care and reorganization.

Under such circumstances, healthcare workers (HCWs) experienced heavy workload, physical exhaustion, frustration and helplessness, and fear of infecting themselves and their relatives (1). Thus, besides physical safety, HCWs' mental health was a major concern for authorities (2) and occupational physician. Moreover, studies conducted during previous epidemics [SARS, MERS, and Ebola; (3, 4)] and primary studies conducted in China at the very beginning of the COVID-19 pandemic showed a high prevalence of post-traumatic stress disorder (PTSD), depression, and anxiety disorders among HCWs (5–7). More recently, several studies, including reviews, have been conducted from the very beginning of the COVID-19 pandemic on HCW mental health and confirmed that a considerable proportion of workers developed adverse psychological outcomes during the COVID pandemic (8–12). These studies found that being frontline workers, female gender, younger age, lower job seniority, and nursing profession predicted worsened mental health (13, 14).

Most of these studies are focused on critical care workers and data collected through web-based questionnaires, being able in several cases to collect only a proportion of the workers' data. Thus, results could be partially affected by the self-selection of respondents, and the comparison of mental health outcomes between more exposed workers and other colleagues is limited. Another relevant common limitation is the lack of information of non-occupational important risk factors (such as COVID infection in the family): although HCWs of intensive care units faced a large number of COVID-19 deaths and substantial work-related stress, all healthcare professionals were also exposed to personal grief and family concerns (15). Finally, because the majority of the published studies were conducted during the first phases of the pandemic, results are focused on the early onset symptoms with little evidence on the persistence of symptoms and delayed-onset PTSD, which typically occurs a few months after exposure.

This is why we point out that, even in the current pandemic scenario, it is crucial to evaluate and monitor the mental health of HCWs during different phases and waves of the COVID pandemic (1) to prevent possible mental disorders, (2) to discover work-related and individual risk factors that can exacerbate psychological distress, and (3) to target rehabilitation strategies on more vulnerable people. For these reasons, we designed a prospective study that systematically evaluates the mental wellbeing of all workers employed in a large second-level general hospital in Milan, Italy. They were followed by the occupational physician health surveillance, using a multistep approach to assess psychological workload and symptoms with validated scales. The study covered almost a period of 1 year and has been characterized by two waves of the epidemic as well as a massive and rapid campaign of health workers' vaccination that in our region (Lombardy) occurred in January to February 2021.

METHODS

Study Design

We developed a multi-step process to evaluate workers mental health to encourage participation with a first brief screening and then offering further support to those who need it. To take into account the requirements of both brevity and validity, we adopted extensively used screening instruments for common psychological impairment (PsI) related to COVID-19 pandemic [an extensive description of the methodology adopted for this study was illustrated in a previous report (16)]. We proposed our screening to all workers employed in our hospital.

1. First level: to detect possible PsI with standardized scales during a structured medical-assisted interview in the context of occupational health surveillance;
2. Second level: when first-level scales show PsI, workers are invited to undergo a second-level questionnaire to better assess possible psychological distress;
3. Third level: to offer a specialist evaluation and psychological support and/or psychiatric treatment to workers who show specific symptoms at the second-level questionnaire.

We plan to perform a follow-up re-evaluation on all participants within 12 months from enrollment to evaluate trends in psychological burden, recognize delayed onset of symptoms, and evaluate the efficacy of specialist treatments.

Setting and Participants

The study is conducted jointly by the units of Occupational Medicine and Psychiatry.

From July 2020 onward, all workers have been invited to participate, independently from age, sex, department, and job title. The only two exclusion criteria were being employed after the beginning of the study and the refusal to sign the informed consent; there were no exclusion criteria on pre-existing pathologies, aiming to include the overall and most general pool of the population. An extended informed-consent form has to be signed before the first-level evaluation. Formal

ethical approval was also obtained from the Hospital Ethical Committee in July 2020.

Assessment Measures

First-level evaluation is composed of an occupational physician interview collecting (i) socio-demographic characteristics (age and gender); (ii) occupational data, including information about occupational role (administrative staff, heath assistant, nursing staff, physicians, and others), hospital unit/department, and engagement in COVID-19 area (none, concluded, and still ongoing) with respective intensity (high/low) and length; and (iii) clinical information regarding chronic conditions and habitual medications, specifying which drugs were taken after pandemic began and a psychometric questionnaire.

The questionnaire is collected directly on digital support and consists of the following:

- The General Health Questionnaire (GHQ-12) (17) in the validated Italian version (18, 19) for assessing psychological distress and short-term changes in mental health. We adopted the dichotomous scoring method (0-0-1-1) and a score above or equal to 4 as the cutoff point (20, 21).
- Impact of Event Scale-Revised (IES-r) for assessing post-traumatic stress symptoms (22). A brief description guides subjects to answer the following questions by assessing their subjective responses related to the COVID-19 emergency in the previous 7 days with 22 questions exploring intrusion, avoidance, and hyperarousal symptoms. A total score of 33 on the IES-r yielded a diagnostic sensitivity of 0.91 and specificity of 0.82 (23). The Italian version has also shown optimal psychometric properties and validity (24).
- Generalized Anxiety Disorders (GAD-7) (25) to screen anxiety symptoms. With robust psychometric properties and strong validity, a score of 10 or greater represents a reasonable cutoff point to identify cases of GAD; increasing scores on the GAD-7 are also strongly associated with multiple domains of functional impairment and disability.
- A section collecting individual COVID-19 exposure and COVID-related health concerns/beliefs: to have been positive of COVID-19 and duration of the condition, to have been in quarantine and duration, to have family members that tested positive/were hospitalized/died of COVID-19, personal concern for infecting family members, the experience of social discrimination outside the hospital, changes in family's habits, thoughts about changing job, fear for their own safety, and the experience of moral injury at work.

The second-level questionnaire contains specific scales to further investigate psychopathological symptoms and disorders:

- Symptom Checklist-90-Revised (SCL-90-R) (26) is a self-administered scale for the evaluation of psychiatric symptomatology;
- The Dissociative Experience Scale II (DES II) (27, 28). Dissociative symptoms are frequently found in the aftermath of trauma and occur to some degree in individuals without mental disorders and are thought to be more prevalent in persons with major mental illnesses. The DES II has been developed to offer a means of reliably measuring dissociation in normal and clinical populations;
- Patient Health Questionnaire-9 (PHQ-9) (29). The PHQ-9 is aimed at assessing depression disorder by scoring each of the nine DSM-IV criteria.

A specialist psychiatric feedback of second-level evaluation results is sent to the occupational physician who, if tests are indicative of impairment in psychological functioning, proposes to the worker a specialist consultation in person. That third-level evaluation is comprised of the specialist consultation within 1 week from the second-level evaluation and is followed, according to every single case, by an eventual psychiatric follow-up or psychotherapy. To individuate late signs and to assess individual changes in psychological distress, all subjects repeat tests after no more than 12 months.

Statistical Analysis

Data were collected through an automatic database generated by the REDCap platform (30), which was subsequently analyzed by R software (31). An independent coded dataset accessible only to the PI guarantees data protection linking individual information (i.e., name and surname) with an alphanumeric code.

Statistical analysis was aimed to individuate risk factors for sub-optimal psychological wellbeing and/or impaired psychological function.

In univariate analysis, the relationship between each potential risk factor and outcomes, treated as continuous variables, was preliminarily investigated in terms of mean differences across subgroups through independent samples *t*-test and one-way ANOVA. Comparison in the percentage of subjects with a total score higher than the cutoff for each scale was evaluated through the Chi-square test.

In multivariate analysis, each potential risk factor is included in multiple logistic regression models to explore the relative contributions [in terms of odds ratios (ORs)] of the various risk factors to the dependent variables including potential covariates and confounders. The overall significance of each variable was tested through the likelihood ratio test.

The relationship between personal concerns and feelings about COVID-19, collected through six questions with multiple answers (not at all, little, enough, and very), and first-level outcome variables was graphically explored, and the difference in the distribution was investigated through the Kolmogorov–Smirnov test for discrete variables. To study their effect on first-level scores in terms of risk factors, they have been converted into dichotomous variables (yes = not at all and little; no = enough and very) and put one by one in the multivariate logistic regression model.

The effect of vaccination on psychological scales has been investigated exploring differences between workers enrolled before and after the COVID-19 vaccination campaign, which started in January 2020. To study how the effect of risk factors, in particular of the variables related to COVID-19 exposure, varied after the vaccination, we performed multivariate logistic regression on first-level screening dividing the dataset into two sub-samples ($N = 584$ and $N = 406$, before and

after vaccination campaign, respectively). The significance of the relationship between these variables and vaccination was evaluated including an interaction term in the multivariate logistic regression model on the whole dataset, using a binary variable indicating enrollment before or after the vaccination campaign.

A $p < 0.05$ will be considered statistically significant. ORs are calculated with their relative 95% confidence intervals.

RESULTS

The occupational medicine unit, where workers underwent the periodical health surveillance already prescribed by the current Italian legislation, proposed the study protocol to all workers since July 2020. By July 2021, we had enrolled 990 subjects out of a total population of 1,610. The participation rate was 62%. In detail, 220 (13%) workers did not answer

TABLE 1 | First level screening scales across subgroups: number of enrolled subjects, means, standard deviations and frequencies of scorings above the cutoff at the different first level psychometric scales.

		GHQ-12		IES-R		GAD-7	
	***N* (%)**	**Mean (sd)**	***N* (%) > cutoff**	**Mean (sd)**	***N* (%) > cutoff**	**Mean (sd)**	***N* (%) > cutoff**
Gender							
Male	297 (30%)	2.79 (3.07)	96 (32%)	16.2 (15.3)	46 (16%)	4.58 (4.43)	44 (15%)
Female	693 (70%)	3.27 (3.32)	270 (39%)	20.5 (17.0)	146 (21%)	6.38 (5.30)	161 (23%)
p-value		*0.03**	*0.06****	*<0.001**	*0.05****	*<0.001**	*0.003****
Age group							
20–30	137 (14%)	3.73 (3.54)	62 (45%)	20.6 (16.5)	30 (22%)	6.55 (4.93)	33 (24%)
30–40	276 (28%)	3.21 (3.17)	110 (40%)	19.3 (15.5)	55 (20%)	5.92 (4.84)	56 (20%)
40–50	245 (24.5%)	3.27 (3.43)	90 (37%)	19.9 (18.6)	53 (22%)	6.13 (5.60)	60 (25%)
>50	332 (33.5%)	2.72 (3.02)	104 (31%)	17.9 (16.0)	54 (16%)	5.27 (5.02)	56 (17%)
p-value		*0.01***	*0.02****	*0.35***	*0.32****	*0.06***	*0.17****
Occupational role							
Administrative staff	119 (12%)	2.44 (2.83)	34 (29%)	16.8 (14.3)	14 (12%)	5.32 (4.92)	20 (17%)
Health assistant	63 (6.5%)	2.67 (3.45)	17 (27%)	23.1 (18.2)	15 (24%)	5.98 (5.23)	17 (27%)
Nursing staff	416 (42%)	3.79 (3.52)	188 (45%)	23.0 (18.4)	115 (28%)	6.71 (5.52)	111 (27%)
Physician	233 (23.5%)	2.81 (2.89)	80 (34%)	15.0 (13.6)	27 (12%)	4.96 (4.49)	34 (15%)
Others	159 (16%)	2.55 (2.97)	47 (29%)	15.6 (14.0)	21 (13%)	5.20 (4.68)	23 (14%)
p-value		*<0.001***	*<0.001****	*<0.001***	*<0.001****	*<0.001***	*<0.001****
COVID-19 area working experience							
Never	544 (55%)	2.54 (2.92)	160 (29%)	16.7 (14.3)	72 (13%)	5.27 (4.79)	90 (17%)
Yes†							
Previously	202 (20%)	3.63 (3.47)	86 (43%)	21.5 (17.9)	48 (24%)	6.04 (5.25)	46 (23%)
Currently	244 (25%)	4.01 (3.52)	120 (49%)	23.9 (18.6)	72 (30%)	7.04 (5.49)	69 (28%)
p-value		*<0.001***	*<0.001****	*<0.001***	*<0.001****	*<0.001***	*<0.001****
<4 months	227 (23%)	3.93 (3.54)	107 (47%)	22.7 (18.6)	58 (26%)	6.38 (5.44)	54 (24%)
>4 months	219 (22%)	3.74 (3.45)	99 (45%)	23.1 (18.1)	62 (28%)	6.81 (5.38)	61 (28%)
p-value		*<0.001***	*<0.001****	*<0.001***	*<0.001****	*<0.001***	*<0.001****
Low-intensity area	101 (10%)	3.26 (3.41)	37 (37%)	18.6 (15.2)	19 (19%)	5.70 (4.94)	21 (21%)
High-intensity area	345 (35%)	4.01 (3.51)	169 (49%)	24.1 (19.0)	101 (29%)	6.85 (5.52)	94 (27%)
p-value		*<0.001***	*<0.001****	*<0.001***	*<0.001****	*<0.001***	*<0.001****
Positive nasoph. swab							
Yes	153 (15%)	3.15 (3.40)	55 (36%)	18.9 (16.2)	31 (20%)	5.89 (4.84)	28 (18%)
No	837 (85%)	3.13 (3.23)	311 (37%)	19.3 (16.7)	161 (19%)	5.83 (5.17)	177 (21%)
p-value		*0.93**	*0.83****	*0.83**	*0.85****	*0.87**	*0.48****
Family member positive to COVID-19							
Yes	209 (21%)	3.43 (3.15)	89 (43%)	19.1 (15.6)	44 (21%)	6.04 (4.72)	45 (22%)
No	781 (79%)	3.16 (3.29)	277 (36%)	19.3 (16.9)	148 (19%)	5.79 (5.22)	160 (21%)
p-value		*0.30**	*0.07****	*0.86**	*0.56****	*0.55**	*0.9****

**t-test.*

***One-way ANOVA.*

****Chi-square test.*

†p-values refer to comparisons between subjects with working experiences in COVID-19 area (current/previous, number of days, intensity area) and subjects with no experience in COVID-19 area.

our calls or were unavailable and 400 (25%) refused to participate.

Table 1 summarizes the numbers and main characteristics of enrolled subjects and the results of the first-level questionnaires. The percentage of subjects scoring above the cutoff of the first-level scales widely differed by gender, age, occupational role, and COVID-19 exposure at work and in their own family. No significant differences were found dividing subjects with or without a previous COVID-19 infection (stated by a positive swab). Similar results were found considering average values in each psychometric scale, instead of cutoffs.

Table 2 presents multivariate logistic regression analysis for first-level screening scales. Adjusted OR showed that gender, occupational role, working experience with patients with COVID-19, and having a family member with previous COVID-19 infection were risk factors for PsI. Women had an increased risk of developing anxiety symptoms by around 70% (see GAD-7 scale), being a nurse almost tripled the risk for developing

TABLE 2 | Multivariate logistic regression for f first level screening scales: adjusted OR for scoring above the cut-offs with associated 95% confidence intervals and corresponding LR test *p*-values.

	N (%)	GHQ-12 AdjOR (95% CI)	IES-R AdjOR (95% CI)	GAD-7 AdjOR (95% CI)
Gender				
Male	297 (30%)	1.00	1.00	1.00
Female	693 (70%)	1.37 (1.01, 1.85)	1.44 (0.99, 2.13)	1.72 (1.19, 2.54)
p-value		*0.04*	*0.06*	*0.003*
Age				
>50	332 (33.5%)	1.00	1.00	1.00
20–30	137 (14%)	1.12 (0.72, 1.76)	0.69 (0.39, 1.20)	1.02 (0.59, 1.72)
30–40	276 (28%)	1.05 (0.73, 1.51)	0.79 (0.50, 1.24)	0.96 (0.61, 1.49)
40–50	245 (24.5%)	1.05 (0.73, 1.46)	1.06 (0.68, 1.66)	1.35 (0.88, 2.07)
p-value		*0.03*	*0.31*	*0.17*
Occupational role				
Physician	233 (23.5%)	1.00	1.00	1.00
Administrative staff	119 (12%)	1.07 (0.63, 1.80)	1.58 (0.74, 3.27)	1.44 (0.75, 2.75)
Health assistant	63 (6.5%)	0.66 (0.34, 1.22)	2.27 (1.09, 4.61)	2.07 (1.04, 4.05)
Nursing staff	416 (42%)	1.41 (1.00, 2.01)	2.90 (1.82, 4.73)	1.95 (1.26, 3.06)
Others	159 (16%)	0.99 (0.62, 1.56)	1.60 (0.84, 3.05)	1.14 (0.75, 2.75)
p-value		*0.003*	*<0.001*	*0.007*
COVID-19 area working experience				
Never	544 (55%)	1.00	1.00	1.00
Yes[†]				
Previously	202 (20%)	1.75 (1.20, 2.52)	2.08 (1.31, 3.29)	1.43 (0.91, 2.22)
Currently	244 (25%)	2.27 (1.59, 3.25)	2.80 (1.82, 4.34)	1.96 (1.29, 2.96)
p-value		*<0.001*	*<0.001*	*0.007*
<4 months	227 (23%)	2.07 (1.44, 2.97)	2.26 (1.45, 3.54)	1.49 (0.97, 2.29)
>4 months	219 (22%)	1.95 (1.35, 2.82)	2.66 (1.71, 4.15)	1.93 (1.26, 2.96)
p-value		*<0.001*	*<0.001*	*0.009*
Low-intensity area	101 (10%)	1.41 (0.87, 2.28)	1.67 (0.90, 3.03)	1.35 (0.75, 2.37)
High-intensity area	345 (35%)	2.22 (1.61, 3.09)	2.69 (1.81, 4.05)	1.80 (1.23, 2.66)
p-value		*<0.001*	*<0.001*	*0.009*
Positive nasoph. swab				
No	837 (85%)	1.00	1.00	1.00
Yes	153 (15%)	0.78 (0.53, 1.15)	0.94 (0.58, 1.48)	0.73 (0.45, 1.16)
p-value		*0.55*	*0.98*	*0.21*
Family member positive				
No	781 (79%)	1.00	1.00	1.00
Yes	209 (21%)	1.48 (1.05, 2.08)	1.17 (0.77, 1.76)	1.11 (0.74, 1.65)
p-value		*0.02*	*0.64*	*0.61*

[†]*p-values refer to comparisons between subjects with working experiences in COVID-19 area (current/previous, number of days, intensity area) and subjects with no experience in COVID-19 area.*

TABLE 3 | Second level screening scales ($N = 316$): means, standard deviations and frequencies of scorings above the cutoff across subgroups.

		PHQ-9		DES		SCL-90	
	***N* (%)**	**Mean (sd)**	***N* (%) > cutoff**	**Mean (sd)**	***N* (%) > cutoff**	**Mean (sd)**	***N* (%) > cutoff**
Gender							
Male	81 (26%)	8.63 (4.79)	22 (27%)	9.94 (10.4)	12 (15%)	0.66 (0.48)	17 (21%)
Female	235 (74%)	9.54 (5.44)	88 (37%)	13.2 (13.7)	50 (21%)	0.84 (0.64)	73 (31%)
p-value		*0.16**	*0.12****	*0.03**	*0.27****	*0.01**	*0.12****
Age group							
20–30	57 (18%)	9.11 (5.15)	15 (26%)	11.3 (9.29)	9 (16%)	0.73 (0.57)	13 (23%)
30–40	91 (29%)	8.95 (5.29)	27 (30%)	14.4 (14.2)	27 (30%)	0.78 (0.61)	29 (32%)
40–50	81 (25.5%)	9.98 (5.49)	34 (42%)	11.3 (13.1)	13 (16%)	0.84 (0.60)	25 (31%)
>50	87 (27.5%)	9.18 (5.21)	34 (39%)	11.9 (13.8)	13 (15%)	0.81 (0.63)	23 (26%)
p-value		*0.59***	*0.14****	*0.37***	*0.04****	*0.72***	*0.62****
Occupational role							
Administrative staff	27 (8%)	8.44 (5.01)	9 (33%)	14.4 (17.5)	6 (22%)	0.86 (0.71)	10 (38%)
Health assistant	16 (5%)	12.2 (4.62)	11 (69%)	21.3 (19.1)	8 (50%)	1.27 (0.83)	9 (56%)
Nursing staff	173 (55%)	10.3 (5.43)	64 (37%)	14.1 (13.3)	43 (25%)	0.86 (0.60)	55 (32%)
Physician	62 (20%)	7.34 (4.58)	13 (21%)	6.48 (6.29)	2 (3%)	0.54 (0.32)	6 (10%)
Others	38 (12%)	7.18 (4.46)	13 (34%)	8.92 (9.17)	3 (8%)	0.67 (0.61)	10 (26%)
p-value		*<0.001***	*0.008****	*<0.001***	*<0.001****	*<0.001***	*<0.001****
COVID-19 area working experience							
Never	138 (44%)	8.65 (4.92)	47 (34%)	12.2 (12.8)	23 (17%)	0.80 (0.62)	41 (30%)
Yes†							
Previously	64 (20%)	10.1 (5.47)	26 (41%)	12.0 (11.9)	16 (25%)	0.77 (0.60)	15 (24%)
Currently	114 (36%)	9.64 (5.56)	37 (32%)	12.8 (13.9)	23 (20%)	0.80 (0.59)	34 (30%)
p-value		*0.13***	*0.53****	*0.89***	*0.37****	*0.95***	*0.63****
<4 months	82 (26%)	10.0 (5.50)	31 (38%)	13.5 (14.1)	22 (27%)	0.77 (0.60)	19 (23%)
>4 months	96 (30%)	9.65 (5.55)	21 (33%)	11.6 (12.5)	17 (18%)	0.81 (0.58)	30 (31%)
p-value		*0.14***	*0.79****	*0.61***	*0.15****	*0.93***	*0.47****
Low-intensity area	30 (9%)	9.20 (5.46)	10 (33%)	12.9 (14.2)	8 (27%)	0.80 (0.69)	9 (30%)
High-intensity area	148 (47%)	9.94 (5.54)	53 (36%)	12.4 (13.1)	31 (21%)	0.79 (0.57)	40 (27%)
p-value		*0.12***	*0.93****	*0.95***	*0.39****	*0.97***	*0.86****
Positive nasopharyngeal swab							
Yes	51 (16%)	9.69 (5.08)	18 (35%)	13.4 (15.7)	8 (16%)	0.76 (0.56)	12 (24%)
No	265 (84%)	9.23 (5.33)	92 (35%)	12.1 (12.5)	54 (20%)	0.80 (0.61)	78 (29%)
p-value		*0.56**	*0.9****	*0.58**	*0.56****	*0.63**	*0.47****
Family member positive to COVID-19							
Yes	76 (24%)	9.14 (4.72)	23 (30%)	10.9 (9.91)	11 (15%)	0.74 (0.51)	16 (21%)
No	240 (76%)	9.36 (5.46)	87 (36%)	12.8 (13.9)	51 (22%)	0.81 (0.63)	74 (31%)
p-value		*0.74**	*0.41****	*0.19**	*0.25****	*0.32**	*0.12****

**t-test.*

***One-way ANOVA.*

****Chi-square test.*

†p-values refer to comparisons between subjects with working experiences in COVID-19 area (current/previous, number of days, intensity area) and subjects with no experience in COVID-19 area.

symptoms of post-traumatic distress (see IES-R scale), almost doubled the risk of anxiety (GAD-7), and increased by 41% the risk of general discomfort (GHQ-12). Direct experience with patients with COVID-19 was associated with an increased risk of PsI in all three scales. In detail, the risk to score above the cutoff (for all measured scales) increased with time spent in the COVID-19 area, with a higher level of clinical intensity, or dividing subject with none, former, or current involvement in COVID-19 units.

For subjects with a family member that was previously infected by COVID-19, *the risk of general discomfort (GHQ-12) was increased by 48%*; age was not found as a significant risk factor for PsI.

Table 3 shows the univariate analysis for the second-level scales, collected among 316 subjects. Similar to first-level screening, gender and occupational role resulted as statistically significant factors associated with psychological distress: means and percentage of scoring above the cutoff were higher for

TABLE 4 | Multivariate logistic regression for second level scales: adjusted OR of scoring above the cut-offs with associated 95% confidence intervals (CI) and corresponding LR test *p*-values.

		PHQ-9	DES	SCL-90
	***N* (%)**	**AdjOR (95% CI)**	**AdjOR (95% CI)**	**AdjOR (95% CI)**
Gender				
Male	81 (26%)	1.00	1.00	1.00
Female	235 (74%)	1.40 (0.77, 2.60)	1.68 (0.80, 3.79)	1.48 (0.78, 2.94)
p-value		*0.14*	*0.1*	*0.11*
Age				
>50	87 (27.5%)	1.00	1.00	1.00
20–30	57 (18%)	0.39 (0.17, 0.88)	0.78 (0.27, 2.21)	0.68 (0.328 1.64)
30–40	91 (29%)	0.44 (0.21, 0.91)	1.71 (0.72, 4.17)	1.05 (0.50, 2.24)
40–50	81 (25.5%)	0.93 (0.48, 1.79)	0.88 (0.35, 2.20)	1.19 (0.58, 2.48)
p-value		*0.14*	*0.05*	*0.61*
Occupational role				
Physician	62 (20%)	1.00	1.00	1.00
Administrative staff	27 (8%)	2.12 (0.70, 6.40)	8.23 (1.61, 62.65)	5.41 (1.62, 19.6)
Health assistant	16 (5%)	9.45 (2.79, 36.3)	26.7 (5.48, 202.3)	11.9 (3.29, 47.5)
Nursing staff	173 (55%)	2.79 (1.34, 6.10)	8.53 (2.39, 54.6)	4.81 (1.99, 13.6)
Others	38 (12%)	2.35 (0.89, 6.30)	2.53 (0.39, 20.5)	3.52 (1.13, 11.8)
p-value		*0.004*	*<0.001*	*<0.001*
COVID-19 area working experience				
Never	138 (44%)	1.00	1.00	1.00
Yes[†]				
Previously	64 (20%)	1.59 (0.79, 3.20)	1.41 (0.60, 3.29)	0.71 (0.32, 1.51)
Currently	114 (36%)	1.32 (0.70, 2.50)	1.19 (0.54, 2.62)	1.20 (0.62, 2.33)
p-value		*0.34*	*0.65*	*0.38*
<4 months	82 (26%)	1.51 (0.78, 2.96)	1.55 (0.69, 3.48)	0.71 (0.34, 1.46)
>4 months	96 (30%)	1.35 (0.70, 2.60)	1.05 (0.46, 2.39)	1.27 (0.65, 2.49)
p-value		*0.38*	*0.44*	*0.27*
Low-intensity area	30 (9%)	1.19 (0.44, 3.09)	1.80 (0.57, 5.55)	1.03 (0.37, 2.75)
High-intensity area	148 (47%)	1.47 (0.82, 2.67)	1.20 (0.58, 2.52)	0.97 (0.52, 1.81)
p-value		*0.37*	*0.55*	*0.97*
Positive nasopharyngeal swab				
No	51 (16%)	1.00	1.00	1.00
Yes	265 (84%)	0.92 (0.44, 1.88)	0.85 (0.32, 2.02)	0.80 (0.36, 1.71)
p-value		*0.6*	*0.52*	*0.31*
Family member positive to COVID-19				
No	76 (24%)	1.00	1.00	1.00
Yes	240 (76%)	0.77 (0.41, 1.42)	0.66 (0.29, 1.41)	0.61 (0.30, 1.17)
p-value		*0.4*	*0.29*	*0.13*

[†]*p-values refer to comparisons between subjects with working experiences in COVID-19 area (current/previous, number of days, intensity area) and subjects with no experience in COVID-19 area.*

females, nurses, and health assistants (although the latter are composed by a few cases). Contrary to first-level outcomes, working exposure to COVID-19 and having a family member with previous COVID infection were not associated with higher psychological scales scoring.

Table 4 presents multivariate logistic regression analysis for psychological distress (second-level questionnaire results). Nurses and health assistants had sensibly higher adjusted OR for developing symptoms of depression or other psychological symptoms than physicians. ORs were greater in women considering all the three scales (even if not statistically significant). Similar to univariate analysis, the occupational exposure with COVID-19 seemed not to be an independent risk factor for psychological distress.

Figure 1 illustrates the distribution of health beliefs and COVID-19 concerns for each answer, which significantly differed according to the first-level screening result (Kolmogorov–Smirnov test). Worries, discomfort, and fear were expressed more frequently by subjects who scored above the cutoff on at least one scale compared to colleagues with no evidence of PsI. Adjusted ORs of having a first-level scale above the cutoff dividing subjects according to their personal concerns and beliefs

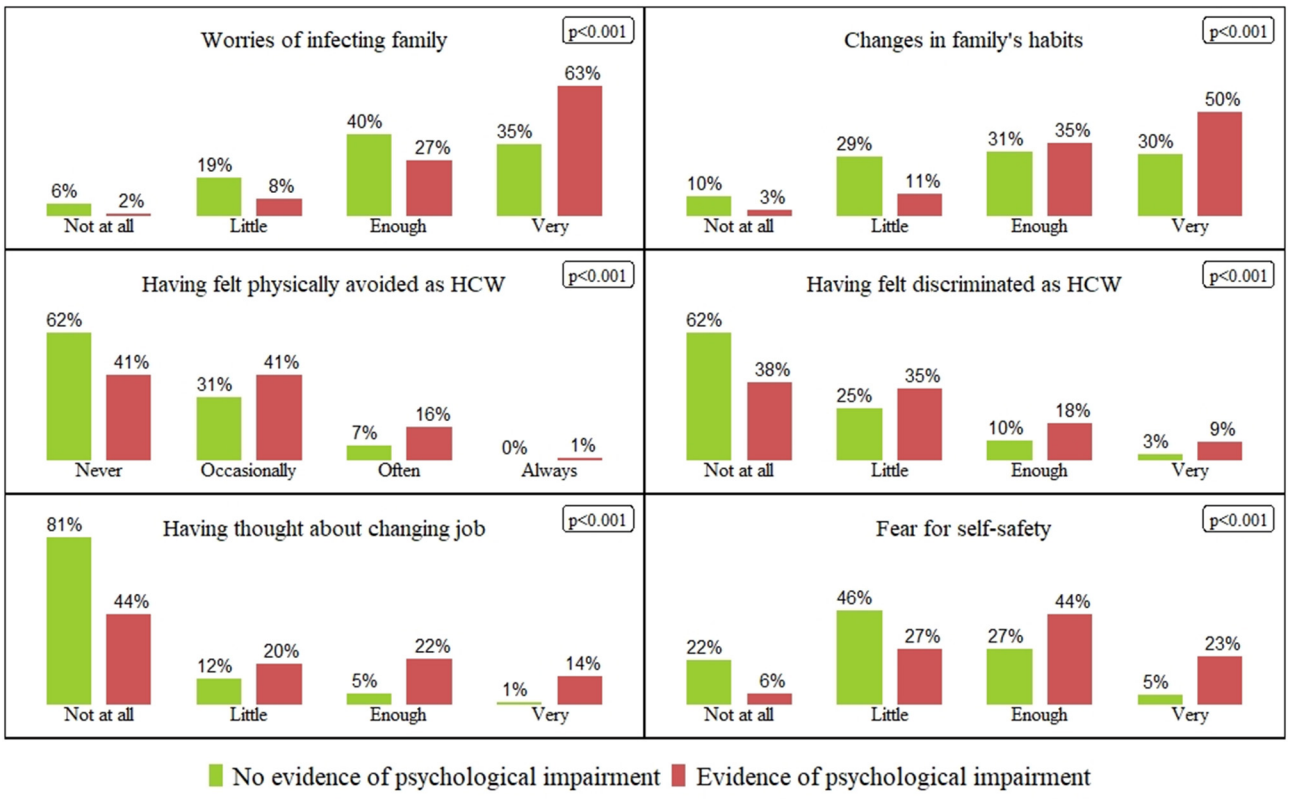

FIGURE 1 | Health beliefs and COVID-19 related concerns: percentage of each answer dividing subjects with evidence of psychological impairment (red columns) and without psychological impairment (green columns).

TABLE 5 | Personal concerns about COVID-19 and risk to score above the cut-off at the first levels scales (reference subject answering No).

		GHQ-12	IES-R	GAD-7
	***N* of positive (%)**	**AdjOR* (95% CI)**	**AdjOR* (95% CI)**	**AdjOR* (95% CI)**
Worries of infecting family	792 (80%)	2.43 (1.60, 3.47)	4.13 (2.30, 8.11)	2.15 (1.34, 3.59)
Changes in family's habits	695 (70%)	3.22 (2.31, 4.54)	4.89 (3.04, 8.25)	4.34 (2.78, 7.04)
Having felt physically avoided as HCW	111 (11%)	1.72 (1.13, 2.61)	3.50 (2.25, 5.43)	2.54 (1.63, 3.91)
Having felt discriminated as HCWs	179 (18%)	2.07 (1.44, 2.86)	3.46 (2.37, 5.03)	2.16 (1.48, 3.13)
Having thought about changing job	175 (18%)	6.71 (4.58, 10.0)	6.17 (4.21, 9.08)	6.38 (4.36, 9.37)
Fear for self-safety	445 (45%)	3.59 (2.72, 4.77)	5.65 (3.89, 8.35)	3.92 (2.79, 5.56)

**ORs are adjusted by gender, age group, occupational role, COVID-19 area, personal infection and family member infection.*

about COVID-19 are presented in **Table 5**. Each variable resulted in a statistically significant risk factor with a high OR, indicating a strong relationship with psychological distress. The highest risks that increased by more than six times were associated with thoughts about changing jobs and fear for self-safety.

Figure 2 shows the time trends in the percentage of subjects, resulting in scores above cutoff in first- and second-level scales. Looking at the first-level screening, the highest levels were reached between October and December 2020, during the second pandemic wave in Italy. In particular, the percentage above the cutoff of the GHQ-12 scale increased from September to December, reaching a peak of around 60%. A rapid increase in September to October was present also for GAD-7 and IES-R scales. From January 2021 percentages of subjects with PsI started to decrease, returning to baseline values in a few months.

Time trends of second-level questionnaires were more irregular and different from each other: percentage of overpass PHQ-9 cutoff was constant around 30–40%, and for DES and SCL-90, no clear trend during the study period was found.

In the period of January-February 2021, more than 90% of HCWs received anti–COVID-19 vaccination. We explored the effect of vaccination on psychological wellbeing, comparing results in subjects evaluated before and after the vaccination campaign started.

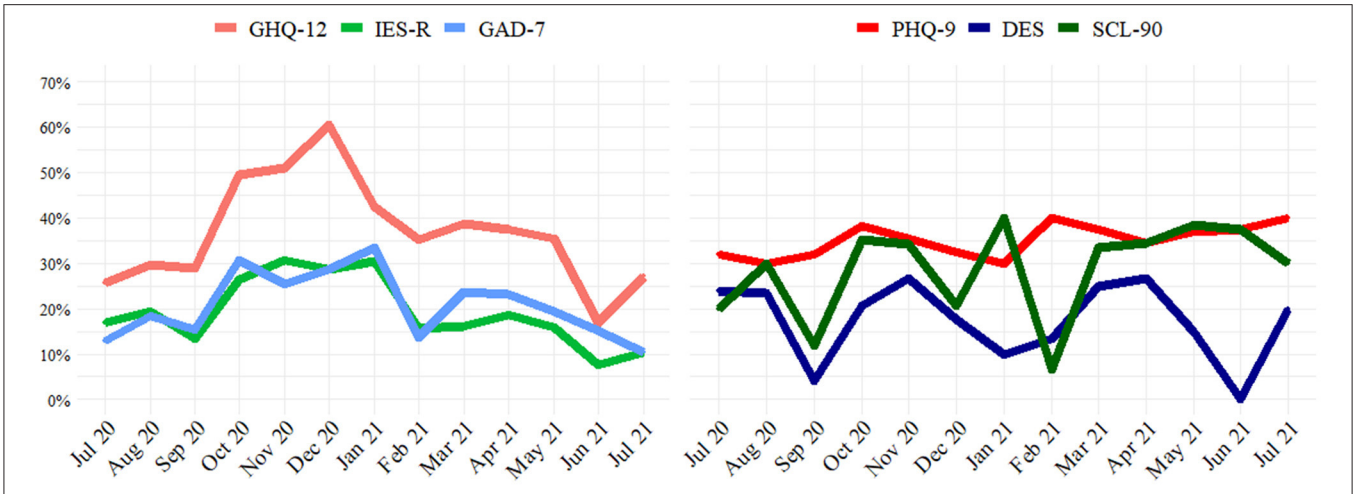

FIGURE 2 | Time trend of first level screening **(left)** and second level evaluation **(right)**. Percentage of subjects scoring above scales cut-off over time.

Values of OR for PsI related to exposure to the COVID-19 working area did not vary with vaccination: although statistical significance was lost in the post-vaccine subsample, results showed a stable increased risk among subjects working in the COVID-19 area. Similarly, a personal COVID-19 infection was not a risk factor before or after vaccination. Having a family member previously infected was a risk factor for PsI only for workers enrolled before the vaccination campaign (ORs are equal to 2.25 for GHQ-12, 1.46. for IES-R, and 1.71 for GAD-7) but not for vaccinated workers (ORs are equal to 1.18, 1.10, and 0.86, respectively). Detailed data for GHQ-12, IES-R, and GAD-7 scales are illustrated in **Table 6**.

CONCLUSIONS

We conducted a 12-month-long systematic evaluation of mental health in all workers that underwent occupational surveillance ($n = 990$) in a tertiary hospital in Milan that was identified as one of the COVID-19 hub centers in the Lombardia Region (Italy). Our study investigated psychological wellbeing (by GAD-7, IES-R, and GHQ-12) and specific psychiatric symptoms (by PHQ-9, DES, and SCL-90) with a focus on risk factors associated with mental health issues.

As consistently stated by the previous investigation, PsI was more frequent among nurses and female workers (13, 14, 32).

By comparing psychological scales in workers with or without direct involvement with patients with COVID, we observed a statistically increased risk for impairments (in all considered scales) in exposed workers, which was confirmed when we considered the duration of employment in COVID wards (>6 months, < 6 months, and none) and the level of intensity of care (high, low, and none). This is consistent with research on previous coronavirus outbreaks, showing the exposure level as a major risk factor for mental health problems (9, 33). On the other hand, we observed a not negligible proportion of workers with PsI even in HCWs without experience with patients with COVID-19 and among administrative staff (34). These results are both compatible with a background proportion of mental health issues in the working population and with the effect of pandemic-related changes and concerns that involved the entire working population. COVID-19 pandemic represented a psychological challenge and a trigger of psychological distress for all, and our data confirmed that personal concerns and health beliefs related to COVID-19 (e.g., worries about infection or about infecting family members) strongly impact the risk for PsIs.

In this regard, our observation of increased psychological distress in workers as having a family member with previous COVID-19 infection confirmed the multidimensional (occupational and non-occupational) impact of the pandemic on workers' mental health (35, 36).

Three hundred and sixteen workers (32%) presented signs of PsI at the first-level screening (i.e., with scores above the cutoff in at least one scale among GAD-7, IES-r, and GHQ-12); among these, only a proportion of subjects presented clinically relevant symptoms (second-level screening) on PHQ-9 (35%), DES (20%), and SCL-90 (28%). The relative frequency of PsI was strongly associated with the pandemic trends in the region (with a rapid increase in the last trimester 2020) but sensibly decreased after January 21, when almost all workers received the vaccination. Differently, specific psychiatric symptoms showed a different pattern of association with potential risk factors and different time trends compared to PsI. In fact, results of second-level scales were associated neither to direct working experience with patients with COVID nor to COVID experience in the family and seemed not to be influenced by pandemic waves or workers vaccination. Instead pre-existing and more stable conditions (specifically gender and occupational levels) resulted associated with sensibly higher ORs.

These results are not completely surprising as psychiatric symptoms may have pre-existed and therefore are not associated with COVID-19 risk factors; also, we cannot exclude that a self-selection bias had occurred as HCW involved in high-intensity wards may have more resilience, psychological wellbeing and

TABLE 6 | ORs (adjusted for gender, age, occupational role) of scoring above cut-off of first level screening scales before and after vaccination campaign.

	N (%)		GHQ-12			IES-R			GAD-7		
	PRE	POST	AdjOR (95% CI)		*p*	AdjOR (95% CI)		*p*	AdjOR (95% CI)		*p*
	N = 584	*N* = 406	PRE	POST		PRE	POST		PRE	POST	
COVID-19 area working experience											
Never		295 (73%)									
Yes†	249 (43%)		1.00	1.00		1.00	1.00		1.00	1.00	
Previously	133 (23%)	69 (17%)	1.72 (1.05, 2.83)	1.54 (0.82, 2.87)	0.75	1.97 (1.08, 3.64)	1.60 (0.72, 3.49)	0.67	1.44 (0.79, 2.63)	1.15 (0.54, 2.38)	0.71
Currently	202 (34%)	42 (10%)	1.99 (1.25, 3.18)	2.64 (1.23, 5.70)	0.71	2.25 (1.29, 4.01)	2.55 (0.94, 6.63)	0.73	1.86 (1.07, 3.28)	1.66 (0.66, 4.01)	0.64
Low-intensity area	65 (11%)	36 (9%)	1.11 (0.59, 2.06)	2.04 (0.87, 4.76)	0.3	1.19 (0.52, 2.59)	2.30 (0.77, 6.61)	0.56	1.31 (0.61, 2.72)	0.99 (0.33, 2.72)	0.71
High-intensity area	270 (46%)	75 (18%)	2.17 (1.40, 3.39)	1.80 (0.99, 3.27)	0.57	2.47 (1.45, 4.31)	1.74 (0.80, 3.69)	0.68	1.78 (1.05, 3.07)	1.43 (0.70, 2.85)	0.58
Positive nasoph. swab											
No	515 (88%)	322 (79%)	1.00	1.00		1.00	1.00		1.00	1.00	
Yes	69 (12%)	84 (21%)	0.58 (0.32, 1.03)	1.03 (0.60, 1.77)	0.28	1.00 (0.51, 1.88)	1.00 (0.47, 2.01)	0.84	0.52 (0.24, 1.04)	0.98 (0.49, 1.85)	0.58
Family member positive to COVID-19											
No	500 (86%)	281 (69%)	1	1		1	1		1	1	
Yes	84 (14%)	125 (31%)	2.25 (1.34, 3.83)	1.18 (0.73, 1.91)	0.06	1.46 (0.81, 2.58)	1.10 (0.57, 2.05)	0.28	1.71 (0.95, 3.03)	0.86 (0.47, 1.54)	0.11

P-values are referred to the significance of the interaction term.

†p-values refer to comparisons between subjects with working experiences in COVID-19 area (current/previous, number of days, intensity area) and subjects with no experience in COVID-19 area.

better coping resources compared to colleagues involved in other wards (37, 38).

However, to detect susceptible populations that develop psychiatric problems in a context of generalized and persistent stress, as was the experience during the pandemic, it is a key challenge in terms of occupational medicine. For example, the higher proportion of mental health issues observed among nurses and health assistants (when compared with doctors) is a matter of concern and suggests targeting specific efforts and care to preserve psychological wellbeing in those working groups.

Our results must be considered in light of several limitations. First of all, we have no data collected before COVID. Thus, we cannot attribute to the pandemic, all the observed psychological distress. We were aware that psychological symptoms are present in all working populations and that HCWs, in particular, experienced a high level of job stress and even burnout from work shifts, long working hours, and several other job-related psychological risk factors. However, the increasing trend in PsIs with increasing direct working involvements with patients with COVID suggested that care for patients with COVID had a specific and independent effect in determining psychological burden even if (or maybe because of) HCWs constitute a population previously exposed to a high level of job strain.

We collected both exposure and effect with questionnaires; thus, our study is prone to potential biases as self-selection of respondents (39) and common methods bias (40). We managed to minimize those risks grounding our investigation on the occupational physician health surveillance (obtaining a very high participation rate and minimizing the risk of untrue or uncompleted answers in describing job tasks) and by assessing individual "COVID exposure" by objective data (hospital wards, duration of employments, and swab results etcetera).

Our results about the effect of vaccination campaigns among HCWs are interesting and, nowadays, represent one of the first shreds of evidence collected in Europe. However, we were not able to evaluate each worker before and after vaccination, and we only compared mental wellbeing in the same population in the period before and after the vaccination campaign. Thus, we cannot exclude that the better psychological scores observed were a consequence of another unmeasured time-dependent factor, first of all, a general improvement of the pandemic situation in Italy. In this respect, we must say that, in Italy, vaccination among HCWs was performed sensibly before (2–4 months as average) the general population, and we experienced, within the study period (March to July 2021), a sensible increase of cases and hospital admission (COVID-19 pandemic third wave in Europe) without observing an evident effect on workers psychological burden after their vaccination.

Our study plans to follow all enrolled workers for another year to properly assess both late onsets of symptoms, to analyze the risk factors for symptoms persistency, and to overcome some of the abovementioned limitations. The next results may provide further insights on preventive and beneficial interventions to support HCW mental health during and after a pandemic. Indeed, different programs aimed at addressing mental health issues in HCWs during pandemics have been found to be effective (41, 42). In this respect, it is also crucial to maintain an ongoing

cooperation with public health stakeholders, policymakers, and the occupational health and safety players within hospital contexts (43).

The evaluation of the psychological wellbeing of all hospital workers, directly or indirectly exposed to pandemic consequences, constitutes a unique condition to detect individual, occupational, and non-occupational risk factors for PsI in situations of high stress and/or disasters, as well as variables associated with symptom chronicization.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because collected variables include information about occupational stress, job satisfaction and psychological wellbeing. For ethical reasons, to avoid any possible workers identification, data are available only in aggregate format upon reasonable request to the corresponding authors. Requests to access the datasets should be directed to matteo.bonzini@unimi.it; paolo.brambilla@unimi.it.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Milan Area 2 Ethical Committee, n.652_2020 of July 21, 2020. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MB, AF, and PB conceived the study, wrote the study protocol, and wrote the paper. MB and AC performed the statistical analyses. FC, EC, and VT supervised the second level questionnaires and contributed to study interpretation. EM, MG, LB, CN, and GS supervised the first level questionnaire and performed occupational health surveillance. LR supervised the study and contributed to results interpretation. All authors contributed to the article and approved the submitted version.

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BRIEF RESEARCH REPORT
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"Post-lockdown Depression": Adaptation Difficulties, Depressive Symptoms, and the Role of Positive Solitude When Returning to Routine After the Lifting of Nation-Wide COVID-19 Social Restrictions

Shoshi Keisari[1,2,3], *Yuval Palgi*[2,4], *Lia Ring*[4], *Adi Folkman*[5] *and Boaz M. Ben-David*[6,7,8]*

[1] School of Creative Arts Therapies, University of Haifa, Haifa, Israel, [2] The Centre for Research and Study of Aging, University of Haifa, Haifa, Israel, [3] The Emily Sagol Creative Arts Therapies Research Center, University of Haifa, Haifa, Israel, [4] Department of Gerontology, University of Haifa, Haifa, Israel, [5] Department of Counseling and Human Development, University of Haifa, Haifa, Israel, [6] Baruch Ivcher School of Psychology, Reichman University (IDC), Herzliya, Israel, [7] Department of Speech-Language Pathology, University of Toronto, Toronto, ON, Canada, [8] Knowledge, Innovation, Talent, Everywhere (KITE), Toronto Rehabilitation Institute, University Health Networks, Toronto, ON, Canada

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Daria Smirnova, Samara State Medical University, Russia

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***Correspondence:**
Boaz M. Ben-David
boaz.ben.david@idc.ac.il

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Objectives: The aim of the current study was to identify difficulties in adapting to normal life once COVID-19 lockdown has been lifted. Israel was used as a case study, as COVID-19 social restrictions, including a nation-wide lockdown, were lifted almost completely by mid-April 2021, following a large-scale vaccination operation.

Methods: A sample of 293 mid-age and older Israeli adults (*M* age = 61.6 ± 12.8, range 40–85 years old) reported on return-to-routine adaptation difficulties (on a novel index), depression, positive solitude, and several demographic factors.

Results: Of the participants, 40.4% met the criteria of (at least) mild depressive symptoms. Higher levels of adaptation difficulties were related to higher ratios of clinical depressive symptoms. This link was moderated by positive solitude. Namely, the association between return-to-routine adaptation difficulties and depression was mainly indicated for individuals with low positive solitude.

Conclusions: The current findings are of special interest to public welfare, as adaptation difficulties were associated with higher chance for clinical depressive symptoms, while positive solitude was found to be as an efficient moderator during this period. The large proportion of depressive symptoms that persist despite lifting of social restrictions should be taken into consideration by policy makers when designing return-to-routine plans.

Keywords: depressive symptoms, adaptation difficulties, positive solitude, mid-life, older adults, lockdown

INTRODUCTION

The response to the COVID-19 pandemic has led to unprecedented social distancing measures worldwide. These included lockdowns, where individuals were ordered to stay at home for weeks (1). These restrictions were found to yield psychological distress for many, with various aspects of mental health disturbance, including inflated rates of depressive symptoms, occurring across

populations (2, 3). In response to the pandemic, global efforts have been made to vaccinate entire populations to lessen mortality and lift social restrictions (4, 5). Paradoxically, however, achieving the return to normal life may itself have a cost. Although many people waited for the restrictions to be lifted, these same restrictions provided a respite and changed the life course of many individuals who may experience adaptation difficulties and depressive symptoms during the transition period to their former routine. We hypothesize that the long-term effects of social restrictions may be also manifested when people are faced with a return to daily routines and obligations.

Although social restrictions helped mitigate the spread of the virus, they had severe psychological consequences. Social distancing incurred significant life changes that could be experienced as negative or positive, such as losing or changing jobs and un/healthy lifestyle changes (6). Restrictions also severely disrupted social interactions, social presence, communication and daily routines, all important to maintain cognitive performance and wellbeing [see (7, 8)]. Taken together, social restrictions have been found to impair mental health, including an increase in anxiety, depressive symptoms, loneliness and social isolation (9–11). The current study focuses on depressive symptoms when returning to routine following the release from COVID-19 lockdown.

Depressive disorders are usually conceptualized along a continuum, progressing from mild to moderate to severe, characterized by the duration and severity of the symptoms (12). Moderate and severe depression are leading causes for disability, with greater stability and a higher risk for suicidality (13). However, mild symptoms are still considered as a serious medical condition that leads to professional and personal disabilities, social problems and reduced quality of life (14, 15). Mild depression often represents a maladaptive response of the individual to environmental stressors and is frequently prodromal to major depression disorders (16). Note, mild depression is different than normal sadness, as based on the number, duration and quality of presented symptoms, and can be diagnosed by linguistic indicators (17). Recent literature shows that since the COVID-19 outbreak, the prevalence of depressive symptoms increased among the adult population worldwide (2). For example, in 2020 ∼24.6% of adults in the USA experienced mild depressive symptoms vs. 16.2% before the pandemic. A similar trend was also noted for moderate depressive symptoms, with an increase from 5.7% before the pandemic to 14.8% for US adults [(18, 19); for European samples, see (20, 21)].

Demographic characteristics have been found to have a large impact on the extent of the effects of COVID-19 social restriction (11, 22). For example, a higher prevalence of depression and anxiety symptoms were indicated for women, and for people who are not partnered. In addition, caregivers who must adapt their work routines to care for others at home were at a higher risk of psychological burden (23). Middle-aged adults appear to be more susceptible to experiencing symptoms of mental illness during the pandemic, as compared to older adults (11). In the current study, we examine the possible contribution of these demographic characteristics to depressive symptoms, following the termination of a COVID-19 lockdown.

Coping strategies, skills and personality traits were also associated with the impact of the pandemic (24). For example, centrality appraisals and planning, controllability appraisals, as well as coping strategies were related to the differences in subjective wellbeing among adults during the early stage of the pandemic (25). High levels of arts engagement constituted a potent buffer against subsequent COVID-19 anxiety (26, 27). Personality traits of neuroticism and extroversion were also associated with mental health during the COVID-19 pandemic: neuroticism negatively related and extroversion positively related to mental health (28).

In the current study, we focus on positive solitude—the volitional positive experience while being by oneself (29)—as a possible moderator for the negative effects of lockdown. Positive solitude is defined as the choice to dedicate time to a meaningful, enjoyable activity or experience conducted by oneself. This activity/experience might be spiritual, functional, recreational or of any chosen type, and it is independent of any external or physical conditions (30). It is not surprising to find that positive solitude has been identified as a source for resilience during social restrictions (31). In general, it is associated with wellbeing and better emotion regulation and introspection (32, 33). Moreover, a high capacity of solitude was associated with low levels of depression (34) and post-traumatic stress symptoms (35). During COVID-19 social restrictions, it was found that the preference for solitude (in tandem with other personality variables) predicted individuals' improved mental health and creativity. Namely, people who experience themselves as more stable when they are alone expressed a lower level of loneliness and performed better than their peers on a creative insight task (31).

As aforementioned, numerous studies have examined the effects of social restrictions on mental health. However, no study to date has directly explored the negative impacts of returning to normal life after social restrictions have been lifted. Nevertheless, the literature points to the possible negative impacts of returning to routine. For example, during the first COVID-19 wave, Europeans expressed negative expectations regarding the future and return to normal life, fears of an economic depression, and concerns regarding dangers to freedom (36). A study in our lab showed that even after COVID-19 vaccinations, mental health symptoms were not alleviated (5). Indeed, even the release from incarceration, a much stronger form of restriction, incurs post-prison adaptation difficulties and psychological symptoms (37). Paradoxically, as social restrictions can be experienced as a break from work life (6) and even relate to improved wellbeing for some individuals (38, 39), the difficulties involved in return-to-routine when they are lifted can be related to difficulties adapting to daily work when returning from vacation (40).

In the current study, our main aim was to identify difficulties in adapting to normal life once a nation-wide COVID-19 lockdown (imposed on the whole population) was lifted during April 2021 in Israel. Our second aim was to test whether a higher level of return-to-routine adaptation difficulties is associated with higher depressive symptoms. Our third aim was to test whether this link is moderated by positive solitude, after controlling for

individual demographic characteristics (gender, age, SES and family status).

Israel constitutes a special case study, as it was one of the first countries to initiate a large-scale vaccination operation (41), with social restrictions lifted almost completely by mid-April 2021. Israel is also unique as every Israeli citizen is entitled to healthcare services under the National Health Insurance Law. This was at the base of the success of the early vaccination campaign that lead to a quick nation-wide (rather than regional) release from lockdown and other social restrictions, and full re-opening of schools for the first time in over a year, at the end of the COVID-19 third wave (41, 42).

METHODS

Participants and Procedure

Data from 293 Israeli adults (age $\geq$ 40) were collected *via* social media platforms from April 12 to May 3, 2021 (342 individuals replied and 49 individuals did not complete the survey). By April 12, the first day of distribution of the questionnaire, 57.3% of the population had received the first dose of the vaccination. Only 225 Israelis tested positive for COVID-19 on that day, and the Israeli government announced a return to routine including the re-opening of schools, workplaces and shopping centers (41).

Data were obtained using a convenience sample of 293 Israelis [M age = 61.57, SD = 12.81, range (40–85) years old]. Most of them were women (n = 222, 75.8%), married or cohabitating (n = 232, 79.2%). Socio economic status was self-reported as M = 3.88, SD = 0.88 (on a scale ranged from 1 = *"Not good at all"* to 5 = *"Very good"*). All participants were informed about the subject of the research and electronically provided their informed consent to participate. Ethical approval was received from the Institutional Review Board of Reichman University, Herzliya.

Measures

Participants completed a demographic questionnaire, including age, gender, marital status as well as economic status.

Depression

Depression was assessed using the 9-item Patient Health Questionnaire-9 (PHQ-9). Participants were asked: "Over the last 2 weeks, how often have you been bothered by the following problems?" An example of a problem is: "Little interest or pleasure in doing things." Items were rated on a scale of 0 (Not at all) to 3 (Nearly every day). In this study, the Cronbach's coefficient was $\alpha = 0.837$.

Positive Solitude

Positive Solitude was assessed by the 9-item Positive Solitude Scale (43). An example of an item is: "When I find time for myself, I succeed better at making future plans." Items were rated on a scale ranging from 1 (Not at all) to 5 (Most of the time). In this study, the Cronbach's coefficient was $\alpha = 0.913$.

Adaptation Difficulties in Returning to Routine Following COVID-19 Lockdown

Adaptation Difficulties in Returning to Routine Following COVID-19 Lockdown, is a new 6-item index that was developed for this study. In this novel index, participants were asked to rate how much they agreed with statements on a scale of 1 ("Strongly disagree") to 5 ("Strongly agree")—i.e., higher scores on the index represented more difficulties in returning to routine. Six statements were presented: "Although the days of social restrictions were difficult___" ___: (1) "… I miss the days of social restrictions;" (2) "… I have some concerns returning to routine;" (3) "…I would rather gradually return to routine;" (4) "…I wish I could stay at home for a longer time;" (5) "…I find it difficult to return to routine;" (6) "…I find it difficult to leave behind the days of social restrictions." In this study, the Cronbach's coefficient was $\alpha = 0.845$. A summary of the properties of this new measure is available in **Table 1**.

TABLE 1 | Adaptation difficulties in returning to routine following COVID-19 scale.

			Sum	Variance of sum	α
	M	*sd*	If item deleted	If item deleted	If item deleted
1.	2.17	1.07	12.29	16.97	0.78
2.	2.44	1.15	12.02	16.75	0.79
3.	3.35	1.16	11.11	20.16	0.87
4.	2.27	1.13	12.19	16.04	0.76
5.	2.32	1.18	12.14	15.85	0.77
6.	1.91	1.03	12.55	16.55	0.76

Scores are on a scale of 1 ("Strongly disagree") to 5 ("Strongly agree").
The six items are: "Although the days of social restrictions were difficult_____".
1) "…I miss the days of social restrictions".
2) "…I have some concerns returning to routine".
3) "…I would rather gradually return to routine".
4) "…I wish I could stay at home for a longer time".
5) "…I find it difficult to return to routine".
6) "…I find it difficult to leave behind the days of social restrictions".

Data Analysis

At the first stage, we examined the means for the study variables. Namely, depression: M = 4.44, range (0–17), SD = 3.87; return-to-routine adaptation difficulties: M = 2.42, range (1–5), SD = 0.81; and positive solitude: M = 3.69, range (1–5), SD = 0.76. We also examined the preliminary links between the study variables with Pearson's correlations (see **Table 2** for means, standard deviations, and correlation for the study variables).

Subsequently, to examine our hypotheses, we conducted a multiple hierarchical linear regression analysis. Demographic variables (age, gender, marital status, and social economic status) were entered in Step 1. Level of return-to-routine adaptation difficulties and the moderator, positive solitude, were entered in Step 2. The interaction between level of return-to-routine adaptation difficulties and positive solitude was entered in Step 3. All predictors were mean-centered prior to moderation analysis. Significant interactions were probed with the PROCESS computational tool [V3.5; (44)]. This tool probes the significance of slopes at different levels of the moderator (i.e., positive solitude).

TABLE 2 | Demographics and correlations for the study variables.

	M/%	*SD*	1	2	3	4	5	6
1. Depression[a]	4.44	3.87	-					
2. Adaptation difficulties	2.42	0.81	0.21**	-				
3. Solitude	3.69	0.76	−0.15*	0.01	-			
4. Age	61.57	12.81	−0.14*	−0.39**	−0.18**			
5. Gender[b]	75.8%	-	−0.13	−0.19**	−0.15*	0.20**		
6. Marital status[c]	79.20%	-	−0.30**	−0.01	0.15*	−0.05	0.21**	
7. Economic status[d]	3.88	0.88	−0.27**	−0.06	0.07	0.035	0.08	0.27**

Total N = 293 (Regression included N = 234).
[a]*Depression, PHQ-9.*
[b]*Gender, woman.*
[c]*Marital status, currently married, or living with a partner.*
[d]*Higher score (range 1–5) reflect better economic status.*
*$p < 0.05$, **$p < 0.01$.

RESULTS

Based on the PHQ-9 cut-off score of ≥5, the sample demonstrated that 40.4% of the participants met the criteria of mild depressive symptoms and above, while 10.8% of the sample met the criteria of moderate to severe level of depressive symptoms, based on the PHQ-9 cut-off score of ≥10.

The median of *return-to-routine adaptation difficulties* was 2.33. In our sample, 44% reported moderate-to-high level of adaptation difficulties (≥2.50), whereas only a third of responders reported a low level (a score of < 2) of adaptation difficulties.

As presented in **Table 2**, the level of return-to-routine adaptation difficulties was positively correlated with depressive symptoms ($r = 0.21$, $p < 0.01$). The level of positive solitude was negatively correlated with depressive symptoms ($r = -0.15$, $p < 0.05$). However, no significant correlation was found between the level of return-to-routine adaptation difficulties and the level of positive solitude. Return-to-routine adaptation difficulties, positive solitude and depressive symptoms were also negatively correlated with age ($r = -0.14$, $p < 0.05$; $r = -0.39$, $p < 0.005$; $r = -0.18$, $p < 0.005$, respectively).

Notably, older adults in our sample (age ≥ 65, $N = 145$) had lower rates of depressive symptoms (32.2%) than those of middle-aged adults (48.7%). Similarly, only 8.6% of the older adults in our sample reported a high level of return-to-routine adaptation difficulties (a score of ≥3) vs. 24.7% of middle-aged adults. Yet, for older adults the positive correlation between level of return-to-routine adaptation difficulties and depressive symptoms persisted ($r = 0.38$, $p < 0.001$).

The hierarchical regression analysis is presented in **Table 3**. It revealed that higher levels of return-to-routine adaptation difficulties were related to higher levels of depressive symptoms ($\beta = 0.15$, $t = 2.34$, $p < 0.05$). However, higher levels of positive solitude were related to lower levels of depressive symptoms ($\beta = -0.15$, $t = -2.38$, $p < 0.05$).

The combination between level of return-to-routine adaptation difficulties and level of positive solitude was entered in the third step, revealing a significant interaction ($\beta = -0.23$, $t = -3.95$, $p < 0.001$), accounting for an additional 5% of the variance in depressive symptoms. The whole model explained 23.4% of the variance. Appling Hayes's (44) computational procedure showed that for individuals reporting low level of positive solitude (−1 SD), each additional return-to-routine adaptation difficulties score was associated with a significant increase of 1.62 points in level of depressive symptoms ($B = 1.62$, $t = 4.31$, $p < 0.001$)—i.e., the slope of return-to-routine adaptation difficulties × depressive symptoms was statistically significant. However, for individuals with a high level of positive solitude (+1 SD) each additional increase in return-to-routine adaptation difficulties was associated with an insignificant change in the level of depressive symptoms ($B = -0.40$, $t = -0.97$, $p = 0.33$) (**Figure 1**).

DISCUSSION

The current study tested difficulties in adapting to routine following lifting of COVID-19 social restrictions and the cessation of a nation-wide lockdown in Israel. About half of the responders reported moderate-to-high levels of return-to-routine adaptation difficulties. These difficulties were positively correlated with depressive symptoms, while positive solitude was found to moderate this link. Namely, the association between return-to-routine adaptation difficulties and depression was mainly indicated for individuals with low positive solitude.

Given the global efforts to lift social restrictions, it is of interest to find that a large portion of adult individuals, express difficulties and concerns returning to normal life. For example, about half of our respondents agreed to some extent (provided a rating of 3 and above on a 1–5 scale) with the statement: "Although the days of social restrictions were difficult, I have some concerns returning to routine." In other words, respondents were hoping to return to normal life, but now that social restrictions have been lifted, they express some anxiety. This seemingly paradoxical result confirms our hypothesis, indicating that the toll of social restrictions may have prolonged effects.

The current findings are of special interest to public welfare, as return-to-routine adaptation difficulties were associated

TABLE 3 | Regression coefficients for the association between return-to-routine adaptation difficulties, positive solitude and depressive symptoms.

		Depressive symptoms (PHQ-9)	
	Predictor	***B (SE)***	**β**
Step 1	Age	−0.04* (0.02)	−0.13
	Gender[a]	−0.35 (0.60)	−0.04
	Marital status[b]	−0.28*** (0.63)	−0.24
	SES[c]	−0.83** (0.28)	−0.19
Step 2	Adaptation difficulties	0.72* (0.31)	0.15
	Positive solitude	−0.76* (0.32)	−0.15
Step 3	Adaptation difficulties × Positive solitude	−1.30*** (0.33)	−0.23
Total R^2	0.23		

Total N = 293 (Regression included N = 234).
[a]*Gender, woman.*
[b]*Marital status, currently married, or living with a partner.*
[c]*Higher score (range 1–5) reflect better economic status.*
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.*

with higher chance for clinical depressive symptoms. Note, for individuals with high positive experience while being by themselves (high positive solitude) the level of return-to-routine adaptation difficulties was not significantly associated with depressive symptoms. The finding supports the role of positive solitude as an efficient moderator in this period (30, 31). This should come of no surprise, as the main stressors during the COVID-19 pandemic are related to extreme social restrictions and lockdown (45).

In the current study, older adults report on less depressive symptoms than those reported by adults in general following COVID-19. This trend is in line with previous findings in the literature (11, 22). Interestingly, older adults have also reported fewer return-to-routine adaptation difficulties than have middle-aged adults. This may be related to retirement, as fewer older adults must return to work following the termination of social restrictions, and to increased resilience in older age [specifically emotional regulation; (46)]. Importantly, the link between adaptation difficulties and depressive symptoms persists in older age, indicating its strength across the adult life span.

Moreover, the ratio of individuals with mild (or more severe) depressive symptoms in our sample was very high, 40.4%, as compared to the pre- COVID-19 rate, 18.6%, found for Israeli adults (47). This extremely high proportion of depressive symptoms echoes other studies conducted during the pandemic across the globe (3, 11), pointing to the long-term negative effects of social restrictions. In addition, the literature indicates a link between life transitions and higher levels of depressive symptoms (48). Transitions, even from restrictions to improved conditions, might lead to psychological distress as indicated in our study. The large proportion of depressive symptoms that persist despite lifting social restrictions should lead policy makers to take actions incorporating clinical support on the national and personal levels, as part of the return to routine plan.

Finally, our analyses show that being able to enjoy spending time alone, as represented by high levels of positive solitude, was related to lower levels of depressive symptoms. It appears that these individuals are more resilient, not only during, but also after the end of a lockdown. More specifically, the moderation model indicates that higher levels of positive solitude could compensate for the deleterious outcomes of high levels of return-to-routine adaptation difficulties, and relate to lower levels of depressive symptoms. These findings support previous studies that

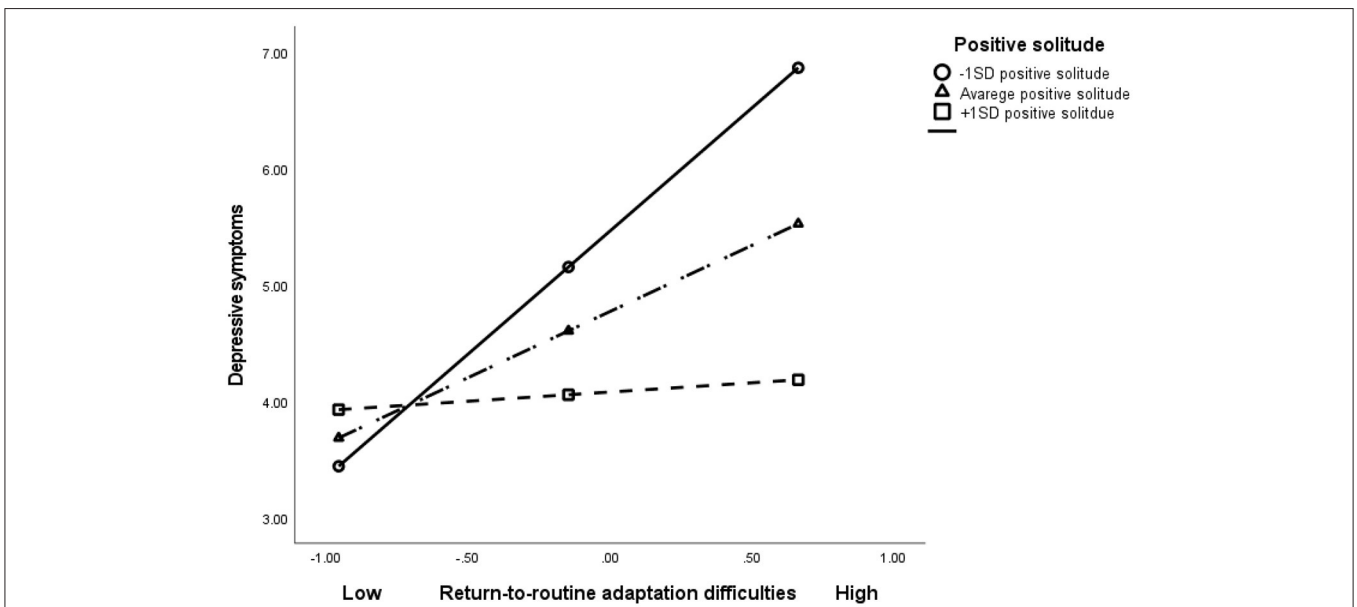

FIGURE 1 | The association between return-to-routine adaptation difficulties, positive solitude and depressive symptoms.

present positive solitude as a potent capacity related to resilience (35).

Limitations and Future Directions

This preliminary foray to the psychological cost of the transition to routine has several limits. The time sensitivity of the study (during the transition of Israel out of lockdowns) led to the choice of a cross-sectional and self-report design. This was also a convenience sample that may not represent the Israeli adult population. For example, 76% of our responders were women, possibly impacting the results [note, a higher proportion of female participants is not uncommon in this age group; e.g., (26, 49)]. The study was conducted in Israel with unique cultural aspects (51). Future studies may consider adapting our novel index to other languages and try to replicate the results in other countries and cultures (50), providing a more general statement regarding the association between return-to-routine adaptation difficulties and other indices of mental health. Moreover, due to the cross-sectional nature of the study, causality cannot be inferred. Thus, future studies should examine the long-term effects of social restrictions on mental health using additional cohorts, employing longitudinal and/or experimental designs.

CONCLUSIONS

The current study offers a pioneering insight into the adaptation difficulties during the transition period from COVID-19 restrictions to routine. To the best of our knowledge, this is among the first studies to directly test post-lockdown psychological implications. The results point to the long-term effects of the pandemic on mental health issues, even when restrictions are lifted, and to positive solitude as a coping mechanism in time of stress (**Figure 1**). The current findings have global implications for clinicians as well as for governments, social organizations and other stakeholders. We hope the findings will raise awareness to adaptation difficulties returning to routine following social restrictions. We call policy makers to initiate programs informing the public on these issues. Simply put, it appears that negative psychological implications linger, even after the lockdown and associated restrictions have been lifted. In accordance, there is a need to develop accessible interventions and assessments, both *via* traditional face-to-face interactions and *via* tele-health platforms (7), to support a wide range of the population during social restrictions and upon return to routine. These interventions may wish to use positive solitude as a resource for coping during social isolation.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Reichman University, Herzliya. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SK, YP, and BB-D contributed to the study design, data collection and analysis, and reporting and discussion. LR and AF contributed to the study design, data collection, reporting and review. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Psychological Impact in Healthcare Workers During Emergencies: The Italian Experience With COVID-19 First Wave

Elisabetta Pisanu[1]*, *Annalisa Di Benedetto*[2], *Maria Rita Infurna*[2] and *Raffaella I. Rumiati*[1,3]

[1] Neuroscience Area, International School for Advanced Studies (SISSA), Trieste, Italy, [2] ANVUR, Rome, Italy, [3] Scuola Superiore di Studi Avanzati Sapienza (SSAS), Rome, Italy

Background: The COVID-19 outbreak imposed an overwhelming workload as well as emotional burdens on Healthcare workers (HCWs). In May 2020, an online survey was administered to HCWs in Italy to assess the pandemic's psychological impact and to investigate possible predictive factors that led to individual differences.

Methods: The psychological experience was measured based on the prevalence of self-reported feelings during the pandemic, including negative and positive emotional states. We analyzed the relationship between factors of gender, age, geographic region, professional role, and operational unit, and the four-point scale used to rate the frequency of each emotional state experienced by performing several multinomial logistic regressions, one for each emotion.

Results: Our findings suggest that more than half of HCWs experienced psychological distress during the first COVID-19 outbreak in Italy. Female and younger respondents, especially those operating in northern Italy experienced more frequently negative emotional states such as irritability, anxiety, loneliness, and insecurity. However, positive feelings, first of all solidarity, were also reported especially by female and older workers. The majority of the negative as well as positive emotional states were experienced almost equally by both doctors and nurses, and independently of the operational unit in which they operated.

Conclusions: This study can be very useful as a contribution to the current literature on the psychological effects of this pandemic on health workers. Moreover, our findings can provide useful information in planning more tailored psychological interventions to support this category of workers in the ongoing and future emergencies.

Keywords: COVID-19, pandemic, psychological impact, mental health, healthcare workers (HCWs)

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***Correspondence:**
Elisabetta Pisanu
episanu@sissa.it

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INTRODUCTION

On December 31, 2019, the World Health Organization (WHO) received the news about an unusual rise in pneumonia cases in the city of Wuhan, China. This was the first manifestation of the coronavirus disease-19 (COVID-19) caused by an acute and highly contagious virus (SARS-CoV-2) that rapidly affects the respiratory system (1). Due to the rapid increase in the number of

cases outside of China, on March 11, 2020, the WHO general director announced the global pandemic (2), leading to a global health emergency that has strongly marked and affected our era.

In Italy, the first outbreak of COVID-19 began at the end of February 2020 in the North and then rapidly spread to the rest of the country. Consequently, in order to limit the infection, the Government declared the *lockdown* from March 9 until May 3 of the same year. During this first wave, highly restrictive measures were adopted such as physical and social distancing, quarantine, movement restrictions, military control (3). In the following summer, given the reduction in the number of infections, the restrictions were revised with the re-opening of commercial activities after adopting safe measures ensuring social distancing and specific hygiene rules to avoid the contagion. However, with new waves of infections, from the end of October 2020 new restrictions were adopted, including the closure of numerous activities (schools, restaurants, bars, gyms, swimming pools, cinemas, theaters etc.), movement limitations, and the introduction of the curfew (from 10 pm to 5 am) (4). Furthermore, color coded zones were established throughout Italy defined by specific parameters to be adopted individually by each region, based on the level of risk of the virus spreading (*Rt* index). In May 2021, we exited what was defined as the third wave thanks to a successful vaccine campaign which has clearly helped keeping the spread of the virus under control. However, at the end of July, we have entered the fourth wave fuelled by the delta variant of the virus.

This pandemic can be defined as one of the most challenging of the twenty-first century for the scientific communities and societies world-wise (5). The socio-economic impact of the COVID-19 pandemic is upsetting, characterized by a global economic loss due to the abovementioned measures adopted to contain the spread of the virus (6–8).

Although the economic aspect is pivotal, the severe impact on the population's mental health is no less important (9–13). Indeed, we can refer to this situation as a collective trauma, during which we have been living our daily life in a dramatic climate of uncertainty, fear and loss (14, 15). The fear of contracting the virus, as well as the fear of infecting other members of the family, in a climate of total loss of control where social relationships are discouraged, has led to a strong increase of mental diseases such as anxiety and depression (9, 16–18). Furthermore, repeated media exposure as well as the spread of fake or contradictory news has heightened stress responses, negatively affecting health overall (19, 20).

The COVID-19 outbreak has imposed an overwhelming workload as well as emotional burdens in particular on Healthcare workers (HCWs). Indeed, since the beginning of the health emergency, they have been on the frontline fighting the epidemic, being at higher risk of becoming infected and experiencing an emotional overload. The literature on work-related stress has reported the presence of psychosocial risk factors in the healthcare sector (21–23) that are associated with staff's working conditions, safety and health: the emergency has been amplifying these factors (23–26). Psychological and physical stress among HCWs could be also increased by social isolation, social distancing and quarantine measures or even discrimination as potentially infected people in the common imagination, and the lack of family support due to fear of infection (27–29). Furthermore, the psychological distress might have been enhanced by the lack of effective treatments and shortages of dedicated equipment, as well as by witnessing people dying alone, without their loved ones (30, 31).

As a result, HCWs might have felt angry, hostile, frustrated or helpless, experience symptoms of depression and anxiety accompanied by physical complaints, and suffer from insomnia (25, 32–34). Additionally, frontline HCWs are also exposed to the risk of developing secondary stress disorder by taking care of patients who are both physically and psychologically suffering from the emergency (32, 35). Because of this strong physical and emotional overload experienced by HCWs, various listening and psychological support numbers as well as teleconsultation services have been activated. However, only a small number of them exploited these services and their effectiveness still remains unclear (36–38). Recent studies reported that sometimes these services were not considered adequate enough by HCWs because they are disorganized, difficult to reach, incompatible with HCWs' work schedules, with an insufficient number of sessions, and characterized by an individual modality (typically, *ad hoc* created listening services). In contrast, a group approach would have been more adequate as it allows sharing needs and difficulties together. However, HCWs also reported to believe their problems were not severe enough to require these services and to be able to manage them on their own, despite the high psychological distress reported (39–42).

The main aims of this study consist in analyzing the nature and the severity of the mental complaints reported by the HCWs during the first COVID-19 outbreak in Italy, and in highlighting possible predictive factors that led to significant differences in experiencing this psychological distress. A further aim is to analyze the possible experience of positive emotions, in spite of the dramatic situation, to highlight possible protective factors. In fact, positive emotions have been associated with increased well being and improved psychological resources needed for adaptive coping (43, 44).

MATERIALS AND METHODS

Study Design and Sampling

Two *ad hoc* questionnaires were designed to be administered online via Google Forms specifically to doctors and other healthcare workers. Respondents were invited to participate in the study via social media (Facebook, Whatsapp) and email, as well as through the website of scientific societies. The procedure involved filling in an online consent form and all data were collected anonymously and organized in electronic format in the password-protected Google Drive archive. The questionnaires were answered individually and voluntarily by participants. The survey was run from April 28 to May 31 2020. The study and procedures of informed consent have been approved by the corresponding author's institutional ethics committee.

Measures

Two structured questionnaires were designed and administered to HCWs operating in Italy. Both questionnaires consisted of 31 closed-ended questions dedicated to their emotional experience during the emergency. Moreover, beyond the demographic information including age, gender, geographical place of employment, professional role, and operational unit, different thematic areas were addressed:

- Possible sources of work-related stress (temporal and content aspects of the workday and the work activity, the organization conditions);
- Specific aspects related to COVID-19 (emotional responses, stress factors specific to frontline staff, resilience and psychosocial support);
- Governance and care responsibilities (governance actions and medical support, psychological actions and tools adopted, psychological assessment areas).

In this study we analyzed in particular the psychological impact. This was measured based on the prevalence of self-reported feelings during the pandemic, including negative and positive emotional states, such as loneliness, anxiety, irritability, sadness, tiredness, insecurity, apathy, intolerance, frustration, insomnia, fear, impatience, impotence, anger, resignation, pride, satisfaction, trust, hope, solidarity, quiet ("*During the emergency, how often did you feel...*"). The responses were scored on a four-point Likert scale, depending on the frequency of each feeling experienced ("*Never or almost never*," "*Sometimes*," "*Often*," "*Always or almost always*").

Data Analysis

Descriptive statistics were carried out to analyse categorical variables; percentage of responses was calculated according to the number of respondents for each question compared to the total number of responses to a question.

We analyzed the relationship between factors of gender, age, geographic region, professional role, and operational unit, and the four-point scale used to rate the frequency of each emotional state experienced by performing several multinomial logistic regressions, one for each emotion, using the R function "multinom" (45). We performed this analysis to test whether the five abovementioned factors could be good predictors of the emotional experience by considering each emotion independently. Therefore, we built several models, one for each emotion that represented our categorical dependent variable with four levels, where we entered the five factors as independent categorical variables. The categorical nature of our variables made suitable this type of analysis; however, the data were previously evaluated to ensure that all the other model's assumptions were fulfilled too (sample size, outliers, multicollinearity). More specifically, first we used G*Power (46) software to confirm the minimum sample size necessary to detect a small population effect size at power = 0.95 for $\alpha = 0.05$ for the study's number of variables. Then, we checked carefully our data to avoid the possibility of outliers, and we ruled out multicollinearity by means of a correlation matrix.

Additionally, Spearman rank correlation was computed to assess correlations with all the emotions. P values < 0.05 were considered statistically significant, and missing values were excluded for analysis purposes. Data were processed and analyzed in accordance with the privacy protection legislation, and the results of the data analysis were disclosed exclusively in aggregate form.

Furthermore, we performed the Harman's single factor test by using the R function "fa" and choosing the principal axis factoring for extraction to rule out common-method variance bias.

RESULTS

Sample Details

In total 577 people completed the online survey. One participant was excluded due to an excessive lack of demographic information, yielding a final sample of 576 participants (68% females) with mean age of 44.3 (SD = 11.9, range = 22–69). Of these, 38.7% were doctors, while 61.3% were other Healthcare workers, mostly nurses (81%) and for this reason, in the tables and in the results section, we used the label "nurses" to indicate the respondents belonging to all the other healthcare professions involved. About 68.9% of the sample was from northern Italy (54.5% North-East, 14.4% North-West), and 30.9% was from central-southern regions (21% central regions, 8.3% South, 1.6% islands). Regarding the operating unit or department, 16.3% worked within the *ad hoc* created COVID units, 5.6% in anesthesia, reanimation and intensive care, and 73.4% in other departments. **Table 1** summarizes the details of the study sample.

TABLE 1 | Demographic characteristics of the sample.

***N* = 576**	***N* (%)**
Gender	
F	392 (68.1%)
M	184 (31.9%)
Age category	
≤34	162 (28.1%)
35–54	268 (46.5%)
≥55	146 (25.3%)
Professional role	
Doctor	223 (38.7%)
Nurse	353 (61.3%)
Region of Italy	
North	397 (68.9%)
Centre-South	178 (30.9%)
Missing	1 (0.2%)
Operational Unit	
Anesthesia/Reanimation/Intensive care	32 (5.6%)
New COVID unit	94 (16.3%)
Other	423 (73.4%)
Missing	27 (4.7%)

TABLE 2 | Self-reported prevalence of negative feelings.

N = 576	*N* (%)	*N* = 576	*N* (%)	*N* = 576	*N* (%)
Loneliness		**Insecurity**		**Fear**	
Never or almost never	264 (45.8%)	Never or almost never	160 (27.8%)	Never or almost never	212 (36.8%)
Sometimes	213 (37.0%)	Sometimes	278 (48.3%)	Sometimes	266 (46.2%)
Often	89 (15.5%)	Often	123 (21.4%)	Often	85 (14.8%)
Almost always or always	10 (1.7%)	Almost always or always	15 (2.6%)	Almost always or always	13 (2.3%)
Anxiety		**Intolerance**		**Impatience**	
Never or almost never	135 (23.4%)	Never or almost never	205 (35.6%)	Never or almost never	233 (40.5%)
Sometimes	276 (47.9%)	Sometimes	238 (41.3%)	Sometimes	242 (42.0%)
Often	139 (24.1%)	Often	118 (20.5%)	Often	87 (15.1%)
Almost always or always	26 (4.5%)	Almost always or always	15 (2.6%)	Almost always or always	14 (2.4%)
Irritability		**Frustration**		**Impotence**	
Never or almost never	106 (18.4%)	Never or almost never	189 (32.8%)	Never or almost never	157 (27.3%)
Sometimes	256 (44.4%)	Sometimes	221 (38.4%)	Sometimes	244 (42.4%)
Often	187 (32.5%)	Often	144 (25.0%)	Often	143 (24.8%)
Almost always or always	25 (4.3%)	Almost always or always	22 (3.8%)	Almost always or always	32 (5.6%)
Missing	2 (0.3%)				
Sadness		**Insomnia**		**Anger**	
Never or almost never	144 (25.0%)	Never or almost never	246 (42.7%)	Never or almost never	186 (32.3%)
Sometimes	263 (45.7%)	Sometimes	170 (29.5%)	Sometimes	236 (41.0%)
Often	147 (25.5%)	Often	117 (20.3%)	Often	134 (23.3%)
Almost always or always	22 (3.8%)	Almost always or always	43 (7.5%)	Almost always or always	20 (3.5%)
Tiredness		**Apathy**		**Resignation**	
Never or almost never	72 (12.5%)	Never or almost never	400 (69.4%)	Never or almost never	279 (48.4%)
Sometimes	232 (40.3%)	Sometimes	124 (21.5%)	Sometimes	195 (33.9%)
Often	233 (40.5%)	Often	41 (7.1%)	Often	88 (15.3%)
Almost always or always	37 (6.4%)	Almost always or always	11 (1.9%)	Almost always or always	13 (2.3%)
Missing	2 (0.3%)			Missing	1 (0.2%)

Psychological Impact

Descriptive analysis showed that more than half of the HCWs experienced all the emotional states investigated, in respecting of the valance, with the exception of apathy (30.5%), at least sometimes (loneliness 54.2%, anxiety 76.5%, irritability 81.2, sadness 75%, tiredness 87.2%, insecurity 72.3%, intolerance 64.4%, frustration 67.2%, insomnia 57.3%, fear 63.3%, impatience 59.5%, impotence 72.8%, anger 67.8%, resignation 51.5%, pride 68.6%, satisfaction 83.8%, trust 87.5%, hope 90.4%, solidarity 94.8%, quiet 79.9%) (**Tables 2**, **3**). Correlation analysis across all the emotional states experience during the COVID-19 outbreak is reported in **Table 4**.

Multinomial logistic regressions determined the relationship between demographic factors of gender, age, geographic region, professional role, and operational unit and scores (never, sometimes, often, always) obtained from the psychological impact category (loneliness, anxiety, irritability, sadness, tiredness, insecurity, apathy, intolerance, frustration, insomnia, fear, impatience, impotence, anger, resignation, pride, satisfaction, trust, hope, solidarity, quiet) (**Tables 5**, **6**).

Furthermore, Harman's single factor test showed the total variance explained by a single factor was 28%, which falls well below the threshold of 50%. Thus, common method bias does not appear to be a significant factor in the current research.

Multinomial Logistic Regression: Negative Feelings

Gender was found to be a good predictor of all negative feelings, except for apathy, impatience, anger, and resignation. These last four emotions seemed to be equally not well predicted by the gender factor; among the others, the relationship between gender and loneliness was the one with the lowest significance, while those with insecurity, insomnia, and fear showed high significance. Females experienced more distress (loneliness 58.1%, anxiety 82.1%, irritability 83.6%, sadness 79.3%, tiredness 90.4%, insecurity 72.3%, intolerance 78%, frustration 69.6%,

TABLE 3 | Self-reported prevalence of positive feelings.

N = 576	*N* (%)	*N* = 576	*N* (%)
Pride		**Hope**	
Never or almost never	181 (31.4%)	Never or almost never	55 (9.5%)
Sometimes	216 (37.5%)	Sometimes	201 (34.9%)
Often	144 (25.0%)	Often	249 (43.2%)
Almost always or always	35 (6.1%)	Almost always or always	71 (12.3%)
Satisfaction		**Solidarity**	
Never or almost never	93 (16.1%)	Never or almost never	30 (5.2%)
Sometimes	272 (47.2%)	Sometimes	133 (23.1%)
Often	186 (32.3%)	Often	299 (51.9%)
Almost always or always	25 (4.3%)	Almost always or always	114 (19.8%)
Trust		**Quiet**	
Never or almost never	72 (12.5%)	Never or almost never	116 (20.1%)
Sometimes	266 (46.2%)	Sometimes	263 (45.7%)
Often	202 (35.1%)	Often	170 (29.5%)
Almost always or always	36 (6.2%)	Almost always or always	27 (4.7%)

insomnia 64.3%, fear 69.7%, impotence 76%) than males (loneliness 45.7%, anxiety 64.7%, irritability 76%, sadness 65.8%, tiredness 80.5%, insecurity 59.8%, intolerance 56.5%, frustration 62%, insomnia 42.4%, fear 49.5%, impotence 65.8%).

Age was predictive of loneliness, and insecurity, with a high significance, and of anxiety, irritability, and apathy with a medium significance; however it did not affect the other feelings among which, resignation was the only one to approach a low significance although without reaching it. The < 34-year-old age group experienced psychological distress more often (loneliness 67.9%, anxiety 83.3%, irritability 84%, insecurity 79%, apathy 40.1%) than the > 55 year-old-age group (loneliness 43.1%, anxiety 72%, irritability 78.8%, insecurity 65.7%, apathy 25.7%).

Region was found to be a good predictor of loneliness, anxiety, irritability, tiredness, insecurity, intolerance, frustration, and impotence. The relationship between region and loneliness was the one with the lowest significance, while those with tiredness, insecurity, and frustration showed quite high significance. Respondents from northern Italy showed higher distress (loneliness 52.9%, anxiety 79.4%, irritability 83.3%, tiredness 89.4%, insecurity 76.8%, intolerance 67.8%, frustration 72%, and impotence 76.5%) than those working in the central-southern Italy (loneliness 46.1%, anxiety 70.3%, irritability 76.4%, tiredness 82%, insecurity 62.4%, intolerance 57.3%, frustration 56.7%, and impotence 64.7%).

With regard to the *Professional role*, only tiredness and impatience were found to be predicted by this factor, with a high significance for the former and a medium one for the latter;

TABLE 4 | Spearman correlation coefficient rho: associations across all the emotional states.

	Loneliness	Pride	Anxiety	Satisfaction	Irritability	Sadness	Tiredness	Insecurity	Intolerance	Trust	Frustration	Insomnia	Hope	Apathy	Fear	Solidarity	Impatience	Quiet	Impotence	Anger
Loneliness	–																			
Pride	−0.016	–																		
Anxiety	**0.331*** **	**−0.099***	–																	
Satisfaction	**−0.125*** **	**0.590*** **	**−0.149*** **	–																
Irritability	**0.276*** **	**−0.086***	**0.520*** **	**−0.151*** **	–															
Sadness	**0.411*** **	−0.071	**0.455*** **	**−0.131*** **	**0.410*** **	–														
Tiredness	**0.281*** **	0.063	**0.418*** **	0.003	**0.458*** **	**0.432*** **	–													
Insecurity	**0.221*** **	−0.069	**0.476*** **	**−0.134*** **	**0.347*** **	**0.394*** **	**0.338*** **	–												
Intolerance	**0.300*** **	−0.078	**0.353*** **	**−0.259*** **	**0.467*** **	**0.383*** **	**0.325*** **	**0.416*** **	–											
Trust	**−0.190*** **	**0.288*** **	**−0.194*** **	**0.509*** **	**−0.236*** **	**−0.182*** **	−0.065	**−0.243*** **	**−0.250*** **	–										
Frustration	**0.336*** **	**−0.113***	**0.461*** **	**−0.253*** **	**0.454*** **	**0.440*** **	**0.359*** **	**0.378*** **	**0.443*** **	**−0.308*** **	–									
Insomnia	**0.333*** **	0.013	**0.393*** **	−0.01	**0.348*** **	**0.401*** **	**0.400*** **	**0.281*** **	**0.295*** **	**−0.083***	**0.354*** **	–								
Hope	**−0.130*** **	**0.249*** **	**−0.112*** **	**0.413*** **	**−0.144*** **	**−0.082***	0.012	**−0.126*** **	**−0.148*** **	**0.605*** **	**−0.152*** **	−0.025	–							
Apathy	**0.238*** **	**−0.116*** **	**0.293*** **	**−0.180*** **	**0.303*** **	**0.304*** **	**0.227*** **	**0.297*** **	**0.367*** **	**−0.231*** **	**0.349*** **	**0.223*** **	**−0.210*** **	–						
Fear	**0.294*** **	−0.001	**0.533*** **	−0.032	**0.329*** **	**0.391*** **	**0.238*** **	**0.416*** **	**0.253*** **	**−0.107***	**0.346*** **	**0.300*** **	0.003	**0.250*** **	–					
Solidarity	**−0.022**	**0.280*** **	0.029	**0.392*** **	−0.025	0.066	**0.101***	−0.006	**−0.103***	**0.401*** **	−0.008	**0.128*** **	**0.520*** **	**−0.169*** **	**0.092***	–				
Impatience	**0.218*** **	−0.021	**0.282*** **	**−0.100***	**0.461*** **	**0.290*** **	**0.294*** **	**0.285*** **	**0.485*** **	**−0.113*** **	**0.315*** **	**0.298*** **	−0.072	**0.428*** **	**0.184*** **	−0.053	–			
Quiet	**−0.253*** **	**0.118*** **	**−0.374*** **	**0.313*** **	**−0.356*** **	**−0.276*** **	**−0.239*** **	**−0.322*** **	**−0.240*** **	**0.502*** **	**−0.293*** **	**−0.208*** **	**0.421*** **	**−0.156*** **	**−0.272*** **	**0.242*** **	**−0.195*** **	–		
Impotence	**0.275*** **	−0.053	**0.395*** **	**−0.193*** **	**0.324*** **	**0.450*** **	**0.266*** **	**0.350*** **	**0.359*** **	**−0.174*** **	**0.492*** **	**0.351*** **	−0.028	**0.279*** **	**0.380*** **	**0.151*** **	**0.326*** **	**−0.251*** **	–	
Anger	**0.286*** **	−0.059	**0.362*** **	**−0.139*** **	**0.490*** **	**0.464*** **	**0.313*** **	**0.301*** **	**0.415*** **	**−0.202*** **	**0.462*** **	**0.288*** **	**−0.094***	**0.348*** **	**0.304*** **	−0.026	**0.411*** **	**−0.254*** **	**0.492*** **	–
Resignation	**0.274*** **	**−0.083***	**0.266*** **	**−0.195*** **	**0.248*** **	**0.327*** **	**0.232*** **	**0.313*** **	**0.390*** **	**−0.181*** **	**0.352*** **	**0.198*** **	**−0.166*** **	**0.385*** **	**0.245*** **	**−0.108***	**0.331*** **	**−0.197*** **	**0.423*** **	**0.427*** **

*Bold data indicate significant correlations; *** $p < 0.0001$, ** $p < 0.01$, * $p < 0.05$.*

TABLE 5 | Multinomial logistic regressions omnibus Likelihood Ratio tests for psychological impact category encompassing negative feelings and demographic factors (gender, age, geographical region, professional role, operational unit).

	χ^2	Df	*p*
Gender			
Loneliness	7.94	3	**0.047**
Anxiety	24.83	3	**<0.001**
Irritability	10.57	3	**0.014**
Sadness	14.72	3	**0.002**
Tiredness	16.1	3	**0.001**
Insecurity	18.29	3	**<0.001**
Intolerance	10.41	3	**0.015**
Frustration	15.5	3	**0.016**
Insomnia	24.65	3	**<0.001**
Apathy	4.47	3	0.214
Fear	22.811	3	**<0.001**
Impatience	0.678	3	0.878
Impotence	13.14	3	**0.004**
Anger	3.96	3	0.266
Resignation	3.16	3	0.367
Age			
Loneliness	29.07	6	**<0.001**
Anxiety	14.93	6	**0.021**
Irritability	16.60	6	**0.011**
Sadness	7.96	6	0.240
Tiredness	9.95	6	0.126
Insecurity	21.80	6	**0.001**
Intolerance	11.41	6	0.076
Frustration	7.95	6	0.241
Insomnia	2.10	6	0.91
Apathy	15.67	6	**0.016**
Fear	5.58	6	0.472
Impatience	10.27	6	0.114
Impotence	11.14	6	0.084
Anger	7.88	6	0.247
Resignation	11.74	6	0.068
Region			
Loneliness	7.96	3	**0.047**
Anxiety	11.13	3	**0.011**
Irritability	10.06	3	**0.018**
Sadness	3.066	3	0.381
Tiredness	14.6	3	**0.002**
Insecurity	12.06	3	**0.007**
Intolerance	9.22	3	**0.026**
Frustration	13	3	**0.005**
Insomnia	5.8	3	0.123
Apathy	3.86	3	0.277
Fear	1.35	3	0.717
Impatience	5.76	3	0.124
Impotence	9.28	3	**0.026**
Anger	6.87	3	0.076
Resignation	4.1	3	0.251
Professional Role			
Loneliness	2.89	3	0.409
Anxiety	3.39	3	0.335
Irritability	4.09	3	0.252
Sadness	1.31	3	0.727
Tiredness	16.1	3	**0.001**
Insecurity	3.23	3	0.35
Intolerance	6.69	3	0.082
Frustration	3.72	3	0.293
Insomnia	1.46	3	0.69
Apathy	6.26	3	0.099
Fear	0.437	3	0.933
Impatience	10.97	3	**0.012**
Impotence	1.53	3	0.674
Anger	2.68	3	0.443
Resignation	4.42	3	0.219
Operational unit			
Loneliness	10.28	6	0.113
Anxiety	15.80	6	**0.015**
Irritability	8.61	6	0.197
Sadness	8.78	6	0.186
Tiredness	15.1	6	**0.019**
Insecurity	7.15	6	0.307
Intolerance	2.84	6	0.828
Frustration	1551	6	**0.016**
Insomnia	10.99	6	0.088
Apathy	4.87	6	0.559
Fear	7.86	6	0.248
Impatience	3.42	6	0.754
Impotence	4.97	6	0.548
Anger	4.8	6	0.569
Resignation	4.18	6	0.651

Significant P values are highlighted in bold.
Chi-square value, degrees of freedom and significance are reported.

doctors reported feeling tired always or almost always (9.4%) and impatient often (19.7%) to a greater extent than nurses (respectively 4.5% and 12.2%). All the other feelings were far from being affected by this factor. This data shows that all health workers experienced psychological stress almost equally.

Lastly, *Operational unit* was predictive only of anxiety, tiredness, and frustration with medium significance for all these feelings. HCWs working in the *ad hoc* created COVID-19 units experienced more often the psychological distress (anxiety 78.7%, tiredness 93.6%, frustration 81.9%), than those working in anesthesia, reanimation and intensive care unit (anxiety 68.7%, tiredness, 78.1% frustration 53.1%). **Table 5** summarizes multinomial logistic regressions omnibus Likelihood Ratio tests for psychological impact category encompassing negative feelings and demographic factors (all the models coefficients, standard errors and relative significance are reported in the **Supplementary Material**).

TABLE 6 | Multinomial logistic regressions omnibus Likelihood Ratio for psychological impact category encompassing positive feelings and demographic factors (gender, age, geographical region, professional role, operational unit).

	χ^2	Df	*p*
Gender			
Quiet	23.16	3	**<0.001**
Solidarity	8.5	3	**0.036**
Hope	5.22	3	0.156
Trust	7.97	3	**0.046**
Satisfaction	15.22	3	**0.002**
Pride	2.892	3	0.409
Age			
Quiet	20.96	6	**0.001**
Solidarity	19.51	6	**0.003**
Hope	24.55	6	**<0.001**
Trust	18.25	6	**0.005**
Satisfaction	9.45	6	0.150
Pride	5.429	6	0.490
Region			
Quiet	2.48	3	0.478
Solidarity	7.07	3	0.069
Hope	2.23	3	0.526
Trust	1.43	3	0.696
Satisfaction	2.77	3	0.428
Pride	0.338	3	0.953
Professional role			
Quiet	6	3	0.111
Solidarity	0.43	3	0.935
Hope	1.65	3	0.648
Trust	1.62	3	0.654
Satisfaction	9.62	3	**0.022**
Pride	1.758	3	0.624
Operational unit			
Quiet	7.73	6	0.257
Solidarity	12.90	6	**0.044**
Hope	2.48	6	0.87
Trust	7.60	6	0.269
Satisfaction	5.49	6	0.483
Pride	6.323	6	0.388

Significant P values are highlighted in bold.
Chi-square value, degrees of freedom and significance are reported.

Multinomial Logistic Regression: Positive Feelings

Gender was found to be a good predictor of quiet, solidarity, satisfaction, and trust but not of hope, and pride. Particularly, quiet and satisfaction were the best feelings predicted by this factor with a high significance, followed by solidarity and trust with a medium to low significance. These feelings were more prevalent among females (quiet 79.9%, solidarity 94.8%, satisfaction 83.8%, trust 86.2%). *Age* was predictive of all positive emotions, showing a high significance, except for satisfaction and pride. The > 55-year-old age group experienced more often these feelings (trust 91.2%, hope 94.5%, solidarity 98.6%, quiet 85%) than the > 34-year-old age group (trust 81.5%, hope 85.8%, solidarity 92.5%, quiet 75.4%). As to the *Professional role*, only satisfaction was found to be predicted with a medium to low significance by this factor; this feeling was felt to a greater extent by doctors (86.5%) than nurses (82.1%). Lastly, one low significant relationship was only found between the *Operational unit* and solidarity: HCWs based in anesthesia, reanimation, intensive care units experienced more often this feeling (99.9%) than other units (94.6%). All the other feelings were far from being affected by this factor. However, *Region* did not likely affect the experience of all the positive emotions. This data suggests that HCWs contacted with our questionnaires across Italy experienced the same feelings.

Table 6 summarizes multinomial logistic regressions omnibus Likelihood Ratio tests for psychological impact category encompassing positive feelings and demographic factors (all the models coefficients, standard errors and relative significance are reported in the **Supplementary Material**).

DISCUSSION

Since the beginning of the pandemic, HCWs have been called on the frontline to cope with the current global health emergency. The emergency has imposed on them an overwhelming workload and emotional involvement, thus amplifying those psychosocial risk factors that normally characterize the healthcare sector (21–23, 25, 47). The situation was aggravated by the necessary measures adopted by governments to reduce the spread of the virus such as social distancing and quarantine, which significantly affected their emotional stability and which made impossible for them to benefit from the normal support of family members and friends who are known to represent an asset, a protective factor, especially in difficult times (48–51).

Previous studies have shown that frontline HCWs treating COVID-19 patients experienced higher risk of several symptoms such as anxiety, depression, and insomnia as well as negative feelings including tense, scared, angry, sad, afraid, and impressed (13, 25, 32, 33, 52). Italian health workers, for instance, reported a high level of burnout, psychological symptoms, and emotional exhaustion during COVID-19 pandemic (53). Positive feelings, on the other hand, including conscientiousness and self-sacrifice for patients were also reported by HCWs while they were putting their health and live at risk for patients (43, 44). This finding is particularly interesting as positive emotional states have rarely been investigated in HCWs working in similar circumstances.

With the present study we enrich the extant literature by analyzing the nature and the severity of the psychological complaints reported by the HCWs during the first COVID-19 outbreak in Italy, and by identifying possible predictive factors that led to significant differences in experiencing such psychological distress. Furthermore, we analyzed the possible experience of positive emotions to highlight possible protective factors needed for adaptive coping. We carried out multinomial logistic regressions to investigate

the relationship between 21 accurately selected emotional states, negative and positive (loneliness, anxiety, irritability, sadness, tiredness, insecurity, apathy, intolerance, frustration, insomnia, fear, impatience, impotence, anger, resignation, pride, satisfaction, trust, hope, solidarity, quiet), and five possible predictor factors (gender, age, region of Italy, professional role, operational unit).

Regarding the negative feelings, we found that more than half of the HCWs experienced all the emotional states investigated at least sometimes, with the exception of apathy (30.5% of the sample). The most frequently felt emotions were tiredness, irritability, anxiety, and sadness respectively. Factors associated with a higher psychological impact included being a woman, living in northern Italy and young age. These results are in line with the recent literature reporting higher levels of psychological distress in women and young adults (9, 18, 54). Our findings have shown that this holds true for HCWs.

More than half of the HCWs also experienced all positive feelings with the most frequently felt being solidarity, a feeling that has also been reported for the general population in different countries during this health emergency (55). Factors associated with higher experience of these emotional states included female gender and older age.

Differently from other studies, in which the role of health workers and the type of unit mattered (32, 56), we found that the majority of the negative as well as positive emotional states were experienced almost equally by both doctors and nurses, and independently of the operational unit in which they operated. Our finding highlights the importance of investigating both the working role and unit that led to the psychological discomfort, as it has been done in most studies on this subject to date, and the specific emotions as the distinct, contributing factors.

Our results showed also that, overall, female respondents experienced emotional states, be them negative or positive, more often than men. The prevalence of the psychological impact on women may partly reflect gender differences in self-disclosure and in expressing one's feelings: women have been reported before being more likely than men to report their emotional states, especially the negative ones associated with psychological difficulties (57–59). On the other hand, younger health workers suffered psychological distress more frequently than the older ones who, instead, experienced more positive emotions. This pattern of results observed with HCWs extends the observation during this pandemic that, in the general population, younger adults were subjected to stress, depression and anxiety, while older adults were found to score low on ratings about these measures, thus demonstrating more resilience and higher coping strategies (9, 18, 54). Lastly, territorial differences were found only in the negative emotions of the HCWs operating in northern Italy, as this was the most affected region especially around the time of our data collection.

Our results are in line with the research on the psychological impact caused by the present pandemic on the general population (9, 17, 60–62), as well as with that on a specific category of workers like HCWs (25, 26, 32, 53, 63–65). This study has several other merits. First, we considered differences in emotions experienced by respondents depending on their professional role, work units or departments, and regional territory, in addition to the other most studied demographic variables such as gender and age. Second, we investigated a broad spectrum of negative emotional states to better grasp for the complexity of the psychological experience during the pandemic. Third, we also analyzed positive feelings, often overlooked, as they can help us to better characterize to the full the HCWs emotional experience during the pandemic.

This study suffers from a number of weaknesses. First, we administered questionnaires that were not validated and contained one-item scale. This choice was motivated by our purposes to survey a broad spectrum of emotions of HCWs while the health emergency that imposed heavy timing and accessibility limits. Although single-item measures are very useful and accepted in circumstances like ours, with limited time and the need to minimize the burden of respondents who were already highly busy, suffering and tired, the use of multiple items is generally suggested because it helps to average out errors and specificities that are inherent in single items, thus leading to increased reliability and construct validity. Second, being a self-report, this questionnaire may suffer from social desirability bias which can confound relationships among the variables of interest, particularly regarding negative emotions, by obscuring or producing them artificially despite having been guaranteed anonymity. Third, another risk for self-report measures is the recall bias, especially when respondents have experienced heavy emotional events, as in our case, that may have distorted their memories by leading to an over or under-estimation of positive and/or negative past emotional experiences. However, since the questionnaire was spread a few months after the start of the health emergency, with questions relating to the recent and also current experience of the respondents, we believe the influence of this bias is low, even if it should be taken into account. Fourth, we spread the questionnaire in a period in which the workload was overwhelming for the respondents. This factor might have affected the participation, as well as the representativity of the sample which leans toward the female gender. In future studies more representative and balanced samples should be involved. As an exploratory study, the data were analyzed without multiplicity adjustment and the results were interpreted primarily as preliminary insights (66); therefore, future confirmatory studies are needed to test specific and definitive hypotheses. Moreover, the cross-sectional nature of the study and the lack of longitudinal follow-up do not allow inferences about the causal relationships among the variables, and the long-term consequences of the psychological impact we documented.

CONCLUSION

Our findings suggest that more than half of HCWs experienced psychological distress during the first COVID-19 outbreak in Italy, and that the factors associated with higher psychological impact included being female, young and living in northern Italy. The most frequently negative emotions reported were tiredness, irritability, anxiety, and sadness. However, positive feelings were

also experienced, first of all solidarity, especially by women and older people. Despite some limitations, we believe this study can be very useful as a contribution to the current literature on the psychological effects of this pandemic on health workers. Moreover our findings can inform future policies aimed at providing more tailored and effective psychological interventions in the ongoing and future emergencies. Noteworthy, the HCWs' burdens and mental sufferance affect not only their own health, but pose great concern on their families and friends, as well as on their patients (67). The emergency has been amplifying psychosocial risk factors, already present in the healthcare sector (21–23), that are associated with staff's working conditions, safety and health. Consequently, in addition to support interventions, it would be desirable that hospitals consider adopting work-family policies to foster HCWs' psychological wellbeing by improving their resilience and coping strategies (68). It has become ever so evident that the safeguard of these professionals is necessary and urgent to promote a positive quality of life for them and for the people they come into contact with.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories together with the R syntax file used for the analysis, and the questionnaires. The names of the repository/repositories and accession number(s) can be found below: OSF repository, https://osf.io/h8xyu/.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee, International School for Advanced Studies (SISSA). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

EP conducted the data analyses and wrote the first draft of the manuscript. All authors made important contributions to its final version, have read and approved the final version of the manuscript, and contributed to the study design of the study and its implementation.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.818674/full#supplementary-material

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Prevalence and Factors of Anxiety During the Coronavirus-2019 Pandemic Among Teachers in Saudi Arabia

Riyadh A. Alhazmi[1], Sultan Alghadeer[2], Mohamed N. Al-Arifi[2], Asma A. Alamer[3], Abdullah M. Mubarak[4], Abdulrahman Alwhaibi[2], Raghad Alfayez[2] and Sara Alsubaie[2]*

[1] Department of Emergency Medical Services, Prince Sultan Bin Abdulaziz College for Emergency Medical Services, King Saud University, Riyadh, Saudi Arabia, [2] Department of Clinical Pharmacy, College of Pharmacy – King Saud University, Riyadh, Saudi Arabia, [3] Department of Curricula and Teaching Methods, College of Education, King Faisal University, Al-Ahsa, Saudi Arabia, [4] Department of Basic Science, Prince Sultan Bin Abdulaziz College for Emergency Medical Services, King Saud University, Riyadh, Saudi Arabia

Background: Teachers play a central role in successful education. Due to the COVID-19 pandemic, regular in-person attendance in classes at all levels of education has been disrupted for more than 1 year in many countries. These lockdowns, which include the discontinuation of in person learning at schools and universities has presented a significant challenge for teachers to adapt to online teaching. Given this rapid format change, occupational anxiety levels among educators has increased.

Objective: The primary objective of this study was to assess the prevalence of anxiety among teachers in Saudi Arabia. A secondary objective was to explore characteristics of teachers associated with the level of anxiety level during the period of lockdown.

Methods: An anonymous, online cross-sectional study was carried for 3 months (February 2021 through April 2021). The questionnaire consisted of four sections and included the Generalized Anxiety Disorder instrument (GAD-7). Chi-square tests were completed for categorical comparisons while binary logistic regressions were used for associative relationship exploration. The IRB at King Saudi University Medical City, Saudi Arabia approved this study.

Results: A total of 742 respondents completed the survey yielding an anxiety prevalence of 58.2 % among teachers. Medium degree of statistically significant differences identified as marital status ($p = 0.046$). women had higher anxiety (65.3%) than men (34.7%) but gender with anxiety was low degree of statistical significance compared with non-anxiety status ($p = 0.697$). The odds of anxiety among middle teachers was twice (OR = 2.01) as high as the odds of anxiety among other levels of teacher ($p = 0.01$, 95% CI 0.94–4.26).

Conclusions: This study identified that many teachers experienced anxiety during the lockdown, especially women and middle school teachers. Future studies should identify contributing factors to estimate the magnitude of the exposure to anxiety between different types of teachers to help establish better preventive measures based on the workplace environment.

Keywords: COVID-19, pandemic, anxiety, education, occupational health, educator, teacher, mental

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****Correspondence:***
Riyadh A. Alhazmi
rialhazmi@ksu.edu.sa
orcid.org/0000-0002-7084-5645

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INTRODUCTION

With advances in education and curriculum, the teacher still plays a central role in a successful educational experience. Formal education is an integrated system, relying upon systematic and structural approaches provided in educational facilities (1). Through teachers, the learning process of formal education is intended to provide students with essential knowledge and skills required to achieve their desired goals. Therefore, regular in-person attendance for teachers and students is mandatory in most educational environments (2). However, many of the standard approaches have been suspended due to the COVID-19 pandemic.

While the disease is theorized to have emerged in Wuhan, China in December 2019 in <3 months the World Health Organization (WHO) declared COVID-19 a global pandemic (3–5). Shortly thereafter, the WHO announced comprehensive recommendations and preventive measures to reduce transmission and decrease the rate of new infections (5). The rapid onset and global spread of COVID-19 is not only one of the most critical public health emergencies in modern times, but the cascading effects on the health and wellbeing of persons is concurrently impacted across many areas of like. As a result of the pandemic, the changing of many aspects of life combined with a constant concern of transmission of infection, has increased anxiety worldwide (6).

Many countries adhered to WHO's recommendations including travel and work restrictions and educational institutions lockdown (5). In addition to their regular workload, teachers experienced a significant shift to online learning in many countries. The additional burdens of developing and deploying new teaching methods while potentially being exposed to a novel pathogen in-person led to a cumulative impact on the stress and anxiety among teachers (7, 8).

Temporary feelings of being anxious or tense will impact persons differently than chronic anxiety as these tend to be acute episodes. However, an event like a pandemic, can lead to extended anxiety, whether a formal anxiety disorder or chronic feelings of anxiousness, these episodes ng can have an adverse effect on one's quality of life as well as mental and physical health (9). Extended periods of anxiety and anxiety disorders can lead to other serious medical conditions such as heart diseases and cancer (10, 11). Otherwise healthy people experiencing high levels of stress can eventually develop health anxiety (12) which will cause people to suffer more, and have influence their thinking and decision-making processes in day to day life (13).

One study showed increased anxiety levels among teachers during the COVID-19 pandemic (14). High school teachers were found to develop an anxiety disorder more than teachers in other stages of education (15). Studies have assessed the incidence of anxiety among different occupations, finding teachers among the most impacted among occupations (16–23). Specifically, female teachers had higher levels of anxiety than male teachers. On the other hand, previous studies have not addressed an association between married teachers and anxiety level, as may be a step in realizing a contributing factor in anxiety level. Although, studies shown positive association between media exposure and anxiety level (24). More precisely, several studies showed exposure to different types of media information such as a twitter, TV news and other sources can a play an important role in anxiety level (25–27). Similarly, social media greatly impacted the level of anxiety during the period of COVID-19 (16, 26, 28). Evidence suggests that sharing concerns by social media improved people's mental condition for the period of COVID-19 crisis (29).

In Saudi Arabia, the first confirmed case was on March 2, 2020, resulting in implementing preventive measures in a line with the WHO guidelines (30). Our restrictive lockdowns included the closure of schools and universities was created a huge challenge to teachers to find ways to adapt to online teaching method. The stress of the pandemic and its impact on daily life can has significant effects on occupational health. Teachers around the world have been impacted by the lockdowns, however, there is very limited research examining teacher's mental health during COVID-19 in many nations, including Saudi Arabia. The primary objective of this study was to assess the prevalence of a state of anxiety among teachers in Saudi Arabia. A secondary objective was to explore characteristics of Saudi teachers and their association with anxiety level during the period of lockdown.

METHODS

Study Design and Population

A cross sectional study was completed using an anonymous online survey to assess the anxiety among Saudis' teachers during the period of COVID-19 pandemic. An invitational email was sent to educational regions in Saudi Arabia, in turn they distributed the survey link to comprehensive list of public and private education from primary through college teachers, instructors and faculty members. Study instructions and an electronic cover letter were shown at the beginning of the survey. The survey was conducted for 3 months (February 2021 through April 2021) to assess the prevalence of anxiety and its contributing factors. It was estimated that the total number of teachers in public schools and universities in Saudi Arabia is around 577,700 teachers according to the latest annual report of the Saudi Arabia Monetary Agency for population and workforce (31). Based on this number, the minimum sample size was calculated, with 95% confidence level and 5% margin of error, to be 384 participants. The institutional research board (IRB) at King Saud University Medical City approved the conduction of study (No. E-21-5914).

Survey Instrument and Data Analysis

The questionnaire consists of three sections, including demographics (i.e., age, gender, educational level, type of school, school location, and income), in addition to sources for gaining information about COVID-19. The second section included the behavioral status and commitment of teachers to the health policy restricted regulations toward COVID-19. All behavioral questions such as wearing mask, increased hand washing, social distancing, and limited family gatherings were categorized into three levels: high (if all answers were correct), moderate (with some correct answers), and low/none (with incorrect answers for all questions). The final section was

the Generalized Anxiety Disorder instrument (GAD-7) of an Arabic version and was used after the permission of author was obtained.

Cronbach's alpha has been calculated with 0.817 ($\alpha > 0.7$) of the behavioral status and GAD-7 all together and reported in additional file (**Supplementary Material 3**). A comparison of the instruments found the Cronbach's alpha was 0.763 (32). The Inter-Item Correlation Matrix showed there is sufficiently weak correlation between the independent variables (<0.7) (**Supplementary Material 3**). It was assessed by scores of 0, 1, 2, and 3 to answers options of (never, several days, more than half the days and nearly every day). The total score ranged from 0 to 4 indicated no anxiety, scores of 5–9 indicated mild anxiety, scores of 10 to 14 showed moderate anxiety and scores of 15–21 showed severe anxiety.

Categorical data were shown as frequency, mutually exclusive and had expected count <5 with 20.14 of the minimum expected count, compared using chi-squared test. Categorical data were shown as frequency including dichotomous outcome with, dichotomous nominal and ordinal independent variables. Spearman's rho was performed to test outliers and correlation (**Supplementary Material 2**). Consequently, the data successfully met the assumptions that are required for Binary logistic regression model used to obtain odds ratio (OR) and their associated 95% confidence interval (CI).

The degree of statistical significance was set based on near or far from a *P*-value of = 0.05 with very high, high, medium, low, and very low significance to a *P*-value of = 0.05. Analysis was performed using Statistical Package for the Social Sciences 24 (IBM-SPSS-24). The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

RESULTS

A total of 742 respondents completed the survey. Most respondents (64.6%) were women. According to an Arabic version of GAD-7 survey, the prevalence of anxiety in Saudi teachers was 58.2%, showed by **Figure 1**. Of these 742 respondents, 42, 35, 15, and 8%. Had no, mild, moderate and severe anxiety, respectively, described in **Figure 1**.

Table 1 presents the features of respondents by anxiety vs. non-anxiety status with the only medium degree of statistically significant differences identified as marital status ($p = 0.046$). Our results showed that women had higher anxiety (65.3%) than men (34.7%) but gender with anxiety was low degree of statistical significance compared with non-anxiety status ($p = 0.697$). In addition, fears teaching online and getting infected were very high degree of statistical significance $P = 0.001$ with OR and 95%CI of 1.936 (1.319–2.841) and 1.739 (1.246–2.426), respectively. However, the behavior status was very low degree of statistical significance.

Participant's responses were explored to look for an association using binary logistic regression with binary outcome of anxiety and without anxiety as shown in **Table 2**. Male gender was found to have very low degree of a statistically significantly association ($p = 0.36$, OR 0.830, 95% CI 0.556–1.240). However, the odds of anxiety among middle teachers was twice (OR = 2.01) as high as the odds of anxiety among other levels of teacher ($p = 0.01$, 95% CI 0.94–4.26). Furthermore, teachers who used social media as source of pandemic information had increased 1.6 times the odds of anxiety compared to persons not reporting pandemic related information from social media (95% CI, 1.08–2.3) with $p = 0.02$.

DISCUSSION

Education is a fundamental institution for development of social and cultural aspects in every country. Schools serve not only as learning centers but as centers for development. The COVID-19 pandemic response resulted in schools and universities in most countries including Saudi Arabia being closed and moved to online educational methods (5). The rapid proliferation of online education through various digital platforms not only impacts a person's teaching skills but also their mental health.

In this study of 742 teachers completing an online cross-sectional survey, the majority of teachers (58.2%, $n = 433$) reported increased anxiety during the lockdown, with 35.3% reporting mild anxiety. While globally there is limited research in this area, these findings align with previously conducted research confirming teacher anxiety during lockdown (14). However, we believe there may be significant underreporting of anxiety due in part to the time of this study and that the teachers may be underestimating the situation. The nature of teaching requires continuous work and daily preparations to carry out the educational objectives. This effort, by its nature, is a source of increasing stress and anxiety level among teachers (7, 8). Nevertheless, the anxiety felt by the teachers during the COVID-19 pandemic has been higher than prior to the lockdowns (14). This is likely due to restricted social movements and consistent health anxiety and concerns about the pandemic (33). In addition, utilizing online teaching method involves a high level of anxiety among teachers (14).

Teachers serve different stages of education such as primary, middle, high school and… etc. Therefore, they face varying levels of anxiety and stress. In COVID-19 pandemic, previous research found high school teachers confronted an increased level of anxiety and stress compared to other stages of education (15). In our study, the findings showed an association between the types of teacher stage and anxiety, in which middle teachers were highly associated with anxiety level during the lockdown. In contrast, Ozamiz-Etxebarria et al. found primary teachers showed a high level of anxiety during lockdown (14). These results indicate teachers are exposed to a great amount of anxiety and stress depends on the stage of education. Our result showed ages group of middle education (13–15 years) could cause more stress and pressure to the teachers. This could be students at these ages want to be more independent and give physiological changes can be more irritable, distant, and disobedient (34). Consequently, it can be a source of stress and conflict for teachers working in the middle school education. Not to mention, online teaching requires more attention from teachers which increases challenges

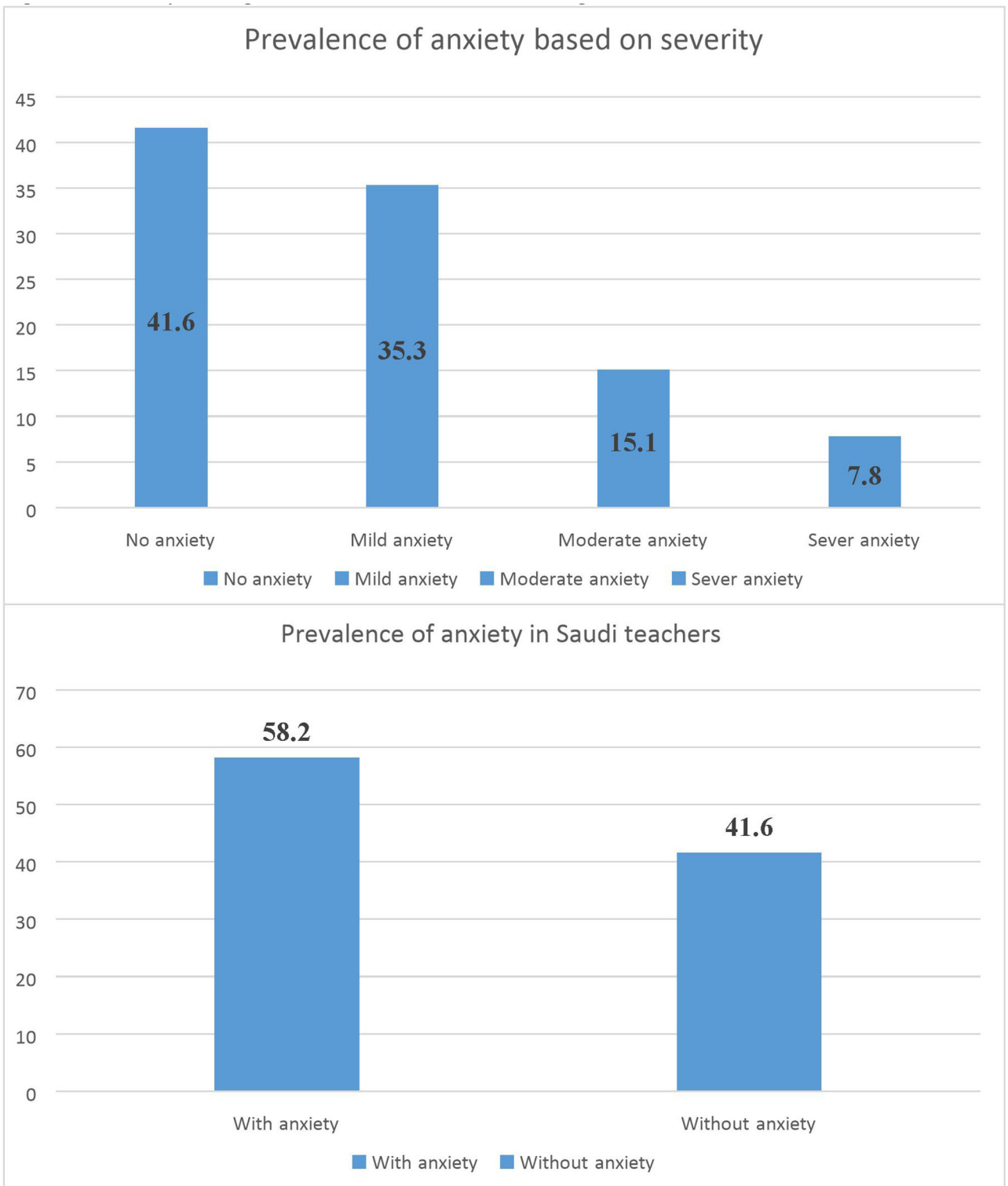

FIGURE 1 | Anxiety among teachers in Saudi Arabia during COVID-19 pandemic.

TABLE 1 | Demographics of the teachers based on their anxiety status.

Demographics	All respondent (n = 742)	With anxiety (n= 432)	Without anxiety (n = 310)	*P*-value*
Sex				0.697
Male	263 (35.4%)	150 (34.7%)	112 (36.2%)	
Female	479 (64.6%)	282 (65.3%)	197 (63.8%)	
Marital status				0.046
Married	426 (57.4%)	233 (54.2%)	192 (63.4%)	
Single	271 (36.5%)	172 (40.1%)	99 (32.7%)	
Divorced	36 (4.9%)	24 (5.6%)	12 (9.0%)	
Type of teachers				0.051
Primary teachers	206 (27.8%)	108 (25%)	98 (31.7%)	
Secondary teachers	88 (11.9%)	61 (14.1%)	27 (8.7%)	
High teachers	239 (32.2%)	114 (33.3%)	95 (30.7%)	
University teachers	209 (28.2%)	119 (27.55%)	89 (28.8%)	
Information resources				
Internet	281 (37.9%)	147 (34.3)	133 (43.2)	
Friends	2.8 (21.0)	13 (3.0)	8 (2.6)	0.061
Social media	329 (44.3)	208 (48.6)	121 (39.3)	
TV	106 (14.3)	60 (14.0)	46 (14.9)	
Teach online				0.003
Yes	217 (29.2)	145 (33.8)	72 (23.8)	
No	516 (69.5)	284 (66.2)	231 (76.2)	
COVID 19 infected				
Yes	346 (46.6)	223 (51.6)	123 (39.8)	0.002
No	396 (53.4)	209 (48.4)	185 (60.2)	

**P-value is calculated by Chi Square test.*

in completing all the new requirements in a timely manner. The result indicates a need for further research to identify factors that might be a cause of anxiety for middle teachers during COVID-19 outbreak and lockdown.

The sex differences in anxiety levels have been the subject of numerous studies with women more likely to report anxiety during the current pandemic (16–23). In our study, the results found similar degree of evidence between anxiety and sex. However, our study showed marital status to be a factor at increased level of anxiety. This suggests married teachers are more likely to display higher levels of anxiety than their single counterpart. The pandemic could have an amplifying effect to anxiety especially for teachers with children because they have to adapt to new teaching strategies using different medium of instruction along with childcare and household responsibilities.

In our study, there is also a positive association between anxiety and social media exposure compared to other information resources. Recent research has recognized a positive association between media exposure and anxiety before and during the current pandemic (16, 24, 26, 28). In addition, studies conducted in Saudi Arabia (25), UK (26), and China (27) showed the effects of different types of media sources on person's anxiety level. A consensus was reached that social media consumption is linked to higher levels of anxiety compared to other media platforms. Similarly, our findings suggest that teachers who receive their information about the pandemic from social platforms are also more likely to have anxiety. However, it is unclear whether persons with anxiety tend to use social medial platforms to seek information or that social media consumption aggravates mental health issues. Therefore, establishing any cause and effect relation could be misleading. Social media could have positive effect on mental health such as providing social support through this difficult period (29). On the other hand, misinformation along with rumors are easily disseminated through social media platforms in comparison to traditional platforms where information is verified and controlled. Future research should evaluate the difference between types of information shown in different types of media resources as well as how fast it can impact teachers' perspective.

LIMITATIONS

In our study, numerous limitations need to be recognized. First, our findings are not generalizable to the entire population because of the cross-sectional nature of the research. Second, the study did not cover age groups and years of experience of teachers. Varying ages and years of experience might be a factor of negatively or positively increasing a level of anxiety in the COVID-19 pandemic. Third, there is also the possibility of selection bias since the research was performed with an online questionnaire. Teachers who are unable or unwilling to

TABLE 2 | Association between participants responses with presence of anxiety.

Demographics	OR (95% CI)	*p*-value*
Gender		
Sex	Reference	-
Male	0.830 (0.556–1.240)	0.363
Marital status		
Married	Reference	-
Single	1.334 (0.835–2.130)	0.228
Divorced	1.543 (0.684–3.485)	0.296
Education level		
Primary/secondary school	0.957 (0.162–5.638)	0.961
High school	2.005 (0.944–4.262)	0.070
University	1.352 (0.767–2.384)	0.307
High education	Reference	-
Type of teachers		
Primary teachers	Reference	-
Secondary teachers	2.091 (2.091–1.169)	0.013
High teachers	1.128 (0.728–1.749)	0.590
University teachers	1.123 (0.664–1.901)	0.665
Information resources		
Internet	Reference	-
Friends	2.068 (0.713–5.998)	0.181
Social media	1.557 (1.083–2.237)	0.017
TV	1.315 (0.789–2.189)	0.293
Teach online		
No	Reference	-
Yes	1.936 (1.319–2.841)	0.001
COVID 19 infected		
No	Reference	-
Yes	1.739 (1.246–2.426)	0.001

OR, odds ratio; CI, confidence interval.
**Significant result at a = 0.05.*

use smartphones or email could not participate in the study. Fourth, the study did not include a section related to teachers with pre-existing anxiety disorders such as panic attack, social health anxiety, social phobia, or generalized anxiety disorder (GAD) that can be associated with teachers. Future research should consider pre-existing anxiety disorders when carrying out teachers' mental health study. Last, the study showed marital status is associated with level of anxiety, and yet, the study did not address the number of children one's have and their possible effect on anxiety.

CONCLUSION

This study identified that many teachers experienced anxiety during the lockdown. We found that most teachers (58.2%, $n = 432.5$) reported anxiety during the lockdown especially women and middle school teachers. Future studies should identify contributing factors to estimate the magnitude of the exposure to anxiety between different types of teachers to help establish better preventive measures based on the workplace environment. In addition, our study showed a positive association between anxiety and social media exposure compared to other information resources. Future research should evaluate the difference between types of information shown in different types of media resources as well as how fast it can impact teachers' perspective.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by IRB approval letter. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

RAA, SAlg, and MA-A provided the main framework and identified main factors and materials. AAla, AAlw, and RA collaborated in identifying appropriate references and collaborated in writing the manuscript. SAls and SAlg were involved in data collection and cleaning data. AM and MA-A were involved in data analysis, interpreted the results, and collaborated in writing the manuscript. SAlg, RAA, and AAla collaborated in writing and editing the paper. All authors read and agreed to the published version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.827238/full#supplementary-material

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Initial Psychometric Evidence of Physical Inactivity Perceived Experience Scale (Pipes): COVID-19 Pandemic as a Pilot Study

Noomen Guelmami[1,2,3], *Nasr Chalghaf*[1,2,4], *Amayra Tannoubi*[1,2,3,4], *Luca Puce*[5], *Fairouz Azaiez*[1,2,4] *and Nicola Luigi Bragazzi*[1,6,7]*

[1] Postgraduate School of Public Health, Department of Health Sciences (DISSAL), University of Genoa, Genoa, Italy, [2] Group for the Study of Development and Social Environment (GEDES), Faculty of Human and Social Science of Tunis, Tunis, Tunisia, [3] Department of Human and Social Sciences, Higher Institute of Sport and Physical Education of Kef, University of Jendouba, Jendouba, Tunisia, [4] Department of Human Sciences, Higher Institute of Sport and Physical Education of Sfax, University of Sfax, Sfax, Tunisia, [5] Department of Neuroscience, University of Genoa, Genoa, Italy, [6] Laboratory for Industrial and Applied Mathematics (LIAM), York University, Toronto, Toronto, ON, Canada, [7] Department of Mathematics and Statistics, York University, Toronto, ON, Canada

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***Correspondence:**
Nicola Luigi Bragazzi
robertobragazzi@gmail.com

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Aims: Our study aimed to develop a two-factor self-administered orthogonal questionnaire to assess the experience of perceived physical inactivity, to test its psychometric properties, to confirm its relationships with fear of COVID-19, and finally, with perceived stress during the pandemic.

Methods: A total of 481 Tunisian subjects collected in several cities, aged from 16 to 67 years with a mean age = 32.48 ± 9.46, and of both sexes participate in our study with (male: 51.8%) and (female: 48.2%), divided according to the level of study into three categories. All subjects voluntarily answered the PIPES questionnaire, the IPAQ scale, the COVID-19 fear scale and the PSS-10 test.

Results: The results of the exploratory and confirmatory factor analysis supported the robustness of the tool measure. In addition, examination of configurational, metric, scalar, and strict invariance supported the equivalence of the structure by gender and educational level. Concurrent validity was established by the positive association of a negative perception of physical inactivity with scores measured by the IPAQ scale and a negative association with scores of COVID-19 fear and perceived stress. Whereas, a positive perception of physical inactivity from the COVID-19 scale was negatively associated with the IPAQ and positively associated with fear of COVID-19 and perceived stress.

Conclusion: The PIPES-10 scale can be used to measure the perception of physical inactivity in different situations.

Keywords: COVID-19, physical inactivity, fear, perceived stress, factorial invariance, scale validation

INTRODUCTION

The benefits of physical activity and exercise on physical and mental health, as well as the negative impacts of physical inactivity, have been well documented in the scientific literature for both adults and children (1–4). For physical health, many researchers have highlighted the role of physical inactivity in the prevalence of various pathologies. Several longitudinal and cross-sectional studies for different age groups and in both sexes report evidence of the benefits of exercise on the prevention and treatment of several diseases related to the cardiovascular systems (5–9), respiratory (10, 11), immune (12), diabetes (13, 14), neurogenic diseases (15, 16), cancer (17), obesity (18), and many other diseases.

Similarly, in human psychology, numerous studies have confirmed strong associations between physical inactivity and various negative behaviors and psychological parameters such as stress, depression and anxiety (19–22). Moreover, in contemporary sociology, a plethora of work has established links and explanatory models for the benefits of physical activity with several social factors (23–25).

As a result, findings have been reported by physicians, biologists, psychologists, and sociologists on the need to promote exercise and regular physical activity. Many researchers cite sedentary behavior and physical inactivity as a major risk factor that increases lethality rates in contemporary societies.

Despite all of these substantial changes, lifestyles across countries vary and physical inactivity in many countries is likely to persist to become an international pandemic in 2012. Globally, physical inactivity is presented as the greatest public health problem of the twentyfirst century (26) and the fourth leading cause of death (27), its economic consequences are also severe (27). Physical inactivity is currently considered a pandemic that has become a major concern for several international organizations, such as the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC). Sustained physical inactivity and sedentary behavior are generally associated with poor physical and mental health and increased risk of mortality (6, 7, 28–30).

Physical inactivity across multiple populations and countries is increasingly worsening, particularly during the COVID-19 pandemic, which was a particular global experience characterized by specific measures that imposed containment, restrictions on travel between countries, and even habitual travel within cities of the same country (31, 32). Indeed, during the COVID-19 pandemic, several studies have reported a significant increase in physical inactivity would be evident due to the requirements of self-isolation and quarantine in addition to the curfews. In other words, in several countries, the rapid growth of the COVID-19 pandemic has forced governments to put in place a curfew (33), stoppages, or restrictions on movement.

Abbreviations: CF-19, COVID 19 Fear; IPAQ, International Physical Activity Questionnaire; IPAQ-C, International Physical Activity Questionnaire (short, last 7 days); PSS10, Perceived Stress Scale 10 items; MET, Metabolic Equivalent Tasks; PIPE S, Physical Inactivity Perceived Experience Scale; PIPES1, Physical Inactivity Perceived Experience Scale (Factor1); PIPES2, Physical Inactivity Perceived Experience Scale (Factor1).

These government decisions were accompanied by a decrease in physical loads at work, the cessation of schooling, the suspension of all sports activities and competitions, in addition to the closure of several places of physical activities such as sports centers, sports halls, amusement parks, municipal stadiums and private fields (31).

Under these specific conditions often accompanied by fear of COVID-19, stress, anxiety, and depression (34–37), physical inactivity could significantly increase mortality rates in several populations (38–40) and particularly in patients and vulnerable groups such as obese, diabetic, hypertensive, and cancer patients. In this regard, Stanton et al. (41) reported during the pandemic an increase in physical inactivity associated with increased depression, anxiety, and stress.

This increase in inactivity can be dramatic in many populations and deserves a measurement tool specific to this environment. Indeed, several physical activity measurement tools have been developed over time to target the perception of physical activity (42). As an example, Fox and Corbin (43) developed the physical self-perception profile based on self-esteem theories. In another work, Kerner and Kalinski (44) developed a measure for young people through attitudes, beliefs, perception of control, and intention to engage in leisure-time physical activity. And Salvador et al. (45) study who develops the "Perception of the environment and leisure-time physical activity in the elderly". However, these scales were not general (for example, focused on specific physical activities such as leisure activities), never considered physical inactivity, and were mostly developed for specific populations. To the best of our knowledge, there is no measurement scale which attempted to measure the perception of the experience of physical inactivity in relation to a pandemic environment and adjacent specific measures. It is therefore very important to construct a standard tool that can assess this, especially in a phase of awareness of the importance of having a healthy body with strict measures such as movement restriction and containment. The objective of this paper is to develop a self-administered questionnaire that measures the perception of the experience of physical inactivity, to test its psychometric properties and to confirm the relationships between the perception of the experience of physical inactivity with the fear of COVID-19, and the perceived stress during the pandemic.

MATERIALS AND METHODS

Instruments

The questionnaire items were developed based on an in-depth analysis of specific literature and expert feedback. Before making decisions about scale development, we considered several models and theories in the context of physical exercise, such as the behavioral epidemiological framework advocated, which looks at the link between behaviors and health and disease (46), the theory of planned behavior which has been dominant for years (47) and the Health Belief Model (48). After examining and criticizing the first two theories [e.g., (49)], we are committed to exploiting the latter model for those overarching considerations

that could classify attitudes toward activity and physical inactivity at my time.

Indeed, current research based on the Health Belief Model considers that verbal responses regarding attitudes toward physical activity must include expressions about the intention to be physically active or not (50).

As a result, a self-reported measure of attitudes applied to physical activity must include two constructs: one construct centered on expressions that promote physical activity, while the second construct is interested in evaluating a positive attitude with regard to physical inactivity.

In the process, the theoretical design of the first concept of perceived experience of physical inactivity (PIPES1) avoided conceptualizing the construct from a perspective that considers the specific effects of physical activity on physical health factors, mental health or social interactions. This allows for a general conceptualization that can encompass all the factors mentioned without detailing the perceived benefits that are detailed in the non-verbal model of attitudes.

For the second concept, which is also the negative perception of physical inactivity, a general construct was established. This construct was generally related to barriers to practice without detailing the reasons for physical activity inability, such as time required, lack of adequate infrastructure, lack of safety, physical disability. This choice made it possible to measure the concept in a global way. As a result, the cognitive and affective response categories of the Health Belief Model (50, 51). Non-response to long-form questionnaires in the health context [see: (52–54)], the cost and time of administration [for example, (55)], led us to limit ourselves to a reduced number of items.An initial 12-item instrument was generated to measure the two constructs with 6 items for each. Next, the tool was subjected to a review by two experts in physical activity behavior and two university professors specializing in Arabic and English. The thorough review by the panel of experts recommended the elimination of two items that could present ambiguities in the responses (their link with the time factor). The two items "I consider that doing physical activity is a waste of time" and "I consider that the moment of doing physical activity is essential" were eliminated.

The final version led to the generation of 10 items that were retained to measure two orthogonal constructs.

The two factors Positive and Negative perceptions of physical inactivity were then measured with five-items for each of them. A five-point Lickert scale was favored for collecting responses as follows: strongly disagree (1 point), disagree (2 points), neutral (3 points) agree (4 points), totally agree (5 points).

Physical Activity Level

The level of physical activity was assessed by the official Arabic abbreviated version of the IPAQ (56).

This measure of physical activity has established good psychometric properties in several populations (57–59).

The seven-item IPAQ-C records self-reported physical activity over the past seven days. Responses were converted into minutes of metabolic equivalent tasks per week (MET-min/week) according to the IPAQ scoring protocol: the total number of minutes in the last seven days spent in vigorous activity, moderate-intensity activity, and walking was multiplied by 8.0, 4.0, and 3.3, respectively, to create MET scores for each activity level. MET scores in the three sub-components were added to indicate overall physical activity. Levels of physical activity were also categorized into three categories: small, moderate, and high, according to the scoring system provided by the IPAQ. In this research, we consider this classification of three categories to make a judgment on practicing physical activity.

COVID-19 Fear Scale

An adapted Arabic version of the COVID-19 scale was applied to illustrate the fear of COVID-19 (60). Reliability and validity were inspected through 693 Saudi participants and confirmed the unique construct of the tool. The internal Arabic consistency was satisfactory ($\alpha = 0.88$), with a healthy concomitant validity indicated by significant and positive correlations with the HADS anxiety scale ($r = 0.66$).

The initial scale was examined with 717 Iranian participants. After evaluation, using both the classic test theory and the Rasch model, the properties of the scale were satisfactory: internal consistency ($\alpha = 0.82$) and test-retest reliability (ICC = 0.72) were acceptable.

Good psychometric properties similar to the original instrument have been proven in a Turkish version, an Italian adaptation, and a model built in Bangladesh.

The Turkish version reveals its robustness of measurement and the one-dimensional nature of the tool in 1,304 participants, aged 18 to 64, in 75 cities across confirmatory factor analysis, Item Response Theory, convergent validity, and internal consistency (Cronbach's α, McDonald's ω, Guttmann's λ6, and composite reliability). Likewise, Cronbach's alpha of the Italian version was 0.871 and displayed high-quality reliability. The results of the confirmatory factor analysis of the Bangladeshi version confirmed the unidimensional factor structure of the scale and very good internal reliability.

Perceived Stress Scale

To assess perceived stress, the version of 10 items in Arabic validated by Almadi et al. (61) was used. The instrument is adapted from the initial scale of Cohen et al. (62), which is the most widely used scale in the world to assess perceived stress as two first-order components, assessed on a Lickert scale of 5 points.

The psychometric properties of the initial scale and the different adaptations have confirmed their measurement robustness in several studies for different populations (63–65).

Data Collection

Data were collected with a total of 481 subjects aged between 16 and 67 years old with a mean age (M = 32.48, SD = 9.46), over a three month period (March, April, May 2020) in two ways: (1) on work sites, shops, and administrations in several Tunisian cities ($n = 257$, 53.4%) and (2) by a questionnaire sent by email to several contacts ($n = 224$, 46.6%).

Study participants consist of males ($n = 249$, 51.8%) and females ($n = 232$, 48.2%). The distribution of the study level was (34.7%) subjects who had a basic study level (<10 years; $n = 167$),

34.5% who had completed their secondary school studies (n = 166), and 30.8% who had a higher level (n = 148). No significant difference in the χ^2 test was demonstrated according to the three variables: age (p = 0.44), method of administration (p = 0.13) and level of study (p = 0.49).

Statistical Analysis

Preliminary data analysis was performed to examine the quality of the data collected and to inspect if there are any anomalies or missing boxes. Missing data were excluded from the analysis. Subsequently, tests for univariate (Skewness and Kurtosis) and multivariate normality by the Mardia coefficient, were performed. Also, descriptive statistics for each variable were done.

Exploratory factor analysis was performed by the Unweighted Least Squares method with Direct-Oblimin rotation and Kaiser Normalization.

The reliability of the instrument was examined simultaneously by Cronbach's α coefficient, McDonald's ω coefficient, and the composite reliability coefficient CR calculated from the Factor Loading set and the error variances.

The questionnaire structure of the entire population was carried out by confirmatory factor analysis (CFA). Several indices of the CFA were retained to examine the model: (1) the χ2; (2) χ^2/DF, (3) the comparative fit index (CFI); (4) Tucker-Lewis index (TLI); and (5) the Root Mean Square Error of Approximation (RMSEA).

The recommendations of Hu and Bentler (66) suggested values >0.95 for CFI and TLI and RMSEA values of<0.08 for reasonable fits. The equivalence of the two-factor and 10-item model across the three variables gender, study level, and the method of administration was achieved through confirmatory multi-group factor analysis for four models of invariance tested successively.

The first invariance tested is the Configural Invariance. This step is designed to test whether the indicators have the same free and fixed load pattern across groups.

Once the Configural invariance is confirmed, the increasing comparisons from one model to the next, by imposing a more restrictive level of invariance between the samples of nested model configuration, are tested according to a complexity hierarchy with constraints.

The second step, called the metric invariance test, is to ensure that the different groups answer the questions similarly or equivalently. The technical examination of metric invariance consists of showing that factor loadings are similar to the factors of the measurement scale in the groups.If the metric invariance is assured, the next step is to evaluate the scale invariance. Scalar invariance means that the item interceptions are equivalent between the groups, which means that the group differences in the item mean should give differences in the means of the factors constructed by these indicators. In other words, this implies that subjects with the same value in a factor should have equal values of the indicators.

The last step is to test the residual invariance or the similarity of errors across groups. Residual invariance means that the sum of the specific variance (variance of the item that is not shared with the factor) and the measurement error variance is similar for the different groups.

The Chi-square difference between models was performed to test for invariance in structural equation models. Also, the difference in CFI which must be <0.01 was retained as a criterion to establish the factorial invariance.

Concurrent validity was tested by examining the association between the two instrument factors and the three scales: the IPAQ scale, the COVID-19 Fear scale, and the Perceived Stress Scale *via* a Pearson correlation.

Statistical analyzes were performed using IBM SPSS Software version 26.0 for Windows. While the examination of the different factor structures was carried out by IBM SPSS Amos Software for Windows version 23 (See **Table 1**) .

We retained the significance levels for a value of $p < 0.05$ for all statistical analysis.

Ethics Statement

This work has received approval from the ethics committee of the "Research Unit, Sportive Performance, and Physical Rehabilitation, High Institute of Sports and Physical Education, Kef, University of Jendouba, Jendouba, Tunisia" and received ethical clearance from the UNESCO Chair "Health Anthropology Biosphere and Healing Systems," "University of Genoa, Genoa (Italy)," the "Higher Institute of Sport and Physical Education of Kef, Kef (Tunisia)," and the "Higher Institute of Sport and Physical Education of Sfax, Sfax (Tunisia)." The proposal has been also approved by the "Jendouba University" Ethics Committee and was undertaken following the legal standards of the Helsinki declaration in 1964 and its corresponding amendments.

RESULTS

The statistical analysis began by calculating descriptive statistics (means and standard deviations) and inspecting the distributions of the 10 items of the questionnaire. The normality of each item was considered through the examination of Kurtosis and Skewness.

The results of the exploratory factor analysis by the Unweighted Least Squares method using a Direct-Oblimin rotation with Kaiser Normalization resulted in the extraction of two factors that explain 72.17% of the total variance.

The 10 items were subjected to exploratory factor analysis using the Unweighted Least Squares method. The adequacy of the sampling is supported by the index KMO = 0.92 (Kaiser-Meyer-Olkin which measures the quality of the sampling and the quality of the correlation matrices by the significant Bartlett test (x^2 = 607,132, p <0.001).

Internal Consistency

Instrument reliability was examined by both Cronbach's α coefficient, McDonald's ω coefficient, and the composite reliability coefficient CR calculated from a Factor Loading set and the error variable (derived from the initial model output of AMOS Software for the whole population).

Table 2 denotes the reliability coefficients for the two instrument factors.

To test the factorial invariance of the designed tool, several successive models were tested. The specification of the links, variances, and covariances of these models gradually becomes more severe until the complete invariance of the model is demonstrated (67, 68).

The results of the configuration invariance by gender indicated that the model fit was adequate, χ^2 (66) = 137.28; p <0.001; CFI = 0.9842; TLI = 0.975; and RMSEA = 0.047. These values demonstrate that women and men conceptualize the two perception constructs of physical activity similarly (See **Table 3**).

For the metric invariance tests, a non-significant statistical difference χ^2 was demonstrated [$\Delta\chi^2$ (8) = 9.10; p = 0.334]. As a result, participants from different groups respond to items in the same way, that is, the strengths of the relationships between specific scale items and their constructed factors are the same from group to group.

The scalar invariance provided a non-significant statistical difference χ^2 [$\Delta\chi^2$ (12) = 9.37; p = 0.670]. As such, the results indicated that the equal interception constraints kept the solution fit. Assuming the equivalence of the item intersections, we were able to compare the latent means. This implies that the factor loads and their means are equivalent to women and men (See **Table 3**).

To test for strict factor invariance, equal constraints were imposed on the factor loads, the intersections, residuals, variances, and covariances. The results for Strict invariance across the three variables, the gender, the level of study, and the methods of administration showed non-significant Δdf with ΔCFI that are <0.01. This demonstrates the strict invariance of the tool for the different groups.

For the strict factorial invariance, a statistical difference χ^2 [$\Delta\chi^2$ (12) = 20.22; p = 0.063] and a ΔCFI = −0.002 were highlighted. This result indicates that our model is gender invariant (See **Table 3**).

The tests of configural invariance according to the study level and the method of administration of the questionnaire proved the robustness of the factorial structure through the two models M5 and M9 respectively. Indeed, the results of the configural invariance for the M5 model presented a value of X^2 (99) = 174.89, CFI = 0.981, TLI = 0.973 and RMSEA = 0.040. While for the M9 model, the value of X^2 (99) = 174.89, CFI = 0.983, TLI = 0.977 and RMSEA = 0.046, which shows good adjustment indices (See **Table 3**).

The metric invariance for the level of education and the method of administration of the questionnaire proved through the comparisons M6-M5 and M10-M9 respectively. The comparisons yielded ΔX^2 = 18.05 (Δdf = 20; p = 0.584) and ΔCFI = 0.000 for the variance according to the level of education. While for the method of administration of the questionnaire, the comparisons generated ΔX^2 = 2.38 (Δdf = 8; p = 0.967) and ΔCFI = 0.002 (See **Table 3**).

The scalar invariance for the level of education and the method of administration of the questionnaire proved through the comparisons M7-M6 and M11-M10 respectively. The comparisons yielded ΔX^2 = 27.58 (Δdf = 20; p = 0.12) and ΔCFI = −0.002 for the scalar variance according to the level of education. While the comparison M11-M10 generated ΔX^2 = 6.38 (Δdf = 12; p = 0.90) and ΔCFI = 0.001 (See **Table 3**).

Strict invariance across study level (M8-M7) and according to the administration of the questionnaire method (M12-M11)

TABLE 1 | Mean (M), SD, confidence interval 95%, skewness (S), kurtosis (K), and factor loadings (λ) by item.

Items	Mean	SD	Skewness	Kurtosis	Lamda
Item1	2.88	1.36	0.09	−1.14	0.903
Item3	2.98	1.39	0.01	−1.26	0.829
Item5	3.02	1.39	−0.02	−1.24	0.797
Item7	2.99	1.41	0.03	−1.28	0.853
Item9	2.99	1.36	−0.02	−1.21	0.896
Item2	2.65	1.24	0.24	−0.97	0.831
Item4	2.63	1.25	0.28	−0.98	0.845
Item6	2.63	1.24	0.28	−0.89	0.847
Item8	2.60	1.28	0.37	−0.92	0.831
Item10	2.62	1.28	0.24	−1.01	0.842

TABLE 2 | Reliabilities of the PIPES-10.

English items	Factors	McDonald's ω	Cronbach's α	Composite reliability
1. The lack of physical and sports activities is understandable to me.	PIPES1	0.933	0.933	0.887
2. Reducing or discontinuing my physical and athletic activity is worrying to me.				
3. Not being physically active or exercising is something I do not easily accept.				
4. The lack of physical and sports activities has several negative repercussions.				
5. I consider the decision not to engage in physical and sports activities to be completely unsatisfactory.				
6. I canceled many of my physical moves and activities with complete conviction		0.906	0.905	0.881
7. Physical and sporting activities should be discontinued.				
8. I find that reducing physical and athletic activity is necessary.				
9. I am fully convinced that I should not be physically or physically active.				
10. Not doing sports and physical activities has a negative repercussion.				

TABLE 3 | Factorial invariance comparison.

Invariance	X^2(df)	df	CFI	TLI	RMSEA	Δ	ΔX^2	Δdf	p	ΔCFI
M.0	91.3	33	0.985	0.980	0.061					
Gender										
Configural (M1)	137.28	66	0.982	0.975	0.047					
Metric (M2)	146.38	74	0.983	0.979	0.043	M2-M1	9.10	8	0.334	0.001
Scalar (M3)	155.75	86	0.982	0.981	0.045	M3-M2	9.37	12	0.670	−0.001
Strict (M4)	175.97	98	0.980	0.982	0.041	M4-M3	20.22	12	0.063	−0.002
Study Level										
Configural (M5)	174.89	99	0.981	0.973	0.040					
Metric (M6)	192.94	119	0.981	0.978	0.036	M6-M5	18.05	20	0.584	0.000
Scalar (M7)	220.52	139	0.979	0.980	0.035	M7-M6	27.58	20	0.120	−0.002
Strict (M8)	234.71	163	0.982	0.985	0.031	M8-M7	14.19	24	0.942	0.003
Administration of the Questionnaire										
Configural (M9)	131.47	66	0.983	0.977	0.046					
Metric (M10)	133.85	74	0.985	0.981	0.041	M10-M9	2.38	8	0.967	0.002
Scalar (M11)	140.23	86	0.986	0.985	0.036	M11-M10	6.38	12	0.90	0.001
Strict (M12)	154.54	98	0.985	0.987	0.035	M12-M11	14.31	12	0.281	−0.001

All values of X^2 were significant at $p < 0.001$.

TABLE 4 | Pearson's correlation between the two dimensions of PIPES, the IPAQ, the CF-19 fear, and the PSS-10.

	IPAQ	PIPES1	PIPES2	CF-19	Stress1	Stress2
IPAQ	–					
PIPES1	0.328**	–				
PIPES2	−0.380**	−0.579**	–			
CF-19	−0.223**	−0.378**	0.331**	–		
Distress	−0.209**	−0.219**	0.226**	0.600**	—	
Coping	0.119**	0.008	−0.012	0.059	0.063	–

***P < 0.01.*

demonstrated a value of $\Delta X^2 = 14.19$ ($\Delta df = 24$ at $p = 0.942$) and $\Delta CFI = -0.002$ for the first invariance and $\Delta X^2 = 14.31$ ($\Delta df = 12$ at $p = 0.281$) and $\Delta CFI = -0.001$ for the second invariance (See **Table 3**).

As a conclusion, the factorial invariance of the measuring instrument was confirmed across the gender, the study level, and also the method of administration of the questionnaire.

Table 4 shows the results of correlations between the two dimensions of the PIPES scale with the measures of the IPAQ scale, the COVID-19 fear scale, and the two dimensions of the PSS10 scale.

A positive association between PIPES1 with IPAQ was demonstrated by a value of r = 0.328. While a negative correlation was found between the PIPES2 scale and the IPAQ scale. The IPAQ was able to explain 38% of the variance in the internal factor and 32.8% of the variance in the environmental factor of the PIPES.

Likewise, the results demonstrated a significant negative correlation between fear of COVID-19 and the PIPES1 scale ($r = -0.378$) and a moderate correlation with distress ($r = -0.219$). However, no link has been demonstrated between PIPES1 and the PSS-10 coping subscale.

For the link of PIPES2 with fear of COVID-19 and stress, the results showed a moderate positive correlation, on the one hand between PIPES2 and CF-19 ($r = 0.331$) and on the other hand between PIPES2 and general distress ($r = 0.226$).

DISCUSSION

The purpose of the present study was to develop and examine the psychometric properties of an instrument originally developed to measure perceived physical activity.

The reliability of the instrument examined in three ways showed that the two factors selected were consistent.

The results of the exploratory and confirmatory factor analysis and the factor invariance tests showed the robustness of the structure. The examination of configurational, metric, scalar and strict invariance confirmed the equivalence of the structure according to gender, level of education and mode of administration of the questionnaire.

Concurrent validity was tested by examining the association between the two factors of the instrument with the three scales: the IPAQ, COVID-19 fear, and perceived stress measured in two components.

The results showed that a negative perception of physical inactivity was positively associated with the IPAQ scale, and negatively associated with COVID-19 fear scores and perceived stress measured by Cohen's scale. Whereas positive perception of environment-related physical inactivity in COVID-19 was negatively associated with the IPAQ and positively associated with fear of COVID-19 and perceived stress. However, no association was found between coping strategies and the two components of the PIPES-10 scale.

To explain physical activity/physical inactivity, the two main models that have been put forward are the personality trait-based model and the ecological model.

The first model focuses on personality and will explain physical activity/inactivity by specific personality traits. For example, another study by Hoyt et al. (69) attempted to explain physical activity adherence through personality trait theory. They suggested that the traits of extraversion and activity awareness were associated with exercise behavior.

From the same perspective, Sutin et al. (70) studied the relationships between personality traits and physical inactivity in both sexes in several age groups. The results of their study concluded that lower neuroticism and elevated consciousness were linked to more physical activity and less physical inactivity. Furthermore, extraversion and openness were also associated with more physical activity and less inactivity.

Individuals who are rich in neuroticism (the tendency to feel negative emotions and stress) tend to avoid physical activity, while individuals who are rich in extroversion (the tendency to feel positive emotions and be outgoing) and conscience (the tendency to be organized and disciplined) tend to be more physically active (71). Openness to traits (the tendency to be open-minded and creative) has recently been associated with greater physical activity (72).

The second model addresses this issue in a system that integrates external factors to the individual, such as the environment, culture, politics, and society. Indeed, several studies have been able to establish the evidence of a great impact of the environment on personal choices in several contexts, such as participation in physical activity. Another parameter that favors the ecological approach is that it is possible to act on internal and external factors for the promotion of physical activity (73) while the personality traits are unchangeable in nature.

Several studies have supported the relationship between environmental characteristics and physical exercise. The results highlighted the relationship between physical practice such as infrastructure, adequate pedestrian walks, easy access to stores and services, access to recreational parks and public open spaces, and pedestrian accessible infrastructure, greenery and aesthetic landscapes, low crime rate, and sense of personal safety. Similarly, Liu et al. (74) linked access to physical activity infrastructure at work and home time spent on physical activity.

The ecological model attempts to explain participation in physical activity through the combination of internal individual factors such as beliefs, attitudes, and behavior (intra-individual) and individual factors such as environment, society, and culture (extra-individual) at the same time.

Moreover, on the one hand, there is a gap between perception and adherence to physical activity.

Much more, the perception of health itself can influence the perception of physical activity. As an example, in an exploratory work by Martinez-Harvell et al. (75) which aimed to identify predictors of adherence to physical activity in patients, the results showed that subjects with poor health, daily smoking, obesity, or kidney disease did not follow recommendations for physical activity.

On the other hand, in another study, Tuakli-WosorRowan and Gittelsohn (76) explored the links between perceptions of physical activity and physical activity behaviors with health factors among Ghanaian women using both qualitative and quantitative analysis. They concluded that physical activity barriers were associated with the time load that leaves no time for activity, family, and work obligations, as well as the absence of sports facilities. While the correct perception was related to weight loss, health issues and the top motivational factors for physical activity were "weight loss," and "increased energy."

However, specific interventions can affect the perception of physical activity. In this context, West et al. (77) explored the effects of a focus group session on behavior change in physical activity across subjects with a high risk for diabetes. They showed that the chat session helped improve the maintenance of physical activity.

During the COVID-19 pandemic, physically inactive people were considered by several authors to be at higher risk and the impact of the disease would be more severe.

Therefore, several global scientific recommendations have emphasized the major importance of maintaining optimal physical activity despite the security measures of quarantine and social distancing. In this regard, Hall et al. (38) classified physical inactivity and sedentary lifestyle as a persistent pandemic and aggravated by the containment measures taken during the COVID-19 pandemic period. Other researchers such as (78) even proposed physical activity as both a physical and mental therapeutic tool to withstand the negative consequences of quarantine during the pandemic.

Similarly, Jakobsson et al. (79) recommended that individuals maintain regular physical activity during self-isolation to prevent future chronic health problems due to sedentary behavior. They emphasized maintaining a minimum threshold of 150 min of moderate-intensity physical activity or 75 min of vigorous physical activity per week, as recommended by the World Health Organization as a health support solution (80).

This study makes some recommendations regarding physical activity practice.

Conclusion and Recommendations

The present study developed an instrument to measure the perception of physical activity through two factors that have proven to be robust. The developed scale can be used as a tool for the perception of physical inactivity.

Examination of associations between PIPES scores with different background variables should be considered in future research. For example, the ease of access to physical activity and sports facilities, the safety of these structures in residential and professional areas can be linked to the perception of physical activity.

Also, future research must establish the links between daily time management and the time devoted to physical activity on the one hand, and the perception of PIPES physical activity and inactivity. Difficulty in time management, especially for people who have a job that requires a lot of time, can lead to a negative attitude toward physical activity.

Further person-centered studies could be conducted to categorize populations according to their perceptions of physical

activity. this can lead to effective awareness campaigns that target vulnerable and at-risk people.

In future research, it is interesting to build measurement scales centered on both the perception of physical activity and the environment. Such an ecological approach can make it possible for us to measure the perception of physical activity that takes into account cultural and social specificities. This will facilitate the intervention for the promotion of physical activity.

Limits of the Study

The first limitation concerns the study of the temporal stability of the two factors of the instrument, which could not be implemented in the present study.

Similarly, factorial invariance across different ages was not investigated, and it is very important to do so, especially for the elderly.

Although this study offers very interesting avenues for measuring perceived physical activity from an ecological perspective that takes into account the COVID-19 pandemic situation, it would be appropriate to expand the population and examine the psychometric properties of the instrument and its factorial invariance in other populations as well as to test for cultural differences.

It is important to note that examining the tool in specific populations such as those with chronic illnesses may contribute to the sensitivity of the instrument.

Finally, another limitation is the need to implement a review that addresses the relationship between perceived physical inactivity and environmental factors such as culture, policy and infrastructure specific to physical activity, and life safety.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

This work has received approval from the Ethics Committee of the Research Unit, Sportive Performance, and Physical Rehabilitation, High Institute of Sports and Physical Education, Kef, University of Jendouba, Jendouba, Tunisia and received ethical clearance from the UNESCO Chair Health Anthropology Biosphere and Healing Systems, University of Genoa, Genoa (Italy), the Higher Institute of Sport and Physical Education of Kef, Kef (Tunisia), and the Higher Institute of Sport and Physical Education of Sfax, Sfax (Tunisia). The proposal has been also approved by the Jendouba University Ethics Committee and was undertaken following the legal standards of the Helsinki declaration in 1964 and its corresponding amendments. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

NG and NB conceived the experiment. NG, NC, and NB collected and analyzed data. NG, NC, AT, LP, FA, and NB drafted and critically revised the paper. All authors contributed to the article and approved the submitted version.

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The Associations Between Parental Burnout and Mental Health Symptoms Among Chinese Parents With Young Children During the COVID-19 Pandemic

Minglong Chen[1†], Yashuang Bai[1†], Mingqi Fu[2], Ning Huang[1], Farooq Ahmed[3], Muhammad Shahid[4], Xiaohua Wang[5], Chengbin Liu[6], Xing Lin Feng[1] and Jing Guo[1*]*

[1] Department of Health Policy and Management, School of Public Health, Peking University, Beijing, China, [2] Center for Social Security Studies, Wuhan University, Wuhan, China, [3] Department of Anthropology, Quaid-I-Azam University Islamabad, Islamabad, Pakistan, [4] School of Insurance and Economics, University of International Business and Economics, Beijing, China, [5] School of Social Development and Public Policy, Beijing Normal University, Beijing, China, [6] School of Sociology, Huazhong University of Science and Technology, Wuhan, China

The Coronavirus Disease 2019 (COVID-19) pandemic has caused numerous unexpected changes for families and societies, which have likely contributed to higher amounts of stress for most parents. This study aimed to examine the relationship between burnout and mental health among parents during the COVID-19. Pandemic exposure and household factors (e.g., family structure, family function) were examined as moderators. An online cross-sectional survey recruiting 1,209 adults was conducted from April 21st to April 28th, 2020 during the COVID-19 lockdown in China. The multivariable linear regression analysis was employed to test the association between burnout, household factors, and mental health among parents. Findings suggested that for parents with a young child, poorer mental health was related to a higher level of burnout ($\beta = 0.220$, $P < 0.001$) and greater exposure to the pandemic. Mothers of a single and/or young child had considerably poorer mental health. Moreover, the relationship between mental health and burnout among parents was significantly moderated by epidemic exposure ($\beta = 2.561$, $P < 0.001$), family structure (number of children: $\beta = -1.257$, $P < 0.001$; first child age: β =-1.116, $P < 0.001$) and family function ($\beta = -0.574$, $P < 0.05$). This study indicated that burnout symptoms were significantly associated with worse mental health among parents in China. Besides, exposure to the pandemic, family structure, and family function was found to moderate the association between burnout and mental health among parents. Therefore, the present study stressed enhanced access to mental health resources and emotional supports for parents during a public crisis to reduce the deleterious effects of burnout.

Keywords: parental burnout, mental health symptoms, family structure, family function, Chinese parents, COVID-19

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***Correspondence:**
Jing Guo
jing624218@163.com
Xing Lin Feng
fxl@bjmu.edu.cn

†These authors have contributed equally to this work and share first authorship

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INTRODUCTION

The coronavirus disease 2019 (COVID-19) outbreak spread rapidly throughout the country and quickly attracted global attention (1). To contain the infection spread, the Chinese government has issued nationwide emergency policies, with strict quarantine measures, including shutting down schools and non-essential businesses, and home quarantine. Those strict containment measures, severe economic loss, and great concerns regarding the virus infection all disrupted families' daily routines and stimulated overwhelmed pressures among families and society. A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic found that almost 35% of the respondents experienced psychological distress (2). In particular, during a prevalent pandemic lockdown, parents may experience extra pressures from family unemployment, income deduction, or the inability to work from home (3), as well as from home-schooling and parental communications (4).

Pressures from work and family are associated with an increased risk of parental burnout and push parents to be more vulnerable to mental health disorders during the pandemic (5). It should be noted that parental burnout differs from daily parenting stress because it is a prolonged response to chronic and overwhelming parental stress, with high risks and limited resources, and possibly followed by parental neglect and violent behaviors (5, 6). Existing studies pointed out that chronic stresses would deplete individuals' resources and lead to burnout symptoms if they last too long (7). Though gained little attention until recent years (8, 9), burnout was found to have significant impacts on mental wellbeing among parents (10, 11). An existing study has revealed that burnout was associated with higher levels of depressive symptoms, sleep disorders, as well as addictive behaviors among parents (12). In particular, unemployment, low levels of social support, and financial insecurity during the COVID-19 pandemic were found to place parents at a greater risk of burnout (13). For example, results from a survey conducted in Italy showed that the prevalence of parenting-related exhaustion (the main symptom of parental burnout) during the COVID-19 lockdown was as high as 17%, and greater parenting-related exhaustion was predicted by lower parental resilience, motherhood, having a child with special needs, and having younger children (14). Quasi-longitudinal research also revealed a higher parental burnout level during the pandemic lockdown than before including emotional distancing, exhaustion, and contrast (15). However, little was known about the relationship between burnout and mental health among Chinese parents during the COVID-19 pandemic. Moreover, these associations might vary between genders. According to the gender role theory (16), mother's mental health is more vulnerable to parenting issues than that of fathers, as they took more responsibilities in taking care of children. Simultaneously, mothers spent more time on primary childcare than fathers, and this gender inequality in the distribution of parental responsibilities and associated strains were linked to greater distress among mothers than fathers (17, 18). Indeed, mothers are more likely to regard the caregiving role as part of their social identity than fathers do and tend to ignore their own needs to meet society's expectations, therefore, are at an increased risk of becoming overwhelmed (19). As showed in recent research on the psychological wellbeing of parents, mothers had higher parental burnout and lower psychological wellbeing than the fathers during the prevalence of COVID-19 in Iran (20). Thus, burnout among mothers is likely to associate with higher mental health risks as compared to male caregivers.

Besides exploring the relationship between burnout and mental health among parents, this study further hypothesizes that several factors may work as moderators in this relationship. This first goes to the COVID-19 exposure. As noted by a cumulative risk model (21), the impact of burnout on mental health may be larger while the individuals are exposed to greater threats like the perceived impact of the pandemic. Meanwhile, the second one goes to family structure and functional factors (22). Regarding family structure, parents with more than two kids undoubtedly have to pay more time and energy to meet the extra parenting demands. A recent study in China indicated that mothers from two-kids families had higher parenting stress than their one-child counterparts (23), while Krieg (24) found that mothers in both one-child and two-child families reported equivalent levels of stress. Besides, age interval between siblings also accounts. One previous study proposed that mothers experienced greater stress during their kids' early childhood and their parenting stress would decrease as the kids became older (25). In addition, recent research found an increasing level of emotional symptoms such as frustration and sadness among mothers with pre-school children (from 2 to 5 years) during the pandemic (26). Another study conducted among Italian parents showed that parents of younger children experienced a higher level of parental stress as these children require continuative supervision and greater parental involvement (27). Thus, extra pressures in parenting more and younger kids may underdress parent's vulnerability in coping with burnout symptoms, and put them at higher risks of mental health disorders. Thirdly, the family functional factor might be a third moderator in the relationship between parental burnout and mental health. Impaired family functioning could contribute to decreased resources for the parental job (11), making parents more vulnerable to the consequence of burnout which occurs when resources are limited (6), thus leading to deteriorating mental health.

To date, emerging studies have investigated the effects of the COVID-19 crisis on parenting stress and the mental health of parents in China (28, 29). However, to our knowledge, no investigation has explored parental burnout, which differs from daily parental stress, and its relationship with psychological wellbeing among Chinese parents under this special background. In the present study, we administered a web-based survey of Chinese parents promptly to examine the relationship between burnout and parent mental health during the COVID-19 outbreak. Furthermore, prior research on burnout among parents have mainly focused on the risk factors analysis (10). For example, parents are at increased risk of burnout when they have prior psychiatric disorders, have lower emotional capabilities (30), have part-time work or off-work (10, 30), and lack social support (11). One existing study explored the consequence of burnout and found higher levels of escape, suicidal ideation, and other negative psychopathologies among parents with substantial

burnout (5). This study tries to extend the post-burnout studies into traumatic context, and give a new perspective to evaluate the mental health burden of the COVID-19 pandemic on families and society.

Aims and Hypothesis

The main objective of this study is to examine the relationship between burnout and mental health among parents in China. Then, we aim to explore the differences of this association between different genders. Finally, we want to further test if this association is moderated by pandemic exposure, family structure, and functional factor. On basis of the above-mentioned literature, three hypotheses were proposed. The first hypothesis is that parents with a higher level of burnout might be at greater mental health symptoms than their lower-leveled counterparts. The second hypothesis suggests that burnout among mothers is likely to associate with higher mental health risks, compared to fathers. Lastly, we assume that parents with higher traumatic exposure, having more and younger kids, and living with unhealthy family functions have higher levels of mental health disorders once they experienced levels of burnout.

METHODS

Study Design and Participants

Data in this study were drawn from an online survey in April 2020, in China. During this time frame, governmental pandemic measures included: working remotely, keeping social distance, and closing schools and daycare centers. The questionnaires were distributed and retrieved through a web-based platform (https://www.wjx.cn/app/survey.aspx). A two-stage cluster sampling method was used to choose participants. In the first stage, three primary schools in Henan, Hubei, and Guangdong were selected. These schools were selected from the ordinary schools instead of special education schools, with the parents of children with special needs (e.g., developmental disabilities or physical illnesses) excluded. In the second stage, all students and their parents in selected schools contributed to a survey pool of this study. Headteachers helped to process the survey. Only parents with kid(s) aged 0 to 10 years were included in this study since they would experience a higher level of parenting stress due to the more parental assistance younger children often require. Participants were excluded if (1) they were unwilling to give informed consent; (2) The time to complete the questionnaire was <5 min; (3) We added quality control questions into the questionnaire. We excluded the questionnaires with obvious logical errors. According to a previous study, the incidence of various mental health problems among Chinese citizens during the epidemic was 20∼35% (1). A sample size of 400 participants was required to achieve sufficient power to detect moderately sized associations (power $= 0.80$, $r = 0.20$, $\alpha = 0.05$). The online survey required respondents to answer every question, so there was no missing data in our study. The final study sample consists of 1,286 participants. Participants received a small gift (e.g., 1–3 RMB) as a token of appreciation at the end of the session.

All participants joined the study voluntarily and gave written consent after being informed about the aim of the survey. This study was approved by the Ethics Committee of Peking University Medical Center and conducted in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

MEASURES

Dependent Variables

Mental health was accessed by the Brief Symptom Inventory 18 (BSI-18, omitting suicidality) measuring somatization (6 items), depression (5 items), and anxiety (6 items), and a subset of 10 questions of the posttraumatic stress disorder (PTSD) checklist for DSM-5. All the questions were rated as "1 = never," "2 = occasionally," "3 = sometimes," "4 = often," "5 = Very often." Since the four dimensions of mental health symptoms were highly correlated (ranging from 0.776 to 0.961), the total score of this scale was computed by averaging all 27 item scores. The higher the score, the poorer the mental health was. Confirmatory factor analysis supported this decision by indicating that one general psychopathology factor explained the correlational structure of the four latent psychopathology factors (RMSEA = 0.06; CFI = 0.974; SRMR = 0.043). The Cronbach's alpha of the scale in this study was 0.96.

Independent Variables

Burnout among parents is assessed by the Parental Burnout Assessment (31). This scale includes 23 items in four dimensions (exhaustion, contrast with previous parental self, feelings of being fed up, and emotional distancing). All the items referred to general parenting. Specifically, in the case of multiple children, the questions referred to all their offspring (e.g., "I feel completely run down by my role as a parent," "I don't think I'm the good father/mother that I used to be," and "I can't stand my role as father/mother anymore"). Response options for each question are based on a 7-point Likert scale ranging from "never" to "every day." Items were summed for a total score, with higher scores indicating a higher level of parental burnout. In this study, internal consistency for the total scale was 0.89, and for the four subscales were 0.91, 0.88, 0.84, and 0.63.

Exposure to COVID-19 was assessed with a question to describe if the subjects, family members, neighbors, or friend's exposure to COVID-19 pandemic, with "0" refers to "no," while "1" denotes "yes." Then, a total score was obtained by summing the scores of these items.

The family function was measured by the General Functioning 12-items (GF12) of The McMaster Family Assessment Device (FAD) (32), which has been validated as a single index measure to assess family functioning. The GF12 subscale is made up of 12 items, six items that reflect healthy family functioning and the other six items reflecting unhealthy functioning (33). Respondents could mark the level to which they agree with the statements with 1 to 4 points: 1 for completely disagree; 2 for disagree; 3 for agree; and 4 for completely agree. We calculated the score with inverse unhealthy item scores and the total score was the sum of these 12 items, with higher scores indicating fewer problems in a family's functioning. The internal consistency for this scale was 0.84.

Socio-Demographic and the Family Structure

Based on previous related studies (34, 35), this study took the following demographic and socioeconomic characteristics into consideration: gender (male/female), age, province (Hubei/Henan/Guangdong/Else), occupation (manager/professional staff/individual/else), education level (high school and below/ college/undergraduate/master and above), marital status (married/others), family annual income (<100,000¥/100,000∼200,000¥/>200,000¥), first child age, number of children (one/two/more than two).

Statistical Analysis

Data in this study were analyzed with the SPSS version 24.0. Descriptive statistics were calculated to describe the parental burnout, mental health of parents, exposure to COVID-19, family function, family structure (including the number of children and first child age), and other covariates. Means and standard deviations were used for continuous variables, and frequencies and percentages were computed for categorical variables. Main analyses included several multivariable linear regressions on mental health were conducted in three steps, with the same covariates used in each step: gender, age, province, occupation, family income level, and parental education level. In the first step, we examined the specific associations between parental burnout and mental health. Model 0 included every predictor separately to estimate its "raw" contribution to the mental health of parents. Model 1 put all the predictors into the model to determine the relationship between parental burnout and mental health. In the second step, the whole sample was divided into 2 groups by gender to examine gender differences in the effects of parental burnout on mental health. In the final step, interactions between parental burnout and the other three predictors (exposure to COVID-19, family structure, and family function) were examined in each model. Specifically, in Model 2 the interaction between parental burnout and COVID-19 exposure was included to examine its effect on parent mental health. Whereas, Model 3 included the interaction between parental burnout and number of children, Model 4 included the interaction between parental burnout and first child age, and Model 5 included the interaction between parental burnout and family function.

RESULTS

The socio-demographic characteristics of the study are presented in **Table 1**. Among the 1,286 participants, 74.2% of the surveyed parents were female. Nearly 22.4% were from Hubei, 14.6% from Henan, 42.0% from Guangzhou, and the remaining were from other provinces. In terms of the number of children, 46.2% of the parents had one child, 47.6% had two children, and 6.2% had three or more. Regarding the exposure to COVID-19, 18.2% reported that someone in their family, neighborhood, and friends had suffered from COVID-19. The average parental burnout score was 48.03 (SD = 21.60), and the mean overall family function score was 22.56 (SD = 5.42). The mean parental mental health score was 33.97 (SD = 11.44). More details are listed in **Table 1**.

TABLE 1 | Parental burnout, family exposure, socio-demographic characteristics, and its binary relationship with mental health score among Chinese parents (N = 1,286).

Variable	Frequency (*N*)	Percent (%)	B	Std.Err	β
Parent gender					
Male	332	25.8			
Female	954	74.2	0.544	0.729	0.021
Province					
Hubei	288	22.4	−0.583	0.765	−0.021
Henan	188	14.6	0.986	0.903	0.030
Guangdong	540	42.0	−2.694	0.642	−0.116***
Else	270	21.0			
Types of professionals					
Manager	207	16.1	0.880	0.868	0.028
Professionals & technical	466	36.2	1.614	0.662	0.068*
Individual	194	15.1	−2.692	0.888	−0.084**
Else	419	32.6			
Education level					
High school and below	371	28.8	−3.385	0.698	−0.134***
college	237	18.4	−0.838	0.823	−0.028
undergraduate	460	35.8	1.206	0.665	0.051
Master and above	218	17.0			
Marital status					
Living with a partner	1,217	94.6	−2.731	1.414	−0.054
Others	69	5.4			
Annual income					
<100,000¥	790	61.4	−0.947	0.655	−0.040
100,000∼200,000¥	266	20.7	1.203	0.787	0.043
>200,000¥	230	17.9			
COVID-19 exposure					
None	1,052	81.8			
Yes	234	18.2	7.005	0.804	0.236***
Number of children					
One	594	46.2	3.325	0.633	0.145***
Two	612	47.6	−2.611	0.635	−0.114***
More than two	80	6.2			
	Mean	**SD**			
Parental burnout scores	48.03	21.60	0.230	0.013	0.434***
Parent age	35.99	5.504	−0.158	0.062	−0.071*
First child age	6.791	2.368	−0.535	0.137	−0.110***
Family function (10–47)	22.599	1.041	−0.456	0.057	−0.216***
Mental health scores (27∼135)	33.97	11.44			

*B, coefficient; Std.Err, standard error; β, beta; SD, standard deviation; ***p < 0.001, **p < 0.01, *p < 0.05.*

Table 2 shows the results of the multivariable linear regression analysis for the relationship between parental burnout and mental health. In model 0, parental burnout, exposure to COVID-19, and family function were all significantly associated

TABLE 2 | Multivariable linear regression analysis for the relationship between parental burnout and mental health score among Chinese parents ($N = 1,286$).

Variable	Model 0			Model 1		
	B	Std.Err.	β	B	Std.Err.	β
Burnout	0.227	0.013	0.429***	0.220	0.015	0.414***
Exposure	6.143	0.830	0.207***	5.322	0.781	0.179***
Number of children (ref: > 2)						
One child	3.353	1.372	0.146*	3.202	1.246	0.138*
Two children	0.947	1.345	0.041	1.658	1.212	0.072
First child age	−0.303	0.146	−0.062*	−0.364	0.130	−0.075**
Family function	−0.484	0.057	−0.229***	−0.090	0.059	−0.043*

*B, coefficient; Std.Err, standard error; ß, beta; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; Control variables: Gender, age, province, occupation, marital status, family income level.*

TABLE 3 | Multivariable linear regression analysis for the relationship between parental burnout and mental health score among Chinese parents by gender.

Variable	Male			Female		
	B	Std.Err.	β	B	Std.Err.	β
Parental Burnout	0.192	0.032	0.329***	0.233	0.017	0.453***
COVID1-9 Exposure	7.823	1.639	0.246***	4.427	0.890	0.152***
Number of children (ref:>2)						
One child	3.269	3.134	0.130	3.288	1.347	0.147*
Two children	1.817	3.115	0.072	1.473	1.307	0.066
First child age	−0.470	0.280	−0.090	−0.364	0.147	−0.077*
Family function	−0.210	0.126	−0.090	−0.033	0.067	−0.016*

*B, coefficient; Std.Err, standard error; ß, beta; *$p < 0.05$, ***$p < 0.001$; Control variables: Gender, age, province, job, marital status, annual income.*

TABLE 4 | Multiple linear regressions for interaction effects of family exposure, demographic factors, and family function predicting parents' mental health.

	Model 2			Model 3			Model 4			Model 5		
	B	Std.Err.	β	B	Std.Err.	β	B	Std.Err.	β	B	Std.Err.	β
Parental Burnout	0.210	0.014	0.395***	0.219	0.015	0.411***	0.222	0.015	0.418***	0.207	0.016	0.389***
COVID-19 Exposure	4.938	0.748	0.166***	5.409	0.771	0.181***	5.297	0.772	0.178***	5.274	0.777	0.177***
Number of children	−1.695	0.488	−0.089***	−1.489	0.504	−0.078***	−1.554	0.505	−0.081***	−1.551	0.508	−0.081***
First child age	−0.369	0.124	−0.076***	−0.348	0.128	−0.072***	−0.342	0.128	−0.070***	−0.373	0.129	−0.077***
Family function	−0.082	0.057	−0.039	−0.095	0.058	−0.045	−0.094	0.059	−0.044	−0.109	0.060	−0.051
Parental Burnout*COVID-19 exposure	2.561	0.253	0.240***									
Parental Burnout*number of children				−1.257	0.267	−0.114***						
Parental Burnout*first child age							−1.116	0.276	−0.099***			
Parental Burnout*family function										−0.574	0.293	−0.053*

*B, coefficient; Std.Err, standard error; ß, beta; *$p < 0.05$, ***$p < 0.001$; Control variables: Gender, age, province, job, marital status, annual income.*

with mental health. In model 1, the family function became marginal significant to parents' mental health. Parents with younger children ($\beta = -0.075$, $P < 0.01$) have more mental health symptoms than their counterparts. Compared to parents with more children, parents with one child ($\beta = 0.138$, $P < 0.05$) have more mental health problems. Details can be found in **Table 2**.

Table 3 displays gender differences in the relationship between parental burnout and mental health. Parental burnout (Male: $\beta = 0.329$, $P < 0.001$; Female: $\beta = 0.453$, $P < 0.001$) and epidemic exposure (Male: $\beta = 0.246$, $P < 0.001$; Female: $\beta = 0.152$, $P < 0.001$) are significantly associated with mental health for both males and females.

Table 4 reveals the relationships between four interactions and mental health (model 2–5). Participants who reported greater exposure to the COVID-19 and higher parental burnout showed elevated levels of mental health symptoms, while those who experienced higher parental burnout and parenting younger showed less mental health symptoms. Parents with more children and

high family function would decrease the likelihood of developing mental health symptoms among parents with burnout symptoms.

DISCUSSION

This study examined the relationship between burnout and mental health among Chinese parents during the COVID-19 pandemic. In this relationship, we further tested the moderating role of exposure to the COVID-19, family structure, and family function. Our findings suggested that experiencing burnout, having greater exposure to the pandemic were related to worse mental health symptoms among parents. Mothers with one child or young children had worse mental health symptoms. Besides, the relationship between burnout and mental health among parents was significantly moderated by the level of epidemic exposure, the family structure, and the wellbeing of family function. Greater exposure to the pandemic enhanced the relationship between burnout and more mental health symptoms. On the contrary, parents with older-aged and/or more than one kid, and/or reported healthy family function are less likely to develop mental health symptoms despite burnout.

Firstly, burnout is significantly associated with mental health among parents, which is in line with previous studies (10, 36). These studies have indicated a high level of stress and low mental wellbeing among parents who experienced parental burnout caused by prolonged exhaustion from parenting tasks (6, 36). According to the transactional model of stress, a sense of burnout among parents might evolve into one specific chronic stress (37), while overburden pressure could lead to poor psychological adjustments and more mental health problems (38). Meanwhile, the Job Demand-Resources (JD-R) model (39) posits that job burnout occurs when job demands are high and job resources are limited. Alike, parental burnout develops when more parenting needs are not compensated by enough resources (40). Poor access to parental resources might cause frustration and disengagement among parents, and result in exhaustion and other mental health impairments potentially (6). Moreover, in Chinese society, families generally outsource care resorting to after-school training institutions and grandparents that can help with the education and caring of their children. However, during the lockdown, all these external supports were limited and parents had to run childcare tasks and newly acquired family issues themselves, which made them exhausted from parenting tasks and reduced their mental health (28). Taken together, burnout among parents could be either a factor of acute mental health disorders during the pandemic or a signal of long-term mental health problems after the trauma. We urge that more attention should be paid to burnout symptoms among parents in China.

Secondly, the correlations between parental burnout and mental health are significant in both father and mother groups. In agreement with previous studies (20, 41), we found that mothers were more vulnerable to mental distress than fathers owing to parenting issues, which reflects that female takes most of the home care responsibilities in China. In addition, these results are in line with other studies that highlight COVID-19 could bring additional gender burdens, with women experiencing increased vulnerability and low psychological wellbeing (42, 43). Thus, we propose that more services in mental health protection should be delivered to females in a household context.

Besides, this study reveals that having a younger and only one child was associated with an elevated level of mental health symptoms among mothers, yet healthier family function played an inverse connection. It is obvious that younger kids compared with their older counterparts need more intensive family care, and produce greater parenting stress among parents (25). However, it is counterintuitive that parents with only one child are with more mental health problems than those parenting more kids. Possibly, parents in China still hold a traditional belief that "more children indicate more happiness," thus a greater number of kids in their family are helping to shape a sense of happiness and resilience (44). In Guangdong province, in particular, the number of kids often indicates the level of life satisfaction under the local "Zongci" culture. Parents could obtain more emotional support from their children in multi-children family (45). When it comes to a family function, an existing study found that an unhealthy family function may lead to marital conflicts and eventually to depression among family members (46). A healthy family function, on the contrary, would work with a sense of life satisfaction and hopefulness, and serve to protect mental health (47).

Thirdly, this study suggests that the relationship between burnout and mental health was significantly moderated by epidemic exposure, family structure, and family function. Previous studies also showed a high level of traumatic exposure forced parents into a more frightened and fragile condition, which lowers their threshold of burdening the burnout sensation (14, 15). On the other hand, burnout, as a sense of exhaustion or a result of long-term stress, makes parents more vulnerable to the following negative life events and exacerbates their capabilities to cope with the potential negative affections. Meanwhile, family structure with more and older children reduced the risk of mental health problems among parents with burnout. A possible explanation is that children being older-aged and with a sibling(s) are more probable to care for others, and more likely to provide social support inversely to the parents once burnout emotions existed (25, 48). Thus, this study proposes that reducing the level of traumatic exposure and/or giving voice to a healthy family function might be the interesting starting point in mental health protection among parents in China.

LIMITATIONS AND STRENGTHS

Several limitations of this study should be acknowledged. First, apart from the covariates mentioned in this study, there are yet many other factors such as living arrangements that have not been controlled in this study. In addition, the measure of COVID-19 exposure is not detailed and important information (e.g., severity and duration of symptoms) are overlooked. Moreover, gender differences are addressed but

parents in the study were not couples and dyadic processes (co-parenting, coping, division of labor, the degree of caregiving involvement) are not addressed. Second, the parents of children with special needs (e.g., developmental disabilities or serious physical illnesses) were excluded in our study, whose mental health might be worse due to a higher level of parental burden. The samples including parents of children with developmental disabilities or physical illnesses are expected in future research to examine the child-related predictors on parents' mental health. Third, the sampling methods used in our study were not based on a random selection, which might constrain the generalizability of our findings. Finally, with the cross-sectional design of the current research, it is hard to ensure the direction of causal relationships among the major variables tested in the model, though the theoretical framework has provided full support for these hypotheses. Longitudinal data are expected in future research to help clarify the relationship patterns.

Despite these limitations, there are several implications for practitioners that can support the parents during the COVID-19 difficulties. First of all, urgent consideration should be given to how additional support can be provided to Chinese parents experiencing burnout during the COVID-19 pandemic context. Applicable and proactive interventions, and family education programs, for example, can be proposed. Meanwhile, given the direct and moderating effect of family function in mental health inflammation, community service to help to facilitate better family communications and increase life satisfaction should be encouraged. Last but not the least, it is vital to identify what advice and support could help parents most according to their different situations during the COVID-19 lockdown. In detail, for those women who have only one child or parenting younger children, more effective strategies to prevent burnout and more support of childcare may effectively reduce mother's parenting stress and therefore be beneficial to their mental health.

CONCLUSION

This study indicates that burnout symptoms are significantly associated with worse mental health among parents in China. It also finds out the relationships between parental burnout and mental health differs across gender. Females are more vulnerable to parenting-related pressures than their male counterparts. Besides, exposure to the pandemic, family structure, and family function is found to moderate the association between burnout and mental health among parents. This study urges that community services and target interventions with a healthy family structure and function might be beneficial to improve parent's mental health.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Peking University. The patients/participants provided their electronic informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JG designed the study. MC and YB drafted the manuscript and analyzed the data. MF, NH, FA, MS, XW, CL, and XLF were involved in revising the manuscript. All authors were involved in writing the manuscript and approve of its final version.

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Investigating Anxiety and Fear of COVID-19 as Predictors of Internet Addiction With the Mediating Role of Self-Compassion and Cognitive Emotion Regulation

Reihaneh Moniri†, Kimia Pahlevani Nezhad*† and Fahimeh Fathali Lavasani*

Deputy of Behavioral Sciences and Mental Health, Tehran Psychiatric Institute, Iran University of Medical Sciences, Tehran, Iran

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Daria Smirnova, Samara State Medical University, Russia

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***Correspondence:**
Reihaneh Moniri
reihaneh1996@yahoo.com

†ORCID:
Reihaneh Moniri
orcid.org/0000-0002-2725-2174
Kimia Pahlevani Nezhad
Orcid.org/0000-0002-7039-0142

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Background: In addition to many deaths due to the Coronavirus pandemic, many psychological issues and problems are affecting people's health. Including the constant anxiety and fear of infecting themselves and their families, COVID-19 has led to excessive spending of time in cyberspace and the Internet.

Methods: In this study, the role of fear and anxiety of COVID-19 in predicting Internet addiction among 1,008 students was investigated. The mediating role of the two components of self-compassion and cognitive emotion regulation has also been measured. Data collection was done online due to the outbreak of the disease and a modeling method was used to analyze the data.

Results: The results shows that anxiety and fear of COVID-19 has a positive and significant relationship with both Internet addiction ($r = 0.32$) and maladaptive cognitive emotion regulation strategies ($r = 0.17$), and it has a negative relationship with self-compassion ($r = -0.25$).

Conclusions: The findings suggest that self-compassion can play a protective role against internet addiction at the time of COVID-19 pandemic while maladaptive strategies for emotion regulation can be risk factors for anxiety and fear of the virus.

Keywords: anxiety, COVID-19, internet addiction, self-compassion, cognitive emotion regulation

INTRODUCTION

In December 2019, a virus of unknown origin entangled the world called SARS-CoV-2, or more commonly referred to as the COVID-19 virus. The virus began to spread from China and the city of Wuhan, which spread widely around the world despite China's rapid quarantine efforts (1). According to the World Health Organization (WHO), the coronavirus pandemic has become a global concern and measures such as social distancing, regular hand washing, and in a case of infection, house quarantining for 7 to 14 days is necessary (2). Based on WHO, the number of confirmed cases worldwide is more than 373 million and the number of deaths is about 5.65 million

people as of January 2022, and is on an ascending path. In particular, Iran has reported about 6.34 million confirmed cases and more than 132 thousand deaths (3). The pandemic has effected almost every part of human life (4) such as: socializing, working, planning and even shopping. Also the social isolation which is one of the consequences of the pandemic, has not only changed the lifestyles of the people all over the world, such as the quantity of physical activities and sleep patterns, it has also influenced mental health and emotional responses of the people (5). Even it is studied that less physical activity, sleep problems related to the quarantine, and internet usage can be the risk factors for increased anxiety at the time of pandemic (6). Some psychological impacts of the disease have been investigated with the onset of the prevalence but the solutions in order to reduce the damage have been somehow neglected (7). Fear and anxiety caused by little knowledge about the virus (8), fear of disease and death (2), spreading false news (9), reduced social contacts (1), restrictions on the use of public transportations (10), economic problems (11) and excessive use of social media (12) are among the problems of this period of time. Dr. David Murphy (president of the British Psychological Society) introduced fear and anxiety as one of the basic variables that should be investigated during COVID-19 pandemic (13). Besides that, fear and anxiety as consequences of COVID-19 can lead to disorders such as depression and anxiety among adolescents (14).

An unavoidable requirement of the coronavirus pandemic is observing physical and social distancing. Physical distancing means staying 6 feet away from others while social distancing is home-staying and prohibition of outdoor activities, which has encouraged the use of virtual ways of communication. By returning people to the routine of social life, the importance of practicing physical distancing is being more emphasized. People who are infected by the coronavirus need to self-quarantine for at least 14 days and in this period of time they should stay at home, wash their hands regularly, not share items such as towels and utensils, and not having visitors. In severe cases, hospitalization and intensive care may be required. At the end of the illness, when subjects have no symptoms, with doctor's diagnosis, they can return to normal life. Quarantine has many psychological impacts such as PTSD, anxiety and irritability, insomnia, depression and anger. Also due to the fact that people spend most of their time at home, the risk of intimate partner violence (IPV) in multiple domains of abuse has increased (15–19), however its benefits typically outweigh these health issues when setting public policy. Another important impact of staying at home is increasing the usage of Internet both for telecommuting and browsing for information on outbreaks and other news related to the disease such as the mortality rate (20); which can also be a trigger to the fear of COVID-19 and obtaining incorrect information (9). Besides the concern of the COVID-19 pandemic, Internet, social media and games have become an integral part of individual's lives; which has added a disorder called Internet addiction into the list of problems and psychiatric disorders (21). Addiction is defined as a high dependency on something and the inability to control the consumption that can involve some kinds of substance, behavior and process (22) such as gambling, excessive sexual behavior, compulsive buying, Internet use, or stealing (23). According to the recent statistics, about 4.66 billion people are active internet users as of February 2021, where 3.96 billion people are also active social media users (24). As of April 2019, Iran ranks first in the Middle East with 62.7 million internet users (25) and according to the report of Internet World Stats, it is the 17th country with the greatest number of internet users worldwide.

Over the last decade, increasing population size and the frequency of internet use has become a concern of the possible negative consequences of overuse (26). This concern has increased during the time of the COVID-19 pandemic due to social contact restrictions and the reduction of non-virtual communications and outdoor activities (12). There are some psychological factors which can predict addiction to the internet; such as loneliness, self-esteem and life satisfaction (27), shyness and locus of control (28), depression (29), emotional regulation (30), and self-compassion (31).

The concept of self-compassion was created in response to criticisms of the concept of self-esteem as a component of psychological health. As self-esteem is based on the performance of others, kind of social judgment and comparison, self-efficacy, true self-esteem, self-respect, and self-compassion have been identified as components that provide a better explanation for mental health. Self-compassion is a concept that consists of three parts: (a) kindness toward oneself rather than self-blaming and being self-judgmental during times of difficulty, (b) having human commonalities instead of a sense of isolation and (c) mindfulness vs. over-identification or avoidance toward painful feelings. Being self-compassionate is being used for one who understands his/her condition in a non-evaluative manner and keeps being empathic instead of over criticizing. The person interprets the situation as an experience which may occur to everyone during their lifetime, acknowledging that suffering and he is not the only person in pain in the world. Furthermore, he can keep thoughts and emotions in balanced awareness instead of attaching to one and avoiding the others (32). The relationship between self-compassion and anxiety, depression and self-criticism are negatively significant, while the positive association between self-compassion and wellbeing, optimism and happiness are proven. There is a negative relationship between internet addiction and depression and lower self-esteem thus self-compassion can play a protective role against this psychopathology (33).

Another factor that can predict internet addiction is cognitive emotion regulation which is a general term that is defined as the human's ability to manage and modulate emotions in every difficult situation of life, consciously or unconsciously (34). According to Gross' model, emotion regulation includes 5 stages: (1) situation selection, (2) situation modification, (3) attention deployment, (4) cognitive change and (5) response modulation (34). Moreover, various studies have introduced different emotion regulation strategies that fall into two categories: adaptive and maladaptive. Maladaptive strategies include repression, avoidance, and mental rumination; which are associated with a variety of disorders such as anxiety and depression. Adaptive strategies include problem solving

(ability to change conditions that create undesirable emotions), acceptance (accepting emotions and feelings as they are) and reappraisal (positive interpretation of stressful situations as a way of anxiety reduction) (34, 35). Inability to use healthy strategies to moderate negative emotions may lead to many mental disorders such as affective and anxiety disorders; while adaptive ways of emotion regulation are linked to psychological and physical wellbeing (35). Additionally, some research shows that students with severe internet addiction have greater difficulties in emotion regulation (36) and it may be an important variable in understanding the relationship between mental health problems and improper use of social media (37). Other research suggests that activation of maladaptive coping strategies such as rumination, may increase the likelihood of using the Internet as a means of cognitive-emotional self-regulation. Thus, using the Internet may become a strategy for controlling unwanted negative emotions (38).

In general, the pandemic of COVID-19 has affected every part of our lives, on top our psychological health which can be influenced by some non-mental components and some interpersonal issues. Besides that, people are constantly worried about getting infected, whether themselves or their loved ones, so this fear and anxiety has become an integral part of their lives. People may cope with this pressure in different ways; some by exercising at home, some through learning new skills, and some people may spend most of their time in cyberspace, computer games, and more generally, on the Internet. In order to help with the current situation, this work intends to investigate the relationship between anxiety and fear caused by the COVID-19 disease, and Internet addiction with the mediating role of self-compassion and cognitive emotion regulation.

METHODS

Samples

The target sample in this research was students from different academic levels which were selected using the convenience sampling method. They were invited to participate in this research through popular social media pages and groups. Due to the prevalence of the coronavirus and the need to follow health protocols, online methods were used to collect data in this study. Questionnaires were sent to the target population, through programs such as WhatsApp, Telegram and Instagram. The survey was started in January 2020 and the data collection was done after 2 months. Inclusive criteria are students and those who have access to the internet in order to fill out a questionnaire online. If a questionnaire was not completely done, or only one option had been selected in all questions, the person was excluded from the sample. The questuionnaire was sent to more than 1,200 students and 1,008 of them filled the inclucive criterias. Participation or non-participation in the study was not beneficial or harmful for individuals and all of them answered the questionnaires based on personal satisfaction.

In this study, 12 samples for each subscale were collected. This number of samples required is based on the book of multivariate regression in behavioral research written by Kerlinger (39), which indicates the need for 12 or 15 samples per subscale in this method of analysis. With a total of 18 subscales, there was a requirement to collect data from at least 216 students.

MATERIALS

Corona Disease Anxiety Scale

The CDAS has recently been developed and validated to measure anxiety caused by the outbreak of coronavirus in Iran. The final version of this questionnaire has 18 items and 2 components. Items 1 to 9 measure psychological symptoms and items 10 to 18 measure physical symptoms. This tool is scored in a 4-point Likert scale (never = 0, sometimes = 1, most times = 2 and always = 3). High scores in this questionnaire indicate higher levels of anxiety in the individuals. The reliability of this tool was obtained using Cronbach's alpha method for the psychological symptom $\alpha = 0.879$, the physical symptom $\alpha = 0.861$, and the whole questionnaire $\alpha = 0.919$ (40).

Young Internet Addiction Test (IAT)

The IAT is a 20-item questionnaire that assesses the person's performance at work, school and home (3 questions), social behaviors (3 questions), emotional communication and response via the Internet (7 questions), and general patterns of Internet use (7 questions) (41). Respondents answer on a 5-point Likert measure ("does not apply" to "always"), which people score from 0 to 100. Those who get <49 will be in the "average users"' category, participants scoring between 50 and 79 are "problematic internet users," and those scoring 80 and above be categorized as "severely problematic users." In the study of Widyanto et al. (42), the internal validity of the questionnaire was higher than 0.92 and the validity of the retest was also reported to be significant. It also shows good to moderate internal consistency and, alpha coefficients of 0.82 (42). In a Persian psychometric survey of the test, the validity of the retest was 0.82 and internal consistency, where the alpha coefficient was 0.88 (43).

Self-Compassion Scale Short-Form

The Self-Compassion Scale (SCS) is a 26-item questionnaire with six subscales consist of self-kindness, self-judgment, common humanity, isolation, mindfulness and over-identification; which is a valid and reliable test (44). The Self-Compassion Scale Short-Form (SCSSF) is a shorter 12-item questionnaire and with a 5-point Likert measure that is a reliable and valid alternative to the full version with a high correlation ($r \geq 0.97$). The internal consistencies for the SCS–SF subscales were 0.54 and 0.75 for the English version of SCS–SF. Reliabilities for all but one subscale (self-kindness) were above 0.60, and Cronbach's alphas of 0.60 and above are acceptable (45). In the Persian version of the test, Cronbach's alphas of 0.91 for the whole scale and 0.77 to 0.92 for the six subscales were calculated. Validity coefficient with the general health questionnaire was−0.45 and for the subscales from−0.28 to−0.48 (46).

Cognitive Emotion Regulation Questionnaire

The CERQ is a 36-item multidimensional questionnaire designed to identify cognitive emotion regulation strategies that people use in stressful, threatening or traumatic life events; which is a valuable and reliable tool. This questionnaire examines 9 cognitive strategies for emotion regulation (self-blame, blaming others, acceptance, refocusing on planning, positive refocusing, rumination, positive reappraisal, putting into perspective, and catastrophizing) (47). Moreover, the short-form of cognitive emotional regulation (CERQ-short) is an 18-item questionnaire with high alpha reliabilities. Self-blame has the lowest alpha in this questionnaire between the subscale (0.67) and the rest of the alphas were in a range of 0.73 to 0.81 (48). Based on the standardization done in Iran, this questionnaire with Cronbach's alpha between 0.68 and 0.82 (for 9 subscales) has a good validity in the Iranian society (49).

RESULT

The research is a cross-sectional and modeling method using SPSS Statistics v22 and AMOS v22 has been applied to analyze the data. Also a description of the demographic information of the participants is given in **Table 1**.

Descriptive indicators such as mean, standard deviation, range of values, and correlation matrix of the studied variables are reported in **Table 2**. As can be seen, anxiety and fear of COVID-19 has a positive and significant relationship with both Internet addiction ($r = 0.32$) and maladaptive cognitive emotion regulation strategies ($r = 0.17$) and it has a negative relationship with self-compassion ($r = -0.25$).

Considering the significant relationships between research variables, the results of path analysis are summarized in **Table 3** to investigate the mediating role of self-compassion and cognitive emotion regulation strategies as the role of mediators. The results show that the relationship between all pathways in the mediation model except anxiety and fear of COVID-19 pathway with adaptive cognitive emotion regulation strategies were statistically significant ($p < 0.0001$). Therefore, the findings support the mediating role of self-compassion and maladaptive cognitive emotion regulation strategies in the relationship between anxiety and fear of COVID-19 and Internet addiction. The results are summarized in **Figure 1** below. In other words, these findings suggest that people with high anxiety and fear of COVID-19 use maladaptive emotion regulation strategies, which in turn increase their susceptibility to Internet addiction. Also, people with high anxiety and fear of COVID-19 with low levels of self-compassion, are more vulnerable in the path of Internet addiction.

TABLE 1 | Demographic characteristics of study sample ($n = 1,008$).

Variable	Frequency	Percentage (%)
Gender		
Male	284	28
Female	724	72
Education		
Diploma	360	35
Bachelor	340	34
Masters	236	24
Doctorate	72	7
Marital status		
Single	857	85
Married	137	13.5
Divorced	13	1.5
Widowed	1	0.1
Employment status		
Physical presence at work	185	18
Teleworking	217	22
Unemployed	606	60
Type of employment		
Unemployed	630	62.5
Part-time	249	25
Full-time	129	12.5
Income		
Low	75	7.5
Middle	755	75
Good	178	17.5
Have you been infected by COVID-19?		
Yes	189	19
No	819	81
Has any of your family members or friends been infected by COVID-19?		
Yes	556	55
No	452	45
Social distance		
<2 months	120	12
Between 2 and 5 months	187	18.5
More than 5 months	701	69.5

DISCUSSION

The aim of this study was to investigate anxiety and fear of COVID-19 as predictors of Internet addiction with the mediating role of self-compassion and cognitive emotion regulation. From the results, it is concluded that in the days when the world is widely affected by COVID-19, there is an association between the fear and anxiety of the virus and the misuse of the Internet. Although the level of anxiety may not indicate that one is suffering from an anxiety disorder, it still requires awareness and, if necessary, intervention. Also, due to the continuing epidemic and its other consequences, people's fear and anxiety may increase in severity to the extent of psychiatric diagnosis. Various factors can be effective in this regard. For example, it seems that limitations related to social distancing, the need to commit to health protocols and high mortality rates, can cause a significant rise in anxiety and fear, which leads to obsessive behaviors such as spending time in cyberspace.

Our findings show that a high level of compassion can be effective in reducing the effect of COVID-19 anxiety on Internet addiction. Since the compassionate person scores higher in the three main indicators of this component, namely self-kindness, human commonalities and mindfulness, it can be inferred as a

TABLE 2 | Descriptive statistics and the correlation matrix ($n = 1,008$).

Variable	Mean	SD	Range	1	2	3	4	5
1. COVID-19 anxiety	14.09	9.11	1–54	-				
2. Internet addiction	44.20	14.90	20–100	0.32**	-			
3. Self-compassion	36.98	7.82	14–57	−0.25**	−0.43**	-		
4. Maladaptive strategies	25.19	4.72	8–40	0.17**	0.11**	0.11**	-	
5. Adaptive strategies	29.45	5.98	10–49	0.04	0.04	0.23**	0.47**	

*r, Pearson's correlation coefficient; **p < 0.01; *p < 0.05.*

TABLE 3 | Summary of mediation analyses on direct and indirect effects of Corona Disease Anxiety on internet addiction ($n = 1,008$).

Mediator	Direct effect	Indirect effect via mediator		
		Indirect effect	Indirect lower CI	Indirect upper CI
Self-compassion	0.36***	0.15***	0.114	0.206
Maladaptive strategies	0.08***	0.03***	0.015	0.059
Adaptive strategies	0.03	0.000	0.000	0.000

*CI, 95% confidence interval derived based on 5,000 bootstrapped samples; ***p < 0.0001.*

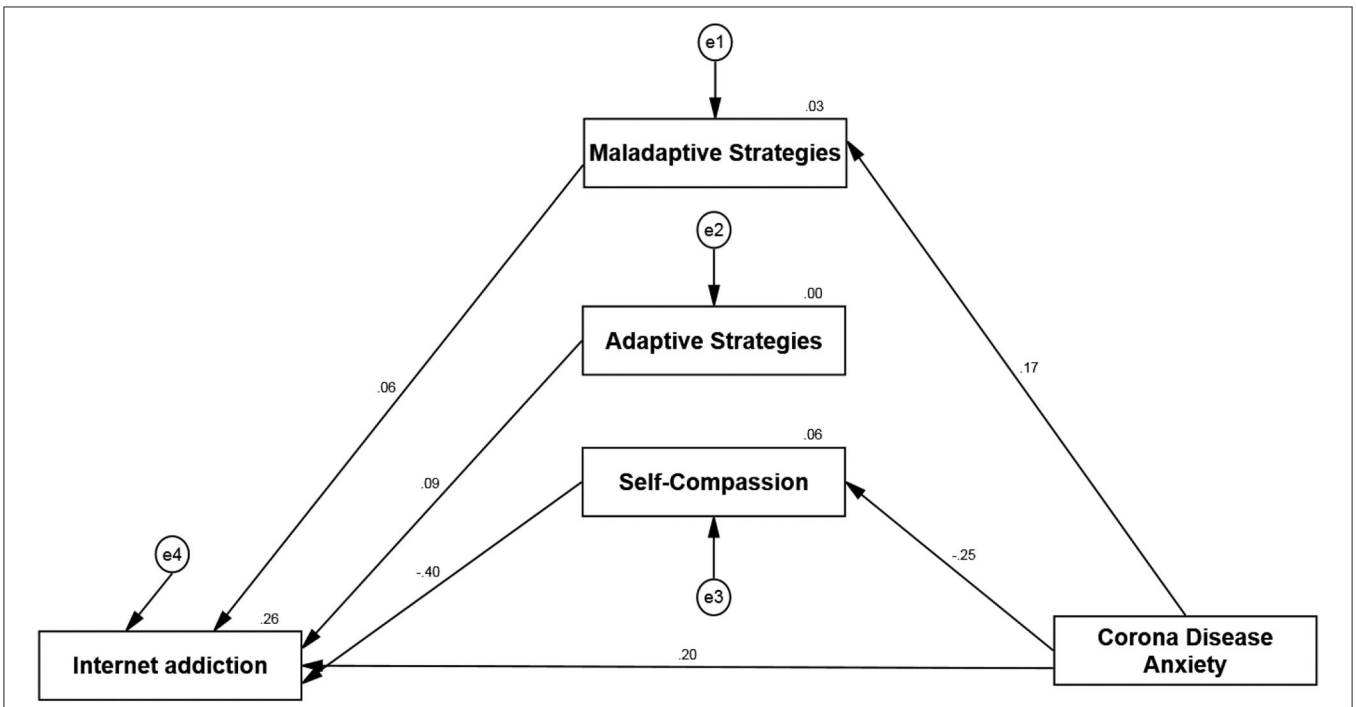

FIGURE 1 | Examining the indirect effect of corona disease anxiety on internet addiction through self-compassion and emotion regulation.

protective variable, which is congruent with the study of Muris et al. (50, 51). Constantly blaming oneself for the possibility that the individual's actions will put himself or his family members at the risk of infection, as well as feeling responsible for the health of people with whom they are in contact, can cause great anxiety, which is contrary to the constructive effects of self-kindness. Another effect of self-blame is that it leads to the application of maladaptive coping strategies, which is followed by decreased self-esteem, the feeling of helplessness, and social isolation (52). The feeling of common humanity, especially during the coronavirus pandemic, can create this perception that people all around the world are involved in an unavoidable condition, which has imposed many deaths and major limitations in the way of normal life. This factor creates a feeling of closeness to other human beings. Therefore, the less one considers themself a member of human society, the more one will experience anxiety

and separation (52, 53). In addition, lack of self-awareness about the present and the constant mental conflict with the issue of coronavirus and fear of death (of themselves and/or their loved ones), and over-identification with these thoughts also increases the level of anxiety. All of these factors explain people turning to virtual networks and the Internet as an inefficient way to deal with this fear and anxiety (12, 54).

Cognitive emotion regulation plays an important role in coping with stressful situations, as it determines the effect of these situations on our mental health. The use of adaptive strategies can help a person cope with stressors such as coronavirus pandemic more efficiently. According to the results, there is a positive relationship between anxiety and fear of coronavirus and the use of maladaptive strategies of cognitive emotion regulation such as avoidance, suppression and rumination, which is consistent with Jungmann and Witthoft (55). Most of people have ruminating thoughts with anxious content such as risk of infection and death of themselves or their loved ones. Moreover, daily exposure to the news of death rates cause people to experience high levels of anxiety. Obsessive use of internet is an avoiding strategy in order to feel less anxious during the pandemic. The negative reinforcing effect of using the Internet turns this behavior into an addiction. Some other reasons for the pathological use of internet could be some dissociative symptoms which are found in their neural pathways (56). It is also proven that social media users have much more social and emotional impairments in comparison with the non-users (57). All these descriptions explain the positive and significant relationship between anxiety and fear of COVID-19 and Internet addiction.

CONCLUSIONS

Due to the increase in addictive behaviors during COVID-19 pandemic (58), self-compassion can play a protective role while maladaptive strategies for emotion regulation such as self-blame, blaming others, and rumination can be risk factors for anxiety and fear of the virus which leads to more obsessive use of internet.

Suggestions

Self-compassion can be enhanced with treatments such as Mindful Self Compassion (MSC), Compassion Focused Therapy (CFT), Mindfulness-Based Stress Reduction (MBSR), Acceptance and Commitment Therapy (ACT), Dialectical Behavior Therapy (DBT) and Mindfulness Based Cognitive Therapy (MBCT) (59). Also, training emotional regulation skills in limited sessions can help control the level of experienced anxiety. It can also improve adaptive strategies and reduce the use of maladaptive strategies at the time of stress (60). In addition internet is not only the cause of addiction but also due to the extreme relation between anxiety and stress and the use of it, Internet-based interventions could be used to promote wellbeing and manage psychological distress during Covid-19 pandemic (61).

LIMITATIONS

This study was performed on a student population, and precautions should be taken in generalizing the results to other individuals. Also, due to the prevalence of coronavirus, data collection has been done online and by the convenience sampling method, which may bias the results.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

All the data collecting, analyzing, and writing the whole research has been done with the efforts of RM and KP, under the supervision of FL. All authors have read and approved the final manuscript.

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Characterizing the Relationship Between the COVID-19 Pandemic and U.S. Classical Musicians' Wellbeing

Grace Wang[1], *Noah R. Fram*[2], *Laura L. Carstensen*[3,4] *and Jonathan Berger*[2]*

[1] Department of Biology, Stanford University, Stanford, CA, United States, [2] Center for Computer Research in Music and Acoustics, Stanford University, Stanford, CA, United States, [3] Department of Psychology, Stanford University, Stanford, CA, United States, [4] Stanford Center on Longevity, Stanford University, Stanford, CA, United States

The COVID-19 pandemic has devastated the economic and social wellbeing of communities worldwide. Certain groups have been disproportionately impacted by the strain of the pandemic, such as classical musicians. The COVID-19 pandemic has greatly harmed the classical music industry, silencing the world's concert halls and theaters. In an industry characterized by instability, a shock as great as COVID-19 may bring negative effects that far outlast the pandemic itself. This study investigates the wellbeing of classical musicians during the COVID-19 pandemic. 68 professional classical musicians completed a questionnaire composed of validated measures of future time horizons, emotional experience, social relationships, and life satisfaction. Findings show that feelings of loneliness had a significant negative association with other measures of wellbeing and were significantly mediated by increased social integration and perceived social support from colleagues, friends, and family. These findings help to characterize the present psychological, emotional, and social wellness of classical musicians in the United States, the first step toward mitigating the hazardous impacts of COVID-19 on this vulnerable group's mental health and wellness.

Keywords: COVID-19, mental wellbeing, social isolation, SARS-CoV-2, musicians

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***Correspondence:**
Jonathan Berger
brg@ccrma.stanford.edu

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INTRODUCTION

On March 17, 2020, health authorities in the San Francisco Bay Area imposed the United States' first COVID-19 stay-at-home order (Allday, 2020). By the end of May 2020, 42 states and territories in the U.S. had enacted similar closures, dramatically disrupting the country's performing arts sector (A Timeline of COVID-19 Developments in 2020., 2021). As concert halls closed, performers faced heightened uncertainty about their careers. Particularly affected were classical musicians, who earn most of their income from live concerts and view performing as integral to their careers and identities (DiCola, 2013). The onset of COVID-19 closures required musicians to adapt creatively, moving performances from the concert hall to places ranging from porches, balconies, and the streets, to the internet (Gelt, 2021).

As concert halls shuttered, musicians faced both professional and personal challenges—as was the case for much of the world, social distancing guidelines greatly isolated individuals, raising concerns for increased loneliness and mental health deficits. For musicians who usually performed with others in an ensemble, such solitude did not only result in loneliness—a key aspect of their music was inhibited.

Even prior to the pandemic, classical musicians faced intense competition and financial insecurity (Macnamara et al., 2014; Pecen et al., 2016; Ascenso et al., 2018), two intense occupational stressors that categorize the occupation as precarious work. Precarious work is defined as employment that is uncertain and unpredictable from the point of view of the worker (Kalleberg, 2009), causing far-reaching consequences to individuals' mental health and social outcomes (Kalleberg, 2011, 2018; Benach et al., 2014; Kelly et al., 2014; Schneider and Harknett, 2019). Indeed, such occupational challenges may contribute to a higher prevalence of mental health disorders in classical musicians than in the general population (Kegelaers et al., 2020). However, despite these occupational stressors, classical musicians tend nonetheless to maintain relatively high levels of satisfaction with their jobs and lives (Bonneville-Roussy et al., 2011; Brodsky, 2011). Many have even described performing as a lifestyle, rather than simply a means of earning a living (Oakland et al., 2012). This appears to hold true for the pandemic's disruptions as well; in recent interviews, classical musicians have described these disruptions to their career as bringing about "existential questions," ranging from "how do we find meaning?" to "do we even continue to play music?" (Gelt, 2021).

The COVID-19 stay-at-home orders found many successful classical musicians unable to perform or earn a living from musical work, raising financial, social, and mental health concerns. A prior study of the pandemic and classical musicians analyzed the UK performing arts community, finding that classical orchestral musicians have been severely impacted by the closures enacted due to COVID-19 (Cohen and Ginsborg, 2021). The current study is, to our knowledge, the first analysis of how the COVID-19 pandemic has affected United States classical musicians' emotional experience, and how factors such as social relationships and loneliness mediate this experience. Given the intense social isolation brought by the pandemic, we frame our study around the important connections between social relationships and mental wellbeing (House et al., 1988; Turner and Marino, 1994; Thoits, 1995; Kawachi and Berkman, 2001; Schnittker, 2008; Wang et al., 2018), which are found to be important mediators to emotional and financial stress (Whelan, 1993; Wang et al., 2014).

From a sociological perspective, social relationships can be understood through three classes of phenomena: social integration, relational content, and social network structure (House et al., 1988). The present study focuses on the first two classes: social integration, defined as the quantity and type (e.g., kin/nonkin) of social ties, and relational content, defined as the functional quality of social relationships. An important aspect of relational content is social support, the positive, potentially stress-buffering aspects of relationships (Hall and Wellman, 1985). Given that the COVID-19 pandemic is a significant stressor to the global community (Bridgland et al., 2021; Whitehead, 2021), we position our study under Cohen and Wills' stress-buffering model of social support, wherein social support is hypothesized to prevent or modulate responses to stressful events that are damaging to health (Cohen and Wills, 1985). Under this model, social support may act on several points in the pathway between stressful events and harm to mental wellbeing, such as influencing an individuals' appraisal of the stressful situation or reducing a negative emotional reaction to stress (Cohen and Wills, 1985; Bailey et al., 1994; Kawachi and Berkman, 2001).

Given the existing literature, we hypothesized that increased measures of social integration and perceived social support would correlate with more positive measures of wellbeing in our study sample. We use validated measures of wellbeing to empirically analyze U.S. classical musicians' outlook on the future, emotional affect, and life satisfaction during the pandemic, focusing on the connections between social relationships and wellbeing.

MATERIALS AND METHODS

Participants

Participants were recruited by email using the listservs of U.S. professional classical musician organizations such as small ensembles, orchestras, composers' associations, and chamber music groups. Inclusion criteria for the study were that participants must: (i) be a professional classical musician, defined as someone who makes the majority of their salary from classical music performances (U.S. Government., 1949), (ii) reside in the United States, and (iii) be over the age of 18. There was no specification of musical instrument detailed in participant criteria. Of the participants recruited for the study ($n = 68$), 32 identified as White, 10 identified as Black or African American, 16 identified as Asian or Asian American, 2 identified as Hispanic or Latinx, 2 identified as mixed-race or "other," and 7 declined to report their race. Given previous data on the racial makeup of the classical music field, our data is mostly racially representative, though slightly overrepresents minority races (Doeser, 2016). 31 of the participants had completed a four-year college or conservatory program, 7 had started but not completed a four-year college or conservatory, 12 had completed a graduate or professional degree, 11 had graduated from high school or obtained a GED, and 8 declined to report their education. The median participant 2020 fiscal year total household income was $70,000. 52% of participants were married, 24% had living children, and 67% had other living immediate family. Upon survey completion, participants had the choice to enter their email address for an optional $10 Amazon gift card raffle.

Measures

The survey was administered in March through May of 2021 using Qualtrics. This survey was comprised of validated measures of wellbeing designed to assess participants' time horizons, subjective wellbeing, social relationships, and a range of emotional experiences.

Time Horizons

Time horizons are defined as individual temporal strategies and orientations toward the past, present, and future (Lundqvist, 2020). We assessed time horizons with a modified version of the Future Time Perspective (FTP) scale (Carstensen and Lang, 1996). The original FTP scale consists of 10 statements about subjective time perception (e.g., "I could do anything I want in the future"), where participants rate how true each statement is for them on a 7-point scale from 1, *very untrue*, to 7, *very true*. This scale has been further adapted to occupational time horizons (Zacher and Frese, 2009; Henry et al., 2017), with prior findings suggesting that FTP at work mediates the relationship between occupational well-being and behavioral or motivational outcomes. In the present study, we adapted the occupational FTP model for classical musicians by altering the statements to pertain specifically to a musical career (e.g., changing "Many opportunities await me in the future" to "In my musical career, many opportunities await me in the future"). Additionally, we added three questions that concerned classical musicians' future planning, such as "I will challenge myself with new repertoire in the future."

Subjective Wellbeing and Life Satisfaction

Subjective wellbeing refers to how individuals experience and evaluate their lives (Stone and Mackie, 2013). We assessed subjective wellbeing through the Diener Satisfaction with Life Scale (Diener et al., 1985, 2006, 2010). This scale assesses participants' satisfaction with their lives holistically, rather than with specific life domains (e.g., health or finances). It is a 5-statement survey, where participants indicate the degree to which they agree with each statement on a 7-point scale, with 1 being *strongly disagree* and 7 being *strongly agree*.

Social Integration and Relational Content

To assess participants' degree of social integration and perceived quality of relational content, we adapted previously validated questionnaires (Schuster et al., 1990; Turner and Marino, 1994), asking about both the quantity and quality of social ties through questions such as "How many musician colleagues do you regularly interact with professionally?" and "How close is your relationship with your musician colleagues?" For questions regarding the number of social or professional ties, several answer categories were presented, such as 0, 1–5, 6–10, 11–15, and 15+. For questions regarding the quality of social or professional ties, participants rated the closeness of their relationships on a four-point scale, where 1 indicated *very close* and 4 indicated *not at all close*. We further investigated the amount and degree of contact participants had with their social network, using the question "On average, how often do you communicate with musician friends and colleagues in the following ways?" with follow-up statements such as "rehearse or jam on-line" or "write or email." For these questions about quantity of contact, participants answered each statement on a 6-point scale, with 1 indicating three *or more times a week* and 6 indicating *less than once a year or never*. Lastly, we further assessed participants' degree of social connectedness using the Social Support Convoy Model, which classifies participants' social connections as a network of social ties that provides protection and support (Kahn and Antonucci, 1980; Antonucci and Akiyama, 1987). This model asks participants to envision their social relationships as three separate levels of closeness and list the first names of people they believe fit into each level.

Positive and Negative Affect

Emotional experience was assessed with queries about the frequency of 29 emotions, 16 of which were positive and 13 of which were negative. We adapted this list of emotions from Carstensen et al. (2020), which measured the valence and arousal level of emotions of the general population during the COVID-19 pandemic. Participants were asked to rate how often they experienced each emotion during the past week on a 5-point scale, with 1 indicating *all or nearly all the time*, and 5 indicating *never*.

Effect on Employment

Participants were asked to indicate the extent to which their employment in a musical career had been impacted during the COVID-19 pandemic through one question, responding on a four-point scale, with 1 indicating *not at all* and 4 indicating *a great deal.*

Ethical Considerations

All study procedures and analyses were approved by Stanford University's Institutional Review Board (IRB #59654), and informed consent was obtained from all participants. Other than the optional email address for the Amazon gift card, no identifying information was collected through the course of the study.

Data Analysis

Statistical analyses were first conducted using R Core Team (2020). First, basic descriptive statistics (means, standard deviations, and frequencies) were calculated for all variables. After verifying assumptions of ordinarily and monotonicity (Wissler, 1905), Spearman's rank correlation coefficients (Savicky, 2014) were calculated to explore the direction and strength of potential relationships between emotional affect, FTP, life satisfaction, social relationships, and career effects. Then, after verifying that our observations were independent and have non-perfect separations, but are not normal, linear, or homoscedastic (Stoltzfus, 2011), we employed single and multivariate logistic regression analyses (R Stats Package, 2020; Wickham et al., 2021) to assess the relationship among loneliness, FTP, life satisfaction, and social relationships, controlling for potential demographic confounding variables such as race, socioeconomic status, and education level. Finally, to assess potential common variance bias, we used Harman's Single Factor Test in SPSS Version 28 (IBM Corp, 2021) (SPSS Statistics for MacOS, 2021).

TABLE 1 | Logistic regression between the question "how many musician colleagues do you regularly interact with professionally?" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	3.1317	0.3653	0.1673	3.159	0.00267**
FTP 2	3.4821	0.3732	0.1809	3.356	0.00150**
FTP 3	3.3856	0.4470	0.1099	2.510	0.0153*
FTP 4	3.1209	0.4351	0.0920	2.274	0.0272*
FTP 5	3.2221	0.4384	0.0650	1.884	0.0653
FTP 6	3.1789	0.4562	0.1096	2.505	0.0155*
FTP 7	5.7758	0.4438	0.2756	4.405	0.0000544***
FTP 8	5.1145	0.4734	0.1210	2.263	0.0115*
FTP 9	3.8798	0.3812	0.1949	3.153	0.000937***
Multivariate FTP	2.35377	1.15565	0.3895	2.037	0.007841**
Life satisfaction 1	3.5219	0.4382	0.0936	2.295	0.0259*
Life satisfaction 2	3.3916	0.4228	0.2151	3.738	0.000469***
Life satisfaction 3	3.3282	0.4861	0.1305	2.766	0.00788**
Life satisfaction 4	3.8366	0.3951	0.1677	3.174	0.00257**
Life satisfaction 5	3.6833	0.4516	0.1126	2.544	0.0140*
Multivariate life satisfaction	3.516	0.9338	0.2765	2.574	0.00895**
Career satisfaction	1.7718	0.42230	0.0467	1.581	0.120

*Both single variable and multivariate logistic regression analyses were conducted. * indicates $p < 0.05$, ** indicates $p < 0.01$, and *** indicates $p < 0.001$.*

RESULTS

Emotional Affect

Participants' most commonly reported emotions were anxiety/worry, loneliness, and concern. These negative emotions were more common than any of the positive emotions. This is notable, given that surveys of the general population during COVID-19 find that participants report more positive than negative emotions (Carstensen et al., 2020). In our study, positive emotions were strongly positively correlated to other positive emotions, while negative emotions were weakly positively correlated to other negative emotions. Generally, positive emotions and negative emotions were negatively correlated. Of all 29 emotions assessed, the emotion of loneliness had the strongest negative correlation to positive emotions. Additionally, loneliness had the strongest negative correlation to measures of life satisfaction and shorter FTP.

Social Integration and Relational Content

There is substantial evidence that low social integration and low degrees of perceived social are related to loneliness (Wang et al., 2018). To explore the emotion of loneliness further, we first examined the relationship between social integration as an independent variable and FTP, career, and life satisfaction as dependent variables using multivariate logistic regression. The question, "How many musician colleagues do you regularly interact with professionally?" was significantly related to all FTP questions, with the exception of the statement, "I could do anything I want in the future." It was also significantly related to all life satisfaction questions, with increased musician colleague interaction associated with more positive life satisfaction. The number of musician colleagues was not associated with career satisfaction (**Table 1**). The question, "How many friends (musician or non-musician) do you have?" was significantly related to all FTP questions, with an increased quantity of friends correlating with a more positive FTP and increased life satisfaction. We were unable to interpret the relationship between "How many friends would you say you have a close relationship with?" and FTP or life satisfaction due to the ambiguity of participants' given answers (e.g., "many," "few"). Quantity of friends was also significantly associated with career satisfaction (**Table 2**).

We further analyzed the relational content of participants' social relationships through multivariate logistic regression using questions examining relationship quality and closeness as the independent variable and questions assessing FTP, life, and career satisfaction as dependent variables. The question, "How close is your relationship with your musician colleagues?" was significantly correlated with higher FTP scores but did not correlate with life satisfaction. However, the perceived quality of relationships with musician colleagues was significantly correlated with career satisfaction (**Table 3**). Answers to "How close is your relationship with your friends?" were significantly associated with FTP and life satisfaction, with closer relationships correlated with more positive scores on both. The quality of friendship was also correlated with career satisfaction (**Table 4**). Relationship quality with kin, as assessed with the question, "How close is your relationship with your family members?" was significantly correlated with all FTP questions, except for FTP8, which states "there are only limited possibilities in my future musical career." Kin relationships were also correlated with career satisfaction (**Table 5**). However, in multivariate logistic regression analyses, family relationships were not correlated with life satisfaction.

TABLE 2 | Logistic regression between the question "how many friends do you have?" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	3.42975	0.27022	0.1962	3.528	0.000897***
FTP 2	3.85573	0.28026	0.1884	3.441	0.00116**
FTP 3	3.23837	0.28556	0.3620	5.379	0.00000189***
FTP 4	3.09697	0.30023	0.2406	4.020	0.000192***
FTP 5	3.12205	0.30404	0.2099	3.681	0.000560***
FTP 6	3.17234	0.31070	0.2745	4.393	0.0000566***
FTP 7	5.0280	0.3505	0.2062	3.640	0.000636***
FTP 8	4.6992	0.3595	0.1099	2.484	0.0164*
FTP 9	4.08969	0.26424	0.3205	4.905	0.00000995***
Multivariate FTP	1.43030	0.95200	0.4327	3.559	0.00233**
Life satisfaction 1	3.60788	0.31311	0.1872	3.428	0.001212**
Life satisfaction 2	3.87624	0.31852	0.2174	3.764	0.000433***
Life satisfaction 3	3.42375	0.33586	0.2708	4.352	0.0000649***
Life satisfaction 4	4.25102	0.30054	0.1547	3.025	0.003924**
Life satisfaction 5	3.80499	0.32084	0.2133	11.869	0.0004933***
Multivariate life satisfaction	2.0147	0.9029	0.3144	4.219	0.00307**
Career satisfaction	1.58897	0.26836	0.4237	5.176	0.000008776***

** indicates $p < 0.05$, ** indicates $p < 0.01$, and *** indicates $p < 0.001$.*

TABLE 3 | Logistic regression between the question "how close is your relationship with your musician colleagues?" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	2.5489	0.1855	0.2179	3.695	0.000555***
FTP 2	2.9046	0.1932	0.2192	3.709	0.000531***
FTP 3	2.6516	0.2343	0.1661	3.124	0.00230**
FTP 4	1.6855	0.2114	0.2961	4.540	0.0000367***
FTP 5	1.9450	0.2145	0.2406	3.941	0.000268***
FTP 6	2.1156	0.2307	0.2159	3.673	0.000592***
FTP 7	6.4058	0.6324	0.2554	4.099	0.000156***
FTP 8	6.0704	0.2485	0.1954	3.415	0.00131**
FTP 9	3.5934	0.2074	0.1572	3.023	0.000937***
Multivariate FTP	1.5474	0.8851	0.3514	1.322	0.0274*
Life satisfaction 1	3.3444	0.2432	0.1671	5.250	0.00297**
Life satisfaction 2	3.3581	0.2334	0.0125	2.652	0.111
Life satisfaction 3	3.1908	0.2713	0.0817	2.089	0.0673
Life satisfaction 4	3.3584	0.2123	0.5331	5.354	0.0107*
Life satisfaction 5	3.6386	0.2594	0.51626	3.053	0.0419*
Multivariate life satisfaction	1.1553	0.9419	0.1922	1.074	0.0841
Career satisfaction	1.4713	0.2331	0.05111	1.625	0.1107

** indicates $p < 0.05$, ** indicates $p < 0.01$, and *** indicates $p < 0.001$.*

Future Planning

We assessed the extent of participants' future planning with two questions: "I have an idea of what I will be doing musically 1 month from now" and "I have an idea of what I will be doing musically 6 months from now." Most participants agreed with the first statement (M = 5.15, SD = 1.99, seven-point scale, with 7 indicating *very true* and 1 indicating *very untrue*) but disagreed with the second statement (M = 3.64, SD = 2.28, seven-point scale, with 7 indicating *very true* and 1 indicating *very untrue*). We further examined participants' degree of future planning with multivariate logistic regression, using 1-month and 6-months future planning as the independent variable and FTP, career, and life satisfaction as dependent variables. Both degrees of future planning were highly correlated with FTP scores. Additionally, future planning at both time points was highly correlated with degree of life satisfaction (**Tables 6**, **7**). Interestingly, compared

TABLE 4 | Logistic regression between the question "how close is your relationship with your friends?" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	2.1948	0.1800	0.2182	3.736	0.000481***
FTP 2	2.4357	0.1867	0.2363	3.933	0.000259***
FTP 3	2.2596	0.2259	0.1698	3.198	0.00240**
FTP 4	1.1991	0.2020	0.3047	4.680	0.0000222***
FTP 5	1.6684	0.2143	0.2065	3.607	0.000715***
FTP 6	1.4783	0.2209	0.2477	4.058	0.000174***
FTP 7	6.4987	0.7618	0.1866	3.387	0.00138**
FTP 8	6.2435	0.7462	0.1687	3.154	0.00275**
FTP 9	2.9316	0.1977	0.2108	3.655	0.000617***
Multivariate FTP	2.1948	0.1800	0.2182	3.736	0.00477**
Life satisfaction 1	1.5515	0.2012	0.3172	4.819	0.0166*
Life satisfaction 2	1.6491	0.1970	0.3697	5.416	0.0000138***
Life satisfaction 3	1.2020	0.2217	0.3409	5.085	0.00000176***
Life satisfaction 4	2.2851	0.1886	0.3090	4.681	0.00000554***
Life satisfaction 5	1.9825	0.2203	0.2535	4.121	0.0000229***
Multivariate life satisfaction	1.0762	0.3846	0.4286	2.798	0.0000903***
Career satisfaction	1.6917	0.2263	0.02006	1.012	0.020

** indicates $p < 0.05$, ** indicates $p < 0.01$, and *** indicates $p < 0.001$.*

TABLE 5 | Logistic regression between the question "how close is your relationship with your family members?" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	2.5692	0.1741	0.2106	3.503	0.00104**
FTP 2	2.9735	0.1775	0.2066	3.461	0.00117**
FTP 3	2.0786	0.2026	0.2861	4.294	0.0000898***
FTP 4	2.2186	0.2100	0.1781	3.157	0.00281**
FTP 5	2.3725	0.2104	0.156	2.916	0.00547**
FTP 6	2.1680	0.2161	0.2082	3.478	0.00112**
FTP 7	5.5942	0.2481	0.1054	2.328	0.0243*
FTP 8	4.9835	0.2507	0.0473	1.495	0.142
FTP 9					0.00000827***
Multivariate FTP	0.2456	0.2308	0.4340	3.153	0.00639**
Life satisfaction 1	3.0951	0.2252	0.1077	2.356	0.00637**
Life satisfaction 2	3.4393	0.2250	0.1120	2.408	0.0228*
Life satisfaction 3	2.8638	0.2526	0.1224	2.533	0.0201*
Life satisfaction 4	3.7143	0.2060	0.1075	2.328	0.0148*
Life satisfaction 5	3.2371	0.2405	0.0987	2.244	0.0245*
Multivariate life satisfaction	1.4992	0.2505	0.1551	0.771	0.2093
Career satisfaction	0.8316	0.2117	0.1508	2.859	0.0297*

** indicates $p < 0.05$, ** indicates $p < 0.01$, and *** indicates $p < 0.001$.*

to 6-month future planning, 1-month future planning was less strongly correlated with the question, "compared to this time last year, I am more fulfilled by my career."

Impacts on Employment

We assessed participants' employment during the pandemic using the question, "what describes your current employment status?" 87% of participants were currently working for pay (part time or full time), while the rest were currently unemployed. We also assessed the impact of COVID-19 on participants' employment with the question, "to what extent has your employment or retirement status been affected by the coronavirus pandemic?" using a five-point scale, with 1 indicating *not at all* and 5 indicating *a great deal*. The majority (67.3%) of participants answered *a great deal*. On average, participants' employment statuses were strongly affected by the

TABLE 6 | Logistic regression between responses to the statement "I have an idea of what I will be doing musically one month from now" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	2.7785	0.1004	0.1204	2.668	0.0102*
FTP 2	2.8475	0.0988	0.1823	3.405	0.00128**
FTP 3	2.2312	0.1112	0.2121	3.741	0.000458***
FTP 4	2.3765	0.1135	0.1302	2.790	0.00736**
FTP 5	2.0182	0.1060	0.1909	3.502	0.000956***
FTP 6	2.2215	0.1143	0.1717	3.283	0.00184**
FTP 7	6.3160	0.1221	0.1866	3.453	0.00111**
FTP 8	5.4046	0.1272	0.2082	2.135	0.0376*
FTP 9	2.8898	0.0955	0.2691	4.375	0.0000586***
Multivariate FTP	2.0867	0.3733	0.3283	2.523	0.00132**
Life satisfaction 1	2.3769	0.1078	0.2017	3.590	0.000742***
Life satisfaction 2	2.5955	0.1108	0.2148	3.736	0.000473***
Life satisfaction 3	1.8621	0.1169	0.2677	4.317	0.0000728***
Life satisfaction 4	2.9716	0.09916	0.2223	3.781	0.000418***
Life satisfaction 5	2.5763	0.1123	0.2018	3.591	0.000740***
Multivariate life satisfaction	5.0061	0.3934	0.4440	2.424	0.00203**
Career satisfaction	1.1301	0.1085	0.0835	2.156	0.0358*

** indicates $p < 0.05$, ** indicates $p < 0.01$, and *** indicates $p < 0.001$.*

TABLE 7 | Logistic regression between the statement "I have an idea of what I will be doing musically six months from now" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	2.7089	0.3301	0.3408	5.185	0.00000360***
FTP 2	3.1857	0.0801	0.3046	4.773	0.0000152***
FTP 3	2.8809	0.0943	0.2659	4.340	0.0000659***
FTP 4	2.5410	0.0913	0.2705	4.391	0.0000556***
FTP 5	2.4970	0.0881	0.2757	4.460	0.0000441***
FTP 6	2.8018	0.0976	0.2170	3.796	0.000385***
FTP 7	5.4808	0.1075	0.1829	3.411	0.00126**
FTP 8	5.4583	0.1034	0.2273	3.874	0.000307***
FTP 9	3.5299	0.0795	0.3428	5.208	0.00000332***
Multivariate FTP	0.8988	0.2383	0.4534	3.964	0.000975***
Life satisfaction 1	2.5422	0.0802	0.4363	6.282	0.0000000738***
Life satisfaction 2	2.9299	0.0863	0.3931	5.747	0.000000510***
Life satisfaction 3	2.5858	0.0967	0.3592	5.347	0.00000212***
Life satisfaction 4	3.3659	0.0802	0.3624	5.331	0.00000235***
Life satisfaction 5	3.4088	0.1003	0.1870	3.426	0.00122**
Multivariate life satisfaction	5.0061	0.3934	0.4440	2.424	0.00000923***
Career satisfaction	1.0760	0.0878	0.2343	3.950	0.000240***

** indicates $p < 0.05$, ** indicates $p < 0.01$, and *** indicates $p < 0.001$.*

coronavirus pandemic (M = 4.46, SD = 0.93). Surprisingly, neither 1-month nor 6-month future musical planning as an independent variable was correlated with employment status nor the impact of COVID-19 on employment status as dependent variables. Additionally, multivariate regression analysis of the impact of the pandemic on employment did not correlate to any measure of life satisfaction or FTP. However, it did have a significant relationship to career satisfaction (**Table 8**).

DISCUSSION

This cross-sectional study revealed that the COVID-19 pandemic is negatively associated with the time horizons, life satisfaction, emotional experience, and overall wellbeing of professional classical musicians. The majority of musicians surveyed stated that the pandemic had affected their musical employment status a great deal, reporting that their careers during the pandemic

TABLE 8 | Logistic regression between the question "to what extent has your employment or retirement status been affected by the coronavirus pandemic" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	3.7540	0.2199	0.0277	1.183	0.243
FTP 2	4.3071	0.2363	0.0051	0.500	0.619
FTP 3	3.8084	0.2654	0.0235	1.086	0.283
FTP 4	3.8959	0.2582	0.0014	0.260	0.796
FTP 5	3.5409	0.2536	0.0227	1.069	0.290
FTP 6	3.8462	0.2750	0.0071	0.591	0.557
FTP 7	4.5712	0.2941	0.0233	1.082	0.285
FTP 8	4.1760	0.2855	0.0032	0.395	0.695
FTP 9	4.4328	0.2362	0.0379	1.389	0.171
Multivariate FTP	1.7053	0.1482	0.1881	0.9485	0.434
Life satisfaction 1	4.2258	0.2581	0.0054	0.514	0.610
Life satisfaction 2	4.5053	0.2647	0.0094	0.681	0.499
Life satisfaction 3	3.9521	0.2994	0.0231	1.076	0.287
Life satisfaction 4	4.6561	0.2456	0.0071	0.584	0.562
Life satisfaction 5	4.8902	0.2777	0.0075	0.611	0.544
Multivariate life satisfaction	1.5297	0.1202	0.1324	1.440	0.264
Career satisfaction	1.1301	0.1085	0.0835	2.156	0.036*

* *indicates* $p < 0.05$.

were significantly less fulfilling than their careers prior to the pandemic.

Of the 29 emotions we assessed, the emotion negatively correlated to the greatest number of indicators for wellbeing was loneliness. Three general types of loneliness exist: situational loneliness, developmental loneliness, and internal loneliness. Situational loneliness refers to loneliness resulting from environmental factors and disasters, developmental loneliness results from personal inadequacies, developmental deficits, or poverty, and internal loneliness results from personality factors, mental distress, low self-esteem, and poor coping strategies with stress (Tiwari, 2013). While the loneliness experienced by participants may be classified under any one or multiple of these categories, the current COVID-19 pandemic is a significant environmental stressor that has affected every aspect of the world. Thus, it is not surprising that loneliness has been a defining characteristic of the COVID-19 pandemic, especially given the implementation of social distancing and "stay-at-home" orders for public health (Li and Wang, 2020; Luchetti et al., 2020).

Studies of the general population have found that not only has loneliness significantly surged during the pandemic (Killgore et al., 2020), it has also been associated with a breadth of mental health concerns, such as elevated rates of depression and higher suicidal ideation (Ingram et al., 2020). Even prior to the pandemic, loneliness has been linked to significant psychological health problems and found to increase the risk of distress, depression, anxiety, and suicidal ideation (Beutel et al., 2017). Beyond its mental health impacts, loneliness has also been known to have damaging effects on physical health, negatively affecting health behaviors, health care utilization, cardiovascular activation, cortisol levels, and sleep (Cacioppo et al., 2002). These physical health impacts can lead to disorders such as rheumatoid arthritis, lupus, cardiovascular disease, obesity, physiological aging, and cancer (Mushtaq et al., 2014). These negative mental and physical health effects of loneliness make our results especially concerning.

Though loneliness may be attributed to any number of causes, we posited that it may be related to the musicians' social relationships. Our findings supported this hypothesis, indicating that greater amounts of social integration and perceived quality of social support, whether it be from musician colleagues, friends, or family were negatively correlated with the emotion of loneliness. Both increased quantity and quality of social relationships appeared to yield this benefit, as well as correlate with higher scores on the FTP scale and greater life satisfaction. However, only perceived quality of kin relationships was correlated with career satisfaction, indicating that career and life satisfaction may be influenced by different variables.

Although the relationship between social support and mental wellbeing has been well-established in the sociological literature, we were surprised to find that while the quantity of musician colleague interaction was correlated with career satisfaction, the quality of these relationships was not. This may indicate that the mere presence of musical colleagues plays a vital role in the lives of musicians, even if these colleague relationships are not close. These results support prior work that found relational content to only partially mediate the impact of social integration on psychological wellbeing and mortality (Blazer, 1982). Additional research has also indicated that social integration is more consequential for health than is the perceived quality of relationships (House, 1984; House et al., 1988).

The next two most indicated surveyed emotions were anxiety/worry and concern. Anxiety during COVID-19

pandemic has been well characterized in multiple countries throughout the span of the pandemic. Even early on, social distancing greatly affected individuals' levels of anxiety: surveys of people quarantined in Wuhan, China during the first 2 weeks of lockdown (the first COVID-19 related lockdown in the world) found that the vast majority of respondents (70.78%) reported symptoms of anxiety (Cao et al., 2020). A similar phenomenon was seen in the U.S. at the onset of the pandemic, with anxiety levels significantly increasing compared to pre-pandemic times. However, in the general U.S. population, anxiety/worry has decreased in the most recent stages of the pandemic (spring and summer 2021), reverting to pre-pandemic levels (Li et al., 2021). Thus, it is interesting that the classical musicians surveyed in our study still report high levels of anxiety/worry and concern.

Our findings are in line with prior studies of classical musicians' anxiety, which have found that even pre-pandemic, anxiety is more prevalent in performing classical musicians than the general population (Barbar et al., 2014; Vaag et al., 2016; Kegelaers et al., 2020). This may be due to the precarious nature of the work, caused by occupation-specific stressors such as employment instability and performance anxiety (Ascenso et al., 2018). Our study finds that the COVID-19 pandemic has worsened employment stability for classical musicians, with the vast majority of respondents stating that their employment status has been affected *a great deal* by the pandemic. Job insecurity is linked to multiple aspects of mental health, including anxiety and worry (Menéndez-Espina et al., 2019). Thus, it is possible that pre-pandemic levels of anxiety/worry in classical musicians have been exacerbated by the addition of pandemic-specific occupational stressors.

Prior studies of COVID-19 and musicians have found that during the pandemic, classical orchestral musicians were overwhelmingly concerned about the future of their careers (Cohen and Ginsborg, 2021). Our investigation of musicians' time horizons through the FTP scale aligns with such findings. However, we also hypothesized that participants' time horizons may be moderated by their extent of future planning. Our results found that both 1-month and 6-month musical future planning were correlated with all measures of FTP and life satisfaction, indicating that both short- and long-term plans are related to musicians' wellbeing. Interestingly, only 6-month planning was correlated to career satisfaction, suggesting that long-term planning may have a unique relationship with a musical career. A potential explanation for this is the open-endedness of the question—we asked respondents their level of agreement with the questions, "I have an idea of what I will be doing musically one/six month(s) from now," not limiting participants to musical plans within their employment. Thus, it is possible that participants referred to personal musical projects outside the scope of their primary employment. This may also explain the difference between 1-month and 6-month planning: it is more likely that musicians have scheduled performances 6 months in the future than 1-month in the future, given the present ongoing disruptions of the pandemic. Therefore, 6-month future planning may refer more directly to participants' primary careers, explaining the significant correlations between 6-month planning, positive FTP, and life satisfaction.

Interestingly, even though participants largely indicated that the pandemic had affected their employment status a great deal, most participants were actively employed at the time of survey. This indicates that participants' understanding of "affected employment status" may encompass more than layoffs. Throughout the pandemic, numerous U.S. orchestras and small ensembles furloughed their musicians. A prominent example is New York's Metropolitan Opera orchestra, whose members were furloughed without pay for months. Even after the furlough period ended, musicians were subjected to significant salary reductions (Jacobs, 2021). Numerous other ensemble groups around the country enacted similar pay-cuts to musicians, many of which are substantial and long-lasting, suggesting that employment disruptions will continue long after the pandemic has ended (Jacobs, 2020).

The results of our study find that the effects of the COVID-19 pandemic are significantly associated with classical musicians' views of their careers, time horizons, and wellbeing. At the time of writing, the pandemic continues to pose an ongoing threat to human health and society, even as vaccinations have become widely available in the United States. Fortunately, as social-distancing guidelines decrease, the performing arts sector has begun to return. However, the mere return of music to concert halls does not signify a solution to many classical musicians' challenges. The economic ramifications of the pandemic on the performing arts will be long-lasting, directly impacting musicians' livelihoods and careers. Thus, the challenges classical musicians are currently facing may outlast the pandemic, raising the question, "how do we best support this vulnerable group?"

One answer: help musicians cultivate resilience. Resilience is defined as the ability to withstand setbacks, adapt positively, and bounce back from adversity, all of which are vitally important in the face of increased stressors during the pandemic (Luthar and Cicchetti, 2000). Prior studies of classical musicians have found that increased psychological resilience is negatively correlated with mental health issues (Kegelaers et al., 2020), indicating its importance in our study population. Though studies of resilience in musicians are limited, prior findings suggest that resilience may be promoted by goal setting, increasing social connectedness, and creating a facilitative environment that reduces mental health stigma, increases mental health literacy, and encourages help-seeking behaviors (Polizzi et al., 2020; Wu et al., 2021). Our study finds that participants with increased goal setting (as measured through FTP), social integration, and perceived support demonstrated lower levels of negative emotions and higher levels of life satisfaction and wellbeing. Thus, it may be beneficial for classical musicians to employ goal-setting behaviors and increase social connectedness to increase psychological resilience. Likewise, ensemble groups and other musical organizations might consider implementing mental health resources and wellbeing workshops for their musicians.

Study Strengths

The present study examines a vulnerable, yet greatly understudied population that is particularly positioned to

be negatively affected by the COVID-19 pandemic. Using well-validated measures of wellbeing and social relationships, we draw important connections between social integration and support to time horizons, career satisfaction, and life satisfaction. Such findings reinforce prior sociological and psychological theory, emphasizing the great importance of social relationships in this unprecedented and uniquely stressful time.

Limitations and Future Directions

Potential limitations of this study include our relatively small sample size, which reduces the external validity of the statistical findings. In general survey research, common method bias is a concern. However, we evaluated this possibility *post hoc,* employing Harman's single factor test using exploratory factor analysis. The total variance explained by a single factor was less than 41%, which falls below the threshold of 50%. Thus, while common method bias cannot be ruled out as a contributing factor in the present study, it does not appear to be a significant factor (Podsakoff et al., 2003). Since all data were self-reported, response bias may be a limitation to construct validity, given the potential influence of social desirability bias, recall bias, and demand characteristics. To reduce such bias, we ensured participants their responses would remain anonymous, asked only about events that took place within the last year, and did not reveal the goals nor hypotheses of the study during participant recruitment. In addition, though the COVID-19 pandemic presents a significant stressor to our study population, it is possible that participants may have had very different experiences during the pandemic. For instance, we did not ask musicians to specify their specific employer: it is possible that gig musicians had significantly less economic stability than ensemble musicians during the pandemic. Moreover, the cross-sectional design of our study precludes us from making a causal claim and reduces internal validity. Future studies could investigate the ramifications of COVID-19 on the classical musician population through increased sample size and longitudinal observations.

In conclusion, our study finds that the COVID-19 pandemic is associated with changes in nearly every aspect of U.S. classical musicians' lives, whether it be their careers, view of the future, emotional affect, life satisfaction, or overall wellbeing. Participants' most reported emotions were loneliness and anxiety, which have been defining emotional characteristics of the pandemic. Our results highlight the power of future planning and social connectedness to help benefit the emotional status, life satisfaction, and wellbeing of classical musicians, suggesting that psychological resilience may be an important and necessary protective factor against the stressors of COVID-19 and the classical music industry.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Stanford University Institutional Review Board (Protocol #59654). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

GW conceived the study and drafted the original manuscript, with revisions from JB, NF, and LC. All authors approved the submitted version.

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SYSTEMATIC REVIEW
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Obsessive-Compulsive Disorder During the COVID-19 Pandemic—A Systematic Review

Elisabeth S. Linde†, *Tibor V. Varga**† and *Amy Clotworthy**†

Section of Epidemiology, Department of Public Health, University of Copenhagen, Copenhagen, Denmark

Background: The COVID-19 pandemic and its associated restrictions may contribute to a deterioration in mental health; individuals with obsessive-compulsive disorder (OCD) may be particularly affected. This systematic review aimed to investigate the effects of the current pandemic on people diagnosed with OCD, and whether pandemics may affect the development of OCD symptoms.

Methods: We conducted a systematic search using NCBI PubMed, SCOPUS, and Google Scholar on February 9, 2021. Research articles related to OCD and COVID-19 or other pandemics were attempted to be identified using pre-defined search terms. Case reports, clinical guidelines, letters, and clinical research articles including ≥100 participants were included; reviews were excluded. The systematic review adheres to PRISMA guidelines and the Newcastle-Ottawa Scale was used to assess the quality of the included clinical research articles.

Results: A total of 79 articles were included in the full-text assessment. Of these, 59 were clinical research articles, two were clinical guidelines, six were case reports, and 12 were letters. The research articles examined OCD symptoms in adult patients with diagnosed OCD, the general population, pregnant women, healthcare workers, students, and young adults, children, and adolescents. Only one study on OCD in previous pandemics was identified.

Conclusion: This systematic review found that people both with and without diagnosed OCD prior to the pandemic generally experienced a worsened landscape of symptoms of OCD during the COVID-19 pandemic. However, the responses are heterogeneous and many factors other than the pandemic seemed to affect the development of OCD symptoms. To prevent the impairment of symptoms and the development of new cases, close monitoring of patients with OCD and education of the general public is essential. Literature is still limited; thus, multinational and cross-cultural, longitudinal studies are warranted to gain further insights on this topic.

Keywords: obsessive-compulsive disorder, OCD, COVID-19, Coronavirus, obsession, pandemic, systematic review, mental health

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***Correspondence:**
Tibor V. Varga
Tibor.Varga@sund.ku.dk
Amy Clotworthy
amy@sund.ku.dk

†*These authors have contributed equally to this work*

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INTRODUCTION

Throughout history, pandemics have struck human societies and caused millions of deaths, economic depressions, and even the fall of empires (1). While *epidemic* describes a disease that infects large groups of people within a population or region, the word *pandemic* refers to an epidemic that spreads worldwide and is difficult to contain (2). Pandemics have the ability to shape cultures, politics, religion, health care, and people's mental health for many generations to come (1). Research into pandemics from recent decades also indicates an immediate and long-term negative psychosocial impact on large numbers of individuals (3).

The Coronavirus disease 2019 (COVID-19) pandemic—which was caused by the SARS-CoV-2 virus originating in Wuhan, China, in December 2019—has increased mortality worldwide (4). As of 16 February 2022, there were over 414 million confirmed cases and over 5.8 million deaths worldwide due to infection from the virus and its complications (5). The virus presents with a wide range of symptoms: from milder symptoms like fever, dry cough, and fatigue to severe symptoms like difficulty to breathe, fever, and chest pain (6). About one in six individuals experience complications of COVID-19, some of which are life-threatening (7).

Since the World Health Organization (WHO) declared a pandemic in March 2020 (8), rigorous strategies have been imposed worldwide to limit the spread of SARS-CoV-2. At times, these strategies have included quarantines, physical distancing, and national campaigns on the importance of hand hygiene and wearing protective facemasks (9). It has been reported that fear of the virus and various strategies to limit the virus' spread might have a synergistic effect in exerting a negative impact on the mental health of populations worldwide (10). Quarantines, in particular, may contribute to negative psychological effects (11). According to recent literature, individuals who had been diagnosed with obsessive-compulsive disorder (OCD) prior to the current pandemic may be the group most affected by the pandemic among those with mental disorders (10).

To date, it remains unknown to what extent and through which mechanisms pandemics affect the mental health of people with OCD (12). OCD is a severe anxiety disorder involving uncontrollable obsessions and repetitive compulsions (9). Obsessions are defined as repeated, unwanted thoughts that generate anxiety, whereas compulsions are defined as behaviors subsequent to an obsessive thought (9). OCD is an extremely heterogeneous and idiosyncratic disorder. However, Rajkumar et al. (13) suggest that at least four distinctions can be identified in patients: (a) fear of contamination and cleaning/washing compulsion; (b) obsessive taboo thoughts and checking compulsions; (c) obsessions and compulsions regarding symmetry; and (d) hoarding.

The etiology of OCD is largely unknown but probably consists of a complex combination of both genetic, biological, and environmental factors (14, 15). Evolutionarily, OCD symptoms like contamination fear, handwashing, and hoarding may have developed to protect our ancestors from infectious diseases and from starvation during times of limited resources (13). General risk factors that are known to cause or trigger OCD are stressful life events, comorbid mental-health disorders, a family history of OCD, and/or personality traits like perfectionism, intolerance of uncertainty, and threat overestimation (15–17). High-risk groups include OCD patients in remission/recovery, geriatrics (i.e., people over age 65), pregnant women, children and adolescents, and healthcare professionals (18–20). OCD is associated with reduced quality of life, various comorbid mental disorders and, with severe OCD, an increased risk of suicide attempts (21, 22). The lifetime prevalence of OCD is estimated to be 1.9–2.5% globally (23). Mild symptoms are reported to occur in up to 14–29% of populations, which means that a sizeable proportion of individuals experience symptoms during their lifetime (24).

About 50% of individuals living with OCD worldwide experience symptoms such as a fear of contamination, excessive handwashing, and a fear of dirt (25). Based on current COVID-19 recommendations from WHO, individuals with OCD are encouraged to engage in cleaning habits that were previously considered irrational. Symptoms such as irritability, anxiety, and sadness—which were once restricted to patients with OCD when they came into contact with objects considered contaminated—are now observed in individuals without previous mental disorders (12, 26, 27). This has raised concerns about how to separate rational fears and behaviors exhibited during the COVID-19 pandemic from obsessive fears and compulsions typical of individuals with OCD. Aardema et al. (12) argue that one aspect separating the two groups is the psychological meaning attached to "contamination." The authors suggest that individuals with contamination fear typically attribute personifications to viruses and germs, which thereby threatens their identity and causes inner corruption (i.e., a threat to the self). The authors explain that OCD is not only characterized by an increased fear of certain threats but also whether these threats target the individual's vulnerable self-theme; i.e., the fear of becoming a certain type of person and/or the areas where the person feels vulnerable and wrong (12, 28).

It has been hypothesized that, during a pandemic, individuals with OCD might believe that their fears of contamination are verified or even encouraged, or they might demonstrate a disproportionate concern about getting infected by the disease (10). During the current pandemic, these phenomena might occur as some of the measures to prevent COVID-19 transmission are similar to behaviors demonstrated by people with OCD, especially those with symptoms like contamination fear and compulsive handwashing (10). Although the emergent crisis of the management of OCD during pandemics is evident, literature is still limited. Thus, an investigation is warranted to learn more about the etiology of OCD and the possible consequences of pandemics on mental health. The goals of this systematic review were to analyze the available evidence in order to gain knowledge about: (1) whether the COVID-19 pandemic has increased the prevalence of OCD symptoms; (2) which specific demographic groups are the most susceptible and which personal characteristics contributed to the worsening of OCD symptoms; and (3) whether there are recommendations on how to improve the management of OCD during the current and future pandemics.

This systematic review of the literature includes both articles that report on people with diagnosed OCD and articles that describe people who display OCD-related (self-reported) symptoms in order to obtain a nuanced understanding of the putative effects of pandemics.

Previous research has indicated that OCD may result in significant impaired psychosocial and occupational functionality and reduced quality of life (29). Therefore, it is important to investigate whether pandemics and their associated lockdowns—as well as other restrictive interventions such as quarantines—may worsen the symptoms of OCD in people with a previous diagnosis, and/or even cause OCD in the general population. Our review has produced unique, important findings that contribute to medical knowledge about OCD, and the results of our study have the potential to inform public-health policies that impact the lives of people with OCD.

METHODS

This systematic review follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines (**Figure 1**) (30). The EndNote reference manager was used to organize references. The systematic review was not registered prior to publication.

Eligibility Criteria

We aimed to include studies concerning the following themes, and generated our search terms accordingly:

1. Studies measuring changes in OCD-related symptoms in patients or populations during pandemics.
2. Studies investigating the mental health of patients or populations during pandemics, with a focus on OCD symptoms.

To increase the robustness of our findings, only research articles including $\geq$100 participants were selected (except for case reports, which were also considered to introduce a case-based qualitative aspect of the research area). Only non-review articles, published in the English language, were selected. No restrictions were set based on publication dates or study design.

Information Sources

We conducted searches using NCBI PubMed, SCOPUS, and Google Scholar on February 9, 2021.

Search Strategy

We searched SCOPUS with the search term: *("Obsessive-compulsive disorder" OR "Obsessive compulsive disorder" OR ocd) AND (covid-19 OR "SARS-CoV-19" OR pandemic OR "coronavirus disease 2019")*

We searched PubMed with the search term:

("SARS-CoV-2"[Mesh] OR "COVID-19"[Mesh] OR "Pandemics"[Mesh] OR pandemic[Text Word] OR covid*[Text Word] OR coronavirus [Text Word] OR "corona virus"[Text Word]) AND ("Obsessive-compulsive Disorder"[Mesh] OR "OCD"[Text Word] OR "Obsessive-compulsive disorder"[Text Word] OR "obsessive"[Text Word] OR "compulsive"[Text Word] OR "obsessive compulsive disorder"[Text Word]).*

Study Selection

After removing duplicates, the initial search resulted in 194 articles and 41 additional publications were identified through other sources, including the revision of all articles included in a recent systematic review by Guzick et al. on the topic of OCD and the COVID-19 pandemic (31). The identified publications were categorized as research articles, clinical guidelines, correspondences, case reports, and comments. We examined the abstracts of the 235 potentially eligible articles and used reference tracking for reviews to search for additional potentially eligible articles. After the exclusion of reviews and non-relevant articles based on the abstracts, 115 articles were included for full text assessment. Of these, 79 articles were included in this qualitative synthesis (**Figure 1**). Of the 79 articles, 59 were original research articles, which are summarized in **Table 1**.

Data Collection

The screening of titles and abstracts was conducted by two co-authors (ESL and TVV) independently, and conflicts in this screening process were resolved by including any articles co-authors selected for full-text assessment. Quality assessment was undertaken by TVV.

Data Extraction

We extracted the following data from the full-text clinical research articles: study design, method of exposure and outcome ascertainment, demographic characteristics (mean age and percent female), sample size, country, period of data collection, and main findings. The Newcastle-Ottawa Scale was used to assess the overall quality of the included clinical research articles based on nine aspects related to study selection, comparability, and outcome assessment (88).

RESULTS AND DISCUSSION

We analyzed a total of 79 articles on OCD and pandemics. From these, 59 were research articles (**Table 1**), six were case reports, and 14 articles were communications or clinical guidelines. Of the 59 research articles, 16 examined individuals diagnosed with OCD prior to the pandemic. Twenty-one articles examined the general population of a specific country. Two articles investigated how pregnant women are affected by the pandemic, six studied healthcare workers, nine focused on students and young adults, and four articles investigated COVID-19 in children and adolescents. Only one study was identified on OCD during previous pandemics. Six articles were case reports of individuals with OCD during COVID-19. An additional 12 articles were letters, editorials, and comments with relevant discussion points, and two articles were clinical guidelines on how medical consultations and treatments were being modified during the COVID-19 pandemic. The quality assessment of the 59 original research articles is presented in **Supplementary Table 1**.

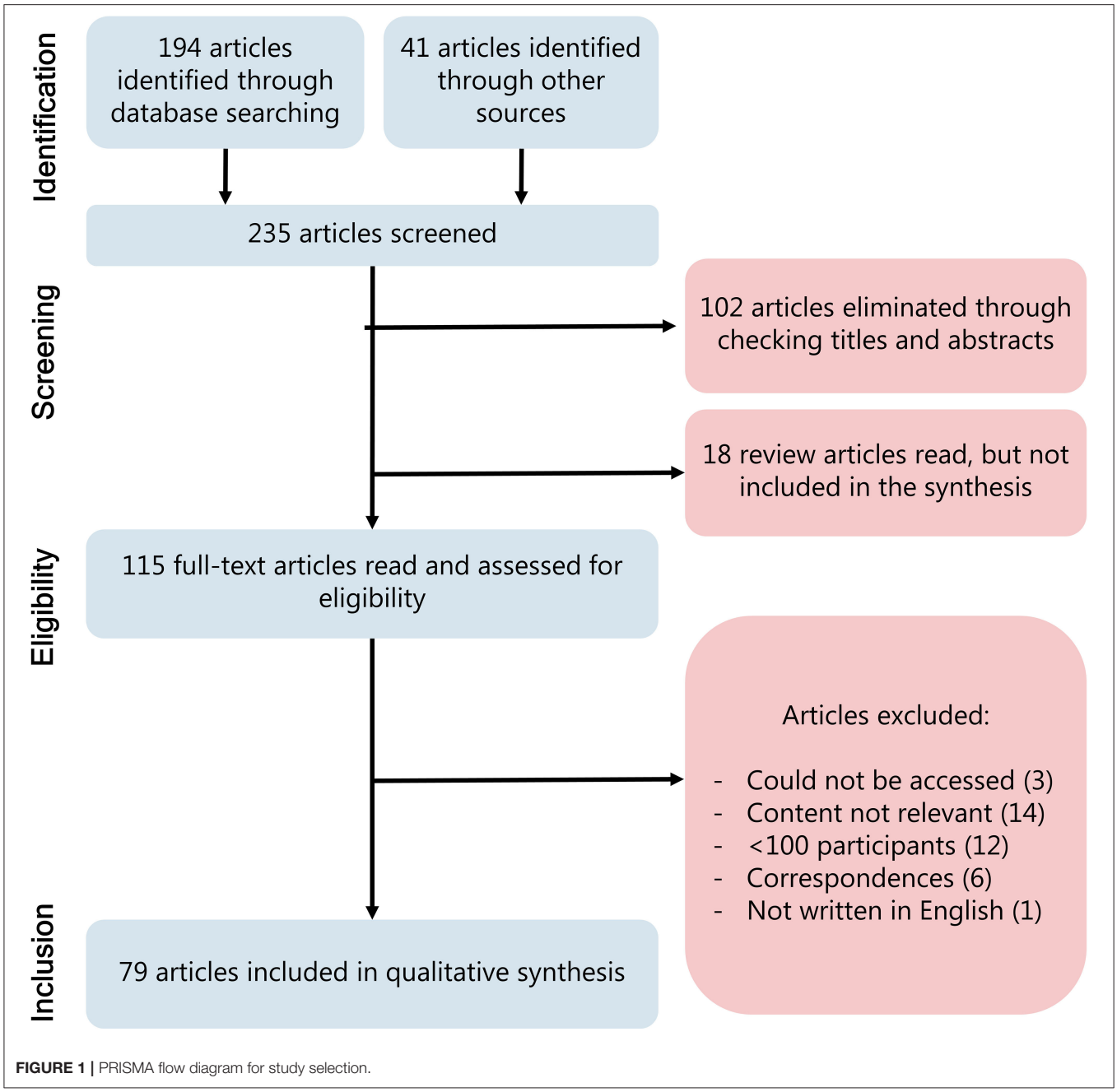

FIGURE 1 | PRISMA flow diagram for study selection.

Overall, the 59 research articles on various demographic groups indicated that the populations studied experienced a worsening of their OCD symptoms as well as increased symptoms of other mental-health disorders and a reduced quality of life. The six case reports provided examples of how the clinical impairments might look among individuals with OCD. The 12 letters reported a more varied picture, arguing that some individuals may be experiencing worsening symptoms during the pandemic, while others were not significantly affected; some may even experience improved mental health. The two clinical guidelines provided information on how to engage with and treat individuals with OCD during this period. We used the data collected from the various articles to answer our three main questions presented in the introduction.

The Prevalence of OCD and Its Symptoms Before and During the COVID-19 Pandemic

The estimated lifetime prevalence of OCD is around 2–3% globally (66). According to a study from 2003, the estimated prevalence of OCD was 1.2% among the adult U.S. population

TABLE 1 | Original research articles related to the COVID-19 pandemic and OCD.

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Individuals with OCD								
Alonso et al. (32)	*Cross-sectional, case-cohort study*. Structured interviews, online, self-report survey (VAS, HDRS, DSM-5, Y-BOCS).	364	Patients: 53.5% Controls: 57.6%	Patients: 42.0 Controls: 40.8	Spain	April 27– May 25, 2020	Patients with OCD and controls from the general population	*Individuals with OCD had more internalizing symptoms, suicidal thoughts, and sleep/appetite changes. OCD symptoms increased to a clinically significant degree in 40% of patients. Contamination symptoms predicted more COVID-focused symptoms and increases in OCD severity. Pre-pandemic OCD severity, depression, and social support predicted increase in OCD severity*.*
Benatti et al. (33)	*Cross-sectional study.* Telephone (94%) and in-person (6%) interview.	123	44.9%	40.0	Italy	N/A (at least 3 months after the initial outbreak)	Patients with OCD	35.3% of patients experienced clinical worsening of OCD. The group with worsening OCD were characterized by the development of new obsession and/or the reoccurrence of past obsessions. The most frequent symptoms were excessive washing and cleaning in the total population.
Carmi et al. (34)	*Longitudinal study, clinical trial.* Clinical evaluation, self-report survey (CGI-I).	113	50%	33.8	Israel	April–May 2020 Reevaluation: September, 2020	Patients with OCD enrolled in a clinical trial	The majority of OCD patients with active therapy and pharmacological intervention did not report a worsening of symptoms during the COVID-19 pandemic. The majority of patients reported that COVID-19 did not impact their OCD.
Højgaard et al. (35)	*Cross-sectional study.* Self-report survey (Y-BOCS)	201	65.7%	39.7	Denmark	April 6–29, 2020	Patients with OCD	61.2% of participants reported a worsening of OCD symptoms. Being female, demonstrating contamination symptoms, and psychiatric comorbidities were associated with increased OCD severity.
Jelinek et al. (36)	*Cross-sectional study.* Online, self-report survey (PHQ-9, OCI-R)	394	73.9%	37.8	Germany	March 23–May 18, 2020	Patients with OCD	72% of the participants experienced a worsening in OCD symptoms. This deterioration was the most prominent in patients with washing compulsions. The worsening of symptoms was associated with reduced mobility and interpersonal conflicts.
Kaveladze et al. (37)	*Cross-sectional study.* Self-report survey (Dimensional Obsessive-Compulsive Scale)	196	71.4%	24.8	USA	June 28–August 10, 2020	Patients with OCD	*Among a sample of adults who participated in online OCD support communities, 93% experienced symptom worsening and 96% stated having OCD made dealing with the pandemic more difficult. Rates of worsening were higher in unacceptable thought, harm, and contamination domains compared with symmetry/completeness*.*

(Continued)

TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Khosravani et al. (27)	*Longitudinal study.* Online, telephone or in-person survey (DOCS, Y-BOCS, CSS)	270	57.4%	36	Iran	Before outbreak. Reevaluation: May –July, 2020	Patients with OCD	Statistically significant increase in OCD severity in all OCD dimensions during the COVID-19 pandemic compared with pre-pandemic levels. COVID-19 related stress associated with increased OCD severity.
Khosravani et al. (38)	*Cross-sectional study.* Self-report survey (CSS, PHQ-4, FCV−19S, C19P–S, SHAI, VOCI, XS, HCQ-54, OCI-R, OCS).	300	58.7%	35.8	Iran	June 1–August 15, 2020	Patients with OCD	*Contamination and checking obsessive-compulsive symptoms were significantly associated with all domains of COVID-19 stress responses, including danger/contamination fears, socio-economic consequences, traumatic stress, xenophobia, and compulsive checking. Patients with OCD had significantly more COVID-related stress in all domains than patients with social anxiety and specific phobias*.*
Khosravani et al. (39)	*Cross-sectional study.* Self-report survey (DOCS, Y-BOCS, CSS, PHQ-4, BSS).	304	58.6%	35.8	Iran	June 5–October 30, 2020	Patients with OCD	*COVID-19-related compulsive checking and traumatic stress mediated the relationships between harm and unacceptable thought symptoms and suicidal ideation. COVID-19-related compulsive checking mediated the relationship between overall OCD severity and suicidal ideation*.*
Pan et al. (40)	*Longitudinal (case-cohort) study.* Online, self-report survey (QIDS, BAI, PSWQ, DJGLS)	1,517	64%	56.1	Netherlands	Before outbreak. Reevaluation: Apr-May, 2020	Patients with OCD, anxiety or depression and controls from the general population	Individuals with OCD, anxiety and depression scored higher on the four-symptom scales compared to healthy controls from the general population both before and during the pandemic. Greater increase in symptoms was observed in healthy individuals.
Rosa-Alcázar et al. (41)	*Cross-sectional, case-control study.* Online, self-report survey (Y-BOCS, HADS, COPE-28)	237	55.7%	33.5	Spain	April 2020	Patients with OCD, and controls from the general population	*Individuals with OCD reported greater use of the following: instrumental support and religion. Individuals with OCD scored higher for self-blame. Within the OCD group, presence of comorbidities was associated with denial, substance use, and self-blame. Overall, results suggest patients living with OCD could benefit from adaptive coping strategies during COVID*.*
Sharma et al. (42)	*Longitudinal study.* Telephone interview (Y-BOCS, MINI, CGI-S, CTS, DSM-5, WSAS)	447	Patients with OCD before the pandemic: 35% Patients with OCD before the pandemic:37%	Patients with OCD before the pandemic: 33.0 Patients with OCD before the pandemic:32.3	India	April 26–May 12, 2020	Patients with OCD before and during the pandemic	No influence of the pandemic was observed on OCD symptoms when comparing patients with OCD during the pandemic with an independent sample of OCD patients before the pandemic. Remission rates among those with OCD were similar before and during the COVID-19 pandemic.

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TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Storch et al. (43)	*Cross-sectional study.* Online survey filled by clinicians about their patients. (NIMH-GOCS, Y-BOCS)	232	51%	28.5	USA	July 19–August 2, 2020	Patients with OCD (data reported by their clinicians)	According to clinicians treating OCD patients with ERP before and during the pandemic, 38% of the patients had worsened symptoms, 47% stayed the same, and 10% had improved symptoms. The pandemic likely attenuated the efficacy of ERP therapy.
Toh et al. (44)	*Longitudinal case-control study.* Online, self-report survey (DASS-21, EUROHIS-QoL, OCI-R)	264	89.4%	32.9	Australia	Baseline: April 2020 Follow-up: May 2020	Patients with OCD and controls from the general population	The OCD group reported increased rates of severe depression, anxiety, reduced quality of life, and stress compared to control group between April and May 2020. Obsessive washing and checking did not increase between the two timepoints.
Tundo et al. (45)	*Cross-sectional study.* Self-report survey (SCID-5, HDRS, Y-MANIA-RS, Y-BOCS, PAAAS, BSPS)	386	59.3%	52.0	Italy	March 10–June 30, 2020	Patients with OCD, and patients suffering from other mental illness	*Patients living with OCD, compared to other patients with depression, had a greater worsening of symptoms as a result of the pandemic. Differences were not found compared to other disorders*.*
Wheaton et al. (46)	*Cross-sectional, case-control study.* Self-report survey (CTS, DOCS, DASS-21)	548	Patients: 79.2% Controls: 41.5%	Patients: 32.2 Controls: 38.2	USA	April 1–August 12, 2020	Patients with OCD and controls from the general population	76.2% of patients reported worsening of symptoms, and 58.3% reported COVID-19 becoming a point of their obsession. Concerns about COVID-19 were associated with OCD severity. 59.1% of patients reported COVID-19 interfering with their treatment.
General population samples								
Abba-Aji et al. (47)	*Cross-sectional study.* Online, self-report survey (BOCS, PSS, GAD-7, PHQ-9).	6,041	86.6%	42	Canada	March 23–30, 2020	General population	60.3% developed OCD symptoms during COVID-19 (fear of germs and viruses). Hand-washing compulsions developed in 53.8% of the population. OCD symptoms were associated with moderate/high stress, generalized anxiety disorder, and major depressive disorder.
Albertella et al. (48)	*Cross-sectional study.* Online, self-report survey (mYFAS2.0, IAT, PPCS-6, PGSI, AUDIT, OCI-R).	878	53%	32.0	Australia	May–June, 2020	General population	*Younger age, greater COVID-19-related disruptions, greater psychological distress, and greater pre-COVID OCD were associated with obsessive-compulsive symptom severity*.*
AlHusseini et al. (49)	*Cross-sectional study.* Online, self-report survey (PHQ-9, OCI-R)	2,187	60.5%	N/A (50% aged <35)	Saudi Arabia	N/A (during lockdown)	General population	62.4% of the respondents are likely to have OCD based on the OCI-R questionnaire. Older age, being male, being married, and having higher income were associated with increased OCD symptoms.

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TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Cox et al. (50)	*Longitudinal study.* Online, self-report survey. (DASS, ISI, OCI-R)	369	89.1%	47.0	USA	Baseline: 2016 Follow-up: April 1–8, 2020	General public	Increase in washing and hoarding symptoms during COVID-19 pandemic compared to 2016 levels. Other OCD symptoms like ordering, neutralizing, and obsession symptoms did not change. Pre-COVID-19 insomnia was associated with an increased COVID-19 incidence of OCD symptoms.
Damirchi et al. (51)	*Cross-sectional study.* Self-report survey (STS, TDAS, MOCI, Folkman and Lazarus Coping Strategies Inventory)	300	N/A (∼72–79%)	N/A (range 18–54 years)	Iran	January 21–March 19, 2020	General public	*Positive correlations were found between self-talk and problem-centered coping. Inverse relationships between self-talk and emotional coping, death anxiety, and OCD symptoms were also found*.*
De Pietri et al. (52)	*Cross-sectional study.* Self-report survey (HAQ, SAI, CES-D, OCI, BAI)	660	86.2%	31.1	Italy	March 26–April 9, 2020	General public	*Retrospectively rated pre-pandemic obsessing and hoarding factors of the Obsessive-Compulsive Index predicted increased anxiety during the quarantine period*.*
El Othman et al. (53)	*Cross-sectional study.* Self-report survey (PHQ-9, PSS-4, LAS, Y-BOCS)	386	75.9%	31.3	Lebanon	March 29–April 6, 2020	General public	*Higher Y-BOCS compulsion scores were associated with more adherence to recommended hygienic practices, and higher Y-BOCS obsession scores were associated with information avoidance*.*
Fontenelle et al. (54)	*Cross-sectional study.* Online, self-report survey (COROTRAS, DOCS, VOCI-MC, AAI, HRS-SR, MGHHS, SPS-R, DASS-21, WHODAS 2.0, Q-LES-Q-SF, CHIT, BIS)	829	52.6%	38.5	USA	July 29–30, 2020	General public	Statistically significant increase in OCD and related disorders, including body dysmorphic disorder and hoarding disorder compared to before pandemic levels. Based on the DOCS scale, 38.6% of respondents demonstrate severe symptoms of OCD during COVID-19, compared to 15.3% before the pandemic.
Karagöz et al. (55)	*Longitudinal study.* Interviews, self-report survey (BDI, BAI, PI-WSUR)	139	31.7%	55	Turkey	March 20–June 20, 2020	Patients with ST-Elevation Myocardial Infactrion (STEMI)	*Higher contamination-related OCD was associated with delays of 120+ minutes going to the hospital for acute ST-Elevation Myocardial Infarction. Statistically significantly higher OCD subscale scores observed in March-April compared to April-June*.*
Loosen et al. (56)	*Longitudinal study.* Online, self-report survey (PI-WSUR, HADS)	406	57.3%	34	United Kingdom	Baseline: April 24–May 7, 2020 Follow-up: July 15–August 15, 2020	General public	*Contamination OCD symptoms in the general population appeared at similar levels as in previously reported clinical samples. Obsessive-compulsive symptoms increased across the timepoints. Information-seeking predicted increased OCD symptoms*.*

(Continued)

TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Mansfield et al. (57)	*Medical record review (longitudinal design).* Electronic health records (Clinical Research Practice Datalink Aurum).	13% of UK population (~10 M/year)	50%	N/A (aged >11)	United Kingdom	Jan 1, 2017–July 18, 2020	General public	*There were statistically significantly fewer visits for OCD (and all other mental-health conditions) in July 2020, compared with January 2017*.*
Mazza et al. (58)	*Cross-sectional study.* Clinical interview, self-report survey (IES-R, PCL-5, ZSDS, STAI-Y, MOS-SS, WHIIRS, OCI)	402	34.1%	57.8	Italy	April 6–June 9, 2020	COVID-19 survivors from the general public	*20% of COVID-19 survivors reported symptoms of OCD. Duration of hospitalization inversely correlated with the OCI-R*.*
Moreira et al. (59)	*Cross-sectional study.* Online, self-report survey (DASS-21, OCI-R)	1,280	79.8	37.1	Portugal	March 23–31, 2020	General public	*Elevated self-reported OCD was reported in 12% of the sample using the OCI-R. Younger age and education were predictors of obsessive compulsive symptoms. Presence of housemates, pets, or continuing work were not*.*
Mrklas et al. (60)	*Cross-sectional study.* Online, self-report survey (PSS, GAD-7, PHQ-9, BOCS)	8,267	86.2%	N/A (>90% aged >26)	Canada	March 23–May 4, 2020	General public	Self-reported prevalence rates of moderate or high stress, anxiety, and depression were 85.6, 47.0, and 44.0%, respectively. Non-healthcare workers reported higher rates of OCD symptoms compared to healthcare workers.
Munk et al. (61)	Cross-sectional study. Online, self-report survey. (BCI, BDI, SHAI, PHQ, OCI-R, WHO-5, COPE, BRS)	949	79.5%	28.9	Germany	March 27–April 3, 2020	General public	Prevalence of at least one mental-health disorder in the sample was 50.6%. 21.4% of the surveyed population reported OCD symptoms.
Ojalehto et al. (62)	*Cross-sectional study.* Online, self-report survey (CAS, DASS-21, ASI3, DOCS, CSS, BVS).	438	75.3%	30.3	USA	August 27–November 5, 2020	General public	Contamination-related OCD symptoms (DOCS contamination subscale) are statistically significant univariate predictors of COVID-19-related severe anxiety.
Quittkat et al. (63)	*Cross-sectional study.* Online, self-report survey (BDSI, DASS-D, EDE-Q, PHQ, PSWQ-d, SIAS, SPS, WI, Y-BOCS)	2,233	80.7	33.2	Germany	April 2–May 6, 2020	General public	*2.1% of the population self-identified as suffering from OCD. No statistically significant changes in the level of OCD symptoms were found from November 2019 during COVID-19 (rated retrospectively). 36% of those with OCD reported worsening mental health*.*

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TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Robillard et al. (64)	*Cross-sectional study.* Online, self-report survey (PSS, DOCS, BRCS)	6,040	70.3%	51.8	Canada	April 3–May 15, 2020	General public	*Obsessive-compulsive symptoms related to germs and contamination were significantly associated with increased stress levels during the outbreak*.*
Samuels et al. (65)	*Cross-sectional study.* Online, self-report survey (Coronavirus Impact Scale, DY-BOCS, SMSPA, OCI-R, PHQ-4)	2,117	54%	46	USA	September 17–30, 2020	General public	COVID-19-related preventive behaviors were associated with contamination obsessions and phobias and an increase in OCD symptoms. 22.2% of responders reported high levels of contamination obsessions and 20.3% reported high levels of contamination phobias.
Wheaton et al. (17)	*Cross-sectional study.* Online, self-report survey (IUS-12, DOCS, SHAI, CTS)	720	50.3%	36.9	USA	March 2–11, 2020	General public.	Positive correlation between OCD symptoms, intolerance of uncertainty, health anxiety, and concerns about COVID-19. DOCS is a statistically significant univariate predictor of intolerance of uncertainty.
Zheng et al. (66)	*Cross-sectional study.* Online, self-report survey (Y-BOCS, SSRS, PSQI)	541	57.5%	N/A (>85% aged <45)	China	July 9–19, 2020	General public	Prevalence of demonstrating OCD symptoms was 18%. 89% of OCD patients had both obsessions and compulsions. Being unmarried, being a student, having a family history of OCD and other mental-health disorders, presence of psychiatric comorbidities, and sleep latency were risk factors for OCD.
Pregnant women								
Xie et al. (67)	*Cross-sectional case-control study.* Self-report survey (SCL90-R, PSQI, FES).	3,346	100%	Before pandemic cohort: 28.9 During pandemic cohort: 29.0	China	Before pandemic cohort: March 1–December 31, 2019 During pandemic cohort: January 1–August 31, 2020	Pregnant women before the pandemic, and pregnant women during the pandemic	*Conflict with family was positively associated with OCD symptoms. No increases in OCD severity were noted among women who were pregnant before vs. during the pandemic*.*
Yassa et al. (19)	*Longitudinal case-control study.* Self-report survey (STAI, MOCI)	304	100%	27.5	Turkey	April, 2020	Pregnant and non-pregnant women	Increased prevalence of OCD (based on high MOCI scores) in 60% of the pregnant women and in 30% of the non-pregnant women during the COVID-19 pandemic. Non-pregnant women demonstrated higher levels of anxiety during the pandemic.
Healthcare workers								
Ahmed et al. (68)	*Cross-sectional study.* Online, self-report survey (BAI, Y-BOCS, BDI-2)	524	57.4%	N/A (>50% aged 31–40 years)	Egypt	May 1–June 1, 2020	Healthcare workers and non-healthcare workers	*7% of healthcare workers self-reported moderate to severe OCD, whereas 3% of non-healthcare workers reported moderate-to-severe OCD. OCD severity was associated with female sex, urban residency, and chronic-disease history*.*

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TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Cai et al. (69)	*Cross-sectional study.* Online, self-report survey (SCL-30, Y-BOCS, SCSQ).	616	63.8%	N/A (~90% aged 19–39 years)	China	February 5–25, 2020	Healthcare workers and non-healthcare workers	*Non-healthcare workers reported statistically significantly more compulsions than healthcare workers*.*
Ergenc et al. (70)	*Cross-sectional study.* Self-report survey (Obsessive-Compulsive Disorders Scale)	198	72%	COVID-group: 35.6 Non-COVID: 33.7	Turkey	N/A	Healthcare workers	Healthcare workers in the COVID-19-section scored higher on OCD, depression, and anxiety scales compared to healthcare workers in other sections.
Juan et al. (71)	*Cross-sectional study.* Online, self-report survey (IES-R, GAD-7, PHQ-9, Y-BOCS, PHQ-15)	456	70.6%	30.7	China	February 1–14, 2020.	Healthcare workers	37.5% of hospital staff experienced symptoms of OCD. Women, those with lower income, and those working on isolation wards had higher rates and more severe OCD symptoms.
Zhang et al. (72)	*Cross-sectional study.* Online, self-report survey (ISI, SCL-90-R, PHQ-4, PHQ-2, GAD-2)	2,182	64.2%	N/A (96.3% aged 18–60)	China	February 19–March 6, 2020	Healthcare workers	Medical health workers had a higher prevalence of insomnia, anxiety, depression, somatization, and OCD symptoms compared to non-medical health workers. Living in rural areas, being at risk of contact with COVID-19 patients, and having organic diseases were risk factors for OCD symptoms.
Zheng et al. (73)	*Cross-sectional study.* Online, self-report survey (PSQI, SCL-90)	207	84.5%	N/A (>60% aged >30)	China	March 1–15, 2020	Healthcare workers	*25.6% of the responding medical workers reported elevated OCD symptoms*.*
Students and young adults								
Abuhmaidan et al. (74)	*Cross-sectional study.* Online, self-report survey (SCL-90-R)	258	76.4%	N/A (91% >20 years)	United Arab Emirates	March, 2020	University students (humanities and science)	The population was characterized by low levels of mental illness. Compared to the other mental health-related dimensions (e.g., depression, anxiety), OCD symptoms were the most severe. Female students and those younger than 20 showed the poorest mental health.
Bahçecioglu et al. (75)	*Cross-sectional study.* Online, self-report survey (OCS, WCI)	628	76.4%	21	Turkey	October 4–17, 2020	University students (nursing)	Nursing students had low levels of obsession with COVID-19, and demonstrated moderate coping skills. On average, female students were more stressed than male students.
Chen et al. (76)	*Cross-sectional study.* Online, self-report survey (CCMD-3, Brief Response Questionnaire)	992	52.8%	19.3	China	March 27, 2020	University students	From a population of young people living in isolation for two months, 6% were categorized as high-risk, 63% were medium-risk, and 31% were low-risk of developing a mental illness. Unhealthy behaviors (e.g., smoking, alcohol consumption) increased the risk for psychological problems. Negative pandemic information increased anxiety, controllability, and vulnerability.

(Continued)

TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Darvishi et al. (77)	*Cross-sectional study.* Self-report survey (MOCI, CEQ)	150	64.7%	16.7	Iran	N/A (before July 2020)	High-school and pre-university students	67% of subjects may have demonstrated OCD symptoms. Prevalence in women is higher than in men (72.1 vs. 60.3%). Washing compulsion is the most common symptom.
Ji et al. (78)	*Longitudinal study.* Online, self-report survey (Y-BOCS, SAS)	13,478	65.4%	21.3	China	Survey 1: February 8, 2020 Survey 2: March 15, 2020 Survey 3: April 30, 2020	University students (medical and non-medical)	Higher prevalence of OCD and anxiety levels in March (11.3%) compared to April (3.6%) and May (3.5%). Male students had higher prevalence of OCD symptoms compared to female students at all timepoints.
Jiang (79)	*Cross-sectional study.* Online, self-report survey (SCL-90)	Participants: 472 Population norm: 12,160	51.9%	N/A (aged 17–22 years)	China	February 10, 2020	University students	Students had increased levels of obsessive behaviors compared with the general population. Students had insufficient knowledge about COVID-19 and demonstrate high-risk perceptions (i.e., high levels of fear of the virus and getting infected).
Knowles et al. (80)	*Longitudinal study.* Self-report survey (PI, OCI-R, CAI, CSBS, IAI, ISBS)	108	75%	19.6	USA	Baseline: January 2020 Follow-up: February 27–March 26, 2020	University students	COVID-19 anxiety and precautionary behaviors were higher than for influenza. Mean levels of OCD washing symptoms increased between January 2020 and March 2020.
Meda et al. (81)	*Longitudinal study.* Self-report survey (BDI-2, BAI, OCI-R, EHQ, EDI-3).	358	79.9%	21.3	Italy	Baseline: October–December, 2019 Follow-up: April–June, 2020	University students	*Scores on the OCI-R were reduced over the course of the pandemic, independent of history of mental-health disorder or the participant's sex. 86% of the students did not experience a worsening of symptoms.**
Wheaton et al. (82)	*Cross-sectional study.* Online, self-report survey (ECS, CTS, DASS-21, OCI-R)	603	87.6%	22.9	USA	April 5–May 13, 2020	University students	*Greater susceptibility to emotion contagion was associated with concerns about COVID-19, depression, anxiety, stress, and OCD symptoms. Emotion contagion moderated relationship between COVID-19-related media consumption and OCD symptoms.**
Children and adolescents								
Cho et al. (83)	*Longitudinal study.* Self-report survey (SHAPS, DTS, CASI, UPPS Impulsive Behavioral Scale, RCADS)	2,120	61.2%	21.2 (at follow-up)	USA	Baseline: 2016 Follow-up: May–August, 2020	Adolescents	*High school students completed substance use assessments in 2016 and again in May-August 2020. Substance use in adolescence did not predict OCD severity in young adulthood during the pandemic.**
McKune et al. (84)	*Cross-sectional study.* Self-report survey.	280	51.8%	N/A (range 5-18)	USA	April 2020	School-age children	*32.1% of the population were at risk and 8.9% at high risk of OCD. OCD symptoms were associated with loss of household income, female sex, and younger age.**

(Continued)

TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Nissen et al. (85)	*Cross-sectional study.* Patient records, self-report survey (Y-BOCS)	102	Clinical group (CG): 63.1% Survey group (SG): 66.7%	Clinical group (CG): 14.9 Survey group (SG): 14.1	Denmark	April–May 2020	Children newly diagnosed with OCD (CG), and children diagnosed with OCD years ago (SG)	Children newly diagnosed or long-term diagnosed with OCD both experienced worsening of OCD, anxiety, depression, and avoidance behavior. Changes in the total OCD severity scores correlated with worsening levels of anxiety and depression. These findings were the most pronounced in children with early onset of ADHD and family history of ADHD.
Seçer et al. (86)	*Cross-sectional study.* Online, self-report survey (OCI-CV, ERS, Depression and Anxiety Scale for Children, Fear of COVID-19 Scale)	598	61.1%	16.4	Turkey	N/A	Adolescents	Increased OCD symptoms in adolescents. Fear of COVID-19 is associated with the development of OCD symptoms and is a predictor of depression- and anxiety-related symptoms. Experiential avoidance mediates the relationship between fear of COVID-19 and OCD symptoms.
Previous pandemics and OCD								
Brand et al. (87)	*Cross-sectional study.* Self-report survey (OCI-R, ASI3, Swine Flu inventory, OBQ-44, DS-R)	393	68%	20.1	USA	November 2009–March 2011	University students	OCD symptoms predicted Swine Flu-related fears. Disgust sensitivity mediated the relationship between both OCD beliefs and OCD symptoms and Swine Flu-related fears.

**Summary extracted or adapted from the systematic review: A.G. Guzick, A. Candelari, A.D. Wiese, S.C. Schneider, W.K. Goodman, and E.A. Storch, Obsessive–Compulsive Disorder During the COVID-19 Pandemic: a Systematic Review. Current psychiatry reports 23 (2021) 1-10.*

AAI, Appearance Anxiety Inventory; ASI3, Anxiety Sensitivity Index-3; AUDIT, Alcohol Use Disorders Identification Test; BAI, Beck Anxiety Inventory; BCI, Behavioral Item Regarding Corona; BDI, Beck-Depression-Inventory; BDSI, Body Dysmorphic Symptoms Inventory; BIS, Barratt Impulsivity Scale; BOCS, Brief Obsessive-Compulsive Scale; BRCS, Brief Resilient Coping Scale; BRS, Brief Resilience Scale; BSPS, Brief Social Phobia Scale; BSS, Beck Scale for Suicidal Ideation; BVS, Body Vigilance Scale; C19P–S, COVID-19 Phobia Scale; CAHSA, Continuum of Auditory Hallucinations – State Assessment; CAI, Coronavirus Anxiety Inventory; CAS, Coronavirus Anxiety Scale; CASI, Childhood Anxiety Sensitivity Index; CCMD-3, Chinese Classification of Mental Disorders; CEQ, Cognitive Errors Questionnaire; CES-D, Center for Epidemiologic Studies Depression Scale; CGI, Clinical Global Impressions; CGI-I, Global Clinical Impression–Improvement; CGI-S, Clinical Global Impression–Severity; CHIT, Cambridge-Chicago Compulsivity Trait Scale; COPE, Coping Survey; COROTRAS, Coronavirus Traumatic and Stressful Life Events Scale; CSBS, Coronavirus Safety Behaviors Scale; CSS, Contamination Cognitions Scale; CSS, COVID Stress Scale; CTS, COVID-19 Threat Scale; DASS, Depression Anxiety Stress Scales; DASS-D, Depression Anxiety Stress Scales – Depression Subscale; DJGLS, De Jong Gierveld Loneliness Scale; DOCS, Dimensional Obsessive Compulsive Scale; DSM-5, The Diagnostic and Statistical Manual of Mental Disorders; DS-R, Disgust Scale-Revised; DTS, Distress Tolerance Scale; DY-BOCS, Dimensional Yale-Brown Obsessive-Compulsive Scale; ECS, Emotion Contagion Scale; EDE-Q, Eating Disorder Examination-Questionnaire – 2nd Edition; EDI-3, Eating Disorder Inventory – 3; EHQ, Eating Habits Questionnaire; ERS, Emotion Reactivity Scale; EUROHIS-QoL, European Health Interview Surveys-Quality of Life; FCV−19S, Fear of COVID-19 Scale; FES, Family Environment Scale; GAD-7/GAD-2, Generalized Anxiety Disorder Assessment; HADS, Hospital Anxiety and Depression Scale; HAQ, Health Anxiety questionnaire; HCQ-54, Health Concerns Questionnaire-54; HDRS, Hamilton Depression Rating Scale; HRS-SR, Hoarding Rating Scale-Self Report; IAI, Influenza Anxiety Inventory; IAT, Young's Internet Addiction Test; IES-R, Impact of Events Scale-Revised; ISBS, Influenza Safety Behavior Scale; ISI, Insomnia Severity Index; IUS-12, Intolerance of Uncertainty Scale; LAS, Lebanese Anxiety Scale; MGHHS, Massachusetts General Hospital Hairpulling Scale; MINI, Mini International Neuropsychiatric Interview; MOCI, Maudsley Obsessive-Compulsive Inventory; MOS-SS, Medical Outcomes Study Sleep Scale; mYFAS2.0, Modified Yale Food Addiction Scale 2.0; N/A, Not available information; NIMH-GOCS, National Institute of Mental Health Global Obsessive Compulsive Scale; OBQ-44, Obsessional Beliefs Questionnaire-44; OCI-CV, Obsessive Compulsive Inventory – Child Version; OCI-CV, Obsessive Compulsive Inventory–Child Version; OCI-R, Obsessive-Compulsive Inventory-Revised; OCS, Obsession with COVID-19 Scale; PAAAS, Panic Attack and Anticipatory Anxiety Scale; PCL-5, PTSD Checklist for DSM-5; PGSI, Problem Gambling Severity Index; PHQ-2/PHQ-4/PHQ-9/PHQ-15, Patient Health Questionnaire; PI, Padua Inventory; PI-WSUR, Padua Inventory-Washington State University Revision; PPCS-6, Short Version of the Problematic Pornography Consumption Scale; PSQI, Pittsburgh Sleep Quality Index; PSS, Perceived Stress Scale; PSWQ/ PSWQ-d, Penn State Worry Questionnaire; QIDS, Quick Inventory of Depressive Symptoms; Q-LES-Q-SF, Quality of Life, Enjoyment, and Satisfaction Questionnaire-Short Form; RCADS, Revised Children's Anxiety and Depression Scales; SAI, Social Anxiety Inventory; SAS, Zung Self-Rating Anxiety Scale; SCID-5, Structured Clinical Interview for DSM-5; SCL-30, Symptom Check List-30; SCL90-R, Symptom Checklist-90 Revised; SCSQ, Simplified Coping Style Questionnaire; SHAI, Short Health Anxiety Inventory; SHAPS, Snaith Hamilton Pleasure Capacity Scale; SIAS, Social Interaction Anxiety Scale; SMSPA, Severity Measure for Specific Phobia–Adult; SPS, Social Phobia Scale; SPS-R, Skin Picking Scale-Revised; SSRS, Social Support Rating Scale; STAI/ STAI-Y, The State-Trait Anxiety Inventory; STS, Self-Talk Scale; TDAS, Templer Death Anxiety Scale; UPPS, UPPS Impulsive Behavioral Scale; VAS, Visual Analog Scale; VOCI-MC, Vancouver Obsessional Compulsive Inventory – Mental Contamination; VOCI-MC, Vancouver Obsessional Compulsive Inventory; WCI, Ways of Coping Inventory; WHIIRS, Women's Health Initiative Insomnia Rating Scale; WHO-5, Well-being Index; WHODAS 2.0, World Health Organization Disability Assessment Schedule 2.0; WI, Whitely Index; WSAS, Work and Social Adjustment Scale; XS, xenophobia scale; Y-BOCS, Yale-Brown Obsessive-Compulsive Scale; Y-MANIA, Y-MANIA Rating Scales; Y-MANIA-RS, Y-MANIA Rating Scales; ZSDS, Zung Self-Rating Depression Scale.

(89). We were unable to identify comprehensive studies on the prevalence of OCD globally or nationwide since the pandemic started. Only the prevalence of OCD (or its symptoms) in specific demographic groups and specific nationalities has been investigated so far and, as it is discussed in the following section, research shows a tendency towards increased OCD symptoms in all investigated demographic groups.

In 2020, Zheng et al. (66) investigated the prevalence of OCD symptoms in Wuhan, China. In July, three months after reopening after lockdown, 17.93% of the investigated population had symptoms of OCD, but unfortunately there was no pre-pandemic statistic for comparison. While this figure is certainly higher compared to the estimated 1.2% OCD prevalence in the U.S. population, a significantly larger percentage of populations (14–29%) has been shown to demonstrate mild symptoms of OCD even prior to the pandemic (24). The study found that being single, student, having comorbid mental disorders, family history of OCD, and sleep latency were all associated with OCD.

In Iran, Khosravani et al. (27) found increased levels of OCD severity when comparing pre-pandemic and pandemic levels in patients diagnosed with OCD prior to the pandemic. The results of the study indicated that the increased severity of OCD symptoms was primarily was primarily due to stress induced by the current pandemic.

A study by Munk et al. (61) found a higher prevalence of OCD symptoms in Germany during the first weeks of the pandemic (March, 2020) compared to the reported prevalence pre-pandemic; 21.4% of the participants expressed clinically-significant OCD symptoms during the pandemic compared to 3.6% reported in the general population. Prevalence of depression and general anxiety disorder were also significantly higher than what was reported in the general population, which again indicates an overall initial stress response to the pandemic.

In India, Sharma et al. investigated relapse rates in individuals diagnosed with OCD prior to the pandemic compared to a control group (42). The authors did not find worsening in severity of illness nor did they find increased relapse rates. Also, very few patients developed COVID-19-related OCD symptoms. They argue that this might be because data collection was conducted relatively early in the pandemic (April-May, 2020), that patients were already on medication, and/or that the lockdown and various restrictions and recommendations might have limited their exposure to COVID-19 (42).

With regards to the etiology of OCD during COVID-19, many articles in our review report various risk factors that triggered OCD symptoms during the current pandemic (16, 71, 74, 75, 77). Banerjee (16) lists seven factors that may play a role in the worsening of OCD symptoms: 1. an increased demand for hand-washing; 2. recommended hand-washing steps that may reinforce ritualistic patterns; 3. recommended hand-washing after suspected exposures, which may provide cognitive justification; 4. the prompting of family to ensure strict hygiene measures; 5. the media's regular reporting of possible sources of contamination; 6. increased ruminations and repeated washing, which can become normalized during the pandemic; and 7. stocking protective equipment and disinfectants, which may increase hoarding symptoms (16).

An interesting point by Banerjee is that in previous pandemics like Severe Acute Respiratory Syndrome (SARS), Middle Eastern Respiratory Syndrome (MERS), and influenza, the worsening of OCD symptoms has advanced up to 6–12 months *after* the end of the outbreak. They argue that symptoms might not be evident during a pandemic due to under-detection and alternate public-health priorities. As several studies in our review suggested, some patients with OCD may not seek treatment and follow-up meetings because of fear of contamination, stigma, or lack of knowledge about what is excessive cleaning/washing; this is a possible explanation for an increase in their symptoms (27, 90). The largest study identified in our review by Mansfield et al. (57), which investigated electronic health records of millions of individuals from the United Kingdom before and during the pandemic, also observed fewer visits related to OCD during the pandemic compared to the years before. Thus, it is important that clinicians follow up with patients who have been previously diagnosed with OCD but who are not in active treatment. As the COVID-19 pandemic is still active, it is quite possible that we will see an increase in OCD incidence once the pandemic has ceased.

Worsening of OCD in Specific Demographic Groups and Personal Characteristics

Two letters (10, 91) report that responses from patients with OCD have been varied; some people experience increased anxiety while others feel validated in their concerns and/or reassured by the strict guidelines (10). Based on such findings, Perkes et al. argue that the recommended measures may be more stressful to those without OCD compared to individuals who are already accustomed to these practices (91).

In the 16 research articles on the effects of COVID-19 on *patients diagnosed with OCD prior to the pandemic*, the clinical landscape has been more homogenous; most of these articles found a clinically significant increase in OCD symptomatology in patients suffering from OCD (27, 32, 33, 35–38, 45, 46). However, some articles did not, or reported mixed results (34, 40, 42–44). The findings from these studies suggest that the COVID-19 pandemic represents a stressor for many individuals with OCD resulting in increased OCD symptoms, although not all of the studies identified in our search fully support this notion. For example, in some patients with clinical worsening of OCD symptoms, their symptoms were only a part of a larger clinical impairment (33). Of all the previously characterized subgroups of individuals with OCD, *those with washing and cleaning compulsions* have had the most severe impairment during the current pandemic (33, 36, 47, 77, 79, 80). Research indicates that COVID-19-related stress was also associated with increased OCD severity (27) and that, compared to the general population, individuals with OCD were more likely to have moderate/high stress, general anxiety disorder, and depression (47, 78).

When investigating OCD symptoms among the general population, some studies (17, 50, 61, 66) found a small increase in OCD symptoms after the pandemic's initial outbreak, with hand-washing symptoms and contamination obsessions being predominant. The results of these studies indicate that many

aspects of OCD remain unaffected by the COVID-19 pandemic, at least among the general population. However, there may also be an increased prevalence of other mental-health disorders; this indicates that not only are certain at-risk groups under psychological distress but also that the pandemic is affecting all groups of society (61, 66). This is supported by the majority of studies of students and young adults, which generally showed a complex influence of COVID-19 on mental health. Although not all of these studies indicated an increase in OCD symptoms, they generally indicated that the young adults' mental health did in fact decline (74–80).

Several studies found that *pregnant women and medical workers* are more susceptible to OCD symptoms compared to the general public (71, 72, 92). A number of studies found an increase in obsessive-compulsive symptoms and anxiety levels among pregnant women and healthcare workers (19, 70–72). These results highlight the necessity of adequate working conditions and recovery programs so that medical workers may progress toward improved psychological wellbeing as well as an increased focus on the mental health of pregnant women (70–72).

Children and adolescents were also identified as a risk group. Research indicates an association between negative and traumatic childhood experiences and OCD symptoms in adulthood (93). The adverse experiences during the current pandemic may have an immediate negative impact on children and adolescents both with and without OCD, especially among those with early age of onset and a family history of psychiatric disorders (85, 86). Reactions seemed to be more severe if the child did not have access to a psychiatric facility. These effects carry a high risk of long-term consequences for the individuals affected (93); hence, we believe that this at-risk group needs closer attention and further research.

Even though good hand hygiene was one of the first precautionary behaviors consistently recommended by multiple national governments, none of the studies we identified examined the physical consequences of OCD with regards to *compulsive hand-washing*. Nor did any studies examine the physical consequences of excessive *hand sanitizing*. Studies published prior to the COVID-19 pandemic have shown that compulsive hand-washing often induces severe skin damage and hand eczema (94, 95). As such, there is often a high burden in the field of dermatology due to patients with obsessive hand-washing and fear of contamination. Some of the research suggests that recommendations for good hygiene provide patients with cognitive justification, which consequently results in cases of hand eczema (16, 95). Moreover, Xerfan et al. (94) suggest an interaction between hand eczema, sleep disturbances, and OCD. Research prior to the current pandemic has also reported a link between sleep disturbances and OCD, either directly or indirectly via other mental-health disorders. These findings align with our findings from the literature during the current pandemic, in which sleep disturbances may also be associated with OCD symptoms (50, 66).

The six case reports included in our review provide examples of how individuals with OCD may react to their circumstances during the current pandemic; we chose to include these reports in our systematic review to exemplify how the pandemic might have impacted individuals living with OCD. Several of these reports (4, 96–98) reported an exacerbation of symptoms in patients diagnosed with OCD. The main symptoms were self-isolation, avoidance of certain foods, and excessive hand-washing, and cleaning. In the most severe cases (4, 96), individuals reported panic symptoms and suicidal ideation or attempts. Previous studies have suggested that, of all OCD symptoms, patients with predominant contamination obsessions and compulsive cleaning tend to exhibit the highest rates of suicidality (99). In all of the case reports, patients benefitted from a combination of pharmaceutical and psychological treatment in healthcare facilities. Nevertheless, these reports are a warning that patients with OCD should be more closely monitored to prevent severe mental-health consequences from the pandemic.

Two of the case reports described possible improvements of OCD symptoms during the pandemic; in the case report by Conrad et al. (40), five adolescent female patients diagnosed with OCD attended an experiment without a control group consisting of cognitive-behavioral group therapy for a period of 12 weeks in the U.S. With social support, education about OCD symptoms, coping, and adaptions during lockdown, these patients recovered and improved their outcomes during the therapy. In the report by Kuckertz et al. (47), eight OCD patients in a residential treatment program reported various experiences. None of them had a significant decline in their quality of life during the pandemic; in fact, most patients experienced an improvement of their symptoms.

It is worth noting that, in these small interventions, patients with close, continuing contact with healthcare providers seemed to be more resilient and more equipped to meet the challenges posed by the pandemic. In contrast, those patients who experienced an acute exacerbation of their OCD symptoms were typically those who had been diagnosed prior to the pandemic or those who did not receive regular follow-ups and support from healthcare professionals.

Only one study from a previous pandemic (the H1N1 "Swine Flu" pandemic) examined the effects of pandemics on OCD symptomatology. Brand et al. (87) found a relationship between OCD symptoms and a fear of the Swine Flu. However, the authors did not specifically evaluate the effects of the pandemic on the worsening of symptoms in individuals with OCD, nor the rates of OCD.

The Management of OCD During Pandemics

Fontenelle et al. (100) hypothesize that cognitive behavior therapy (CBT) with Exposure and Response Prevention (ERP) may clash with the public-health recommendations regarding hygiene and protective equipment during the current pandemic, as an active element of ERP is to expose patients to feared objects. Storch et al. (43) oppose this, stating that empirical support for the abovementioned standpoint is lacking, and that there are no negative consequences of ERP during COVID-19; however, the authors acknowledge that ERP treatment needs to be adjusted to the current situation. They suggest that clinicians should continue to assess compulsions and obsessions, and that exposures should target *excessive* rituals from core obsessions, which are most often not COVID-19-related (43). Some clinicians have advised that ERP therapy should be

conducted online, although the effects of such interventions are yet to be examined (10, 43, 100). In cases of a fear of COVID-19 itself, when planning treatment, clinicians will likely need to weigh the risks of contracting COVID-19 vs. the benefits of overcoming OCD (101). To educate patients on common symptoms and to prevent obsessions and compulsions, Farhan et al. (22) proposed the utilization of an innovative online chatbot. Many clinicians encourage educating both individuals with OCD and the general public in stress management (10, 61, 66).

Various other treatment strategies have been investigated and/or proposed. Chen et al. (66) proposed a six-step intervention strategy, namely: 1. Deliver positive information about the pandemic in order to reduce the abnormally increased risk perception among individuals with OCD; 2. Reduce negative behavioral responses to stress that may worsen OCD symptoms (e.g., smoking, drinking, over-eating, and taking medications); 3. Educate individuals at-risk of OCD about stress management; 4. Improve family relationships and community support; 5. Increase positive behaviors like being active, working, or studying; and 6. Adjust expectations to relieve stress. Treatment should be individually tailored; i.e., when treating individuals with OCD, some—or all—of these steps could be implemented, depending on the severity of symptoms.

When it comes to treatment, many articles advise following the clinical guidelines proposed by Fineberg et al. (10). These guidelines were written by a working group of clinical experts based on empirical evidence, and they emphasize the importance of focusing on resilience and interventions that maintain a calm attitude, build community, and sustain hope (**Figure 2**). However, Farhan et al. (22) were skeptical of these guidelines, arguing that they are of little help in reality due to limited resources, high cost, and a lack of therapists in many countries worldwide. According to these authors, some of the public-health recommendations and preventive measures implemented during the pandemic have been mostly targeted at healthy people, and ambiguous terminology may worsen symptoms in individuals with OCD. They also provide an example: "*The US Centers for Disease Control and Prevention recommends washing hands for at least 20 seconds and disinfecting surfaces daily, whereas WHO suggests cleaning hands regularly and thoroughly.*" As individuals with OCD often overestimate risks, recommendations on hygiene should be precise and with limits.

Several studies in our review warn about the aftermath of the current pandemic. As there is often latency in diagnosis, consecutively worsening prognosis, and resistance to treatment, early identification and prevention of OCD symptoms is of the utmost importance (18). Pozza et al. suggest that early intervention may be especially helpful for individuals with sub-threshold OCD symptoms (18). People at-risk need to receive education about the COVID-19 virus as well as information that the public-health authorities' recommendations are *sufficient* and that excessive behaviors do not further reduce risk (102). While no current evidence suggests that there will be an increase in OCD patients after the pandemic, helping the general population to identify warning signs of OCD (e.g., in close relatives and friends) might be useful for prevention (101).

Limitations and Knowledge Gaps

The literature on changes in OCD symptoms during the COVID-19 pandemic is still limited, and the studies included in our review have several limitations as revealed by the quality assessment (**Supplementary Table 1**).

First, the majority of the identified studies (76%, 45/59) are cross-sectional in nature and data were collected during the first months of the pandemic. Due to cross-sectional designs, most of the studies revealed statistical associations that are unable to demonstrate causal relationships (70, 74, 86). Of note, several studies are planning longitudinal follow-ups of their populations. Further longitudinal studies are warranted to examine the long-term effects of public-health recommendations related to the COVID-19 pandemic on OCD symptoms.

Second, apart from one article, most studies (98%, 58/59) included self-reported questionnaires as the means to assess outcomes; this data-collection method reduces accuracy and likely biases the results compared to data collection *via*, e.g., structural clinical interviews. As one study stated, it is possible that individuals with OCD were more likely to participate in some of the studies during the pandemic, potentially overestimating their own symptoms (36). Furthermore, an increase in OCD symptoms likely reflects the real threat of the SARS-CoV-2 virus, and not necessarily obsessive-compulsive trends in the populations (47).

Third, there is a lack of comprehensive and comparative assessments of incidence rates of OCD in populations before and during the COVID-19 pandemic. We were unable to identify recent statistics on the prevalence or incidence of OCD globally. Furthermore, most of the current research studies on the prevalence of OCD or its symptoms after the COVID-19 outbreak in certain demographic groups do not report pre-pandemic statistics for comparison. Hence, it is difficult to reach conclusions on the effect of the pandemic on the incidence of OCD cases in populations.

Fourth, enrollment in some of the studies (42, 80, 85) occurred over a longer period, resulting in heterogeneous study populations. While these populations allow for a wider generalizability of results, more focused studies are needed to gain a complete understanding about key aspects of OCD pathophysiology during the current pandemic. Related to this point, further studies will need to include a broad variety of demographic groups—cross-cultural and multinational—in order to gain more extensive and generalizable knowledge on general populations and OCD during the COVID-19 pandemic. Only three out of all articles analyzed representative samples or took measures to ensure representative samples of the underlying populations; conversely, most studies (95%, 56/59) did not utilize representative samples. This review has examined studies focusing on several at-risk subpopulations during the pandemic: patients with pre-existing OCD, children, adolescents, and pregnant women. However, we did not identify any articles that investigated OCD symptomatology specifically in older populations, another key high-risk group.

Last, most articles reviewed in this study investigate contamination-related OCD symptoms and were less focused on other types of OCD. Further research is warranted on less studied clinical manifestations.

Clinical guidelines according to Fineberg, N. A. *et al., Comprehensive Psychiatry (2020)*

1. Use a compassionate, calming approach. Use telemedicine in areas where it is possible.
2. Careful history taking. Confirm diagnosis. Clarify the extent to which symptoms represent rational or exaggerated relations. Establish level of insight from patient. The concerns are often idiosyncratic. Assess comorbidities.
3. Assess suicidal risk.
4. Provide psychoeducation with balanced information about know risks and impact of COVID-19 on physical and mental health.
5. Enquire about media consumption. Offer a balanced approach and suggest trusted sources.
6. If OCD symptoms are the main problem: Review medication status, review and risk assess the CBT plan, help with social and occupational care, provide career support. Have regular follow-ups by the therapists. Establish a daily routine.

FIGURE 2 | Clinical guidelines for the treatment of obsessive-compulsive disorder during the COVID-19 pandemic.

As with most systematic reviews, there is a risk that relevant articles were missed. To mitigate this risk, two authors (ESL and TVV) scanned the literature and read all titles and abstracts to narrow down the search results to those articles that were read in full. During the drafting phase, another systematic review on OCD and COVID-19 was published (31); we incorporated all of the original research articles identified by these authors and their key findings in this report. We also acknowledge that scientific literature related to the COVID-19 pandemic is rapidly accumulating; thus, since conducting our final search, it is likely that additional research has been published that might nuance our findings or address the knowledge gaps we identified above.

CONCLUSIONS

Despite increased focus on OCD during this pandemic, literature is still limited. A recently released systematic review on various aspects of OCD during the COVID-19 pandemic highlights the exacerbation of OCD-related symptoms and the emergence of new symptoms during the pandemic. Most important, it emphasizes the importance of continuing established evidence-based therapies during the pandemic (31). We add to this body of evidence by our review of the literature; current evidence from research articles suggests that both people with and without OCD prior to the pandemic show increased symptoms of OCD during the COVID-19 pandemic. High-risk groups include OCD patients in remission/recovery, geriatrics, pregnant women, children and adolescents, and healthcare professionals. Of all demographic groups included in the articles, individuals with diagnosed OCD prior to the pandemic with hand-washing and cleaning compulsions have had the most severe impairment during the pandemic.

To prevent worsening of symptoms in OCD patients, clinicians are encouraged to check in with their patients and adjust treatment based on the specific needs of the patient. As early intervention is key to prevent new cases, the articles suggest the need for sufficient education of the general population on both stress management, OCD symptoms, and on the COVID-19 pandemic.

OCD is an extremely heterogeneous and complex disorder. While not all individuals are affected negatively by the current conditions, most of our results show a worsening of OCD symptoms in the examined populations. The time frame makes any conclusion even more complex, since OCD develops and presents itself slowly. Due to the acute nature of COVID-19, and because the pandemic is still ongoing, we do not yet have long term data on the putative effects of the pandemic and its associated lockdowns. Multinational and cross-cultural, longitudinal studies are warranted to address the extensive remaining knowledge gaps.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

EL drafted the article. EL and TV conducted the article search. TV conducted the quality assessment. TV and AC provided supervision and edited the article. All authors approved the final version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.806872/full#supplementary-material

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The Right to Health: COVID-19 Pandemic and the Opportunity to Transform Mental Health Inequalities in Indonesia

Gina Anindyajati[1†], Diashati Ramadhani Mardiasmo[2†], Laras Sekarasih[3], Damar Susilaradeya[2,4], Bagus Takwin[3], Dicky C. Pelupessy[3] and Hervita Diatri[1]*

[1] Department of Psychiatry, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia, [2] Medical Technology Cluster, Indonesia Medical Education and Research Institute, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia, [3] Faculty of Psychology, Universitas Indonesia, Depok, Indonesia, [4] Department of Physiology and Biophysics, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia

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***Correspondence:**
Diashati Ramadhani Mardiasmo
diashati.ramadhani.mardiasmo@gmail.com

[†] These authors share first authorship

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The COVID-19 pandemic has caused major catastrophes worldwide. In Indonesia, the pandemic has caused greater barriers for individuals to access mental health services. This article aims to capture the state of public mental health in Indonesia using data from various national surveys. Four main problems were identified: the increase in depression, loneliness, and distress in the general population, disruption in accessing mental health services, mental health problems among vulnerable populations, and the limited scope of available mental health services and facilities in the community. This article provided practical recommendations for the Indonesian government that focuses on preparing a resilient mental healthcare system for future crises, reducing barriers to access mental health services, and expanding the available resources and programs to ensure equal and sustainable access to mental health services in the community.

Keywords: COVID-19, pandemic, Indonesia, mental health service, psychosocial support

INTRODUCTION

As the largest diverse archipelagic country and the fourth most populous country in the world, Indonesia faces unique challenges in controlling the COVID-19 pandemic (1). First, as a low-level resource country in the southeast Asia region, tremendous efforts are required to keep the number of active cases and virus transmission low. Before the pandemic, the physician to population ratio was lower than the internationally recommended ratio. Moreover, the ratio of hospital beds to population remained below WHO standards and trails behind neighboring countries (2). The archipelago also requires connectivity to distribute medical supplies and the COVID-19 vaccines to different parts of Indonesia. The country's geographical position has also put Indonesia at risk for natural disasters, 2,059 natural disasters were recorded between January and September 2020, creating another layer of complexity in managing the COVID-19 pandemic (3). Second, the pandemic has shown to throttle Indonesia's economic growth as Indonesia went from upper-middle income to lower-middle income status and the national unemployment rate has remained at a high 6.49% percent in August 2021 (1, 4). The uncertainty the pandemic poses with the rise and fall of cases, changes in restriction policies as well as the economic stress, not only has introduced risks at the societal level, but also at the individual level.

One of the challenges that seems to be less overt than the physical and financial stress among Indonesians is mental health problems (5, 6). The requirement for physical distancing and limited spatial mobility during the pandemic, while crucial in slowing down the virus transmission, have created some constraints for individuals to maintain their psychological wellbeing. The third phase of COVID-19 vaccination rollout included people with mental illnesses and the Indonesian government even provided door-to-door vaccination services to people who were severely mentally ill however, this was still insufficient in facilitating routine access for their recovery (7, 8). Unfortunately, equal and affordable access to mental health facilities remains one of the issues in many parts of Indonesia, even among individuals residing in the country's major cities.

This perspective is written based on a collaborative work between mental health professionals, academics, and administrators with broad expertise on mental health and public health. The objective of this perspective is to identify priority issues in mental health and provide specific recommendation to anticipate the effect of COVID-19 pandemic toward Indonesia's mental health system.

MAIN ISSUES

This section provides our report on priority issues regarding the burden of mental health problems in Indonesia during COVID-19 pandemic.

High Proportion of Depression, Distress, and Loneliness

Proportion of depressive symptoms between March and May 2020 during the pandemic reached 35%, 5–6x higher than the current incidence of depression in Indonesia and 1.5x higher than depression rates seen in other (non-pandemic) disasters (9–11). Periods of quarantine and self-isolation causes loneliness and a sense of deprivation which can lead to suicidal thoughts. According to Indonesian Psychiatric Association (May 2020), mental health issues was observed highest among 17–29 years old and >60 years old (12). They observed suicidal thoughts in 49% of respondents who showed depressive symptoms. A year later, numbers were still reportedly high (39.3%) (13). Fluctuations in social restriction policies may also contribute to anxiety and loneliness. A nationwide survey in November 2020 by Universitas Indonesia Big Data Synergy Against COVID-9 Team found 42.4% of participants felt lonelier since the pandemic (14). In Mei 2021, Into the Light Indonesia reported almost double the number (13), 98% of participants experienced loneliness within the past month.

The pandemic has taken a mental toll on HCWs. Moderate-severe burnout syndrome was found in 83% of Indonesian HCWs, 41% had moderate-severe emotional fatigue, 22% had moderate-severe loss of empathy, and 52% had moderate-severe loss of confidence (15). Compared to pre-pandemic, these numbers have doubled (16–18). Data regarding prevalence of burnout among HCWs pre-pandemic is very limited. A survey by KOMPAS (local newspaper) identified financial stress as the highest (57.6%) type of distress caused by the pandemic, most likely due to a surge in unemployment and a decrease in income (14, 19). In addition, sleeping difficulties are common during the pandemic and a high prevalence was observed in COVID-19 patients (57%) (20). The pandemic has limited opportunities to engage in physical activities due to the state-mandated requirement to stay at home. Both sleeping difficulties and lack of physical activity were associated with depression and anxiety (20, 21). Dynamic changes in living circumstances, policy fluctuations, health uncertainties, and financial burden brought on by the pandemic has resulted in high levels of depression, distress, and loneliness.

Disruption of Mental Health Services

During the COVID-19 pandemic, a series of mental, neurological, and substance (MNS) related services such as psychotherapy, counseling, mental health interventions, suicide prevention programs, and many others have been completely or partially disrupted in 93% of countries worldwide (22). In Indonesia, one of the main issues is difficulty in accessing healthcare facilities for mentally ill people. Data from 2018 showed a shortage of mental health facilities. Of 9,000 primary-care facilities throughout Indonesia, only 40% have operational mental health programs (23). Only 60% of all hospitals have mental health programs and 6 out of 34 provinces in Indonesia do not have a psychiatric hospital (24). At Dr. Cipto Mangunkusumo General Hospital, a national referral tertiary hospital, quota for psychiatry ward and psychiatry outpatient clinic were significantly reduced during COVID-19 surge e.g., in the psychiatry ward, 24 beds were reduced to 2 and in the outpatient clinic, only 20 patients/day were allowed (adult and geriatric patients combined). This was done to maintain physical distance and as a result of resource allocation to COVID-19 unit (beds, nurses, and resident doctors). At primary-care facilities, general practitioners, and community leaders have not been able to conduct home-visits, consequently severely mentally ill patients who relied on these home-visits for routine check-ups and monthly prescriptions, have had their treatments halted.

People with mental illnesses are at a higher risk for transmitting COVID-19 due to numerous factors such as: (1) self-care limitations (poor hygiene and unhealthy lifestyle); (2) co-morbidities e.g., diabetes; (3) densely populated living environment poses social distancing challenges. One study showed that people with depression and schizophrenia were 7 times more likely to be infected with COVID-19 (25). Those with mental disorders were also associated with an increased risk of hospitalization and COVID-19 mortality (26, 27). On top of all this, mental-illness related stigmatization acts as a barrier to mental health as well as healthcare services in general (28, 29). Thus, these disruptions are disastrous as the need for mental health services during the pandemic is higher than ever.

Increased Mental Health Issues Among the Diverse Vulnerable Population

Sandwich generation refers to a group of people (usually working population) who simultaneously care for their children and aging parents, causing immense emotional distress during the

COVID-19 pandemic, thereby rendering them vulnerable to mental health problems. The pandemic increases the risk of domestic conflict, divorce, elderly, and child abuse. Victims of abuse may feel unsafe at home so they desperately opt to "escape" their homes despite the risk of COVID-19 transmission. Children and adolescents are vulnerable to mental health issues as the pandemic has caused significant learning as well as social changes, since it now heavily relies on technology. Marginalized young people are a community of young adults who are usually homeless, LGBTQ+, disabled, and/or HIV positive. They live in such poor conditions and are already prone to mental health issues, therefore the pandemic only exacerbates their problems. More than half of Indonesian marginalized youths from sexual minority groups (intersex, transgender, non-binary, non-heterosexual) were reported have suicidal and self-harm thoughts (13). One Indonesian study found particular individuals were more vulnerable to anxiety, including those younger in age, of the female sex, suspected COVID-19 infection, and lack adequate social support (30). Lastly, within the geriatric population, apart from feelings of loneliness and abandonment, periods of quarantine can also worsen cognitive function (31). Those among the vulnerable population are already susceptible to mental health problems and the pandemic has amplified their susceptibility.

Limited Scope of Mental Health Services Within the Community

In Indonesia, identification of mental health issues does not reach all varying layers of society due to lack of access to independent mental health assessment. Current mental health assessment utilizes psychological self-assessment online questionnaire which is not equipped with an adequate referral system (http://pdskji.org/home). Moreover, current healthcare services have failed to integrate both mental and physical aspects of health as well as community-based mental health services, contributing to the limited scope of mental health services in Indonesia.

During the COVID-19 pandemic, the dynamic of mental health services has shifted from in person counseling to e-counseling (telemedicine) due to social restrictions. As of May 2021, 68% of people access mental health services through a phone application or via website (13). Although the new norm of voice and video call consultation is deemed acceptable, its practical use is limited. Those who are digitally illiterate, have no stable internet connection and/or a smartphone, are at a disadvantage. Another important issue is telemedicine services not covered by JKN (National Health Insurance), therefore patients may be discouraged from using telemedicine. Other issues include shorter consultation period, lack of physical examination (e.g., examinations to assess anti-psychotic side effects) and troubles with tele-pharmacy (i.e., inter-province prescription writing is prohibited). A survey by Department of Psychiatry, Universitas Indonesia (32) revealed these mental health service changes were perceived as "less convenient" for patients.

Moreover, misperceptions and poor knowledge regarding mental health issues are common among Indonesian. Into the Light Indonesia found 7 out of 10 respondents admitted to not knowing that mental health expenses were covered by BPJS (Healthcare Social Security Agency) and 3 out of 5 respondents did not know there were mental health facilities within their sub-district (13). Additionally, none of the respondent was able to correctly answer questions regarding suicide facts and myths. All of these key points contribute to the limited scope of mental health services in Indonesia.

RECOMMENDATIONS

In this section we outline recommendations to improve access to mental health services and ensuring its continuity for people who need it the most.

Preventing a Mental Health Crisis During and After COVID-19 Pandemic

Prevention of mental health crisis is not solely the responsibility of Ministry of Health. Mental health service is bigger than just healthcare, therefore to deal with such concerns, it will need collaboration between COVID-19 taskforce, Ministry of Health, Coordinating Ministry for Economic Affairs, Ministry of Communication and Information Technology, Coordinating Ministry for Human Development and Cultural Affairs, and BPJS (Healthcare Social Security Agency). Based on the problems listed above, it is recommended to:

- Conduct periodic surveillance on the impact of COVID-19 on mental health issues and its effects toward productivity, work performance, economic wellbeing and social security.
- Conduct surveillance on mental health resources within all types of healthcare facilities.
- Provide digital access to those self-isolating both at home or at a healthcare facility (33, 34) so they have access to relevant information and can continue to communicate with family and friends as well as consult with healthcare professionals online.
- Increase the number of primary-care facilities with operational mental health programs.
- Develop a "Psychosocial and Mental Health Support Team" which includes trained personnel and medical professionals that creates and assists with long term support programs (35, 36); inclusive for the general population and HCWs, easily accessible and inter-connected from sub-district to provincial level.

Ensuring Continued Services to Mentally Ill Patients

Lack of access during the pandemic has caused disruption of mental health services. Continuity of care is especially critical for mentally ill patients as it prevents decompensation and other consequences (37). Therefore, it is essential to ensure that people with mental illness can access mental health services (38). COVID-19 taskforce and Ministry of Health should collaborate to:

- Provide telemedicine and hotline crisis services (39, 40).

- Ensure stable patients receive enough medication for 2–3 months.
- Provide a system in place for patients who were lost to follow up so they still receive medication.
- Ensure availability of medication in accordance with national formulary standard.

As for COVID-19 prevention, it is crucial ensure that each patient with severe mental illnesses, receive the standard of care by providing them with information on COVID-19 health precautions, educating them on the importance of family and community support to prevent COVID-19 infection, and having community leaders and/or HCWs reach out to them directly.

Providing Psychosocial and Mental Health Support to the Working Population and Other Vulnerable Population

It is important to ensure the provision of psychosocial and mental health support to all during COVID-19 pandemic (41). It is considered particularly important to provide such support for the working population, people living with HIV/AIDS, children and adolescents, elderly, women, and marginalized young people due to their high exposure to stress (26, 42). Collaboration between COVID-19 taskforce, Coordinating Ministry for Economic Affairs, and Coordinating Ministry for Human Development and Cultural Affairs is required in order to:

- Ensure social security networks are active and working effectively.
- Provide psychosocial support to those who struggle to adapt with working from home/online school and evaluate its effect on their mental wellbeing.
- Develop a guidebook that focuses on how to develop better interpersonal, self-regulation, and communication skills to facilitate the challenges of quarantine.

Expanding the Scope of Mental Health Services Within the Community

Considering the shortage of mental health facilities, unequal distribution of competent resources, failure to integrate both mental and physical aspects of health as well as community-based mental health services, it is necessary to develop strategies to expand the scope of mental health services within the community. Several recommendations include:

- Provide access to integrate both physical and mental health services, which consists of assessment for anxiety and depression. This access should be in accordance with clinical practice guidelines and should utilize professional and competent human resource. This access should also facilitate online and offline referral systems.
- Provide psychological and emotional support that is integrated with COVID-19 health services available for patients, patient family and healthcare professionals.
- Develop a guidebook that provides information on where to seek help for those suffering from mental health issues/symptoms. Ensure guidebook are readily accessible at primary-care facilities and are disseminated to target populations.
- Conduct routine community outreach activities (43), especially to those isolated from technology.

To achieve these objectives, it will be crucial for COVID-19 taskforce, Coordinating Ministry for Human Development and Cultural Affairs, and Ministry of Health to all work together.

CONCLUSION

We identify four priority mental health issues, including high proportion of common mental disorders, service disruption, increased risk among the vulnerable population, and limited service within the community. Therefore, we recommend collaboration between multi-sector government bodies involved in the COVID-19 response and beyond to anticipate the effect of COVID-19 pandemic toward Indonesia's mental health system. The aforementioned bodies include but are not limited to healthcare regulators, funders and providers, such as the COVID-19 taskforce, Ministry of Health, Coordinating Ministry for Economic Affairs, Ministry of Communication and Information Technology, Coordinating Ministry for Human Development and Cultural Affairs, and BPJS (Healthcare Social Security Agency). It is important to optimize utilization of established infrastructure in order to prevent mental health crises due to the pandemic. We also suggest the government provide mental health and psychosocial support, emphasizing on the need of working and other vulnerable populations. For mentally ill patients, we must ensure they receive continuous treatment. Furthermore, with the available resources, we should start to integrate mental health services into current health programs in the community to expand its reach. Other pandemic-related issues such as, effectivity, restriction policy challenges, virus mutations, changes in values and culture, are important areas that would be interesting to study for future evidence-based policies.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

GA, DM, LS, DS, BT, DP, and HD: conception and design of the article and writing. All authors read and approved the final version of the article.

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Stress Experience of COVID-19 Patients as Reported by Psychological Supporters in South Korea: A Qualitative Study

Hyein Park[1†], *Nabin Lee*[2†], *Jung Hyun Lee*[1], *Dayoung Lee*[1], *Kyoung Ae Kim*[1], *Hyun-Seung Kim*[1], *Eunhye Oh*[1], *Ji Hyun Ha*[1], *So Yoen Hyun*[1], *Juyeon Lee*[1], *Jiae Kim*[1], *Kyoungsun Jeon*[1], *Hyeong Taek Kim*[3] *and Minyoung Sim*[1*]

[1] National Center for Disaster Trauma, National Center for Mental Health, Seoul, South Korea, [2] Korea Trauma Research & Education Institute, Seoul, South Korea, [3] Department of Psychiatry, Yongin Severance Hospital, Yongin, South Korea

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***Correspondence:**
Minyoung Sim
mdsim@hanmail.net

[†] These authors have contributed equally to this work and share first authorship

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Background: COVID-19 patients experience various stressors during the quarantine period and after release from quarantine. However, stressors experienced during each period remain unclear.

Methods: A total of 15 mental health experts from the integrated psychological support group for COVID-19participated in this study. Psychological support was provided for the total 932 confirmed COVID-19 patients and their families. Qualitative data were collected using Focus Group Interview (FGI). The participants were divided into two groups and semi-structured questions were used to allow participants to speak their minds.

Results: During the quarantine period, difficulties of being diagnosed with COVID-19, concerns about recovery from COVID-19, stress related to quarantine, issues related to the treatment environment, and limited information about COVID-19 and communication were frequently reported. After release from quarantine, the reported main stressors include reinfection or reactivation, concerns about complications, and financial difficulties. Confusion as vectors and victims, stigma and discrimination, and conflicts within a family were observed during both periods.

Conclusions: COVID-19 patients suffered various stressors during the quarantine period and after release from quarantine. Moreover, returning to their daily life required timely psychosocial support, intervention, and treatment for COVID-19 infection.

Keywords: COVID-19, quarantine, stigma, psychological support, stress

BACKGROUND

COVID-19 has become the worst pandemic in this century since the WHO reported its first case in December 2019 in China. The pandemic has continued for more than a year, steadily increasing the number of infected persons. During this period, there has been a considerable amount of interest in the mental health of COVID-19 patients (1, 2). Contracting COVID-19 could be traumatic in terms of threatened death or serious physical injury and accompany with shame and guilt, which can lead to social withdrawal, negative intrusive thought, post-traumatic stress disorder, and depression (3, 4).

Patients with infectious diseases suffer from various stressors such as longer quarantine duration, fear, boredom, inadequate supplies and information, financial loss, and stigma about the infection (5). Preventive measures, including social distancing, cross-border movement restrictions, lockdown, and self-quarantine, has impacted mental health globally. Moreover, emerging infectious diseases such as COVID-19 induce a lack of factual information, uncertainty about the epidemic trend, and continuity of the chain of events (6).

Furthermore, based on observation from previous outbreaks of Severe Acute Respiratory Syndrome (SARS) and the Middle East Respiratory Syndrome (MERS), providing psychological support for the confirmed patients was heavily emphasized during the pandemic. In addition, for effective intervention, it is necessary to identify the psychological problems of patients over the course of the disease (7). However, previous studies on stressors experienced by COVID-19 patients mainly focused on the contagious period (8–10).

National Center for Disaster Trauma (NCT) provided psychological support services for COVID-19 patients, quarantined individuals, and their families in South Korea. In this study, we aimed to find out stressors experienced by COVID-19 patients by analyzing the interviews of mental health experts who provided counseling to them. These experts provided psychological support and observed the patients during the quarantine period right after diagnosing COVID-19 and after release from quarantine. We hypothesized that the types of stressors would differ depending on under quarantine or after release from quarantine. Specifically, health and quarantine related issues would be prominent during the quarantine and secondary stressors such as financial difficulties would intensify after release from quarantine.

METHODS

Participants

The integrated psychological support group for COVID-19 was established under the Ministry of Health and Welfare in January 2020. They provided mental health services, including 24-h hotline service and tele-counseling by mental health experts. They sent text messages containing information on mental health services and a self-rated screening tool to a list of COVID-19 patients given by the government. Psychological First Aid was provided through tele-counseling to those who called back to hotline service and for the high-risk group identified from mental health screening. For those who needed continuous counseling, psychological support was given from the quarantine period after diagnosing COVID-19 till after release from quarantine. A total of 15 mental health experts, including two psychiatrists, five psychologists, and seven social workers, provided tele-counseling to 932 COVID-19 patients and their families. All participants gave informed consent. They participated in psychological support for more than 3 months at the time of the interview.

Data Collection

Qualitative data were collected using Focus Group Interview (FGI). The FGI is a method of interviewing a group of individuals at the same time, in which questions are freely discussed together and structured for research purposes. In the FGI, a moderator can also ask questions depending upon the situation (11).

Generally, to provide sufficient opportunity for participants to report, the size of FGI group is maintained as a minimum of 4 and a maximum of 12 individuals per group (12). We divided 15 participants into two groups and two mental health specialists oversaw each group and semi-structured questions were used to allow participants to speak their minds. The FGI was conducted once for each group and lasted 1 h. The questions included 10 open-ended ones (**Table 1**).

The moderators played an active role in initiating interactions and discussions within the group. They familiarized themselves with the procedure and planned what to ask before the interview.

Analysis Method

The analysis was carried out by two psychiatrists and one psychologist who had experience in conducting qualitative research. They had more than 2 years of work experience in disaster mental health and participated in providing psychological support for COVID-19 patients. The qualitative data were analyzed using content analysis. The content analysis classifies, abbreviates, and forms meaningful description of data collected to identify the phenomena of researchers' interest (13). The content analysis uses systematic procedures to increase objectivity, and to flexibly use deductive methods for constructing coding frames based on prior knowledge or theory and inductive methods for deriving categories and concepts from data (14).

Accordingly, we constructed a coding framework based on the existing literature on the mental health of COVID-19 patients and reconstructed the existing coding frameworks by categorizing relevant concepts from qualitative data. After pilot coding, triangular verification of coding was done and the process of recoding the review results and triangular verification was repeated. Triangular verification was conducted with the unanimous agreement of all the analysts and when anyone of the three analysts exhibited disagreement, we discussed to reach a consensus.

RESULT

The results are summarized in **Table 2**.

The Quarantine Period due to COVID-19 Infection

Being Diagnosed With COVID-19

The confirmation of COVID-19 could be experienced as psychological trauma. Some patients had difficulty accepting the confirmation and expressed mistrust of testing results. They were pessimistic, pondering why they were infected out of all people, and showed anger toward the unidentified person who infected them.

"The most common responses were, 'I am so unlucky', 'Why does this happen to me?' etc." (Participant 3).

Concerns About Recovery From COVID-19

Depression and anxiety escalated when quarantine release was delayed for 2–3 weeks. The patients were eager for recovery,

TABLE 1 | Focus Group Interview (FGI) questions.

Category	Question
COVID-19 patients general	Was the COVID-19 patient cooperative with the counseling?
	Was the COVID-19 patient under quarantine at the time of counseling or after being completely cured?
Stressors of COVID-19 patients	What were stressors or difficulties reported by COVID-19 patients?
	When did COVID-19 patients report those stressors?; During or after quarantine
	Was the stressors reported during quarantine relieved after release from quarantine?
	Was there a change of stressors over time?
Psychological support	What helped with COVID-19 patients in terms of psychological support?
	Was there a change in the need for psychological support of COVID-19 patients over time?
	Did you experience the difficulties during psychological support activities?
	How did you cope with above difficulties?

TABLE 2 | COVID-19 related stress divided by period.

Period	Common stressors	
During the quarantine	Being diagnosed with COVID-19	
	Concerns about recovery from COVID-19	
	Stress related to quarantine	
	Treatment environment issues	Confusion as vectors and victims
	Limited information and communication	Stigma and discrimination
After release from the quarantine	Reinfection or reactivation	Conflicts within the family
	Concerns about complications	
	Financial difficulties	

sometimes despairing and even fearing death. In wards, the recovery level and release order were compared among patients. This made the patients more impatient.

"Patients considered hospitalization for 2 weeks as common, but after 3–4 weeks, they started to get worried about things like, 'Is there something really wrong with me?' 'Is it just me?' 'Everyone else is getting discharged and will I be the only one who will not?' Patients who have been hospitalized for more than 3 weeks were worried about things like 'What if I will not recover …' etc." (Participant 5).

Stress Related to Quarantine

Patients suffered from loneliness, helplessness, and frustration during the quarantine period. They expressed utter helplessness since they were unable to do anything independently in the isolation ward and it was difficult to spend time meaningfully. Patients with pre-existing psychiatric illness showed fear of not receiving timely assistance due to quarantine and the exacerbation of symptoms. Prolonged quarantine often led to severe suffering.

According to the quarantine policy at the time of the interview, even asymptomatic COVID-19 patients were required to test negative for two consecutive PCR test to be released from quarantine. Therefore, the patients often continued quarantine for more than 20 days.

"The patient had been already in self-quarantine for 1 month due to close contact with another confirmed patient, and additional quarantine continued for 2 months after his confirmation… the patient said that 'I'm so tired, I want to die, I want to kill myself, Should I jump out the window, I think I can only get out of here if I die"' (Participant 11).

Treatment Environment Issues

The change in the daily living environment was a stressor for COVID-19 patients. Staying in a decrepit facility for a long time and frequent transferring to different quarantine facilities intensified the stress even more. Further, one of the most common stressors in the treatment environment was the feeling of being watched, and the patients in hospital facilities experienced discomfort due to healthcare providers' frequent visits and observations.

"The facility is so old… it was suffocating enough…but there is no sunlight at all and the facility is so aged and I am being confined so it is so depressing… The nurse and healthcare providers keep coming and going and checking, so I could not sleep well and it was uncomfortable…" (Participant 5).

Limited Information and Communication

In the early days of the pandemic, the epidemiological characteristics of COVID-19 were unknown and response guidelines were not detailed. There was no accurate information about the process after the diagnosis. Increasing demand made it hard to contact the authorities for acquiring necessary information.

"The patient had to be transported after the confirmation but I think he was not given a detailed explanation. They did not say

that they would come in the protective gear, so the patient said that he was so flustered when they showed up like that. They came in too suddenly and he was not prepared and conscious of how others would think about that, but they just came in and took him, so he was really flustered…" (Participant 5).

After Release From the Quarantine

Reinfection or Reactivation

Concerns about COVID-19 infection continued even after complete recovery. Many patients regarded getting infected with COVID-19 as their vulnerability, which led to concern about reinfection of COVID-19. Some patients were worried that the virus would remain in their bodies for a long time and this anxiety was intensified as they were exposed to the press release on reinfection cases.

"As soon as the patient returned (to work), he started to show severe agitation. His hands were shaking and his heart was pounding on the day before going to work and in the morning, his hands were all sweaty and he was out of breath. He felt suffocated even at work so he had to get some air frequently. Similar symptoms appeared when using public transportation. I think his anxiety was closely related to worry about reinfection" (Participant 7).

Anxiety about reinfection or reactivation thwarted their daily lives. Some patients purchased all types of thermometers on the market and checked their body temperature often. Other patients avoided using public transportation or meeting people. They were concerned that they might spread the infection to other people, and because of this, they refrained from going outside or decided to go out only when neighbors were not around.

"Even after being cured, the patient repeatedly checked body temperature and was highly sensitive to the normal range. If it was any close to that threshold, anxiety level soared further …" (Participant 15).

Concerns About Complications

Various sequelae related to COVID-19 infection were reported, which ranged from physical symptoms such as fatigue and shortness of breath to vague somatic symptoms. Many patients became highly sensitive to all physical symptoms after COVID-19 infection.

"They were nervous that their health might suddenly take a downturn in an unexpected way and they might die suddenly. Some patients urged their family members to go to the emergency room in the middle of the night. They were easily overwhelmed by even minor physical symptoms. 'Is there something wrong with my body?' 'My lung seems to be damaged.' Hypochondriacal concerns have been commonly reported in many recovered patients" (Participant 11).

Financial Difficulties

Many patients were stressed out by financial difficulties as quarantine was prolonged. Patients who were daily employees, under temporary positions, and the sole breadwinners of their families, the quarantine caused severe financial difficulties.

"The patient returned to work for a week after the quarantine release, but his family tested positive again, so he had to undergo quarantine again. He lost all his business contacts and clients and did not know how to continue running the business…" (Participant 6).

Over the Entire Period

Confusion as Vectors and Victims

Guilt feeling was commonly observed among the patients and they thought that they caused trouble and might have spread the infection to others. They felt sorry for those who underwent disinfection and self-quarantine because of them. However, they felt anger for being overly criticized since they were also victims who caught the virus unwittingly.

"The patient talked about a neighbor with a child living across her unit. She was worried that she might spread the infection to the kid, so she would listen to the sounds coming from outside and only go out cautiously when it is quiet…" (Participant 3).

"Patients were often hurt by the online malicious comments and were directly criticized by colleagues or close ones… On the one hand, they felt sorry for causing trouble to others, but on the other hand, they were resentful to those who were criticizing them without consideration of the unintended and unavoidable situation… They felt as if their whole life was degraded and considered relationships as meaningless…" (Participant 11).

Stigma and Discrimination

Patients were concerned that people would avoid or reject them if they disclose COVID-19 confirmation. For example, one patient who visited a hospital for non-COVID-19 symptoms was refused treatment due to the previous history of COVID-19 confirmation. Some patients experienced avoidance from their acquaintances and neighbors.

"After the treatment was over, I went to a community treatment center to submit an application for support payment, and someone said something like, 'Hey, there comes a COVID-19 patient,' and I felt like being treated like a plague. Since then, I could not go to a community treatment center…" (Participant 14).

Discrimination and rejection were experienced even within close relations. The negative social attitude toward confirmed patients gave them a sense of self as a virus, bacterium, corpse, etc. They felt as if they were a toxic being to be avoided and such self-stigmatization harmed their self-esteem and self-efficacy.

"After being discharged, the patient wanted to visit an acquaintance, but the acquaintance kind of sounded like he was unwelcomed… So, he once again felt like he is treated like a bacterium by other people" (Participant 2).

Moreover, forced disclosure of personal information such as their paths and companions served as an excuse for criticism. In the case of mass infection involving religious facilities, gay bars, and mental hospitals, consequent stigma and discrimination were severely experienced.

"When public attention was focused on a particular group through media or online, patients were extremely anxious about being identified, and that was also evident in the counseling. They were afraid that the counselor would have a negative prejudice against them. It took them time to reveal their personal information and situation honestly…" (Participant 15).

Conflicts Within the Family

Furthermore, conflicts within the family increased due to infection and transmission, causing substantial damage and disruption to their daily life. The patients had mixed feelings toward their family, they felt sorry and were worried about their family and, at the same time, they felt lonely because the family members did not understand their difficulties.

"The patient quickly recovered from COVID-19 infection and seemed to be okay. Family members could not understand that patient would have some psychological difficulties. They would react like, 'Why is it hard to return to work?' You only had minor symptoms but why do you keep complaining that you are having a hard time and need counseling?" (Participant 3).

"Some families were too sensitive to the patient. The family dissuaded him from returning to work to rest a little longer, and that just sounded annoying. They fought often. They realized that COVID-19 infection had taken a heavy toll on the whole family…" (Participant 7).

DISCUSSION

This study explored the psychological distress experienced by COVID-19 patients. As we hypothesized, during the quarantine, traumatic stressor, concerns about recovery, and the quarantine related difficulties were noticeable. Stressful treatment environment and limited information about COVID-19 and communication were also observed during this period. After release from quarantine, secondary stressors such as financial difficulties were remarkable as expected. It was noteworthy that concerns about the physical condition still continued after the release from quarantine. Consistent with previous studies of infectious diseases, 'vector or victim' issue and suffering from stigma were reported over entire period (15).

Fear About Health Deterioration

Patients with COVID-19 reported concerns about the exacerbation of the disease, recurrence, unpredictable complications, and even death (9). The daily lives of confirmed patients were greatly affected by preoccupied concerns and anxiety to the extent that the term "COVID-19 health anxiety" is coined (16). They repeatedly checked their body temperature and were reluctant to use public transportation or meet people. This is consistent with previous findings that patients with infectious diseases show health behavior changes such as excessive hand washing and avoiding closed places even after recovery (17, 18).

Moreover, COVID-19 patients suffer from long-lasting symptoms, such as fatigue, headache, loss of smell, and shortness of breath even after recovery (19). Some patients became sensitive to small body symptoms because of their worry about complications (20).

Stress Related to Quarantine

Quarantine or isolation causes psychological difficulties such as loneliness and helplessness (5, 21). Several studies have shown that quarantined persons are more likely to develop depression, irritability, insomnia, post-traumatic stress symptoms, and emotional exhaustion than those who were not quarantined (5, 22).

The psychological disturbance became prominent as the quarantine period was prolonged (9, 10, 23). According to prior study of COVID-19 patients admitted to a community treatment center (CTC) in Korea, only 4.3% of COVID-19 patients had depression at the beginning of quarantine, which increased to 15.6% after 4 weeks (24). A longer quarantine period was related to more emotional and psychological distress (5, 24). It was also a risk factor for post-traumatic stress disorder (25).

In South Korea, quarantine release criteria were changed from test-based to symptom-based, and the average quarantine period was shortened by 10 days. Accordingly, the reports of quarantine stress among patients decreased. The reduction of the unnecessary quarantine period is necessary for maintaining good mental health (5).

Vector or Victim

Being treated as a vector and a victim is a unique feature of infectious diseases (15). A considerable number of COVID-19 patients expressed guilt that they might have spread the infection to their families or others and at the same time, they showed resentment at being criticized without being considered as victims (15, 26). Another qualitative study has also shown that COVID-19 patients suffered from guilt that they were infected and infected others due to their carelessness (26). Given that it is difficult to identify the source of the infection and that asymptomatic infection of COVID-19 is frequent, attributing it to one's own responsibility would be improper in many cases.

Patients feel ashamed of themselves as if they were defective, which is exacerbated by the stigma of COVID-19 (27). Some patients faced disadvantages at work. They were criticized by the people around them. Moreover, they faced difficulty returning to work and society even after recovery, leading them to financial difficulties. Previous studies showed that financial problems, stigma, and discrimination caused stress even after release from quarantine (22).

As well as the impact of maladaptive guilt and shame on mental health (3, 27), the stigma of infected persons caused barriers in testing and diagnosing, which lead to the spread of COVID-19 (28). It also interrupted proper follow-up treatment.

Stress caused by stigmatization cannot be improved by psychological counseling, and it requires accurate government policies to prevent them. A national community-based anti-stigma and advocacy activity could significantly decrease mental health and public health problems, including violence, self-harm, and suicide (29). Reducing the social stigma of patients will help them to return to their daily life without any psychological problems and adjust to their daily life.

Information Delivery

Recognizing and responding to infodemic was one of the most important strategies used for managing COVID-19 pandemic (30).The fear of an unknown illness leads to increased anxiety and sharing of misinformation with unknown sources (31). Therefore, providing information about diagnosis and treatment

procedures, psychological education including stress management, and hotline services to the public could have been helpful.

Furthermore, less knowledge of diseases has a strong link to discrimination and stigma. Hence, efforts should be taken to protect the public from fake news and provide accurate information to control stigma and fear of infection (32–35).

Moreover, factual and transparent information should be provided through official narratives, online news, social media, and local government to the public (36). In addition, since information can be interpreted differently depending on the political orientation, it is necessary to provide accurate information separately from political communication (37).

Practical Implication

Advice for Mental Health Professionals

Immediately after confirmation of an infectious disease, it is easy to be mentally overwhelmed because several stressors occur at once, such as fear of death, deterioration of health, infection with others, and difficulties caused by quarantine, etc. They are often confused whether they are vectors or victim, and it might be hard to report psychological difficulties because they are guilty and ashamed. Therefore, clinicians should be able to fully understand the difficulties that patients with infectious disease face at the beginning of confirmation and actively provide psychological support (38, 39). In addition, normalization that anxiety of re-infection or complication may continue for a while even after quarantine could promote their psychological recovery.

Advice for Policy Maker

WHO emphasized the management of mental health among essential health services to be guaranteed during COVID-19 public health emergencies (40).

As can be seen from the results of this study, COVID-19 patients suffer a lot even after release from quarantine and return to daily life. The long-term effects of infectious diseases has been found as high levels of depression, anxiety, and post-traumatic stress disorder a year after SARS pandemic (41). Disaster-related suicides are said to be on the rise over the next 2–3 years after the disaster (42, 43). In addition to taking mid- to long-term mental health recovery plans, funding for mental health is required (44).

Limitations and Suggestions

This study has several limitations that need to be addressed. In this study, the stress experience of patients was examined through the report of mental health professionals who provided psychological support to them. This is delivered in the language of an experts who provided psychological support rather than directly translating the words of patients. Hence, there might be a bias in the classification system because the stress experience of patients might differ from the practitioner's point of view. However, the problem was reported objectively and accurately since practitioners had prior knowledge of disaster stress experience. Furthermore, psychosocial support was given through telephone counseling, instead of face-to-face counseling. Previous study reported that there is no significant difference in effectiveness between face-to-face and telephone counseling (45), but non-verbal communication restrictions can make it difficult to track the problems of patients in depth. Moreover, in this study, the stress level of patients was not periodically traced in a detailed manner. A longitudinal study of patients' experiences in the future may help us understand the long-lasting stressors of patients with infectious diseases. In addition, our data were collected and analyzed in the early stages of COVID-19. Considering that the quarantine guidelines were frequently changed and the quarantine period was longer, the level of anxiety and stress might have increased at a later stage. In addition, the issue of personal information disclosure and stigma of patients was severe. The pattern of early outbreaks and current trends differ in many aspects. Hence, stress experiences must be analyzed periodically for identifying and responding to the long-term effects of the epidemic.

CONCLUSION

COVID-19 patients experienced various stressors from the moment they were confirmed. The stressors continued even after recovery. Patients had a confusing experience of being treated as both vectors and victims after being confirmed with COVID-19.Stigma and discrimination were important issues over the entire period. During the quarantine period, thoughts about the infection and isolation mainly caused stress. After their release from quarantine, the patients were troubled with concerns about sequelae and reinfection, and financial difficulties.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board of National Center for Mental Health. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

NL, JHL, MS, and DL conceived and designed the study. NL, HK, SH, KK, H-SK, EO, JH, and JL collected the data. NL, JHL, and HP analyzed and interpreted the data. HP, JHL, and MS drafted and wrote the manuscript. MS, JHL, DL, JK, and KJ contributed to critical revision of the article. All authors read and approved the final manuscript.

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The COVID-19 Pandemic and Posttraumatic Stress Disorder: Emotional Impact on Healthcare Professions

Concetta De Pasquale[1,2], *Daniela Conti*[3]*, *Carmela Dinaro*[4], *Rosa Alessia D'Antoni*[2], *Elena La Delfa*[2] and *Santo Di Nuovo*[2]

[1] Vascular Surgery and Organ Transplant Unit, University Hospital of Catania, Catania, Italy, [2] Department of Educational Sciences, University of Catania, Catania, Italy, [3] Department of Humanities, University of Catania, Catania, Italy, [4] Drug Addiction Health Service, SER.T-ASP3, Catania, Italy

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***Correspondence:**
Daniela Conti
danielaconti@unict.it

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The COVID-19 pandemic, which began in March 2020, has resulted in the deaths of hundreds of thousands of people around the world in just a few months, putting at great risk the commitment of healthcare workers unprepared to manage a worldwide phenomenon at great risk. In the early stages especially, medical staff had to deal with the pandemic at the expense of their physical and mental health, putting them particularly at risk for experiencing posttraumatic stress disorder (PTSD). The study aims to analyze the psychopathological aspects associated with PTSD, focusing on the emotional impact caused by the COVID-19 pandemic on healthcare professionals compared with a control group. The sample analyzed over 2 months, from March to May 2021, included 214 participants into two groups, i.e., healthcare professionals ($N = 107$) and a control group ($N = 107$). The online assessment instrument used consisted of an anonymous questionnaire, assembled *ad hoc* with demographic information and different standardized assessment scales (e.g., Fear of COVID-19 scale, Profile of Mood States, and Maslach Burnout Inventory-Human Services Survey), while a further section of the survey used the DSM-5 criteria to investigate Posttraumatic stress disorder (e.g., COVID-19—PTSD). The results reported that healthcare professionals had a consistent perception of stress (mean = 26.18, $SD = 14.60$), but not at a level significantly higher than other categories of workers (mean = 25.75, $SD = 14.65$; $t = 0.20$, $p = 0.84$). However, they showed less emotional disturbance than the control sample, better anxiety management skills, and lower levels of depressive disorder and mental confusion. Specifically, the healthcare professionals showed a condition of emotional exhaustion (T = 0.64, D = 0.74, A = 0.62, S = 0.75, C = 0.64) and depersonalization (T = 0.41, D = 0.52, A = 0.49, S = 0.60, C = 0.40), which is common in the burnout syndrome. In conclusion, the results obtained are useful in understanding the determinants of the emotional involvement of healthcare professions and the risk of burnout syndrome and, therefore, for planning activities and support paths for these workers who are particularly at risk during prolonged and pervasive crises, such as the pandemic.

Keywords: COVID-19 pandemic, Fear of COVID-19 scale, posttraumatic stress disorder (PTSD), emotional disorders, burnout syndrome (BS), healthcare workers

INTRODUCTION

On March 11, 2020, the WHO declared the coronavirus pandemic and SARS-CoV-2 as the causative agent of the COVID-19 respiratory syndrome. The COVID-19 pandemic has attracted worldwide attention for its rapid diffusion: In fact, the highly contagious nature of SARS-CoV-2 has been a major reason for the increasing number of deaths due to COVID-19. Social distancing, confinement, and quarantine were adopted by many countries to contain the diffusion of the infection (1). The literature on the psychological effects of quarantine indicates that the perception of the traumatic event can concern both the fear of contracting the virus and the measures adopted to counter the spread of infection (2).

These extreme measures taken to limit the spread of COVID-19, as well as the fear of contracting the virus, have impacted on people's lifestyles, generating high levels of psychological distress, anxiety, and mood alterations (3, 4). Consequently, they can represent risk factors for many mental health issues and can potentially generate posttraumatic stress disorder (PTSD) symptoms (1, 5).

The DSM-5 (6) indicates that "experiencing repeated or extreme exposure to aversive details of the traumatic event(s)" can be considered as potentially traumatic events. The clinical characteristics required by DSM-5 to define the diagnosis of PTSD provide for the fulfillment of Criterion A, concerning exposure to trauma; moreover, in PTSD, the trauma resurfaces in an intrusive, invasive way, in the subject's memories through flashbacks, vivid images and nightmares, associating with avoidance behaviors of thoughts, places, objects, and situations that recall the traumatic event, with symptoms of affective dulling, negative alterations in cognition and mood, as well as persistent symptoms of increased arousal (Criteria B, C, D, and E of the DSM-5). In addition, a further Criterion F is defined, concerning the significant impairment of social function, work, or other important areas for the individual. In accordance with the criteria expressed in the DSM-5, several studies have been conducted relating to posttraumatic stress disorder.

Although most of the epidemiological studies on PTSD have been conducted in the United States [e.g., (7)], there are some concerning the general European population (8), in particular, the Italian one (9, 10).

An important study was conducted by the European Study of the Epidemiology of Mental Disorders, which analyzed the population of Western Europe, within the WHO World Mental Health Survey Initiative (ESEMeD-WMH); this is a worldwide epidemiological study aimed at estimating the prevalence of PTSD and its association with various traumatic events in the adult population (11). There is evidence of a gender difference in PTSD, with females being more at risk of developing the condition than males (12). Regarding age, some authors have reported that exposure to trauma decreases over the years (13), and other studies show that young age is globally a risk factor for the development of PTSD (14). The pandemic outbreak of an unrecognized infection, such as COVID-19, could be defined as a traumatic experience for its acute and chronic implications at individual and community levels (1). Specifically, the healthcare workers in emergency care settings are particularly at risk of PTSD because of the highly stressful work-related situations they are exposed to, which include: management of critical medical situations, caring for severely traumatized people, frequent witnessing of death and trauma, operating in crowded settings, and interrupted circadian rhythms due to shift work (15). Consequently, investigating the psychological impact of the COVID-19 pandemic on healthcare workers including physicians and nurses has become increasingly important (15, 16).

Aims and Hypotheses

Currently, given the enormous burden of distress and potentially traumatic events experienced by people who work in healthcare, it is important to document the prevalence of mental health problems in this population group (17). In this framework, the purpose of the current study was to investigate the emotional impact and the prevalence of self-reported PTSD symptoms caused by the COVID-19 pandemic by comparing Italian healthcare professionals to a control group of the general population. Specifically, the main hypothesis was to compare the perception of stress between the two groups and its psychological and clinical effects on the lives of participants.

MATERIALS AND METHODS

Participants and Procedure

The inclusion criteria for volunteers were (i) Italian-speaking citizens, (ii) at least 20 years old, (iii) with at least 13 years of education, and (iv) carrying out work in the healthcare sector or not employed (for the control group). Respondents who did not complete the questionnaire on demographic characteristics and who reported psychological distress before the pandemic were preliminarily excluded. We randomly selected, among the 371 initial respondents, those suitable to balance the groups of health workers and control workers by number, age, and gender. The final sample analyzed in the study included 214 participants into two groups, i.e., healthcare workers ($N = 107$) and control group ($N = 107$). Specifically, each group was composed of 29 men (27%) and 78 women (73%), all aged between 20 and 60 ($M = 26.75$, $SD = 3.86$). Also, age ranges were matched in the two groups: ages 20–30, $n = 23$; ages 31–40, $n = 29$; ages 41–50, $n = 24$; age > 51, $n = 31$. However, considering the small number of the general sample, it is only representative of the population investigated. Specifically, the two groups had the following characteristics: the healthcare workers (HCWs) included nurses ($N = 63$), doctors ($N = 19$), healthcare assistants ($N = 9$), and medical and nursing students trainees in hospitals ($N = 14$).

The hospitals involved in the study were the University Hospital "Policlinico—San Marco" and the Drug Addiction Health Service, SER.T-ASP3, of Catania. The control group included employed, self-employed, casual employees, housewives, and not employed.

The volunteer participants were informed of the research via email and subsequently gave online written informed consent and answered the questionnaire anonymously. The

administration time of the instrument used was ∼20–30 min. In the research presentation platform, it was reported that the volunteer participant could leave the completion of the questionnaire at any time of administration.

Data collection occurred from March 14, 2021 to May 30, 2021, namely, 1 year after the onset of the pandemic. In Italy, during this time, the first dose of vaccine and medical treatments were available for the population. Also, the data were collected in aggregate form, and individual users were not identified.

This study was conducted according to the Declaration of Helsinki and was approved by the Ethics Committee of the Department of Educational Sciences at the University of Catania (Italy), which guarantees the confidentiality and anonymity.

The research design was of a correlational type as the objective of the study was to investigate the relationship between the variables used without the researcher controlling or manipulating any of them.

Measures

The online instrument with 112 items consisted of an anonymous questionnaire, assembled *ad hoc* including demographic information and different standardized assessment scales.

The first part of the questionnaire was on sociodemographic parameters (e.g., gender, age and profession), while the second part consisted of standardized scales, i.e., the Fear of COVID-19 scale (FCV19S) (18), the COVID-19—Post Traumatic Stress Disorder (COVID-19-PTSD) (1, 19), the Profile of Mood States (POMS) (20), and the Maslach Burnout Inventory—Human Services Survey (MBI-HSS) (21).

The final part of the questionnaire was a debriefing. The volunteer participants were thanked for their availability, and contact references were given for any questions about the purpose of the research. Also, the online system did not guarantee the possibility of saving the questionnaire without having definitively concluded it.

For our sample, the results indicate that the instruments used has really good internal consistency. Specifically, $\alpha = 0.82$ was for FCV19S, $\alpha = 0.92$ for COVID-19-PTSD test, $\alpha = 0.97$ for POMS, and $\alpha = 0.89$ for the BMI-HSS.

Fear of COVID-19 Scale

The Fear of COVID-19 scale (FCV19S) (18) represents a standardized tool in assessing the generalized fear of COVID-19 among individuals, fear often associated with the transmission speed, and the high mortality rate related to the virus. The scale showed good reliability ($\alpha = 0.87$) and is a one-dimensional questionnaire composed of seven items (e.g., "I'm very afraid of coronavirus-19"; "It makes me uncomfortable to think about coronavirus-19"; "I can't sleep because I worry about getting coronavirus-19"), with a five-point response scale (1 = strongly disagree to 5 = strongly agree), which assesses fear of COVID-19 and its consequences. The score is obtained by adding the scores to the questions.

COVID-19—Posttraumatic Stress Disorder

A section of the questionnaire used the COVID-19—PTSD (1, 19) to investigate posttraumatic stress disorder (F43.10). This questionnaire includes 19 items (e.g., "Having repeated, disturbing and unwanted thoughts related to this stressful experience," "To have difficulty in falling asleep"), requiring a response on a five-point Likert scale, from 0 (not at all) to 4 (extremely), and is developed, thanks to the modification of the PCL-5 (22) in order to focus the attention on a prolonged and current stressor. A COVID-19—PTSD cutoff score of 26 was deemed to correctly categorize a participant as having or not having significant PTSD symptoms.

The COVID-19—PTSD demonstrated a good internal consistency (Cronbach's $\alpha = 0.94$) and a robust convergent validity.

Profile of Mood States

The Profile of Mood States (POMS) scale is a widespread psychological instrument used to measure mood and identify problematic affective states. The scale, developed by McNair et al. (20) is composed of a list of adjectives that measure six aspects or scales of emotions. The POMS scale showed good reliability ($\alpha = 0.85$) and consists of a questionnaire of 58 adjectives (e.g., "Tense," "Energetic," "Fatigued"), is particularly useful in evaluating subjects with stress disorders, and is structured on the basis of six mood states: tension–anxiety (T), which describes an increase in somatic tension that may not be observable from the outside or may concern visible psychomotor manifestations; depression (D), which indicates a state of depression accompanied by a sense of personal inadequacy, the uselessness of effort, a sense of emotional isolation, melancholy, and guilt; aggression–anger (A), which describes anger and dislike toward others; vigor–activity (V), a positive factor including exuberance, energy, euphoria, and optimism; tiredness–indolence (TI), which represents boredom, low energy, and physical fatigue; and confusion (C), characterized by a sense of disturbance and linked to the organization–disorganization dimension, anxiety, and the feeling of cognitive inefficiency. The intensity of the mood is measured on a five-point Likert scale (0 = not at all, 1 = a little bit, 2 = moderately, 3 = quite a bit, and 4 = extremely). Total scoring for the scale [Total Mood Disturbance (TMD)] can be calculated by adding the scores for tension, depression, anger, tiredness, confusion, and then subtracting the score for vigor.

Maslach Burnout Inventory—Human Services Survey

Burnout is a syndrome of high emotional exhaustion and high depersonalization in the presence of a lack of personal accomplishment. The Maslach Burnout Inventory—Human Services Survey (MBI-HSS) is a questionnaire of 22 items, each of which with 7 degrees of response on the Likert scale (0 = never, 1 = a few times a year or less, 2 = once a month or less, 3 = a few times a month, 4 = once a week, 5 = a few times a week, 6 = every day). This questionnaire was designed for professionals in human service employees and is appropriate for respondents working in a diverse array of occupations, including nurses, and other fields focused on helping people live better lives by offering guidance, preventing harm, and ameliorating physical, emotional, or cognitive problems. The questionnaire was developed by Maslach and Jackson (23) and investigates three

TABLE 1 | Means, *t*-test, and *p*-value for the comparison between groups in the factors and total score of Profile of Mood States (POMS).

POMS	Group	Mean	SD	*t*	*p* (df = 212)
T—Tension	Healthcare workers (HCWs)	11.77	7.78	−2.03	0.04*
	Control	14.08	8.86		
D—Depression	HCWs	15.50	11.90	−2.34	0.02*
	Control	19.79	14.83		
A—Anger	HCWs	11.51	9.98	−3.64	<0.01**
	Control	17.07	12.25		
V—Vigor	HCWs	17.90	5.49	1.32	0.19
	Control	16.73	7.34		
TI—Tiredness	HCWs	10.80	6.05	−1.46	0.14
	Control	12.09	6.82		
C—Confusion	HCWs	8.29	5.81	−3.47	<0.01**
	Control	11.15	6.26		
TMD—Total Mood Disturbance	HCWs	39.97	40.04	−2.87	<0.01**
	Control	57.46	48.79		

*The symbol **indicates the value of $p < 0.01$ and symbol *indicates the value of $p < 0.05$.*

TABLE 2 | Mean, *t*-test, and *p*-value for the comparison between groups in the Maslach Burnout Inventory—Human Services Survey (MBI-HSS) (only working respondents were considered: $N = 96$).

MBI-HSS	Group	Mean	SD	*t*	*p* (df = 201)
EE—Emotional Exhaustion	HCWs	19.81	10.10	1.96	0.05*
	Control	16.68	12.72		
DP—Depersonalization	HCWs	12.63	5.39	6.42	<0.01**
	Control	7.06	6.93		
PA—Personal Accomplishment	HCWs	28.18	7.64	1.58	0.12
	Control	26.27	9.57		

*The symbol **indicates the value of $p < 0.01$ and symbol **indicates the value of $p < 0.05$.*

different subscales: emotional exhaustion (EE—nine items—e.g., "I feel burned out from my work"), depersonalization (DP—five items—e.g., "I worry that this job is hardening me emotionally"), and personal accomplishment (PA—eight items—e.g., "In my work, I deal with emotional problems very calmly"). Scales are scored such that higher scores indicate more of each construct. Higher scores on the EE and DP subscales indicate a higher burnout symptom burden; lower scores on the PA subscale indicate a higher burnout symptom burden (21). The reliability of all items measured by Cronbach's index was 0.80 for the Italian version used (24). This scale was not considered for unemployed respondents.

Data Analysis

The SPSS version no. 26 was used for the statistical analyses. We analyzed the data using parametric techniques when the data satisfied the assumptions of normality of the distribution, i.e., Student's *t* and discriminant analysis for detecting significant groups differences, Pearson's *r*, and multiple regression for correlational analyses. In analyzing the compared groups based on criterial variables, we used chi-square statistic.

RESULTS

The fear of COVID is not significantly different in the two groups considered in the study: in healthcare professionals, mean 15.08, *SD* 4.95; in the controls, mean 14.66, *SD* 4.82 ($t = 0.63$, df = 212, $p = 0.53$).

Instead, in the two groups, both POMS factors and the Total Mood Disturbance (TMD) significant differences have been found, with higher scores in the controls. However, the factors vigor and tiredness are not significant (**Table 1**).

Table 2 shows that in two out of three MBI-HSS factors, the scores are significantly higher in the healthcare professionals group than in the control group (excluding the not employee respondents).

Emotional exhaustion and depersonalization are higher in the professionals, while personal accomplishment at work is higher too, but not at a significant level.

PTSD values are high in both groups, higher—but not in a significant level—in healthcare professionals ($n = 107$, mean = 26.18, $SD = 14.60$) compared vs. controls, excluding nonprofessional participants ($n = 85$, mean = 25.75, $SD = 14.65$; $t = 0.20$, $p = 0.84$).

Also, considering the participants with COVID-19—PTSD scores higher than the cutoff (25), the differences between the two groups are not significant: 52.34% ($N = 54$) among health professionals vs. 47.06% ($N = 52$) of controls ($\chi^2 = 0.53$, $p = 0.47$).

Given that the two groups are not significantly different in PTSD scores, we have computed the correlations between the level of stress and the other variables in the whole sample. In the

TABLE 3 | Pearson correlation of COVID-19—Posttraumatic Stress Disorder (PTSD) with Fear of COVID-19 scale (FCV19S), POMS—TMD and subscale, and MBI-HSS scores.

	COVID-19-PTSD
FCV19S—Fear of COVID-19	0.76**
POMS—T (Tension)	0.68**
POMS—D (Depression)	0.59**
POMS—A (Anger)	0.57**
POMS—V (Vigor)	−0.16
POMS—S (Tiredness)	0.67**
POMS—C (Confusion)	0.50**
POMS—TMD (Total Mood Disturbance)	0.63**
EE—Emotional Exhaustion	0.44**
DP—Depersonalization	0.36**
PA—Personal Accomplishment	0.07

*The symbol **indicates the value of $p < 0.01$.*

TABLE 4 | Results of discriminant analysis (Wilks' $\Lambda = 0.67$, $\chi^2 = 20.05$, $p < 0.001$).

Variables	F-to-remove	Coefficient
POMS—TMD (Total Mood Disturbance)	24.79	0.49
DP—Depersonalization	54.88	0.34
PA—Personal Accomplishment	4.34	0.74
FCV19S—Fear of COVID-19	1.51	0.81
EE—Emotional Exhaustion	2.16	0.29

study, all the correlations are highly significant, except for vigor and personal accomplishment at work (**Table 3**).

Posttraumatic stress is significantly correlated with the fear of COVID-19 and other negative emotions (mostly with tension, tiredness, anger, and confusion). Also, emotional exhaustion and depersonalization at work are connected with general stress due to the pandemic event.

To better differentiate the two groups based on the scores in the standardized tests, a discriminant analysis was performed (**Table 4**), using a predictor of the POMS—Total Mood Disturbance score, the Fear of COVID-19, and the three factors of MBI-HSS scores.

Total mood disturbance and depersonalization are the most discriminating variables.

The classification results confirm that the discriminant function based on the test variables can distinguish the two groups with a percent of correct of a medium-high level (77%), more for controls (80%) than for healthcare professionals (74%).

After analyzing the difference between groups, other analyses were addressed to the study of the relations within the target group, i.e., the healthcare professionals. The correlations among the MBI-HSS and POMS factors in healthcare professionals are shown in the **Table 5**. Emotional exhaustion and depersonalization are correlated with all POMS factors except with vigor. Also, the personal accomplishment factor (scored in the positive direction) correlates only with vigor (also positive factor), not significantly with other variables.

Moreover, fear of COVID measured by FCV19S test significantly ($p < 0.01$) correlates with POMS—Total Mood Disturbance (0.49), with factors Tension (0.52), Depression (0.47), Anger (0.33), Tiredness (0.57), Confusion (0.38), and not with Vigor (−0.16).

Table 6 shows the results of a series of multiple regression analyses performed in healthcare professional samples separately for the three variables of the MBI-HSS.

Results demonstrate that depression and tiredness are the best predictors of emotional exhaustion; tiredness is the best predictor also of depersonalization, together with anger and negation of tension. Vigor and tiredness, conjointly with reduced anger, predict personal accomplishment in healthcare professionals.

DISCUSSION AND CONCLUSIONS

Anxiety, depression, burnout, and suicide risk among healthcare workers (HCWs) were considered as critical health issues even before the COVID-19 pandemic (26). However, the coronavirus disease-19 (COVID-19) has brought about a period of world emergency and highlighted the need to focus on the impact caused by the pandemic situation both in the subjects directly involved in the management of this emergency and in the general population. Recent cross-sectional studies reported that increased workload and burnout were especially pronounced among frontline HCWs who volunteered as members of the COVID-19 outbreak response team (25, 27–30). Previous studies of frontline health workers during the SARS and Ebola outbreaks showed that frontline workers suffer significant risks of burnout, anxiety, and PTSD (31–33). However, the psychological suffering that follows exposure to a traumatic and stressful event is highly variable. For this reason, it is not uncommon for the clinical picture to include some combinations of symptoms (e.g., anhedonia, dysphoria, anger, and dissociation) with the presence or absence of anxiety and fear. A recent systematic review (34) showed that 29 studies reported the prevalence of mental health disorders in HCWs. Specifically, the percentage of healthcare workers with anxiety ranged from 9 to 90% with a median of 24%, while the percentage with depression ranged from 5 to 51%, with a median of 21%.

This cross-sectional online study intended to examine the prevalence of PTSD symptomatology and the emotional impact in Italian healthcare workers and the general population during the phases immediately following the possibility of administering vaccines and medical treatment for COVID-19 (over 2 months, from March to May 2021).

The results of the study have indicated that both the groups of our sample show a high level of posttraumatic stress derived from working during a pandemic, with nearly half of the professionals exceeding the cutoff (>26) in accordance with the Italian standardization of the COVID-19—PTSD test (1, 19). Comparing the two groups, we found that healthcare professionals have a consistent perception of stress, but not at a level significantly higher than other categories of workers. However, probably as a result of their specific training and supervision, they showed less emotional disturbance than the

TABLE 5 | Person correlations among the MBI-HSS and POMS factors in healthcare professionals' group.

MBI—Factors	POMS—Factors					
	Tension	Depression	Anger	Vigor	Tiredness	Confusion
EE—Emotional Exhaustion	0.64**	0.74**	0.62**	−0.17	0.75**	0.64**
DP—Depersonalization	0.41**	0.52**	0.49**	−0.20	0.60**	0.40**
PA—Personal Accomplishment	0.19	0.16	0.10	0.37**	0.21	0.04

*The symbol **indicates the value of $p < 0.01$.*

control sample, as they are familiar with, and capable of, dealing with more stress, have better anxiety management skills, and display lower values of depressive disorder and mental confusion. Instead, the healthcare professionals showed a condition of emotional exhaustion and depersonalization, which is common in the burnout syndrome. These symptoms, in the group of healthcare professions, are predicted by specific emotional variables: e.g., Tiredness together with Depression due to Emotional Exhaustion, Tension, Anger, and Depersonalization.

It is, therefore, recommended that the HCWs are provided with a safe and secure environment that promotes their psychological wellbeing to facilitate adequate service delivery during the COVID-19 pandemic and future events of disease outbreak (35). As suggested by Tucci et al. (32), whereas HCWs are not sufficiently capable of managing their individual health while caring for other ill persons, this supports the need for national and local healthcare agencies to place a premium on the psychological and mental health status of HCWs (35). Intervening professionally on the outcomes found on the emotional sphere in times of crisis, as the epidemiological situation in the grip of the COVID-19 pandemic demonstrates, means learning to manage emergency situations and also dealing with them on the psychic side.

Some limitations of this study need to be acknowledged. First, the number of healthcare professionals and controls were not high enough to make differentiation among the jobs. Second, as the sample was not representative of the healthcare workers population, the study should be considered a correlational one. Furthermore, the use of self-report instruments and the lack of data about COVID-19 infection or other variables related to the pandemic (death of a loved one, etc.) may be considered limitations.

In conclusion, the results obtained are useful in understanding the determinants of the emotional involvement of healthcare professions and the risk of burnout syndrome and, therefore, for planning activities and support paths for these workers who are particularly at risk during prolonged and pervasive crises, such as the pandemic. As suggested by Chirico et al. (35), social activities, such as sharing one's experience with colleagues and family members, would help reduce subthreshold syndromes before they evolve to complex conditions. Scientific literature confirms the positive effect of practicing oriental disciplines as Judo, Tai Chi, yoga, or meditation on health and self-control to recover our balance (36). Furthermore, psychological support interventions for healthcare workers should not be limited to a set period of time (e.g., lockdown), but should be constantly monitored and guaranteed regardless of the crisis events. However, further research could be needed to comprehend their cost effectiveness for individuals and health organizations and their sustainability over time.

TABLE 6 | Multiple regressions for the three variables of the MBI-HSS in healthcare professional samples.

Predictors:	EE Emotional exhaustion	DEP Depersonalization	PA Personal accomplishment
	Std. coeff.	Std. coeff.	Std. coeff.
	$r^2 = 0.61$	$r^2 = 0.44$	$r^2 = 0.28$
FCV19S—Fear of COVID-19	0.07	0.00	−0.03
POMS—T (Tension)	−0.21	−0.45*	0.11
POMS—D (Depression)	0.48**	0.10	0.19
POMS—A (Anger)	−0.07	0.44*	−0.49*
POMS—V (Vigor)	0.04	−0.12	0.49***
POMS—S (Tiredness)	0.45***	0.74***	0.48*
POMS—C (Confusion)	0.10	−0.28	−0.03

*Predictors are the scores on the Fear of COVID-19 scale and POMS subscales. The symbol ***indicates the value of $p < 0.001$, the symbol **indicates the value of $p < 0.01$, and symbol *indicates the value of $p < 0.05$.*

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Department of Educational Sciences of the University of Catania (Italy). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CDe, DC, and SD: conceptualization and methodology. DC: validation. DC and SD: formal analysis. RD'A and EL: investigation. SD: data curation and supervision. DC and

RD'A: writing—original draft preparation. CDe, DC, CDi, and SD: writing—review and editing. CDe: funding acquisition. All authors contributed to the article and approved the submitted version.

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Knowledge, Attitudes, and Practices Toward Coronavirus and Associated Anxiety Symptoms Among University Students: A Cross-Sectional Study During the Early Stages of the COVID-19 Pandemic in Bangladesh

Muhammad Mainuddin Patwary[1,2], Asma Safia Disha[1,2], Mondira Bardhan[1,2], Md. Zahidul Haque[1,2], Md. Pervez Kabir[1,2], Sharif Mutasim Billah[1,2], Md. Riad Hossain[3], Md. Ashraful Alam[4], Matthew H. E. M. Browning[5], Faysal Kabir Shuvo[6], Awais Piracha[7], Bo Zhao[8], Sarya Swed[9], Jaffer Shah[10]* and Sheikh Shoib[11]*

[1] Environment and Sustainability Research Initiative, Khulna, Bangladesh, [2] Environmental Science Discipline, Life Science School, Khulna University, Khulna, Bangladesh, [3] Institute of Disaster Management, Khulna University of Engineering & Technology, Khulna, Bangladesh, [4] Department of Global Health Policy, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan, [5] Department of Parks, Recreation and Tourism Management, Clemson University, Clemson, SC, United States, [6] Centre for Urban Transitions, Swinburne University of Technology, Melbourne, VIC, Australia, [7] Geography, Tourism and Urban Planning, Western Sydney University, Penrith, NSW, Australia, [8] Department of Health Administration, Graduate School, Yonsei University, Wonju, South Korea, [9] Faculty of Human Medicine, Aleppo University, Aleppo, Syria, [10] Medical Research Center, Kateb University, Kabul, Afghanistan, [11] Department of Psychiatry, Jawahar Lal Nehru Memorial Hospital (JLNMH), Srinagar, India

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***Correspondence:**
Muhammad Mainuddin Patwary
raju.es111012@gmail.com
Jaffer Shah
jaffer.shah@kateb.edu.af

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Background: University students' knowledge, attitude, and practice (KAP) toward COVID-19 are vital to prevent the spread of the virus, especially in the context of developing countries. Consequently, the present study aimed to determine the KAP levels of university students and associated anxiety during the earlier stage of the pandemic in Bangladesh.

Methods: A cross-sectional, online study with 544 university students was conducted during April 17–May 1, 2020. The questionnaire incorporated several KAP-related test items aligned with the World Health Organization (WHO) guidelines. Anxiety was measured with the 2-item Generalized Anxiety Disorder scale (GAD-2). Multivariable logistic regression analysis was performed to determine the association between KAP levels and anxiety adjusting for sociodemographic variables. Subgroup analyses included rerunning models stratified by gender and quarantine status.

Results: Approximately 50% of students showed high levels of knowledge about COVID-19 guidelines, 59% reported behavioral practices that aligned with COVID-19 guidelines, and 39% had negative attitudes toward COVID-19 guidelines. Attitudes differed by anxiety (χ^2 = 23.55, $p < 0.001$); specifically, negative attitudes were associated with higher anxiety (OR: 2.40, 95% CI = 1.66–3.46, $p < 0.001$). Associations were significant for male (OR = 2.36; 95% CI = 1.45–3.84, $p < 0.001$) and female (OR = 2.45; 95% CI = 1.3–4.34; $p < 0.001$) students. Stratified analyses found non-quarantined students with negative attitudes had three times the chance of experiencing

anxiety (OR = 3.14, 95% CI: 1.98–4.98, $p < 0.001$). Non-quarantined students with low levels of knowledge had half the chance of developing anxiety (OR = 0.49, 95% CI: 0.31–0.78, $p < 0.01$).

Conclusion: Based on these findings, it is recommended that university authorities continue to prioritize proactive and effective measures to develop higher levels of knowledge, more positive attitudes and better behavioral practices regarding COVID-19 for the mental health of their students.

Keywords: KAP, anxiety, COVID-19, cross-sectional, knowledge, university student, Bangladesh

INTRODUCTION

The rapidly spreading coronavirus disease 2019 (COVID-19) has been recognized as a worldwide public health concern. The World Health Organization (WHO) declared COVID-19 a public health emergency of international concern on 30 January 2020 and urged all nations to work together to halt the epidemic (1). In response, countries around the world implemented a variety of containment measures, including the closure of educational and other government and non-government institutions, prohibition of large-scale social gatherings, restrictions on local, national, and international travel, and complete lockdowns to prevent viral transmission (2, 3). Despite these precautions, the world has recorded a massive number of infected cases, about 262 million, with 5.2 million deaths to-date because of the highly contagious nature of the coronavirus (4).

The first COVID-19 case in Bangladesh was reported on March 08, 2020 (5). As one of the most densely populated countries, Bangladesh faced particularly demanding challenges to manage the knowledge, attitudes, and behavior practices regarding COVID-19 in its massive population (6, 7). As of August 14, 2021, Bangladesh reported COVID-19 cases surpassed 1.4 million, and COVID-19-related deaths exceeded 23,600 (5). To control the spread of the virus, the Bangladesh government has taken several precautionary measures, including educational institution shutdowns, ceasing all social gatherings, closing government and non-government entities except emergency services, restricting tourism, and limiting intra-country travel (7–9). Besides, several organizations voluntarily promoted massive advertisements regarding COVID-19 on awareness-raising, proper handwashing practices, wearing facemask appropriately, and maintaining social distancing, among other measures (10).

For Bangladesh to further control the virus, each citizen must be informed, maintain attitudes that support adherence to behavioral practices, and practice measures that reduce health risks and viral transmission (11). Therefore, appropriate knowledge, attitude, and practice (KAP) levels toward this infectious disease are cognitive keys to this public health emergency (12). KAP entails a variety of ideas regarding the disease's etiology and exacerbating variables, and the identification of symptoms, treatment options, and repercussions (13). Studies during the Severe Acute Respiratory Syndrome (SARS) pandemic showed poor level of KAP concerning contagious diseases was an obstacle to containment (14). During the COVID-19 pandemic, some scholars believe that poor knowledge and orthodox religious beliefs may be responsible for negative attitudes and ineffective containment strategies (6).

Knowledge, attitude, and practice surrounding health-related habits, along with environmental and financial factors, status of quarantine, lockdown measures and fear of COVID-19 may influence anxiety levels during the pandemic (15, 16). According to a previous study on Brazilian people, respondents experienced fear and mental distress due to multi-level coping strategies (17). Another study conducted in Latvia found that poor health conditions, fear of contracting COVID-19, having family members contract COVID-19, family conflicts, lack of religiosity and caring for a vulnerable person were associated with depression and anxiety (18). Several studies on infectious diseases found that knowledge and attitude toward these diseases were related to serious psychological distress, fear, and stigma among people that challenged efforts to prevent disease spread (19–21). In the 2003 SARS outbreak, lower levels of anxiety were associated with higher levels of knowledge and positive attitudes toward infectious disease transmission (22). A cross-sectional study of Chinese college students during COVID-19 found that knowledge and attitudes were protective against mental distress (21). Another study in Latvia reported that preventive behaviors during COVID-19 were associated with COVID-19 threat appraisal, trust in information sources, and fear (23). Another study identified protective factors of COVID-19 including disbelief in the effectiveness of precautionary behavior were associated with lockdown-induced anxiety (24). A global analysis of 40 countries reported that physical inactivity, excessive use of the internet, tendency to stay up late, sleeping pills and dreams of being trapped contributed to anxiety during the COVID-19 lockdown (25). Ding et al. (26) conducted a study of 817 pregnant women and reported that high knowledge scores were associated with less anxiety. Alaloul et al. (27) reported high levels of anxiety were associated with preventive measures in Oman during the pandemic. Other studies in Singapore, China and Italy found that self-efficacy and information sufficiency was associated with lower anxiety levels, while higher anxiety levels were catalysts to adopt preventive behaviors (28). Another study in Indonesia found that individuals with correct responses to knowledge tests had significantly lower anxiety scores. That study also found individuals reporting practices that conflicted with WHO guidance, such as attending crowded places, showed higher anxiety scores (29). Collectively, these studies suggest KAP level are associated with anxiety during the pandemic. However,

some contradictory evidence also exists; high anxiety levels in India (30) and China (31) were found even in respondents with reasonably good levels of knowledge about the virus. Chowdhury et al. (32) reported anxiety due to COVID-19 was negatively associated with risky behavior during COVID-19 outbreaks. Based on this literature and the emerging COVID-19 situation, it remains important to determine level of KAP surrounding the coronavirus and its associations with anxiety. Such knowledge would provide further insight into how Bangladesh can prevent the further spread of the contagion and downstream impacts of its citizens' mental health.

At present in Bangladesh, the literacy rate of current status stands for 74.9%, while the Net Enrollment Rate (NER) on primary education is almost 97.94% and over 1.3 million students receive tertiary level of education, of which 74% were male, and 26% were female (33, 34). In the present study, we studied KAP surrounding COVID-19 and anxiety among university students. This sample was chosen because we expected they would be motivated and insightful regarding positive attitudes toward COVID-19 containment measures. In Bangladesh, there have been several studies on the KAP of students and young adults (35–39). Further, Hossain and his research team investigated Bangladeshi general people's KAP toward COVID-19 and their underlying fear levels in relation to sociodemographic factors (40). However, the KAP of university students and their association with mental distress has yet to be investigated. Based on this research gap, the present study aimed to determine KAP toward COVID-19 and associated anxiety of university students during the earlier stage of the pandemic in Bangladesh. More specifically, this study aimed to:

a. Determine Knowledge, Attitude, and Practice (KAP) levels of university students toward COVID-19.
b. Test associations between KAP levels and anxiety during the COVID-19 lockdown period.
c. Explore gender-based differences in associations between KAP levels and anxiety.
d. Examine quarantine status-based differences in KAP levels and anxiety associations.

MATERIALS AND METHODS

Study Participants and Sampling Procedure

A cross-sectional study was conducted during the first wave of the pandemic among university students of Bangladesh to understand their KAP levels and anxiety during the COVID-19 pandemic. Inclusion criteria included current enrollment as a university student and the decision to participate in our study. The questionnaire was prepared in English and then translated to the local language (Bangla). A snowball sampling procedure was used to collect the data. First, we distributed a web-based structured questionnaire through attainable social networks (e.g., Facebook, WhatsApp, and Instagram). Then, we requested our social network communities to provide their responses and asked them to share the questionnaire with their networks. The questionnaire was prepared following the World Health Organization (1) guidelines. It was divided into the following sections: (a) demographic information, (b) knowledge toward the COVID-19 pandemic, (c) attitudes toward the spread of COVID-19, (d) related practices to control the spread of COVID-19, and (e) anxiety.

The questionnaire's relevance was determined by consulting a panel of experts. A relevance analysis was used to determine the content validity of each questionnaire block. Experts offered constructive feedback on readability, general relevance, and specific relevance to the study's aims. The questionnaire was then piloted with 25 participants to gather additional feedback. The questionnaire was modified based on this feedback and made more understandable. Cronbach's alpha values were used to determine the reliability index of both the pilot and final questionnaires. All values were more than 0.75, suggesting that the reliability was satisfactory (41).

Previous studies using our suite of measures were unavailable; therefore, we used an online calculator to estimate our necessary sample size (42). We followed the recommended conservative value (50%) for the proportion of our sample displaying our factor of interest. Thus, we calculated the minimum required number of respondents using an online sample size calculator,[1] which was determined at 427 based on a 10% non-response rate, 5% precision, and 50% proportion, with a 95% confidence range for the overall population size of 3.2 million of tertiary level students in Bangladesh (43).

We gathered 744 responses between April 17 and May 01, 2020. As our target population was university students, we cross-checked our data and found that among the respondents, 544 students from different universities of Bangladesh responded. Thus, a total of 544 responses were used for the final analysis. All survey items were answered by all participants, so missing data analysis was not required. Electronic consent was obtained from all participants prior to their completion of the survey. The participant could opt out at any time. Additionally, the survey did not ask participants to provide their names or email addresses, ensuring that the participant could not be identified. Accordingly, the research ethical clearance board of the Institute of Disaster Management, Khulna University of Engineering & Technology, Khulna, Bangladesh waived the approval for this study.

Measures

The survey gathered information on the independent (KAP levels) and dependent variable (anxiety) as well as basic information on university students. This basic information included their gender, age, degree of education, residential status, living status, quarantine status, and sources of information during the COVID-19 epidemic.

- Participants' knowledge of the COVID-19 pandemic was assessed using 24 yes/no questions about the illness type, mode of transmission, and likelihood of exposure to transmission risk. Respondents were asked to answer questions as true or false, with the option of "don't know." Correct responses received a score of one, while incorrect

[1] https://statulator.com/

or unsure (don't know) responses received a score of zero. The overall score for knowledge was between 0 and 24. Scores greater than the sample mean were classified as having good knowledge while scores having less than the sample mean were classified as having poor knowledge. This differentiation between good and poor knowledge levels is in line with past research, improved the interpretability of the results, and was responsive to differences in information sources between populations (44). Cronbach's alpha value of 0.78 suggested a high degree of internal consistency.

- Attitudes toward COVID-19 were captured with five questions divided into two categories. Three questions captured negative attitudes toward COVID-19: (1) worry about the personal financial condition, (2) worry about academic delays, and (3) worry about social stigma. Two items captured positive attitudes toward COVID-19: (4) daily life returning to normal soon, and (5) social support during the pandemic. To determine the extent of these attitudes, a five-point Likert-type scale was used with responses ranging from 1 (not at all) to 5 (very high). The total attitude score ranged from 5 to 25, with negative attitude items recoded to align with the directionality of the response scale of the positive attitude items. Individuals who scored higher on the attitude scale than the mean were categorized as having a positive attitude, while those who scored lower than the mean on the attitude scale were labeled as having a negative attitude. This categorization also aligned with past research, assisted with the interpretability of the results, and was responsive to population differences (44). The Cronbach's alpha was 0.80, indicating a high degree of internal consistency.
- To capture preventive measures, respondents were asked ten questions about their precautionary behaviors during the COVID-19 pandemic. Each item was answered as 1 (yes) or 0 (no). The total score ranged from 0 to 10. Once again, this score was classified into two levels for the same reasons as the knowledge and attitude classifications (44). A score higher than the mean indicated good practices and a score less than the mean indicated poor practices.
- Anxiety was assessed with the 2-item Generalized Anxiety Disorder scale (GAD-2). GAD-2 is a shortened version of the GAD-7 that has been reported in numerous studies to assess anxiety disorders (45, 46). The GAD-2 evaluates how participants were bothered over the last 2 weeks by "feeling nervous, anxious, or edge" and "not being able to stop or control worrying" (47). Participants responded on a 4-point Likert scale: 0 (not at all) to 3 (almost every day). The total score ranges from 0 to 6 with scores ≥ 3 indicating a higher level of anxiety (47).

Statistical Analysis

Descriptive statistics were calculated to analyze the characteristics of the respondents. Levels of KAPs were reported as frequency distributions. Categorical data were presented as numbers (N) and frequencies (%), while continuous data were displayed as means and standard deviations (SD). Associations between KAP levels and anxiety were tested with Pearson chi-square tests and Student's t-tests. To determine associations between KAP levels and anxiety while adjusting for other factors, multivariable logistic regression models were run. Controls included gender, age, education, place of residence, living status, quarantine status, and information sources. Stratified analyses were conducted to examine associations between KAP levels and anxiety in men vs. women and in students under vs. outside of quarantine. The significance of associations was determined with odds ratios (OR) and 95% confidence intervals (CI). A two-tailed test with a significance level of $p < 0.05$ was considered statistically significant. The R Statistical Package (version 4.0), developed by R Core Team released on 2021 and IBM SPSS Statistics, Version 26.0. IBM Corp., Armonk, NY, United States were used to analyze the data.

RESULTS

Sample Demographics

Demographic characteristics of students are displayed in **Table 1**. Of the total, 56.99% were men, and 43.01% were women. The majority (72.43%) were 25 years old or less. Most were undergraduate students (66.54%), followed by graduate (27.21%) and post-graduate (6.25%) students. A total of 84.74% were urban residents, and 78.86% lived with family members. Approximately one-third (32.17%) were in quarantine during the survey period. The largest share of respondents used social media to collect information about the pandemic (89.34%), followed by traditional media (77.57%), governmental agencies (77.21%), online media (60.85%), and healthcare staff (31.43%). Females ($\chi 2 = 12.34$, $p < 0.05$), participants over the age of 25 ($\chi 2 = 19.32$, $p < 0.05$), graduate students ($\chi 2 = 18.34$, $p < 0.05$), and non-quarantined students ($\chi 2 = 4.56$, $p < 0.05$) were more likely to show high anxiety relative to their counterparts.

Knowledge, Attitudes, Practices, and Anxiety Levels

Frequencies of correct and incorrect answers to knowledge-related questions are provided in **Supplementary Table 1**. Almost all students (91.91%) agreed with the statement, "COVID-19 is an infectious disease." About 94.67% of students answered correctly for droplets as one of the transmission routes of the virus, followed by a face-to-face talk (77.39%), handshaking (97.06%), fecal-oral transmission (66.36%), mosquito bites (72.06%), and touching of objects used by an infected person (96.32%). Most students responded incorrectly that food, air, and pets could transmit COVID-19. More than nine-in-ten respondents knew the common symptoms of COVID-19 such as fever (95.77%), dry cough (90.81%), sore throat (91.91%), and difficulty breathing (93.93%). Most students provided incorrect answers for nose bleeds (95.77%) and aches and pains (60.29%). Another 87.50% of students gave the correct answer for the incubation period as understood at the time of this study (1–14 days). When respondents were asked about individuals at most risk of COVID-19, most students correctly answered

TABLE 1 | Demographic characteristics of respondents for the total sample and among students without vs. with anxiety, and significance tests for differences between each characteristic and anxiety (*N* = 544).

Characteristics	*N* (%)			χ 2	*P*-value[a]
	Total (*N* = 544)	Without anxiety (*N* = 295)	With anxiety (*N* = 249)		
Gender				12.34	0.03*
Male	310 (56.99)	180 (61.02)	130 (52.21)		
Female	234 (43.01)	115 (38.98)	119 (47.79)		
Age				19.32	0.01*
≤25	394 (72.43)	226 (76.61)	168 (67.46)		
>25	150 (27.57)	69 (23.39)	81 (32.54)		
Education status				18.34	0.01*
Undergraduate student	362 (66.54)	210 (71.19)	152 (61.05)		
Graduate student	148 (27.21)	71 (24.07)	77 (30.92)		
Post-graduate student	34 (6.25)	14 (4.75)	20 (8.03)		
Place of residence				1.45	0.34
Urban	461 (84.74)	246 (83.39)	215 (86.35)		
Rural	83 (15.26)	49 (16.61)	34 (13.65)		
Living status				1.02	0.31
Alone	26 (4.78)	15 (5.08)	11 (4.42)		
With family members	429 (78.86)	236 (80.00)	193 (77.51)		
With non-family members	89 (16.36)	44 (14.92)	45 (18.07)		
Quarantine status				4.56	0.04*
Yes	175 (32.17)	94 (31.86)	81 (32.53)		
No	369 (67.83)	201 (68.24)	168 (67.47)		
Information source for COVID-19				0.35	0.96
Government agency	420 (77.21)	228 (77.29)	192 (77.11)		
International agency	347 (63.79)	186 (63.05)	161 (64.66)		
Healthcare staff	171 (31.43)	96 (32.54)	75 (30.12)		
Social media	486 (89.34)	257 (87.12)	229 (91.97)		
Traditional media	422 (77.57)	224 (75.93)	198 (79.52)		
Online media	331 (60.85)	177 (60.00)	154 (61.85)		

[a]*Kruskal–Wallis Test, *p < 0.05.*

that people over 60 years old (97.61%), people with chronic illness (92.28%), healthcare professionals (91.36%), and pregnant women (54.23%) were at increased risk of COVID-19. On the other hand, 71.14% of participants believed that young people were not at high risk of COVID-19. One exception was noticed for children, where more than half provided the incorrect answer.

Supplementary Table 2 shows the positive and negative attitudes students held toward COVID-19 during the lockdown. Nearly half of the respondents believed that life would be back to normal soon. However, 29.41% were not optimistic and reported being undecided about this statement. Approximately 70% believed in the necessity of social support during the pandemic. In contrast, more than half were worried about their economic condition being at risk. Another 39.89% consented that they were worried about their academic routine while almost one-third were undecided about this. Besides, 31.25% were undecided about infected people facing stigma in the society.

Regarding practices toward COVID-19, 56.86% of respondents reported that they were staying at home (**Supplementary Table 3**). The vast majority did not wash their hands more frequently with soap and water (91.36%) or avoid social gatherings (92.83%) and public transports (86.21%).

Table 2 shows the KAP scores of students with and without anxiety during COVID-19. Of the total, 50.55% (N = 275) demonstrated a high level of knowledge, 38.61% showed a negative attitude, and 59.01% maintained good practices regarding the COVID-19 pandemic. Students with anxiety had significantly higher negative attitudes about COVID-19 (52.85%, $\chi 2 = 23.55$, $p < 0.001$). There were no statistically significant differences in knowledge and practice scores between students with and without high anxiety.

Associations Between Knowledge, Attitude, and Practice Levels and Anxiety

Bivariate correlations between KAP levels and anxiety are reported in **Table 3**. Knowledge was positively correlated with attitudes ($r = 0.156$, $p < 0.01$) and practices ($r = 0.227$, $p < 0.01$). Attitudes were also positively correlated with practices ($r = 0.178$, $p < 0.01$). Anxiety was positively correlated with attitudes ($r = 0.287$, $p < 0.01$) but not with knowledge or practices ($p > 0.05$).

Table 4 presents the results of a logistic regression model used to determine fully adjusted associations between KAP

TABLE 2 | Knowledge, attitude, and practice (KAP) levels toward COVID-19 among students with and without anxiety, and significant tests between each level and anxiety.

KAP score	*N* (%)			χ 2	*p*-value
	Total	Without anxiety	With anxiety		
Knowledge				1.836	0.192
High	275 (50.55)	157 (57.09)	118 (42.91)		
Low	269 (49.45)	138 (51.30)	131 (48.70)		
Attitudes				23.55	0.000***
Positive	334 (61.39)	186 (55.20)	151 (44.80)		
Negative	210 (38.61)	99 (47.14)	111 (52.85)		
Practices				0.035	0.853
Good	321 (59.01)	173 (53.89)	148 (46.11)		
Bad	223 (40.99)	122 (54.71)	101 (45.29)		

*Chi-square test was conducted to identify significance difference. ***p < 0.001 (2-tailed).*

TABLE 3 | Correlations between knowledge, attitude, and practice (KAP) levels toward COVID-19 and anxiety among university students in Bangladesh during the early phases of the pandemic (*N* = 544).

	Knowledge	Attitudes	Practices	Anxiety
Knowledge	1			
Attitudes	0.156**	1		
Practices	0.227**	0.178**	1	
Anxiety	0.007	0.287**	0.081	1

***p < 0.01 (2-tailed).*

TABLE 4 | Multivariate logistic regression models to determine associations between knowledge, attitude, and practice (KAP) levels toward COVID-19 and anxiety among university students in Bangladesh during the early phases of the pandemic (*N* = 544).

KAP levels	Crude model		Fully adjusted model[a]	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Knowledge				
Low	0.72 (0.51–1.03)	0.06	0.71 (0.50–1.02)	0.06
High	1.00 (ref.)		1.00 (ref.)	
Attitudes				
Negative	2.43 (1.71–3.45)	0.000***	2.40 (1.66–3.46)	0.000***
Positive	1.00 (ref.)		1.00 (ref.)	
Practices				
Bad	0.95 (0.66–1.35)	0.78	0.90 (0.62–1.32)	0.60
Good	1.00 (ref.)		1.00 (ref.)	

*Abbreviations: OR, odds ratio; CI, confidence interval; ref, reference. [a]Adjusted for gender, age, education, place of residence, living status, quarantine status, and information sources. ***p < 0.001 (2-tailed).*

levels and anxiety. After accounting for co-variables (gender, age, education, place of residence, living status, quarantine status, and information sources), participants with negative attitudes toward COVID-19 expressed 2.4 times higher risk of anxiety (95% CI: 1.66–3.46, $p = 0.000$). Associations between practices and anxiety were not statistically significant, whereas associations between knowledge and anxiety were negative and approached significance (OR = 0.71, 95% CI: 0.50–1.02, $p = 0.06$). However, none of adjusted variables were found significant (**Supplementary Table 4**).

Adjusted associations between KAP and anxiety levels stratified by gender and quarantine status are displayed in **Figures 1**, **2** and **Supplementary Tables 5, 6**. Both men and women who had negative attitudes toward COVID-19 were at greater risk of anxiety (Male: OR = 2.36; 95% CI: 1.45–3.84; Female: OR = 2.45; 95% CI: 1.3–4.34; $p < 0.001$) (**Figure 1** and **Supplementary Table 5**). Non-quarantined students showing negative attitudes had over three times the chance of experiencing anxiety (OR = 3.14, 95% CI: 1.98–4.98, $p < 0.001$), and non-quarantined students with a low level of knowledge had half the risk of experiencing anxiety (OR = 0.49, 95% CI: 0.31–0.78, $p < 0.01$). In the case of quarantined students, no significant associations between KAP levels and anxiety were observed (**Figure 2** and **Supplementary Table 6**).

DISCUSSION

Summary of the Findings

As one of the densely populated countries in the world, Bangladesh has faced challenges to implementing non-therapeutic measures such as avoiding social gatherings and public transport, wearing masks, washing hands frequently, and other practices. In this catastrophic condition, higher education is one of the worst affected sectors of society. However, past research suggests that adequate knowledge, positive attitudes, and good behavioral practices of students not only supports health and safety but also prevents mental distress. Thus, our study investigated KAP levels toward COVID-19 and associated anxiety in university students during the early stage of the pandemic.

Our results show that approximately half of the students had sufficient levels of knowledge and more than half adhered to COVID-19 precautionary practices. These findings corroborate a previous study with over 10,000 Bangladeshi adults that reported high levels of knowledge regarding COVID-19 preventative behaviors (48). Such findings speak to the effectiveness of delivering massive online public health education during lockdown (49). However, more than half of the students gave incorrect answers regarding the transmission of COVID-19 by food, air, and pets. Also, a few students incorrectly did not think that aches and pains were symptoms of the disease and half of respondents incorrectly associated the occurrence of COVID-19 with nasal congestion. The latter belief could be attributed to mistakes of linking the common fever with cold symptoms (50). The origin of the other incorrect beliefs is unclear but indicates that additional education and research are needed.

Less than half of the students showed negative attitudes toward COVID-19. Mostly, students were unclear about whether their economic conditions and academic careers would be disrupted due to the pandemic. This ambiguity can negatively affect mental health and decision-making ability (51). Similar to other studies (52, 53), half of students realized the importance of social support during the pandemic. Furthermore, nearly one-third of students

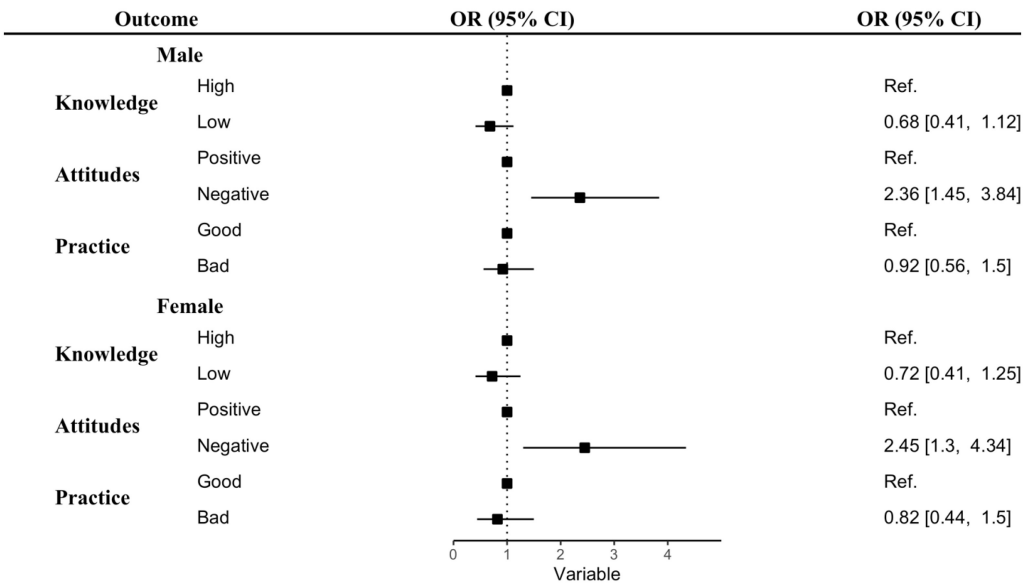

FIGURE 1 | Associations between KAP levels and anxiety during the COVID-19 lockdown by gender. Abbreviations: OR, odds ratio; CI, confidence interval; ref, reference. Adjusted for age, education, place of residence, living status, quarantine status, and information sources.

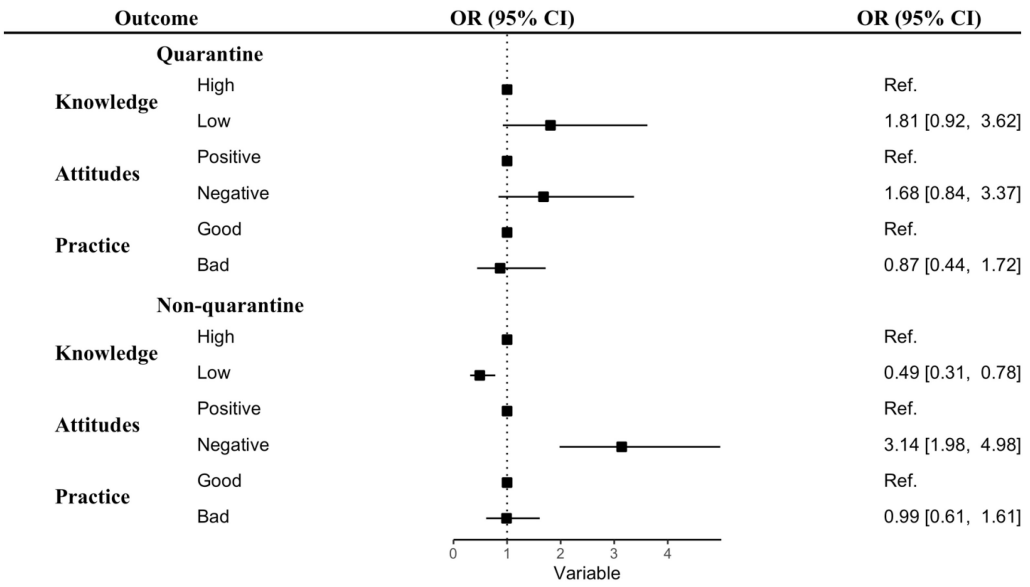

FIGURE 2 | Association between KAP levels and anxiety during the COVID-19 lockdown by quarantine status. Abbreviations: OR, odds ratio; CI, confidence interval; ref, reference. Adjusted for age, gender, education, place of residence, living status, and information sources.

believed that COVID-19 contributed to societal stigma. These findings highlight the importance of social factors on KAP and mental health among university students during the lockdown, which requires the attention of relevant departments.

Compared to other studies (i.e., 54, 55), our study showed a reduced rate of precautionary behaviors toward COVID-19. Despite having sufficient knowledge, half of students did not adhere to such measures, which was similar to the finding reported by Ferdous et al. (56). Such avoidance can stem from lack of clarity in recommended behavioral measures as well as uncertainty regarding their effectiveness against COVID-19 (57). The percentage of students not adhering to these behaviors was much higher than in some past research (22). One explanation may be the educational gap, which reflects a lack of understanding about public health information. Since our study participants were students, they returned to their homes during

lockdown in areas with limited access to information, particularly in rural areas. In addition, people in low-middle income countries, like Bangladesh, generally have poor personal hygiene practices and are less conscious about their health; for instance, only 40% of people have access to facilities to wash their hands with soap and water (58, 59). These factors might contribute to a lack of understanding of COVID-19 protective measures. Although a good knowledge level on infection transmission was found among the students, there was still opportunity to improve these levels. It is widely accepted that a population that is more informed about the disease would adhere to preventative and treatment measures more effectively (56).

Many surveyed students experienced anxiety, including 52% of males and 48% of females. In the early stage of COVID-19, the prevalence of moderate to severe psychiatric symptoms has been documented in several studies (60–63). Prior to the pandemic, the prevalence rate of anxiety was 4.1%, which is approximately five times lower than the present situation (64). Reasons for the higher rates in our sample could be explained by the large share of students (78%) living with their families; one of the reasons for anxiety comes from the fear of spreading the virus between family members through thyself (65). In addition, over 90% of students experiencing anxiety in our sample used social media, such as Twitter and Facebook to update and get information about COVID-19. Past research has found that indirect exposure to mass trauma *via* the media may result in anxiety disorder (66). A recent study conducted in mainland China discovered that increased exposure to social media increased the risk of experiencing anxiety (67).

Our study found that negative attitudes toward COVID-19 were potential risk factors for developing anxiety during the lockdown. In other words, anxiety was comparatively lower among participants who showed positive attitudes toward COVID-19. According to previous research among college students, scholars denoted that positive attitudes were protective against anxiety (OR = 0.822, 95% CI = 0.762–0.887) (21). They mentioned that if people could increase their confidence in resisting COVID-19, it would be advantageous to their mental wellbeing. Another study indicated that young adults intending to gather information about COVID-19 were less likely to develop anxiety (28). As stated in the literature, certain behaviors and responses vary by age and gender (54). One of the reasons for developing anxiety among university students could relate to their academic disruptions. The lockdown caused considerable disruptions that created learning gaps among many students. Such disruptions may have impacted students' mental health since they were more likely to graduate later than expected (68). To comply with strict precautions, educational institutions had to transfer in-person learning to virtual online classes that created extra burdens among many students (69, 70). Additionally, disruptions in academic activities may have led to uncertainty about future career prospects and therefore increased anxiety (71). Finally, the increasing case counts, lack of proper treatment, absence of available vaccine during the time of this study, media speculation and sensational news could have made students more vulnerable to develop psychological distress during early stage of the COVID-19 pandemic (72–75).

Regarding our stratified analyses, showing negative attitudes was significantly associated with anxiety for males, females, and non-quarantined students. Females indicated stronger effects than males as well. Similar findings were reported elsewhere (21); female students with negative attitudes were more likely to develop anxiety. Usually females are more vulnerable to anxiety and depression because of their social expectations. The situations may be exacerbated during the time of a crisis. An extensive review conducted in 30 countries found a greater prevalence of depression among women (76). Studies have also reported that women are 1.6 times more likely to develop mental disorders than men (77, 78). It is important to mention that women must multitask in household duties while providing caregiving roles. In addition, the closing of educational institutions might have put additional pressures on women. To balance such overloads, women appear to be at particular risk of developing higher disorders (79). When stratified by quarantine status, respondents having negative attitudes and not being in quarantine tended to show higher risks of anxiety. This finding is contrary to an earlier study that showed students in quarantine were more anxious than non-quarantined students (80). This contradictory finding may be explained by the possibility of non-quarantine students being less aware of the impacts of COVID-19 during the early stages of the pandemic. An earlier study (81) reported that two-thirds of student participants had confidence that COVID-19 wouldn't be a problem in Bangladesh. Despite the government holiday, students could not communicate with their friends in person due to COVID-19 restrictions, which would could have triggered depression and anxiety (82). The prolonged lockdown restricted students from going outdoors and having family outings, and forced to students to remain in the house idly. Consequently, students appear to have more provision to internet access, social media and news exposure and missed out on the salutatory benefits of physical activity and exposure to restorative environments (i.e., green spaces) (83). Furthermore, many news outlets prioritized sensational news and people frequently shared false and negative news that may have sparked mental stress among young adults, particularly students (84).

Implications

The findings of this study have theoretical and practical implications. Our study is the first of its kind in Bangladeshi university students to examine associations between KAP levels and anxiety. This study therefore expands our understanding about the roles of knowledge, attitudes, and behavioral practices on the mental health of young adults during the COVID-19 pandemic. Even though our study had some limitations, its findings could be relevant for university authorities and policymakers adopting public health interventions in effective and timely manners. Our study suggests that KAPs required to protect students from COVID-19 during the study period were at only moderate levels. Public health education programs should specific target behavioral practices regarding COVID-19 at universities, given the low levels of this dimension of KAPs in our sample. Such programs can be coordinated the Ministry of Education and Ministry of Health and Family Welfare in collaboration with universities. Also, given our notable finding

that negative attitudes and less knowledge were associated with anxiety, teachers can play an important role in improving mental health through education and reinforcing positive outlooks toward the COVID-19 situation.

While a wealth of data has been collected on student's mental health since March 2020, investigations on the psychological and behavioral consequences of lockdowns should continue to be conducted as the pandemic wanes. Simultaneously, interventions should be introduced at universities to alleviate the negative lingering effects of the pandemic on students. Internet based cognitive therapy (CBT) could be an effective way to treat anxiety that works through stress management and relaxation techniques and is convenient for students to complete. Strategies for public policy could also include greater availability of mental health clinicians and psychosocial support interventions. Ultimately, we hope the behavioral data gathered in the current study might serve as a reference for other COVID-19 researchers working on this important and critical area.

Limitations of the Study

There are some limitations to this research. First, our study was cross-sectional, which was insufficient to explain casual relationships between KAP levels and anxiety. To evaluate these hypothesized causal links, longitudinal investigations may be necessary. Secondly, response biases may have existed in the online and self-reported questionnaires. Without internet connections, respondents could not provide their opinions so our study could not reach these populations. In addition, there could be selection bias due to our use of a non-probability sampling method. Finally, we considered only the early stage of the COVID-19 pandemic, which was a short period of time relative to the entire pandemic. Consequently, our results may not apply to different times of the COVID-19, which means ongoing research should be conducted during the pandemic.

CONCLUSION

This is one of the first studies to examine knowledge, attitudes, and behavioral practices knowledge, attitude, and behavioral practice (KAP) levels toward COVID-19 and associated anxiety levels in university students during the first phase of the pandemic. The results provide insights into KAP levels and anxiety rates at this first phase. More than half of students showed high levels of knowledge and good behavioral practices; however, a significant portion of students also held negative attitudes toward COVID-19. Low knowledge levels and negative attitudes were risk factors for anxiety. Consequently, proactive interventions, such as economic and academic security and social support, might be necessary to encourage positive attitudes and psychological welfare. Social support to reduce social stigma is another recommendation. Simultaneously, authentic information sources should be ensured to expand virus-related knowledge and adopt good behavioral practices. The abovementioned suggestions would ultimately support the psychological wellbeing of university students during the ongoing pandemic.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institute of Disaster Management, Khulna University of Engineering & Technology, Khulna, Bangladesh. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MP: conceptualization, methodology, formal analysis, writing-original draft, review, and editing. AD and MB: conceptualization and writing-original draft. MHa: conceptualization, data curation, and writing-original draft. SB, MHo, MA, MHB, FS, AP, BZ, SaS, JS, and ShS: writing-review and editing. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.856202/full#supplementary-material

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Perceptions of Telemental Health Care Delivery During COVID-19: A Cross-Sectional Study With Providers, February-March 2021

Hattie Wilczewski[1], Samantha R. Paige[1], Triton Ong[1], Janelle F. Barrera[1,2], Hiral Soni[1], Brandon M. Welch[1,3] and Brian E. Bunnell[1,2]*

[1] Doxy.me Research, Doxy.me Inc., Rochester, NY, United States, [2] Department of Psychiatry and Behavioral Neurosciences, University of South Florida, Tampa, FL, United States, [3] Biomedical Informatics Center, Medical University of South Carolina, Charleston, SC, United States

The COVID-19 pandemic accelerated adoption of telemental health (TMH). Providers with limited TMH experience faced challenges during the rapid switch to remote patient care. We investigated TMH providers' perceptions about remote care one year into the pandemic according to *when* providers adopted telemedicine (i.e., before *vs.* after March 2020) and *how much* of their caseloads were served remotely (i.e., $< 50\%$ *vs.* $\geq 50\%$). Between February–March 2021, 472 TMH providers completed a cross-sectional, web-based survey that measured perceived benefits and satisfaction with telemedicine, therapeutic alliance, patient-centered communication, eHealth literacy, multicultural counseling self-efficacy, and facilitating factors of using telemedicine. Providers who began using telemedicine before the pandemic reported having better training, task-related therapeutic alliance with patients, and ability to conduct multicultural interventions, assessments, and session management. Providers who served $\geq 50\%$ of their caseload remotely reported greater satisfaction with their practice, stronger beliefs about the benefits of telemedicine, and greater perceived effects of telemedicine on alleviating the impact of COVID-19. There were no differences in reports of patient-centered communication nor eHealth literacy. In conclusion, providers who adopted TMH more recently may require additional training and support to successfully establish a working alliance with their patients, especially with multicultural aspects of care.

Keywords: telemedicine, telemental health, mental health, quality of care, COVID-19

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****Correspondence:***
Hattie Wilczewski
hattie.wilczewski@doxy.me

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INTRODUCTION

Coronavirus Disease 2019 (COVID-19) ignited a shift in mental health care from in-person to remote delivery. In response to the pandemic, studies estimate over 97% of mental health providers have adopted telemental health (TMH) to supplement or replace in-person care (1, 2). Some mental health providers' caseloads increased by 25–50% during the pandemic with patient surges as high as

Abbreviations: COVID-19, Coronavirus Disease 2019; eHEALS, eHealth Literacy Scale; IRB, Institutional Review Board; MCSE-RD, Multicultural Counseling Self-Efficacy Scale – Racial Diversity; MH, Mental Health; TMH, Telemental Health; US, United States; WAI-SR-T, Working Alliance Inventory - Short Revised – Therapist.

6,558% (1, 3). Telemedicine revolutionized the delivery of evidence-based mental health care (4), and proved to be a dependable solution that 90% of providers surveyed intend to use beyond the resolution of COVID-19 (5). It is imperative to understand how mental health providers deliver remote services to inform and sustain post-pandemic TMH care models.

Mental health providers were highly satisfied with telemedicine before the pandemic, despite its slow uptake (2, 6). High satisfaction and benefits of TMH have been attributed to its convenience, the ability to reach more patients, and the opportunity for a better work-life balance (7). The COVID-19 pandemic led to an abrupt transition from in-person care to TMH for most providers, making TMH less of a choice and more of a requirement to continue practicing (8). In a study conducted during the initial months of the pandemic, mental health providers practicing in the state of Florida believed they were still delivering high-quality care and communicating effectively with their patients despite the transition to TMH care (2). We are now years into the pandemic and it is unknown whether TMH providers remain satisfied with their capacity to conduct high-quality care. The purpose of this study is therefore to further explore perceptions of delivering high-quality healthcare remotely among a nationally representative United States sample of TMH providers.

High-quality healthcare is effective, safe, and equitable and delivered by a provider who clearly communicates and involves patients in health decisions (9). Therapeutic alliance–the relationship and tasks to achieve mutually established health goals–is reliably among the strongest predictors of mental health treatment success, making strategies and tactics for building a strong patient-provider relationship paramount to high-quality care (10–14). Consistent with high-quality care, therapeutic alliance thrives in patient-centered environments where providers elicit the "true" wishes of patients to recognize and respond to their needs and values (15). For in-person healthcare settings, patient-centered communication is commonly described as asking and welcoming questions to understand patients' beliefs and needs to ensure that healthcare is concordant with their values (16). The capacity to practice patient-centered communication requires providers to practice cultural competencies, or multicultural counseling self-efficacy (17). Patient-centeredness is integral to the capacity of providers to recognize and become responsive to the diverse backgrounds of patients and integrate their values into clinical decision-making (18). In TMH settings, patient-centered communication occurs when providers help patients navigate the telemedicine platform, which includes facilitating an environment where they can access, evaluate, and discuss online resources as partners in care (i.e., eHealth literacy) (19). Therapeutic alliance, eHealth literacy, and multicultural competence in a patient-centered environment are vital for success in mental health care, but it is unclear how these indicators of high-quality care have fared throughout the pandemic.

Delivering high-quality TMH care is also attributed to organizational factors that facilitate or support providers in using telemedicine. A recent study found that having strong organizational capabilities, such as sufficient information technology infrastructure, is integral to successful telemedicine adoption in healthcare systems (20). However, healthcare providers must also feel supported in using telemedicine to practice their specialty with fidelity and to effectively provide care to their patients (21). This includes feeling confident that the overarching healthcare system is supportive of telemedicine utilization (e.g., timely reimbursement processes), as well as having enough training or resources available to help them most effectively practice their specialty remotely. Harst et al. (22) found that perceptions of organizational factors which impact telemedicine use has most often been explored among patients rather than providers. This is a significant gap in the literature that our study aims to address.

Telemental health providers' perceptions about the quality of care they provide to patients remotely may vary according to when they adopted telemedicine and how frequently they use it. For example, Zhu et al. (1) found that TMH providers were more comfortable with telemedicine during the pandemic than before it began. Other than this finding, little empirical attention has been paid to examining how the temporal aspects of TMH uptake affect perceptions of TMH care delivery. The decision whether to use telemedicine largely depends on the healthcare provider, making them gatekeepers of telemedicine (23, 24). Therefore, it is imperative to understand how perceptions of TMH care vary according to when it was adopted and the frequency of its use.

The purpose of this study was to investigate TMH providers' perceptions about TMH care delivery during the pandemic. Participants were surveyed about their perceptions of TMH satisfaction, benefits, therapeutic alliance, patient-centered communication, eHealth literacy, cultural competence, and organizational factors that facilitate TMH use. A secondary purpose of the study was to examine how perceptions of TMH care vary depending on when telemedicine was adopted (before or after the onset of COVID-19) and the proportion of caseload served remotely ($<$50% or $\geq$50%). Our investigation occurred in Spring 2021, approximately one year after global leaders announced the COVID-19 pandemic.

MATERIALS AND METHODS

Sample and Procedures

Telemental health providers (N = 472) completed a cross-sectional, web-based survey between February and March 2021. Emails were sent to TMH providers who used the Doxy.me telemedicine platform, sampling from which has shown to be consistent with mental health industry demographics (1, 2, 7, 25, 26). After providing electronic informed consent, providers completed a series of screening questions. English-speaking adults (i.e., $\geq$ 18 years) who identified as practicing mental and/or behavioral health providers were eligible to participate. Providers were compensated with a free 1-month Doxy.me professional membership. Study procedures were approved by the Institutional Review Board of the University of South Florida (IRB#002053).

Survey and Measures

The survey was iteratively developed and refined based on prior studies exploring TMH practice (1, 2, 7). The survey included a variety of items selected from validated scales, questions adapted from validated scales, and novel questions related to TMH practice during COVID-19. See **Table 1** for Cronbach's alpha reliabilities for each measure.

Personal and Professional Characteristics of Telemental Health Providers

We collected demographic (e.g., age, gender, race, ethnicity, rurality) and professional characteristics (e.g., professional title, theoretical orientation, disorders treated, age group primarily treated, change in overhead costs).

Beliefs About the Satisfaction and Benefits of Telemedicine Experience

Perception of providers' satisfaction with telemedicine experience was measured using several items reported in Slone et al. (2). These items were linearly rescaled to create a unidimensional satisfaction measure. Each item was anchored on a 5-point Likert scale from *Extremely Dissatisfied* to *Extremely Satisfied*. Benefits of telemedicine (general) was measured using 3 items anchored on a scale from 1 = *Not at all* to 5 = *Extremely*. Benefits of telemedicine specific to COVID-19 was similarly measured using 3 items anchored on a scale from 1 = *Not at all* to 5 = *Extremely*.

Therapeutic Alliance

Therapeutic alliance with patients *via* telemedicine was captured using the Working Alliance Inventory - Short Revised – Therapist version (WAI-SR-T) (27). This measure consists of three subscales: goals, tasks, and bonds. Responses ranged from 1 = *Seldom* to 5 = *Always*.

Patient-Centered Communication

Patient-centered communication *via* telemedicine was measured with an 11-item instrument. Based on best practices in patient-centered communication (28, 29), we identified four subscales: encourage expression, increase confidence in ability, support patients outside the session, and help patients overcome technology issues. Responses ranged from 1 = *Very difficult* to 5 = *Very easy*.

Electronic Health Literacy

Electronic health (eHealth) literacy was measured based off items from the eHealth Literacy Scale (eHEALS) (30) adapted to fit the therapist perspective. For example, "I know what health resources are available on the internet" was rephrased as "I know what health resources are available on the Internet for my clients." We identified three subscales adapted from a prior eHEALS 3-factor model study (31): information awareness, information seeking, and information evaluation. Responses were anchored on a 5-point Likert scale from 1 = *Strongly disagree* to 5 = *Strongly agree*.

TABLE 1 | Perceptions of care by telemedicine adoption and caseload.

Construct and Measure	Telemedicine Adoption		Telemedicine Caseload	
	<March 2020 M(*SD*)	≥March 2020 M(*SD*)	<50% M(*SD*)	≥50% M(*SD*)
Benefits of Telemedicine				
Satisfaction with Practice (0.86)	4.19 (0.79)	4.15 (0.68)	3.93 (0.86)	4.21 (0.66)**
Protects Against COVID-19 (0.81)	4.49 (0.68)	4.51 (0.70)	4.13 (0.99)	4.59 (0.57)***
Improves Practice (0.70)	3.13 (1.17)	3.02 (1.06)	2.50 (1.08)	3.18 (1.06)***
Therapeutic Alliance				
Goals (0.78)	4.07 (0.65)	3.99 (0.66)	3.92 (0.71)	4.03 (0.64)
Tasks (0.81)	4.22 (0.52)**	4.05 (0.60)	4.07 (0.63)	4.11 (0.57)
Bonds (0.81)	4.49 (0.48)	4.41 (0.50)	4.44 (0.44)	4.44 (0.51)
Patient-Centered Communication				
Encourage Open Communication (0.88)	4.19 (0.85)	4.09 (0.85)	3.97 (0.88)	4.16 (0.83)†
Confidence in Providers' Ability (0.88)	4.34 (0.90)	4.23 (0.78)	4.15 (0.83)	4.29 (0.82)
Support Patients After/Outside of the Session (0.91)	4.06 (0.91)	3.97 (0.82)	3.88 (0.90)	4.03 (0.84)
Improve Comfort with the Technology (0.67)	3.69 (0.94)	3.59 (0.80)	3.47 (0.88)	3.65 (0.83)†
eHealth Literacy				
Information Awareness (0.83)	3.88 (0.84)	3.75 (0.83)	3.73 (0.88)	3.81 (0.82)
Information Seeking (0.81)	3.96 (0.79)	3.84 (0.83)	3.83 (0.82)	3.88 (0.81)
Information Evaluation (0.84)	4.04 (0.90)	3.90 (0.88)	3.93 (0.84)	3.95 (0.90)
Multicultural Counseling Self-Efficacy				
Intervention (0.91)	3.98 (0.61)*	3.85 (0.54)	3.85 (0.56)	3.90 (0.57)
Assessment (0.86)	3.39 (0.86)**	3.11 (0.77)	3.31 (0.75)	3.17 (0.82)
Session Management (0.90)	4.07 (0.55)*	3.92 (0.53)	3.97 (0.52)	3.96 (0.55)
Facilitating Factors				
Feeling supported to practice *via* telemedicine (0.78)	4.00 (0.67)	4.13 (0.76)	4.25 (0.71)*	4.05 (0.75)

*Cronbach's alpha reliabilities are in parentheses next to the construct or measure name. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; †$p < 0.10$.*

Multicultural Counseling Self-Efficacy

Multicultural counseling competence was measured with the Multicultural Counseling Self-Efficacy Scale – Racial Diversity Form (MCSE-RD) (17). The measure focuses on MH providers' confidence in multicultural counseling skills with racially diverse clients, a central aspect of multicultural competence. We measured three subscales: multicultural intervention, multicultural assessment, and multicultural counseling session management. The 60 items in the MCSE-RD were reduced to 22 by consulting two clinical content experts. Criteria for inclusion included eliminating redundancies in scale items and item relevance to TMH practice. Each subscale displayed adequate internal reliability. Responses were anchored on a 5-point Likert scale from 1 = *No confidence at all* to 5 = *Complete confidence*.

Facilitating Factors

Finally, we measured the degree that providers receive organizational support to use telemedicine (e.g., training, resources) using a 4-item measure with response ranging from 1 = *Strongly disagree* to 5 = *Strongly agree*.

Data Analysis

SPSS v28 (IBM Corp.) was used for all analyses. Descriptive and frequency statistics were computed to describe the sample and responses to survey items. A series of χ^2 tests were conducted to examine how demographic factors varied according to our two independent variables (IVs), which included when providers began using telemedicine (0 = before March 2020; 1 = March 2020 or later) and how much of their caseload was served remotely ($0 \leq 50\%$; $1 \geq 50\%$). A series of independent samples *t*-tests were also conducted to examine how perceptions of care quality varied by both IVs. Statistical significance was set at $p < 0.05$.

RESULTS

Table 2 shows that TMH providers in this study were, on average, 53.19 years old (*SD* = 13.16) and predominantly female (81.36%), white (80.51%), and non-Hispanic (91.10%). Most (72.68%) providers lived in a Metropolitan area, with either a moderate or strong urban influence.

Table 3 shows the professional characteristics of the providers. Most identified as mental health counselors (47.46%), psychologists (31.14%), and social workers (14.19%). Nearly three-quarters of providers (75.42%) reported working in an individual practice and 18.43% in a network of providers or a small clinic. Over half of providers primarily treated anxiety and mood related disorders (i.e., anxiety, 43.01%; mood, 21.82%; trauma- and stressor-related disorders, 24.79%), followed the cognitive-behavioral treatment paradigm (54.24%), and served adults (18-64 years old; 83.90%). Private health insurance was the most common form of reimbursement for telemedicine services. About half (45.34%) of providers said their overhead costs (including rent, supplies) had not changed because of providing telehealth services. Over half (67.58%) of providers (n = 319) started using telemedicine March 2020 or later, and 79.66% (n = 376) reported seeing at least 50% of their patients *via* telemedicine. There was no statistically significant association between percent of caseload served *via* telemedicine and whether telemedicine was adopted before or during the pandemic ($p = 0.20$).

TABLE 2 | Personal characteristics of TMH providers (*N* = 472).

Personal Characteristics	*n*	(%)
Age (years), *M (SD)*	53.19	13.16
Sex		
Female	384	81.36
Male	79	16.74
Other	3	0.64
Missing	6	1.27
Race		
White	380	80.51
Black or African American	30	6.36
American Indian/Alaska Native	6	1.27
Asian	8	1.69
Native Hawaiian or Pacific Islander	2	0.42
Multiracial	20	4.24
Other	18	3.81
Missing	8	1.69
Ethnicity		
Hispanic, Latinx, or Spanish origin	37	7.84
Not Hispanic/Latino	430	91.10
Missing	5	1.06

Personal and Professional Characteristics of Telemental Health Providers

Most providers who used telemedicine, regardless of onset, were women; however, the proportion of women who used telemedicine was significantly greater during the COVID-19 pandemic (85.48%) than before it (77.46%), χ^2 (1, N = 459) = 4.48, $p < 0.05$. No other statistically significant relations existed for personal demographics.

Providers who used telemedicine to treat the majority (50% or more) of their caseload were more likely to treat adults (18 + years old) rather than children and adolescents (0-17 years old), χ^2 (1, N = 463) = 11.10, $p < 0.05$. There were no statistically significant differences in changes to overhead costs because of adopting telemedicine technology. However, providers who served less than 50% of their caseload reported that overhead costs "haven't changed" (M = 2.91; SD = 0.60) whereas providers who served more than 50% of their caseload *via* telehealth reported that overhead costs have "decreased some" (M = 2.57; SD = 0.99), t (461) = 3.07, $p < 0.01$. This difference should be noted as having a moderate effect (Cohen's d = 0.42). No other statistically significant relationships existed for professional characteristics and telemedicine use.

Beliefs About the Satisfaction and Benefits of Telemental Health Care

Table 1 includes the responses to general satisfaction of using telemedicine and the benefits (i.e., general to telemedicine and specific to protecting against COVID-19 transmission). Providers

TABLE 3 | Professional characteristics of TMH providers (*N* = 472).

Professional Characteristics	*n*	(%)
Professional Title		
Mental Health Counselor	224	47.46
Psychologist	147	31.14
Social Worker	67	14.19
Marriage and Family Therapist	33	6.99
Missing	1	0.21
Type of Mental Health Practice		
Individual Practice	356	75.42
Small clinic or network of providers	87	18.43
Health organization (i.e., hospital, large clinic, gov't agency)	15	3.18
Educational setting (i.e., school, college, university)	5	1.06
Missing	9	1.91
Primary Age Group Treated		
Children (0-10 yrs old)	13	2.75
Adolescents (11-17 yrs old)	47	9.96
Adults (18-64 yrs old)	396	83.90
Older adults (65 + yrs old)	7	1.48
Missing	9	1.91
Most Common Mental Health Disorder Treated		
Anxiety	203	43.01
Mood	103	21.82
Trauma- and stressor-related	117	24.79
Other	40	8.47
Missing	9	1.91
Primary Treatment Paradigm		
Behavioral	11	2.33
Cognitive-Behavioral	256	54.24
Existential/Humanistic	46	9.75
Family Systems	24	5.08
Interpersonal	61	12.92
Psychodynamic/analytic	61	12.92
Social Learning	4	0.85
Missing	9	1.91
Geographical Region		
Metropolitan/City (Urban center)	110	23.31
Strong urban influence	68	14.41
Moderate urban influence	165	34.96
Weak urban influence	62	13.14
Rural/Small Town (Remote - no urban influence)	62	13.14
Missing	5	1.06
Primary Health Insurance Reimbursement		
Public Insurance (Medicare, Medicaid)	68	14.41
Private Insurance	312	66.10
Client out-of-pocket	83	17.58
Other	9	1.91
Change in Overhead Costs		
Greatly decreased	63	13.35
Decreased some	120	25.42
No change	214	45.34
Increased some	56	11.86
Greatly increased	10	2.12
Missing	9	1.91

reported feeling somewhat satisfied with their TMH practice (M = 4.16; SD = 0.71). They believed that telemedicine services moderately benefitted their practice (M = 3.05; SD = 1.09) but that it had been very-to-extremely beneficial in protecting against the spread of COVID-19 while supporting continuity of care (M = 4.50; SD = 0.69). The timing of telemedicine adoption (before or after March 2020) was not associated with providers' satisfaction using telemedicine or its perceived benefits. However, compared with their counterparts who served fewer patients remotely, providers who served 50% or more of their caseload remotely reported greater satisfaction with their telemedicine practice (M = 4.22 SD = 0.66 vs. M = 3.93 SD = 0.86), t (371) = −3.14; 95% CI = −0.47, −0.11; $p < 0.01$. Providers who served most of their caseload remotely also reported stronger beliefs about the benefits of telemedicine to support their practice (M = 3.18 SD = 1.06 vs. M = 2.50 SD = 1.08), t (421) = −5.50; 95% CI = −0.94, −0.42; $p < 0.001$). They were also more likely to report that telemedicine helped to alleviate the impacts of COVID-19 (M = 4.59 SD = 0.57 vs. M = 4.13 SD = 0.99), t (421) = −5.13; 95% CI = −0.62, −0.20; $p < 0.001$.

Therapeutic Alliance

Table 1 shows that providers reported very often agreeing with their patients on the therapeutic goals (M = 4.01; SD = 0.65) and tasks to achieve those goals (M = 4.10; SD = 0.58) *via* telemedicine. Providers also felt they very often-to-always established a meaningful bond with the patients they served remotely (M = 4.44; SD = 0.50). Compared with providers who started using telemedicine during the pandemic, providers who used telemedicine before the pandemic reported having a greater task-related alliance with their patients (M = 4.22 SD = 0.52 vs. M = 4.05 SD = 0.60), t (357) = 2.62; 95% CI = 0.04, 0.31; $p < 0.01$. There were no other statistically significant differences in therapeutic alliance sub-scores based on when providers began using telemedicine or the proportion of caseload served remotely.

Patient-Centered Communication

Table 1 also shows that providers generally felt that it was somewhat easy to encourage patients to openly communicate *via* telemedicine (M = 4.12; SD = 0.85), to increase patients' confidence in their ability as a healthcare professional (M = 4.26; SD = 0.82), and to stay engaged with them outside the telemedicine session (M = 4.00; SD = 0.85). They reported it was "neither easy nor difficult" to help patients feel more comfortable using telemedicine (M = 3.62; SD = 0.84). There were no statistically significant differences in patient-centered communication based on when providers began using telemedicine or how much of their caseload is served remotely. However, two subscales approached statistical significance based on the percent of patients seen *via* telemedicine; providers who served more than 50% of their caseload remotely felt it was easier to encourage their patients to openly communicate (p = 0.06) and help them feel more comfortable to use telemedicine (p = 0.07).

eHealth Literacy

In **Table 1**, providers somewhat agreed that they were knowledgeable about where to find health information on the Internet to benefit their patients (M = 3.79; SD = 0.83), how

to help their patients find health information on the Internet (M = 3.87; SD = 0.81), and how to help their patients evaluate the quality of health information they find on the Internet (M = 3.94; SD = 0.89). There were no statistically significant differences in online health information awareness, seeking, and evaluation skills according to when providers began using telemedicine and the percentage of caseload they served remotely.

Multicultural Counseling Self-Efficacy

Table 1 includes the responses to providers' multicultural counseling self-efficacy. Providers reported some confidence in their ability to conduct multicultural assessment (M = 3.19; SD = 0.81) and some-to-a lot of confidence in their ability to conduct multicultural interventions (M = 3.89; SD = 0.56) and multicultural counseling session management (M = 3.96; SD = 0.54). Compared to providers who began using telemedicine March 2020 or later, providers who used telemedicine before the COVID-19 pandemic reported a statistically significant higher ability to conduct: (a) multicultural interventions (M = 3.98 SD = 0.61 vs. M = 3.85 SD = 0.54), t (344) = 2.00; 95% CI = 0.00, 0.26; $p < 0.05$, (b) multicultural assessments (M = 3.39 SD = 0.86 vs. M = 3.11 SD = 0.77), t (344) = 3.07; 95% CI = 0.10, 0.47; $p < 0.01$, and (c) multicultural counseling session management (M = 4.07 SD = 0.55 vs. M = 3.92 SD = 0.53), t (344) = 2.35; 95% CI = 0.02, 0.27; $p < 0.05$. There was no statistically significant difference in multicultural counseling self-efficacy based on the percentage of their caseload served remotely.

Facilitating Factors

Table 1 shows that providers somewhat agreed they were adequately trained and supported to provide services *via* telemedicine (M = 4.11; SD = 0.74). This perception was stronger among providers who began using telemedicine before rather than during the COVID-19 pandemic (M = 4.25 SD = 0.71 vs. M = 4.05 SD = 0.75), t (409) = 2.54; 95% CI = 0.05, 0.36; $p < 0.05$. Perceptions about facilitating factors did not vary according to percentage of patients served remotely.

DISCUSSION

The current study aimed to investigate TMH providers' perceptions about remote healthcare delivery one year into the pandemic. A secondary aim was to examine the variability in these perceptions according to when TMH providers adopted telemedicine (i.e., before or during the pandemic) and how much of their caseload was served remotely (i.e., less than 50%; 50% or more). Approximately 80% of providers in this study, regardless of whether they adopted telemedicine before or during the pandemic, reported treating at least half of their patient caseload *via* telemedicine. Findings demonstrate heterogeneity in TMH providers' perceptions of delivering care *via* telemedicine.

Principal Results

Telemental health providers generally reported being satisfied with using telemedicine to deliver care one year into the COVID-19 pandemic. Providers believed that telemedicine was beneficial to their practice and to the safety of themselves and their patients during the COVID-19 pandemic. Positive beliefs were consistent among providers who adopted telemedicine before or during pandemic. However, they were strongest among providers who used telemedicine to treat 50% or more of their caseload. In previous research, TMH providers have cited telemedicine as a convenient and considerably low-cost approach to reach patients who otherwise would not have access to care (7). Although TMH providers were generally satisfied with their telemedicine experience, positive beliefs about using telemedicine to deliver care were cultivated when the technology was regularly integrated into their practice.

TMH providers generally felt confident in their ability to establish a therapeutic alliance with their patients. This is a positive finding, as a therapeutic alliance is an integral component of effective mental health care (14). TMH providers reported establishing treatment goals with their patients, despite the challenges of cultivating task-related alliances. Specifically, TMH providers who began using telemedicine during the pandemic reported the weakest task-oriented alliances with their patients. There are several barriers that may impede the ability of providers to achieve mutual understanding and agreement on exercises to help their patients achieve treatment goals. Some examples include poor internet connection, challenges using devices and software, limited knowledge about how to engage patients remotely, and believing that patients are unreceptive to telemedicine (32). In a study conducted prior to the pandemic (26), TMH providers commonly assigned patients exercises that involved coping and emotional regulation, problem solving, mindfulness, interpersonal skills, and modifying and addressing core beliefs. Future research is needed to examine if and how these exercises are conducted by mental health providers who began using telemedicine during the pandemic. Such inquiry would be useful to inform instructional efforts to help providers new to telemedicine to succeed in cultivating therapeutic alliances.

The strongest therapeutic alliances are cultivated within patient-centered environments, meaning that care is discussed and coordinated with the patients' needs, preferences, and values in mind (18). Telemedicine can challenge the patient-centeredness and therapeutic alliances of healthcare appointments, as self-expression and relational connections among other considerations may manifest differently than in-person appointments (33, 34). As a result, telemedicine has a reputation for being provider-centered, as observational analyses of clinical encounters have found that providers exhibit verbal and information dominance (35, 36). And although there is enthusiasm for telemedicine as a patient-centered healthcare delivery solution (37), a study conducted in the early phases of the pandemic found that disparities in patient-centered communication exist *via* telemedicine (e.g., limited opportunities for open-ended communication and poorly expressed empathy) (38). Future research is needed to capture both patient and provider assessments of therapeutic alliance following telehealth appointments.

There are two important findings related to patient-centered care and communication in this study. First, TMH providers believed it was somewhat easy to encourage their patients to openly communicate about their feelings, values, and needs *via* telemedicine. This positive perception about facilitating open communication was consistent regardless of when providers began using telemedicine and how frequently it is used to serve their caseload. Second, providers also felt it was somewhat easy to help patients feel confident in their abilities as a remote healthcare professional. Patients are more likely to ask for providers to repeat information *via* telemedicine than in-person consultations (35). As a result, providers may perceive patients' expressions of perceptual difficulty as engagement, giving them greater opportunity to exhibit their knowledge about subject matter. Future research examining remote patient-centered communication and investigating its effect on how care is delivered by providers and received by patients is a fruitful area.

Another aspect of patient-centered communication is helping patients feel comfortable receiving and navigating health care. In this study, TMH providers in this study felt it was neither easy nor difficult to help their patients feel comfortable receiving care *via* telemedicine. Further, they felt somewhat knowledgeable about where to find online health information and how to help their patients evaluate its quality to support their health-related goals. Nearly 60% of healthcare providers have shared and recommended online health information to their patients (39), and this proportion is expected to be higher now that the internet has penetrated the daily lives of most people worldwide. Future research is needed to explore what online health information is discussed during telemedicine appointments. Understanding what content is introduced during these appointments and exploring the process by which the information is shared and navigated will inform future interventions to support providers in this endeavor.

To appropriately establish patient-centered care and cultivate therapeutic alliance among racially/ethnically diverse patients, TMH providers must be capable of providing culturally sensitive treatments. TMH providers reported some confidence in their ability to apply multicultural competencies in mental health assessment, intervention, and session management. Multicultural counseling self-efficacy was strongest among providers who reported using telemedicine before the pandemic. This difference may be due to differences in the amount of experience using telemedicine to deliver culturally sensitive care, or perhaps the availability of cultural competence training. Despite a great deal of heterogeneity in workforce cultural competence trainings, common strategies include increasing providers' knowledge and skills to facilitate culturally competent care (40). Future research might focus on patients demographics and include observational studies of multicultural counseling competencies in practice *via* telemedicine. Overall, findings of this study echo the need for training to support TMH providers in serving culturally diverse patient caseloads, especially those residing in medically underserved communities who are disproportionately at-risk for mental health concerns (31).

Although not specific to cultural competence, TMH providers reported being trained and feeling supported by their professional organization in using telemedicine to practice their specialty. Providers who felt supported in using telemedicine were more likely to have started using telemedicine before the pandemic rather than during it. Weaker perceptions of support among novice telemedicine users may be due to the abrupt, and sometimes mandated shifts from in-person to remote care in March 2020. Harst et al. (22) report that positive attitudes toward telemedicine and its acceptability (e.g., perceived usefulness and ease-of-use) are some of the most important predictors for its personal decision to adopt the technology. However, social policies and organizational infrastructure are also important predictors of telemedicine acceptance, and they are also crucial in considering the long-term adoption and sustainability of telemedicine. In this study, we operationalized facilitating factors as providers' beliefs about whether they are supported to use telemedicine and adequately trained and provided resources to practice their specialty remotely. Future research is needed to explore the interpersonal, organizational, and policy-oriented factors that facilitate mental health providers' telemedicine use. Several social and organizational factors have been found to affect providers' adoption of mobile health solutions in their practice (e.g., workflow, patient, policy/regulation, social influence, monetary factors, evidence-base, awareness, and user engagement) (41). Similar research conducted among TMH providers will begin to inform policy and future procedural practices of telemedicine.

Limitations

This study was cross-sectional, and it is limited to a single time-point during the COVID-19 pandemic. Surveillance efforts are needed to monitor TMH providers' perceptions about their delivery of care throughout the remainder of the pandemic and after its resolution. Participant recruitment was limited to users of the Doxy.me telemedicine platform, which may not be representative of all TMH providers or practices. However, participant demographics collected in this study are consistent with those reported in mental health industry statistics (1, 2, 7, 24, 25). Meta-analyses and systematic reviews will be vital to aggregate findings across participant samples and studies. Lastly, these survey data are the product of self-report. Studies in the direct observation of TMH sessions and multicultural care practices will be necessary to understand how providers are adapting to remote care.

Conclusion

Telemental health providers have positive beliefs about telemedicine one year after the pandemic. They felt satisfied and adequately supported in using telemedicine to provide high-quality care to patients. Providers also reported being capable of supporting a remote, patient-centered environment conducive to openly discussing and evaluating online health resources, cultivating therapeutic alliances, and conducting multicultural competent counseling. However, heterogeneity exists in TMH providers' perceptions of healthcare delivery according to *when* they adopted telemedicine in relation to COVID-19 and *how much* of their patient caseload is served remotely. Telemedicine is used now more than ever, and providers who hold positive beliefs

about the technology are using it with most of their caseload. However, novice TMH providers may require additional training and support to successfully establish a working alliance with their patients, especially those who are multicultural.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of South Florida. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors contributed equally to conceptualization, research, and manuscript preparation.

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Conflict of Interest: BW is a shareholder, and all other authors are employees of Doxy.me Inc., a commercial telemedicine company.

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BRIEF RESEARCH REPORT
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Causes of Stress Among Poles and How They Cope With Stress During the COVID-19 Pandemic

Estera Twardowska-Staszek, Krzysztof Biel, Irmina Rostek and Anna Seredyńska*

Institute of Educational Sciences, Jesuit University Ignatianum in Kraków, Kraków, Poland

This study aimed to learn about causes of stress among adult Poles and their ways of dealing with stress during the COVID-19 pandemic. A survey questionnaire was used, as well as two standardized research tools: Endler and Parker's *Coping Inventory for Stressful Situations* (CISS), and Watson and Clark's *Positive and Negative Affect Schedule* (PANAS). The research group comprised 595 people, including 80.5% women. They were 18–75 years old. The most important stress factors were concern for one's health, as well as the current political and economic situation in the country. Most of the participants lean toward avoidance-oriented coping with stress, fewer of them prefer emotion-oriented coping, and the remaining ones focus on task-oriented coping. Task-oriented style is typical of those who are older, married and those who have children. Emotion-oriented coping is more common among women, young people, unmarried people and those without children. Avoidance-oriented style is connected with those who are single, childless, and combining study with work. The most adaptive style of dealing with stress in terms of emotions was task-oriented coping. Psychological support focused on strengthening adaptive strategies of coping with stressful situations is an important task for professionals in the field.

Keywords: COVID-19, coronavirus pandemic, stress, coping strategies, cross-sectional survey

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University of Campania L. Vanvitelli, Italy

****Correspondence:***
Estera Twardowska-Staszek
estera.twardowska-staszek@ignatianum.edu.pl

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INTRODUCTION

The whole world has been struggling with the destructive effects of COVID-19 for 2 years. Since reaching Poland, 5540162 people have become infected and 109792 have died of diseases caused by the virus (1).

The COVID-19 pandemic has created a new reality, difficult to compare with other stressful events involving large groups of people: natural disasters or international mass conflicts (2). It is a stressor that, as psychiatrists assume, will increase the number of people in need of mental health professionals (3). Most research results confirm that the pandemic has contributed to an increase in the level of stress experienced by people as well as an increase in the number of patients suffering from depression and anxiety (4–6).

The pandemic contributed to the experience of stress in two ways. A review of studies shows that fear of COVID-19 was reported by 18.1–45.2% of the general population (7). In addition to the stressor associated directly with infection, there are also several stressors related indirectly to the pandemic, e.g., the general political and economic situation of the country, access to healthcare, individual economic situation, isolation and the lack of social contacts, or simply a fear of an unknown future. The meaning of subsequent factors varies in different countries (8), and may also be related to such variables as race (e.g., 9) or age (e.g., 10).

As a consequence of the experience of stress in various areas of functioning people struggle with various problems, mainly those related to anxiety disorders. According to the research results, stress and post-traumatic disorders especially refer to people who work in health services and their family members (e.g., 11). Also, the pandemic exerted a negative influence on people who had already been suffering from mental disorders (12). Their mental health worsened due to increased fear, isolation and cognitive overload. Negative consequences of COVID-related stressors were also found in general populations. Research carried out on a group of 2,457 Poles has revealed that 77% of them are afraid of contracting a disease, 44% have generalized anxiety disorder, and 86% have felt stressed and nervous within the previous 14 days (13).

Autumn and winter of 2020 was a difficult time in Poland. On October 22, 2020, the Constitutional Tribunal ruled that an abortion is (in most cases) inconsistent with the constitution (14). In response, mass social protests against the tightening of abortion regulations in Poland began. As a result, thousands of citizens participated in protests, which took place almost every day until the end of January 2021. In response, the government took further repressive measures, declaring that assemblies during the pandemic were illegal, which resulted in numerous arrests and sometimes the use of police force against the demonstrators (15). Parallel to the fight for women's rights, the fight against the pandemic took place. In December, the number of deaths from COVID-19 exceeded 11,000, and the government introduced a national quarantine. In addition to the closure of schools and universities, gastronomy, cultural facilities, entertainment, sports, and religious institutions, the government introduced a limit of people who can meet at the family table during Christmas and announced the introduction of a curfew (16).

When coping with stress various strategies appear to have differing effects in preventing or supporting psychological symptoms (17). Taking into account the results of studies showing that high resilient copers constitute the smallest group in some populations (18) we assume that the issue of resilience in the context of coping should be considered. The analyses (19) indicate that resilience is based on a "3C" foundation: control, coherence, and connectedness with others. They are the basis for interventions taken in order to minimize the negative effects of stress inducing events.

The objective of the research was to analyze sources of stress among adult Poles and their ways of coping with stress during the COVID-19 pandemic. Moreover, the research aimed at specifying the relationship between coping styles and positive/negative emotions in the context of their adaptiveness. Therefore, three research questions were formulated:

1. What are the main sources of stress in adult Poles during the second wave of the COVID-19 pandemic?
2. What styles of coping with stress are used by adult Poles during the COVID-19 pandemic?
3. Which style/s of coping with stress is/are related to positive and which to negative emotions?

MATERIALS AND METHODS

Participants

A total of 595 people took part in the research. The research participants had to meet the following two criteria: they were to be permanent residents of Poland and aged at least 18. Participation in the research was voluntary and anonymous.

Procedure

The research was carried out in accordance with all Polish and international ethical standards, and with the consent of Ignatianum University's Research Ethics Committee. The study was carried out with the use of the snowball sampling method in social media. This was an example of *ex post-facto* cross-sectional research, carried out with the use of online survey questionnaires sent through e-mails and social media. The survey was carried out between December 2020 and January 2021.

Measures

The research participants were asked to fill in an online questionnaire. Demographic variables were collected with the use of *ad hoc* questions. The analyzed demographic variables included sex, age, marital status, children, education, and employment. Moreover, the participants were asked about their perception of the sources of stress during the pandemic.

The participants' styles of coping with stress were measured using the *Coping Inventory for Stressful Situations* (CISS) by Endler and Parker (20, 21). The questionnaire includes 48 statements related to various behaviors presented by people who experience stressful situations. The respondent is required to provide the answers on a 5-point Likert scale, declaring the frequency of taking up a given activity in difficult situations (from 1–never, to 5–very often). The results of the questionnaire are presented in the form of three styles of coping with stressful situations: task-oriented coping (TOC), emotion-oriented coping (EOC), and avoidance-oriented coping (AOC). The last of these may take the form of either distraction (D) or social diversion (SD).

In order to measure the participants' emotions, the researcher used the *Positive and Negative Affect Schedule* (PANAS) by Watson and Clark (22, 23). PANAS consists of 20 items–adjectives which denote positive and negative emotions. The participant specifies the intensity of such feelings with the use of a 5-point scale (from 1–very slightly or not at all, to 5–extremely). What we obtain are the results in two sub-scales: Positive (PA) and Negative Affect (NA).

Data Analysis

The analysis was carried out using the R programme, version 4.0.3. (24). The comparison of the values of quantitative variables in two groups was made with the use of the Mann-Whitney test. The comparison of the values of quantitative variables in three and more groups was made with the use of the Kruskal–Wallis test. After discovering statistically significant differences, the *post hoc* analysis utilizing Dunn's test was carried out to identify groups with statistically significant differences. The correlations

between quantitative variables were analyzed with the use of semi-partial correlations. The level of significance was established as 0.05 in the analysis.

RESULTS

Participants

A total of 595 people living in Poland took part in the research. Most participants were women (80.50%). The age range was from 18 to 75 years of age (M = 35.95 years). 20.84% of the people surveyed were under 22; 26.22%–from 23 to 34 years of age; 47.06%–aged 35–60; and 5.88% were over 60. Almost half of the participants were married (49.92%), while 41.34% were single. More than fifty percent of the Poles surveyed declared having children (52.10%). 59.33% participants are university graduates, while 27.90% still study. People with secondary education constituted 10.76% of participants; with vocational education–1.85%; with primary education–0.17%. People who worked constituted 53.78% of participants; 19.16% of participants still studied, while 16.47% studied and worked at the same time. Smaller groups of participants included people who do not work (6.72%), as well as retired employees or pensioners (3.87%).

Sources of Stress

Table 1 shows that the research participants declare that the most common stressors during the pandemic are those related to health (difficulty accessing treatment of other diseases and the possibility of contracting COVID-19 by the closest family and friends-as well as those connected with the current situation in the country, i.e. the political and economic situation in Poland). Interestingly, during the time when the risk of contracting the virus and falling severely ill was greater, only less than one fifth of the participants perceived getting infected with COVID-19 as a source of stress.

TABLE 1 | Source of stress during the pandemic according to the people surveyed.

Which of the following situations are the most stressful to you?	*n*	% *
Difficulty accessing treatment of other diseases	338	56.81%
Political situation in Poland	335	56.30%
My family members may get infected with COVID 19	283	47.56%
Economic situation in the country	279	46.89%
Lack of social contacts	275	46.22%
Online learning	209	35.13%
Restrictions	170	28.57%
Lack of respirators and medical staff in hospitals	154	25.88%
No job or risk of losing a job	137	23.03%
My family's financial problems	120	20.17%
Contracting COVID 19	113	18.99%
Other factors	16	2.69%

**The percentage does not add up to 100, because it was not a multiple choice question.*

Styles of Coping With Stress and Positive and Negative Affect

The research results (**Table 2**) show that the highest scores were obtained by the respondents in the TOC subscale, then in the EOC subscale and finally in the AOC subscale. However, taking into account the norms developed for the tool in the period preceding the pandemic–most participants apply avoidance-oriented coping (high level demonstrated by 39,50%), fewer of them–emotion-oriented coping (high level–37,48%), and still fewer of them use task-oriented style of coping with stress (high level–32,77%).

Likewise, while the raw scores of PANAS do not indicate the advantage of negative over positive emotions, referencing them to norms shows 38.15% had a low level of positive emotions, 31.60% people had a high level of positive emotions, and 30.25% people had a medium level of positive emotions. In the sub-scale of negative emotions, 60% people revealed a high level, 29.08% people revealed a medium level, and 10.92%–a low level (25).

Coping Styles and Demographic Variables

Table 3 shows the correlations between the styles of coping with stress and demographic variables. The variables connected with task-oriented coping (TOC) are older age, being married, having children, living in a big city, university education, and employment. Emotion-oriented coping (EOC) is more common among women, younger people, singles, childless people, those with secondary and lower-level education, including those who still go to school, as well as among people who combine study and work. Avoidance-oriented coping (AOC) is related to being single, having no children and combining study with employment. Distraction is typical of younger people, singles and people without children. Social diversion is the most common among people with a university degree, as well as those who study and work at the same time.

Coping Styles and Emotions

Table 4 refers to the relationship between a coping style and positive/negative emotions. There is a positive correlation

TABLE 2 | Participants' questionnaire means scale scores.

Variables	M	Sd
CISS		
TOC	57,16	8,33
EOC	47,74	11,25
AOC	47,01	8,03
D	21,22	5,11
SD	17,26	3,90
PANAS		
PA	26,22	7,22
NA	22,30	7,53

TOC, task-oriented coping; EOC, emotion-oriented coping; AOC, avoidance-oriented coping; D, distraction; SD, social diversion; PA, positive affect; NA, negative affect.

TABLE 3 | Task-oriented, emotion-oriented, and avoidance-oriented coping and demographic variables.

Demographic Variables		CISS									
		TOC		EOC		AOC		D		SD	
		Me quartiles	*p*	Me quartiles	*p*	Me quartiles	*p*	Me quartiles	*p*	Me quartiles	*p*
Sex	Women (*N* = 479)	57 51–62.5	$p = 0.13$	49 41–57	$p < 0.001$*	47 42–52	$p = 0.803$	21 18–24	$p = 0.71$	18 15–20	$p = 0.09$
	Men (*N* = 116)	59 51.75–63		44 34–51		46.5 43–52		22 18–24.25		17 14–19	
Age	Under 22–A (*N* = 124)	54 49–59	$p < 0.001$* D,C > B > A	56 47–62.25	$p < 0.001$* A > B > C,D	48 42.75–55	$p = 0.054$	22.5 18.75–25	$p = 0.023$* A > C	17 14–20	$p = 0.247$
	23–34 years–B (*N* = 156)	56 51–62		50 42–57		48 43–54		22 18–25		18 16–20	
	35–60 years–C (*N* = 280)	60 54–64		45 38–51		46 41–51		21 17–24		17 15–20	
	Over 60 years–D (*N* = 35)	59 56–65		43 35.5–47		46 44–51		22 18–24.5		18 15–19	
Marital Status	Single–A (*N* = 259)	56 50–61	$p < 0{,}001$* B > A	52 44–59	$p < 0.001$* A > B,C	48 42.5–55	$p = 0.016$* A > B,C	22 18–25	$p = 0.025$* A > B,C	17 15–20	$p = 0.288$
	Married–B (*N* = 297)	59 53–65		45 38–52		46 41–51		21 18–24		17 15–20	
	Others–C (*N* = 39)	57 56.5–60		43 36–51.5		46 42–49.5		22 16–23.5		17 14–18.5	
Children	No (*N* = 285)	56 50–60	$p < 0.001$*	52 43–59	$p < 0.001$*	48 43–54	$p = 0.025$*	22 18–25	$p = 0.005$*	17 15–20	$p = 0.934$
	Yes (*N* = 310)	60 53–65		44 38–51		46 41–51		21 17–24		17 14.25–20	
Education	Higher–A (*N* = 353)	60 54–64	$p < 0.001$* A > B,C	46 38–52	$p < 0.001$* C > A,B	47 42–51	$p = 0.394$	21 17–24	$p = 0.001$* B,C > A	18 15–20	$p = 0.002$* A > C,B
	Secondary–B (*N* = 64)	56 48.75–60.25		46 34.75–53.25		46 44–52		23.5 18–26		17 14–19	
	Other–C (*N* = 178)	54 49–59		55 45.25–61		48 42–53		22 18–25		17 14–20	
Employment	Student–A (*N* = 114)	54 49–59	$p < 0.001$* B > C,D,A	55.5 46–61	$p < 0.001$* A,D > C > B	47 39.25–53	$p = 0.016$* D > B,A	21.5 18–25	$p = 0.059$	17 13–19	$p = 0.005$* D > C,A B > A
	Employed–B (*N* = 320)	60 54–64		44 37–51		46 42–51		21 17.75–24		18 15–20	
	Not employed–C (*N* = 63)	68 49.5–61		47 40–54		47 42–51		21 18–25		17 14.5–19.5	
	Employed student–D (*N* = 98)	55 50–60.75		54 47–59.75		49 45–55		22 19.25–25		18 16–20	

**Statistically significant relationship ($p < 0.05$), TOC, task-oriented coping; EOC, emotion-oriented coping; AOC, avoidance-oriented coping; D, distraction; SD, social diversion.*

TABLE 4 | Semi-partial correlations between CISS and PANAS.

PANAS	TOC	EOC	AOC	D	SD
PA	0,292, $p < 0{,}001$*	−0,41, $p < 0{,}001$*	0,032, $p = 0{,}433$	−0,041, $p = 0{,}321$	0,044, $p = 0{,}283$
NA	0,045, $p = 0{,}276$	0,517, $p < 0{,}001$*	−0,026, $p = 0{,}526$	0,023, $p = 0{,}578$	0,005, $p = 0{,}897$

**Statistically significant relationship ($p < 0.05$), TOC, task-oriented coping; EOC, emotion-oriented coping; AOC, avoidance-oriented coping; D, distraction; SD, social diversion; PA, positive affect; NA, negative affect.*

between TOC and positive emotions. EOC correlates positively with negative emotions and negatively with positive emotions. There are no statistically significant relationships between AOC and emotions.

DISCUSSION

The research shows some specific features of the way in which Poles have experienced the pandemic. For most of the research participants, the threat of contracting SARS-CoV-2 is not the greatest source of stress. What they fear the most is the fact that treatment of other diseases is less available during the pandemic and that the health of their closest family members may be affected. The pandemic has clearly shown that the Polish health service is ill-equipped to deal with the direct and indirect consequences of a health crisis. The results of our research confirm that the country's political and economic situation is a significant stressor for Poles. The feeling of being betrayed and abandoned by state institutions correlates with negative emotions (26).

The research results seem to correlate with the data that suggest the adaptive importance of "3C" (control, coherence, and connection) in coping with pandemic stress (27).

Task-oriented coping is related to controlling the surrounding reality and re-formulating the assessment of the situation from threat into challenge. In the context of the pandemic, it may be reflected in taking up tasks reducing the threat of contracting the virus, as well as planning everyday activities, searching for reliable information about the virus, etc. This style of coping has a positive correlation with positive emotions. Complementary results were obtained by Italian researchers who concluded that a sense of self-effectiveness and focusing on a problem strengthen our ability to manage negative emotions (28). This coping style is typical of older people, people who are married, people with children, and employed people, all of which are connected with a more stable lifestyle and responsibility for others.

Coherence, which provides meaning to what is happening, relates to recognizing, naming and accepting emotions that accompany difficult events. Emotion-oriented coping, the essence of which is focusing on one's own feelings, yet combined with taking up actions that aim at releasing emotional tension, seems to be a non-adaptive solution as it negatively correlates with positive emotions and has a positive correlation with negative emotions Similar conclusion were brought by the research indicating a strong correlation between emotional style and depression (17). This coping style is more frequent among younger people, people without children and those with lower levels of education.

Many studies show that connecting with others, remaining in meaningful relationships, perceived social support, has a positive effect on psychological wellbeing (29). At first, analyzing simple correlations between emotions and styles of coping, we found a relationship between social diversion and positive emotions ($r = 0.26$; $p < 0.001$). However, more advanced analyzes did not confirm the existence of such a relationship. Thus, although immersion into the world of social relations may have a salutary effect on psychological wellbeing, several studies (30) show that this effect may be quite opposite. The ambiguity of the obtained results prompts to conduct further research.

The recommendations formulated by the Polish Psychiatric Association (31) indicate the need to pay attention to groups particularly vulnerable to the negative consequences of a pandemic experience: people with pre-pandemic mental disorders history, but also elderly and very young people who do not have enough resources to cope with completely new challenges. Adaptive styles of coping with stress seem to be one of the most important resources in this context. An important task for educators and mental health professionals is to promote and strengthen their use. It may contribute not only to the improvement of the functioning of individuals, but also to the economic recovery of countries (32).

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Ethics Committee of Jesuit University Ignatianum in Kraków. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

ET-S contributed to all the phases of the study, conception and design of the study, results interpretation, and writing and editing of the manuscript. IR contributed to results interpretation, and writing and editing of the manuscript. KB and AS contributed to writing and editing of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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Latent Profile Analysis to Survey Positive Mental Health and Well-Being: A Pilot Investigation Insight Tunisian Facebook Users

Noomen Guelmami[1,2,3], *Amayra Tannoubi*[1,2,3,4], *Nasr Chalghaf*[1,2,4], *Mouna Saidane*[3], *Jude Kong*[5], *Luca Puce*[6], *Azaiez Fairouz*[1,2,4], *Nicola Luigi Bragazzi*[1,6,7]* *and Roobaea Alroobaea*[8]

[1] *Postgraduate School of Public Health, Department of Health Sciences (DISSAL), University of Genoa, Genoa, Italy,* [2] *Group for the Study of Development and Social Environment (GEDES), Faculty of Human and Social Science of Tunis, Tunis, Tunisia,* [3] *Department of Human and Social Sciences, Higher Institute of Sport and Physical Education of Kef, University of Jendouba, Jendouba, Tunisia,* [4] *Department of Human Sciences, Higher Institute of Sport and Physical Education of Sfax, University of Sfax, Sfax, Tunisia,* [5] *Department of Neuroscience, University of Genoa, Genoa, Italy,* [6] *Laboratory for Industrial and Applied Mathematics (LIAM), York University, Toronto, ON, Canada,* [7] *Department of Mathematics and Statistics, York University, Toronto, ON, Canada,* [8] *Department of Computer Science, College of Computers and Information Technology, Taif University, Taif, Saudi Arabia*

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***Correspondence:**
Nicola Luigi Bragazzi
robertobragazzi@gmail.com

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Background: To examine mental health during COVID-19 peaks, lockdown, and times of curfew, many studies have used the LPA/LCA person-centered approach to uncover and explore unobserved groups. However, the majority of research has focused only on negative psychological concepts to explain mental health. In this paper, we take another perspective to explore mental health. In addition, the study focuses on a period of peak decline in the COVID-19 pandemic.

Objective: The present paper aim (a) empirically identifies different profiles among a cohort of Facebook users in Tunisia based on positive factors of mental health using a person-centered approach, (b) outline identified profiles across sociodemographic, internet use, and physical activity, and (c) establish predictors of these profiles.

Methods: Cross-sectional data were collected through an online survey among 950 Facebook users were female (n = 499; 52.53%) and male (n = 451; 47.47) with an average age =31.30 ± 9.42. Subjects filled *Arabic version of Satisfaction with Life Scale, Scale of Happiness (SWLS), Gratitude Questionnaire (GQ-6), International Physical Activity Questionnaire (IPAQ), and the Spirituel Well-Being Scale (SWBS).*

Results: The LPA results revealed three clusters. The first cluster (n = 489, 51,47%) contains individuals who have low scores on the positive psychology scales. The second cluster (n = 357, 37,58%) contained individuals with moderate positive psychology scores. However, a third cluster (n = 104, 10,95%) had high positive psychology scores. The selected variables in the model were put to a comparison test to ensure that the classification solution was adequate. Subsequently, the clusters were compared for the variables of socio-demographics, use of the internet for entertainment and physical activity, the results showed significant differences for gender (low mental well-being for the female gender), socio-economic level (low for the low-income class), and physical activity (low mental well-being for the non-exerciser). However, no significant differences were found for the variables age, location, and use of the Internet for entertainment.

Conclusion: Our results complement person-centered studies (LPA/LCA) related to the COVID-19 pandemic and can serve researchers and mental health practitioners in both diagnostic and intervention phases for the public. In addition, the GQ6 scale is a valid and reliable tool that can be administered to measure gratitude for culturally similar populations.

Keywords: latent profile, survey, positive psychology, mental health, COVID-19, Facebook

INTRODUCTION

After the first case of the infectious disease COVID-19, discovered in Wuhan, China (December 2019) and the spread of a strain with many symptoms and causing high prevalence of hospitalization and/or death worldwide (1), unprecedented health emergency was imposed in several countries and a majority of public sectors were dramatically affected. In response to this health emergency, COVID-19 disease was declared as a pandemic labeled as "Public Health Emergency of International Concern (PHEIC)", the World Health Organization (WHO) and Centers for Disease Control (CDC) began to respond to COVID-19 and its severe impact. Research in this context suggested that COVID-19 have been linked to several of the most significant health, social and economic troubles of the twenty-first century and 250 million people have tested positive for the virus since it began to spread in December 2019, and more than 5 million individuals have perished. Indeed, WHO has been found to have a broad range of physical health challenges and human behavior changes such as sedentary lifestyles, decreased physical activity, insomnia, mental health, disinformation, misinformation spread on the web and social networks, and problematic internet uses (2–4). Furthermore, fear of infection, frustration and boredom, lack of supplies, worry of hospital overcrowding, and financial loss all contribute to the widespread emotional discomfort and increased risk of mental disorders associated with COVID-19 (5, 6), for example, more than a quarter of the Chinese society reported some degree of psychological distress during the first wave of COVID-19 (7). Similarly, other disorders were revealed after the onset of symptoms such as fever, tiredness, and prolonged dry coughs (8), as were social avoidance, anxiety, concern of illness, and global panic (9). Likewise, security guidelines have forced governments to take precautions that ensure physical distancing and self-isolation, such as closing schools, universities, recreational parks, quarantine and firewalls (10, 11). These measures have influenced the quality of life of the majority of people and have resulted in a systematic negative impact on public mental health (12). Several studies have reported unusual and alarming levels of stress, anxiety and depression (13). There has also been an increase in loneliness, self-harm, and suicidal thoughts (14, 15). While high mortality rates have been noted among vulnerable groups (the elderly, obese, diabetics, hypertensive, etc…), the negative effects of the pandemic of the general public's mental health and wellness challenges have been published and well documented in different populations through online collected data (16–18). The majority of studies have agreed that the pandemic has a devastating strategic effect on the deterioration of the health care system which has already been observed in several countries (19–23). However, studies in human psychology and public health in the pandemic context have focused primarily on mental disorders [for example, (13, 24, 25)].

Little research has ranked individuals based on their positive mental health (26). Despite the role of positive psychology factors in the prevention of mental health problems (27), a recent meta-analysis involving internet users reported a trend toward negative mental health parameters such as depression, anxiety, suicidal ideation, fear and stress (28).

Moreover, most of these studies have not given importance to the social and religious context. In fact, religious involvement has been identified as protective factors for mental health (29, 30) and stimulating the positive psychology factors. As an example, spiritual well-being has been highlighted as a key element of social resilience during times of crisis (31, 32). Also, gratitude as a highly valued moral affect in religions (33, 34), was associated with psychological well-being and satisfaction with life (35).

During the COVID-19 pandemic, two mixture modeling techniques have been widely used to segment groups based on several psychological concepts of mental health. The first is Latent Class Analysis (LCA) which deals with qualitative variables, and the second is Latent Profile Analysis (LPA) which deals with continuous variables (36). Latent Profile Analysis (LPA) is a flexible, model-based clustering procedure that supports the probabilistic identification of mental health subgroups. Using this technique, several mental health clusters have been identified for the general population in different countries based on psychopathological symptoms (e.g., stress, anxiety, and depression). But to our knowledge, no study has applied this procedure to class cohorts among positive psychological.

Due to the spread of health-related misinformation and disinformation on social media in problematic ways (37, 38), it is very interesting to target vulnerable groups like Facebook users. Indeed, the massive dissemination of disinformation on the web and social media platforms negatively effects on mental health [see for example: (38)]. In addition, phenomena of Internet addiction have been reported (39). Tunisia can be a favorable geographical space for these problems. The pandemic in this country was associated with high mortality rates (40, 41), behavioral changes (42) and mental health problems (43). Correspondingly, serious internet addiction problems have been reported (41). Furthermore, the country had 6.5 million Facebook users as of January 2020, which is equivalent to 55 percent of the country's total population. As an example,

in pandemic, Sediri et al. (44) found that adult Tunisian women were suffering from severe depression, anxiety, and stress symptoms. Women's use of social media was found to be problematic in ∼40% of cases.

Therefore, the objectives of this study are: (a) empirically identifying, from positive factors of mental health, different profiles among a cohort of Facebook users in Tunisia based on person-centered approach, (b) to outline identified profiles, across the sociodemographic, internet use and physical activity and (c) establish predictors of these profiles.

METHODS

Data Collection and Procedures

Cross-sectional data were collected through a survey designed online using the Google Forms application from October 04 to 28, 2021. We used a snowball sampling method to collect information from Tunisian Facebook users to circulate the questionnaire and involve the maximum number of target people. This method is increasingly applied in studies involving social network users (45, 46). Initially, invitations to fill in an informed consent by specific Google Gmail accounts were distributed on several groups of the social network Facebook. Subsequently, the respondents invited their friends to complete the survey. This procedure makes it possible to create a specific ballot box, in order to be able to control multiple responses. We used this environment based on the Google application's Cloud Computing system which allows for a single response per user. However, the use of this algorithm requires having a Google E-mail address and prohibits access to Internet Protocol (IP) addresses of users for reasons of confidentiality, privacy and security. In the response form, no personal information was obtained (e.g., names, home addresses, email addresses, and phone numbers). While the study follows the Recommended Standards for Conducting and Reporting Online Surveys "CHERRIES" (47).

The inclusion criteria concern each Facebook user aged 18 and over, residing in Tunisia and whose mother tongue is Arabic. However, subjects who do not reside in the country are excluded from the study to maintain the same social and cultural context at the time of the survey.

The study was approved by the local ethics committee of the Institute of Sport and Physical Education of Kef, Jendouba University in Tunisia.

According to Weber et al. (48) the number of Facebook users in Tunisia was 6.5 million. We used Raosoft online sample size calculator (49) and formulas to define subjects needs for this online survey. The method of sampling used in similar previous studies suggested a sample size of 664 as a minimal appropriate participant by assuming a 66% percent response rate, 5% precision or margin of error, and 50% proportion with a 99% confidence interval.

The number of questionnaires was 1,023 regular internet users. We used Mahalanobis distance to eliminate the questionnaires with outlets responses for example random responses and psychological problematic cases ($n = 73$), 950 copies of the measurement instrument were retained. While 8.11% ($n = 77$) of these participants reported having been ill with coronavirus at some point during the pandemic. Participants were female ($n = 499$; 52.53%) and male ($n = 451$; 47.47%) with an average age $=31.30 \pm 9.42$ years. All subjects were of Muslim religion and had permanent access to the internet.

The details of the socio-demographics of the participants and their distributions according to the variables are presented in **Table 2**.

INSTRUMENTS

Sociodemographic Questionnaire

The information solicited on the socio-demographic variables was of age, gender, nationality, country of residence, religion, education level was binary coded (0 < higher; 1 = higher), their residence status (0 < rural; 1 = urban), family income (coded low; medium and high). In addition, access to the internet and its use as a means of entertainment was binary coded (0 = no; 1 = yes).

Arabic Satisfaction With Life Scale [ASWLS]

Among the primary measures of interest in this study was the Satisfaction of Life Scale (SWLS) (50, 51). According to Google Scholar statistics from November 2021, this scale was mentioned in 32,791 papers. This statistic alone demonstrates the magnitude of its impact on the world of study (52). A five-item Likert-type scale has excellent psychometric qualities in terms of both reliability and validity. In terms of reliability, its internal consistency often runs between 0.79 and 0.89, and its rank in item-total correlations typically ranges between 0.51 and 0.80 (53). Indices have been observed to oscillate between 0.83 for 1-month intervals (54), 0.83 for 2-month periods (51), and 0.54 for 4-year periods (53). Regarding the factorial invariance, distinctions in sex or age are seldom seen.

Arabic Scale of Happiness [ASH]

In Arabic context, there are just a few happiness measures. The scale of happiness included 15 short statements as well as five-filler items. Each item was graded on a five-point scale of intensity. The overall score can vary between 15 and 75, with higher numbers indicating greater satisfaction. The results of a primary axis factor analysis, followed by oblique rotation (pattern and structural matrices), provided two factors: general happiness and successful life. Correlations between items and the remainder of the exam varied from 0.42 to 0.77. Internal consistency and temporal stability were shown by Cronbach's alphas and test-retest reliability ranging from 0.82 to 0.94. The Arabic Scale of Happiness (55) had statistically significant correlations with mental health, life satisfaction, optimism, love of life, and self-esteem, demonstrating construct validity (55). Male college and high school students scored higher than their female counterparts did on average. Male and female undergraduates scored higher than their teenage counterparts did on average. The Arabic Scale of Happiness was shown to have strong psychometric qualities. For the present study, we use an average of the total score of the instrument.

Gratitude Questionnaire [GQ-6]

The GQ-6 is a six-item questionnaire designed to assess the dispositional element of gratitude (56). Each item is graded on a seven-point scale ranging from one (strongly disagree) to seven (strongly agree). A simple item is "I have so much to be thankful for". After reversing pertinent items, the scale scores are the total of the items. The scale's higher scores indicate a stronger sense of gratitude. The scale was translated into Arabic using a forward-backward translation process for the purposes of this study. The GQ-6 has strong psychometric qualities in the original article, with a solid one-factor solution and high internal consistency. The internal consistency reliability of the six-item scale, measured by the Cronbach's alpha, was 0.82.

The International Physical Activity Questionnaire (IPAQ)

IPAQ have two available versions: long (five activity domains asked separately) and short (four general items), which may be used through telephone or self-administered techniques. The surveys' goal is to provide standardized instruments that may be used to collect data on health-related physical activity that can be compared across borders. The development of an international physical activity measure began in Geneva in 1998, and extensive reliability and validity testing was carried out across 12 nations (14 locations) in 2000. The final findings indicate that these measures have acceptable measuring qualities for applications in a variety of countries and languages, and that they are appropriate for national population-based prevalence investigations of physical activity participation (57).

In the present study, the Arabic version of the (IPAQ-S) was used. The scale exhibits robust psychometric properties in terms of reliability and validity (58).

The Arabic Version of the Spiritual Well-Being Scale [SWBS]

The Spiritual Well-Being Scale (SWBS) was developed over 30 years ago (59, 60) and has since become a widely used and well-researched tool (61). Despite the fact that the SWBS was initially established in a Christian context and influenced by the Judeo-Christian idea of well-being, Ellison (59) claimed that it is a nonsectarian tool that may be used by other religions that have a personal experience of God. As a result, the SWBS was produced to be extensively used to assess spiritual well-being in religious and unreligious people, as well as people of other religions and cultures.

The SWBS is a self-report paper–pencil instrument with 20 items. It takes 10–15 min to finish. On a six-point Likert scale, ranging from strongly agree to strongly disagree, each item is answered. The RWB and EWB subscales are the two subscales of the SWBS. Ten items are intended to assess RWB and include the term "God," whereas ten items assess EWB and include questions on life fulfillment and direction. To reduce any potential response bias, around half of the items are written in the other manner. Each SWBS item is scored on a scale of one to six, with a higher number indicating greater well-being. Negatively worded items are recorded in the reverse way.

The SWBS and its subscales have great internal consistency, according to the reliability results. Cronbach's alpha scores for the SWBS climbed from 0.66 to 0.85. Cronbach's alpha values for the Arabic SWBS (62) and its subscales (RWB and EWB) were similar to those of other studies with varied samples using the original English version of the SWBS (59, 63, 64), who demonstrated that the SWBS has good internal consistency and reliability consistency. Overall, the SWBS and its subscales are valid and reliable measures that may be used with the population in the Arabic Islamic culture.

Statistical Analysis

Statistical analyses and confirmatory factor analyses were performed using SPSS Version 26.0.0.0 (IBM, USA) and SPSS Amos software Version 23.0.0.0 (IBM, USA) respectively. While the Mclust and Tidy LPA R Studio packages have been adopted for LPA.

The preliminary data analysis was performed by Skewness and Kurtosis normality tests. First, scores for the adapted scale GQ6 were undergone exploratory factor analysis, which performed by the Unweighted Least Squares method with Promax rotation and Kaiser-Mayer-Oklins (KMO) normalization. We retained solutions for KMO $>$ 0.60, Eigenvalue $>$ 1 and a significant Bartlett test (Chi2). The GS6 structure was inspected by confirmatory factor analysis (CFA). Several adjustment indexes of the CFA were retained to examine the model: (1), (2) Goodness of Fit Index GFI. (3) Adjusted Goodness of Fit Index AGFI; (4) Comparative Fit Index (CFI); (5) the Tucker-Lewis index (TLI); (6) Root mean square residual (RMR) and (7) the Root Mean Square Error of Approximation (RMSEA). The $\chi 2$ must not be significant; however, this criterion is very criticized on large samples. While $\chi 2$/DF (DF = degrees of freedom) is widely used and must be less to 2 or superior to 5. According to the recommendations of Hu and Bentler (65), the GFI and AGFI must have values $>$0.90 to accept the model. TLI and CFI values $>$0.95 represent a good fit for the model. The RMSEA should be $<$0.06 for good model fit and $<$0.08 for acceptable model fit (65, 66).

The reliability of all positive psychology scales was achieved by calculating the internal consistency Cronbach's α coefficient. The recommended threshold for the indices is 0.70 to accept it and 0.80 for good reliability.

LPA were used to classify individuals (clusters) with similar characteristics in the various psychological tests performed. This approach is a well-known mixture-model for identifying homogenous latent classes or subgroups within a large heterogeneous group.

In this procedure, four Tidy LPA models (with 2, 3 and 4 classes) were investigated successively: model 1 (Varying means, equal variances, and covariances fixed to 0), model 2 (varying means, equal variances, and equal covariances), model 3 (Varying means, varying variances, and covariances fixed to 0) and model 6 (Varying means, varying variances, and varying covariances). Before analysis, a robust variant of the Mahalanobis distance based on the minimum covariance determinant was considered to detect and delete multivariate outliers.

TABLE 1 | Latent profile fit statistics for attribute preference model with four models and five profiles.

Model	Classes	AIC	BIC	Entropy	prob_min	prob_max	BLRT_p
1	2	10,188.05	10,280.32	0.94	0.98	0.99	0.01
1	3	8,638.08	8,764.35	0.94	0.96	0.98	0.01
1	4	8,051.22	8,211.48	0.90	0.91	0.99	0.01
2	2	9,960.84	10,082.26	0.92	0.97	0.98	0.01
2	3	8,570.54	8,755.09	0.94	0.96	0.98	0.01
2	4	7,884.34	8,132.02	0.92	0.92	0.98	0.01
3	2	7,590.89	7,756.01	0.76	0.90	0.95	0.01
3	**3**	**7,414.30**	**7,613.42**	**0.83**	**0.90**	**0.94**	**0.01**
3	4	7,376.37	7,609.48	0.75	0.75	0.95	0.01
6	2	7,371.83	7,638.94	0.70	0.90	0.92	0.01
6	3	7,225.43	7,628.51	0.80	0.90	0.92	0.01
6	4	7,099.44	7,638.50	0.72	0.78	0.95	0.01

Bold values: retained model.

The fit of the latent profile model is assessed using a variety of statistical measures. (1) Bayesian information criterion [BIC; (67)]. According to several studies (68, 69), this is the most reliable indication of model fit. The BIC encourages models to be as simple as possible, and it can be used to compare competing LPA solutions. BICs with a lower value suggest a better fit. (2) Akaike's information criterion was being studied (AIC). Similarly, a significant value of the bootstrap likelihood ratio test (BLRT) was also considered in selecting the number of classes. (3) The BLRT uses a Bootstrap resampling method to approximate the *p*-value of the generalized likelihood ratio test. (4) Entropy values that are equal to or >0.80 are associated with 90% accurate assignment accuracy, while entropy values of 0.64 and below are associated with high classification error rates.

The comparison between the clusters on all the variables of the LPA model was carried out by the Multivariate analysis of covariance (MANCOVA).

The comparison between clusters of each continuous variable was performed by one-way variance analyses with Bonferroni post-hoc test. In addition, Effect size (Eta Squared) was examined for each comparison. While categorical variables comparisons were made by Chi2 tests with Cramer's *V* effect size.

Completely, gender, family income, academic level, dwelling, and physical activity practice were used in a multinomial logistic regression analysis (with age as a Covariate) to see whether factors had a significant impact on positive mental health outcomes.

RESULTS

At first, the data was visually inspected to make sure that there were no anomalies in the cases, then the skewness and kurtosis coefficients. Scale scores did not present any problems of normality (see **Table 1**).

Before entering the scores of the scales in the LPA model, we carried out a psychometric examination for the GQ-6 since the scale has not been validated on an Arab population. In addition, a check of the internal consistency of the factors of the other scales was carried out to ensure that our data are adequate for the analysis.

We psychometrically tested the adapted version of GQ-6 through exploratory factor analysis, examination of its reliability through Cronbach's alpha internal consistency measure and confirmatory factor analysis.

The Kaiser-Meyer-Olkin index for the sampling quality measure was 0.90 with Bartlett Chi-square = (2,799.70, ddl = 15; $p < 0.01$) sphericity test value. The univariate one-factor model explained 64.31% of the total variance (Eigen value = 3.86).

The results of the confirmatory factor analysis provided a Chi2 value = 46.86 (ddl = 12; $p < 0.01$) with indices (AGFI = 0.96; GFI = 0.98), (CFI = 0.99; TLI = 0.98 and for the measurement error RMR = 0.03; RMSE = 0.067 90 % CI [0.049–0.086].

Subsequently the reliability of the other scales was examined by the same internal consistency coefficients. The results confirmed the reliability of the measurement scales. Indeed, for GQ-6, the coefficient alpha was 0.89 (95%CI [0.88–0.90]).

For spiritual well-being scale alpha = 0.86 (95%CI [0.85–0.088]) and 0.87 (95%CI [0.86–0.088]) for SWB and EWB, respectively.

Similarly, alpha values were = 0.88 (95%CI [0.87–0.90]), alpha = 0.85 (95%CI [0.84–0.86]), alpha = 0.88 (95%CI [0.87–0.90]) For SWLS, AHS and FS.

All four models were examined for 2- to 4-class solutions. The lowest Aic and BIC values were highlighted for model 3 (Aic = 7,414.30; Bic = 7,613.42) and model 6(Aic = 7,225.43; Bic = 7,628.5). Examination of these two indices gives us results that are favorable to the three-class model 6, since the two entropies for 4 clusters are 0.75 (model 3) and 0.72 (model 6), respectively. Also, the posterior probabilities of cluster membership for affected individuals are in the range [0.90–0.94] and exceeded a minimum threshold of 0.70.

The model fit indices from the latent profile analysis are presented in **Table 1**. Among the four models tested, the model, which presents the most values of Aic and Bic and an adequate entropy, is model 3.

To ensure the robustness of the solution, an analysis of variance tests with the scores of the five scales was performed. On all the scales, very significant differences were demonstrated ($p < 0.001$). In addition, the Bonferroni Post-Hoc test showed that cluster 3 has the highest scores on all positive psychology scales, cluster 2 has the moderate scores and cluster 1 has the lowest scores (see **Figure 1**).

As shown in **Table 2**, the first cluster is formed by 59% women, 40.90% men with a mean age of 31.07 ± 9.46. This group is divided into 37.63% with low family income, 40.08% with middle income and 22.29% with high family income. The academic background of this group of people was mostly higher education (62.78%) and almost 37% reported that reported that they use Internet as entertainment medium. According to the practice of physical activity, the distribution of individuals was low (37.83%), average (39.06%) and vigorous (23.11%).

While the second cluster is composed of 48.74% women and 51.26% men with a mean age of 31.10 ± 9.08. This cluster is subdivided for the family income variable: into low (26.33%), medium (48.18%) and high (41.35%). Nearly 61% of this group

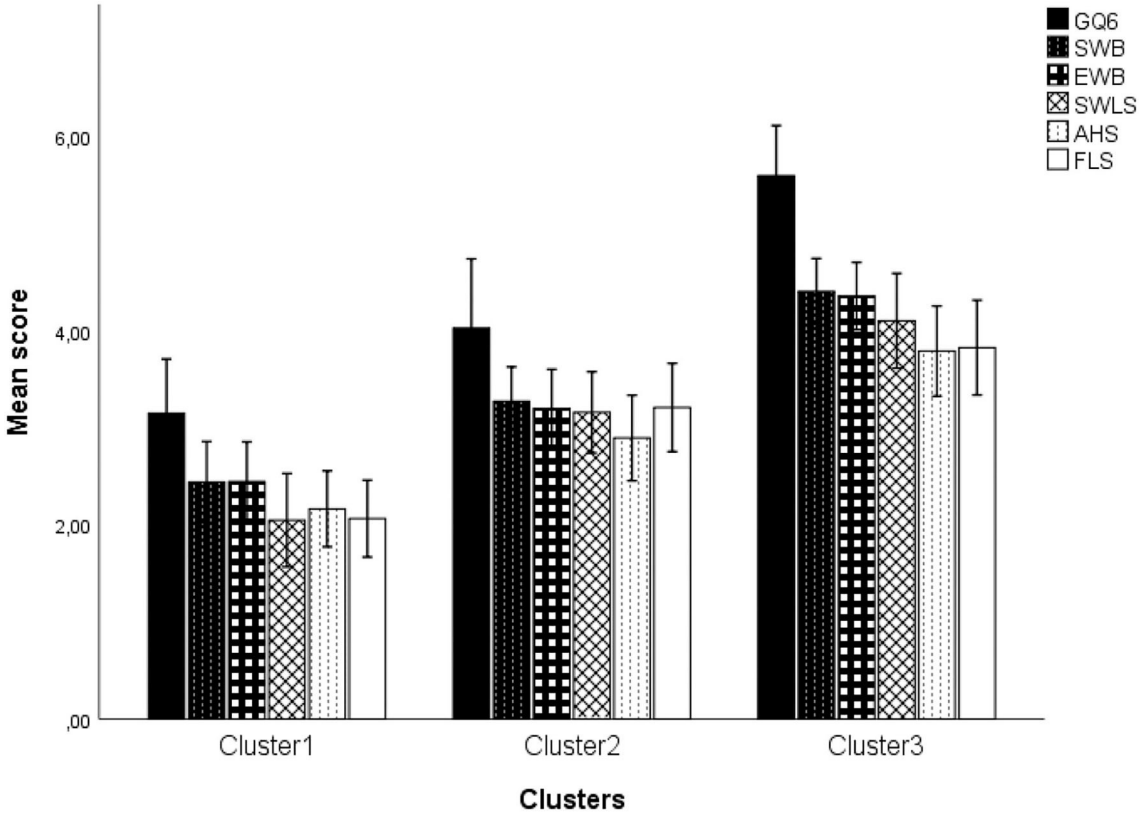

FIGURE 1 | Distribution of the mean scores of scales according to the cluster.

had higher education. In addition, 31.93% of the individuals reported that they use Internet as entertainment medium. The examination of physical activity in this group showed the following results: 35.01% are physically inactive, 40.90% are moderately active and 24.09% practice vigorous physical activity (see **Table 2**).

The third cluster contains 34.62% of women and 65.38% of men with a mean age of 31.10 ± 9.08. The repair by family income for cluster 3 was 27.88% for low levels, 30.77% for medium level and 41.35% for high levels. 23.08% of individuals in this cluster reported that they use Internet as entertainment medium. The majority of this group performs rigorous physical activity (44.23%), compared to 39.42% who perform moderate physical activity and 16.35% who are physically inactive (**Table 2**).

No significant difference between the three clusters was demonstrated for the place of residence (urban vs. rural) and the Internet entertainment medium.

Multinomial Logistic Regression

Modeling the likelihood of predicting class memberships was done using multinomial logistic regression models. The calculated standard error (SE), Wald test values, and adjusted odds ratio (AOR) with their 95 percent confidence intervals are summarized in **Table 3**.

Results of multinomial logistic regression analysis indicated that poor mental health class were related to female gender (AOR = 3.05; 95% CI: 1.88–4.94), poor economic level (AOR = 2.11; 95% CI: 1.22–3.67), medium Family Income (AOR = 2.16; 95% CI: 1.26–3.70), and weak physical activity (AOR = 3.38; 95% CI: 1.81–6.31). However, good mental health was associated to gender (AOR = 1.97; 95% CI: 1.20–3.22), medium Family Income (AOR = 2.29; 95% CI: 1.33–3.94) and Weak physical activity (AOR = 3.18, 95% CI: 1.68–6.01) (see **Table 3**).

DISCUSSION

The present paper aim (a) empirically identifies different profiles among a cohort of Facebook users in Tunisia based on positive factors of mental health using a person-centered approach, (b) outline identified profiles across sociodemographic, internet use, and physical activity, and (c) establish predictors of these profiles.

Initially, an adaptation of the GQ-6 scale was required to measure gratitude. The initial version of the instrument underwent translation into Arabic using the committee method and was subjected to both exploratory and confirmatory factor analysis to test its structure. The results of both analyses confirmed the uni-factorial model initially established. Adaptations of the gratitude questionnaire (GQ-6) in Brazil support our evidence of the validity and reliability of the scale for a single-factor structure (70). The study confirmed a unidimensional solution for two different samples (CFI = 0.99 and CFI = 0.97) with Cronbach's alpha of 0.87. However, the

TABLE 2 | Characteristics of the three clusters.

Variables			Clusters			Chi2/*F* Value	Cramer's *V*
			Cluster1	Cluster2	Cluster3		
Gender	Female	*n*	289	174	36	23,91**	0,16
		%	59,10%	48,74%	34,62%		
	Male	*n*	200	183	68		
		%	40,90%	51,26%	65,38%		
Socio economic level	Poor	*n*	184	94	29	27,81**	0,12
		%	37,63%	26,33%	27,88%		
	Medium	*n*	196	172	32		
		%	40,08%	48,18%	30,77%		
	High	*n*	109	91	43		
		%	22,29%	25,49%	41,35%		
Academic level	Graduate	*n*	307	218	71	1,79	0,043
		%	62,78%	61,06%	68,27%		
	Ungraduate	*n*	182	139	33		
		%	37,22%	38,94%	31,73%		
Dwellings	Urbain	*n*	306	243	70	2,98	0,06
		%	62,58%	68,07%	67,31%		
	Rural	*n*	183	114	34		
		%	37,42%	31,93%	32,69%		
Internet Entertainment medium	Yes	*n*	150	114	24	3,05	0,06
		%	30,67%	31,93%	23,08%		
	No	*n*	339	243	80		
		%	69,33%	68,07%	76,92%		
IPAQ	Weak	*n*	185	125	17	27,22**	0,12
		%	37,83%	35,01%	16,35%		
	Moderate	*n*	191	146	41		
		%	39,06%	40,90%	39,42%		
	Vigorous	*n*	113	86	46		
		%	23,11%	24,09%	44,23%		
Age			31,07 ± 9,46	31,10 ± 9,08	33,14 ± 10,20	2,231	0,005
GQ6			3,15 ± 0,56	4,03 ± 0,71	5,60 ± 0,52	732,872***	0,61
SWB			2,44 ± 0,42	3,28 ± 0,35	4,41 ± 0,34	1,285,721***	0,73
EWB			2,45 ± 0,41	3,20 ± 0,41	4,36 ± 0,35	1,092,456***	0,70
SWLS			2,05 ± 0,48	3,16 ± 0,42	4,11 ± 0,49	1,156,743***	0,71
AHS			2,17 ± 0,39	2,90 ± 0,44	3,79 ± 0,46	770,985***	0,62
FLS			2,07 ± 0,40	3,21 ± 0,46	3,83 ± 0,49	1,139,933***	0,71

*Overall MANCOVA: Wilks' Lambda =0.38; F (6, 943) = 95.86*** (**Eta** =0.62). **: p < 0.01; ***: p < 0.001. The first profile (51.47%) presents vulnerable cluster in terms of positive mental health. The second profile (37.58%) presents clusters with moderate positive mental health. The third profile (10.95%) presents people in good positive mental health.*

study of Dixit and Sinha (71) kept the same factor structure, but with only five scale items with an alpha reliability of 0.74.

Before proceeding to the identification of the profiles, reliability tests by calculating the classical Cronbach's alpha coefficient with confidence intervals on all the scales was carried out to ensure the reliability of the measures. The results were satisfactory and made it possible to integrate all the scales into an LPA model since all the scales presented an adequate internal consistency.

The LPA results revealed three clusters. The first cluster contains individuals who have low scores on the positive psychology scales. The second cluster contained individuals with moderate positive psychology scores. However, a third cluster had highly positive psychology scores. The selected variables in the model were put to a comparison test to ensure that the classification solution was adequate. Subsequently, the clusters were compared to the variables of socio-demographics, use of the internet for entertainment and physical activity, the results showed significant differences for gender (low mental well-being for the female gender), socio-economic level (low for the low-income class), and physical activity (low mental well-being for the non-exerciser). However, no significant differences were found in the variables age, location, and use of the Internet for entertainment.

TABLE 3 | Multinomial logistic regression for the positive mental health profiles.

Clusters[$]	Predictors	SE	Wald test	AOR	95% Confidence Interval for AOR	
					Lower Bound	Upper Bound
Cluster1	Age[a]	0.01	2.66	0.98	0.96	1.00
	[Gender[b] =Female]	0.25	20.59	3.05***	1.88	4.94
	[Family Income[c] =Poor]	0.28	7.09	2.11**	1.22	3.67
	[Family Income =Medium]	0.27	7.92	2.16**	1.26	3.70
	[Academic level[d] =Graduate]	0.26	3.69	0.61	0.37	1.01
	[Dwelling[e] =Urban]	0.24	0.42	0.86	0.53	1.37
	[Internet[f] =No]	0.26	0.90	0.78	0.47	1.31
	[IPAQ[g] =Weak]	0.32	14.64	3.38***	1.81	6.31
	[IPAQ=Moderate]	0.26	2.82	1.55	0.93	2.57
Cluster2	Age[a]	0.01	2.86	0.98	0.96	1.00
	[Gender[b] =Female]	0.25	7.28	1.97**	1.20	3.22
	[Family income[c] =Poor]	0.29	0.89	1.32	0.74	2.33
	[Family income=Medium]	0.28	8.97	2.29**	1.33	3.94
	[Academic level[d] =Graduate]	0.26	2.68	0.65	0.39	1.09
	[Dwelling[e] =Urban]	0.25	0.23	1.13	0.69	1.83
	[Internet[f] =No]	0.27	1.46	0.72	0.43	1.22
	[IPAQ[g] =Weak]	0.33	12.63	3.18***	1.68	6.01
	[IPAQ=Moderate]	0.27	2.54	1.53	0.91	2.57

*[$]Class 3, reference; SE, standard error; AOR, Adjusted Odds Ratio; [a]age, Covariate; [b]male, reference; [c]High Family Income, reference; [d]ungraduated, reference; [e]Rural, reference; Not uses internet for Entertainment, reference; Vigorous, reference. **p < 0.01; ***p < 0.001.*

According to the findings of a multinomial logistic regression study, poor mental health was linked to female gender, low economic status, medium economic status, and low physical activity. On the other hand, good mental health was related to gender, a middle socioeconomic status, and a lack of physical exercise.

To our modest knowledge, no studies have attempted to identify latent groups (LPA or latent class analysis on categorical variables LCA) from positive psychology parameters in the context of COVID-19. However, several studies from a negative or mixed (negative/positive) perspective has been highlighted profile identification for psychological distress, well-being and general mental health from online surveys. As an example, Pierce et al. (72) used LPA techniques to identify psychological distress clusters based on symptoms using the Brief-Symptom Inventory-53. Three latent classes defined by the level of symptom severity were identified (mild, moderate, and severe). Similarly, in another study incorporating negative mental health constructs, Fernández et al. (73), tested an LPA model at ∼4,400 subjects in Argentina that used the constructs of distress and anxiety. Following the analysis, the classification resulted in three profiles that justified the model. However, the results were related to the quarantine phase. In another study, Yalçin et al. (74) identified three latent profiles among University students in Turkey from fear, depression, anxiety, stress, mindfulness, and resilience related to COVID-19. The results also revealed that 38% of the participants were classified in the low psychological symptoms profile vs., 16% who were classified in the high psychological symptoms group. Similarly, female gender was related to high symptoms.

In another example, Fernandez-Rio et al. (75) identified three groups of mental well-being: high (with low depressive symptoms, higher effect and resilience), moderate, and low for an age range above 16 years. In line with the present study, similar results were put for physical activity and gender variable. In fact, the group that presented a highly mental well-being practiced a vigorous and moderate physical activity before the quarantine (81.1%), in addition it contains much fewer women. Similarly for the gender variable, previous research (76–78), indicates that the female gender has a significantly higher risk of psychosomatic health problems and low life satisfaction compared to boys. Fischer (79) explains girls' low mental well-being as a result of being expected to be more emotionally sensitive and expressive.

Regarding the practice of physical activity, the current results agree with a paper by Zhang and Chen (80) highlighted a positive correlation between physical activity, Happiness, and life satisfaction, which are two components of Chinese students' subjective well-being.

Consistent with our study for the family income variable, (81), in a survey of health and well-being for students in Wales, UK, showed that latent classes with higher mental well-being were more affluent. Also, other studies have established strong links between economic standard of living and mental well-being, however other results have suggested the presence of mediating variables, for example the feeling of insecurity among workers (82).

However, our results were not able to show differences between classes according to age, on the other hand, the study of Bernabe-Valero et al. (83) found an inverse association between negative effect and age, indicating that the higher

the age, the lower the negative affects scores. Other studies such as Bidzan-Bluma et al. (84) found that older individuals had better well-being scores than younger individuals. Within this framework, Ebert et al. (85), in a study with participants from the crowdsourcing platform, MTurk, found that mean age differences were observed. However, the trajectory of change did not differ by age. This suggests that responses to COVID-19 maybe age invariant and that effects on well-being are not immediate but may emerge over a longer period of time or in relation to social participation (86).

Daly et al. (87) reported different results for socio-demographic groups examined on mental health problems in a representative British sample. The increase was greatest among those aged 18–34, followed by women and those with higher incomes and education. However, the results that were reported at the beginning of the pandemic were variable over time.

Regarding the association between Internet use and mental health, previous studies have discovered mixed results and depend on several factors. For example, Lam et al. (88) found that frequent Internet use might have beneficial effects on depression and life satisfaction in older adults.

From a different angle, the found clusters point to strong links between thankfulness and spiritual well-being and the other positive psychology variables. Several research (89–92) have shown correlations between religion, well-being, stress management, and happiness. Many additional studies have also shown a link between spirituality and dimensions of subjective well-being including life satisfaction, optimism, self-esteem, and the sense of having lived a meaningful life (93–97). Spirituality may also help patients build psychological toughness and resilience, and patients who are conscious of their own inner strength can create positive attitudes (98, 99). Spirituality and religious coping behaviors (100, 101), such as prayer, supplication, Quranic recitation, trusting and remembering God, forgiveness, patience, starting the day with positive ideas, thanking God for His blessings, are likely to become a coping mechanism after a traumatic experience (32) and may be a key determinant of post-traumatic growth (102). During the pandemic, religious groups rallied to fight the epidemic and its ramifications, demonstrating that religion can have a substantial impact on communal perceptions in times of crisis (103). Spirituality, in this view, conveys hope for the future and may help people cope with problems (104). The COVID-19 pandemic, according to González Sanguino et al. (105), has raised persons' spiritual requirements has been reported to demonstrate the necessity of spirituality more clearly.

LIMITATION OF THE STUDY

Similar to any research, this study had some limitations that we must point out.

First, the exploratory and confirmatory factor analysis of the GQ6 scale were conducted on a single sample and the discriminant and convergent validity were not examined. Future research should examine these psychometric tests across other samples.

Second, resilience as a specific mental health construct in the context of the pandemic has not been examined due to the multitude of scales used. It is crucial that it must be incorporated into other studies to complement our work. Specially, during this study, we did not examine pathological people in terms of mental health. Future research should consider this population.

Third, the study was cross-sectional, further longitudinal studies need to be conducted to examine the transition of latent profiles during different waves of the COVID-19 pandemic.

Finally, future research needs to examine the role of social media and changes in the quality of life and peer relationships that may help explain trends in mental well-being.

CONCLUSION AND RECOMMENDATIONS

The findings of the study led to the identification of three latent profiles: low, moderate, and high positive mental health. It has been shown that a large percentage of Facebook users are vulnerable in terms of mental health. The outcomes also revealed substantial gender, socio-economic, and physical activity practice differences. Moreover, the multinomial logistic regression analysis connected poor mental health to female gender, low socioeconomic position, middle socioeconomic status, and low physical activity. Mental health was linked to gender, middling socioeconomic class, and lack of physical activity.

This study, complement person-centered studies (LPA/LCA) related to the COVID-19 pandemic and can serve mental health researchers and practitioners in the diagnostic and intervention phase.

In addition, psychometric test results suggested that the Arabic version of the GQ-6 scale is a valid and reliable tool and can be administered to measure gratitude toward culturally similar populations.

A need to identify and analyze the constructs of positive psychology can inform the improvement of the practice of psychological intervention, prevention and improve social dialogue. Indeed, focusing on what is going well in life and the positive aspects can contribute to the optimal functioning and development of individuals.

Practical measures to manage our mental health during these difficult times include consuming official media and accessing reliable sources of information that can limit the spread of misinformation related to COVID-19.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

This work has received approval from the Ethics Committee of the "Research Unit, Sportive Performance, and Physical Rehabilitation, High Institute of Sports and Physical Education,

Kef, University of Jendouba, Jendouba, Tunisia" and received ethical clearance from the UNESCO Chair "Health Anthropology Biosphere and Healing Systems," University of Genoa, Genoa (Italy), the Higher Institute of Sport and Physical Education of Kef, Kef (Tunisia), and the Higher Institute of Sport and Physical Education of Sfax, Sfax (Tunisia). The proposal has been also approved by the Jendouba University Ethics Committee and was undertaken following the legal standards of the Helsinki declaration in 1964 and its corresponding amendments. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

NG, AT, NC, AF, NB, and RA have conceived and designed the experiment. NG, AT, NC, MS, JK, LP, AF, NB, and RA have collected and analyzed data. All authors drafted and critically revised the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.824134/full#supplementary-material

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BRIEF RESEARCH REPORT
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Mental State of Inpatients With COVID-19: A Computational Psychiatry Approach

Mikhail Yu. Sorokin[1*†], *Ekaterina I. Palchikova*[2], *Andrey A. Kibitov*[3†], *Evgeny D. Kasyanov*[4], *Maria A. Khobeysh*[1] *and Elena Yu. Zubova*[3]

[1] *The Integrative Pharmaco-Psychotherapy of Patients With Mental Disorders Department, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia,* [2] *The Geriatric Psychiatry Department, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia,* [3] *The Educational Department, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia,* [4] *The Translational Psychiatry Department, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia*

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***Correspondence:**
Mikhail Yu. Sorokin
m.sorokin@list.ru

[†] These authors have contributed equally to this work and share senior authorship

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Background: The overload of healthcare systems around the world and the danger of infection have limited the ability of researchers to obtain sufficient and reliable data on psychopathology in hospitalized patients with coronavirus disease 2019 (COVID-19). The relationship between severe acute respiratory syndrome with the coronavirus 2 (SARS-CoV-2) infection and specific mental disturbances remains poorly understood.

Aim: To reveal the possibility of identifying the typology and frequency of psychiatric syndromes associated with acute COVID-19 using cluster analysis of discrete psychopathological phenomena.

Materials and Methods: Descriptive data on the mental state of 55 inpatients with COVID-19 were obtained by young-career physicians. Classification of observed clinical phenomena was performed with k-means cluster analysis of variables coded from the main psychopathological symptoms. Dispersion analysis with p level 0.05 was used to reveal the clusters differences in demography, parameters of inflammation, and respiration function collected on the basis of the original medical records.

Results: Three resulting clusters of patients were identified: (1) persons with anxiety; disorders of fluency and tempo of thinking, mood, attention, and motor-volitional sphere; reduced insight; and pessimistic plans for the future ($n = 11$); (2) persons without psychopathology ($n = 37$); and (3) persons with disorientation; disorders of memory, attention, fluency, and tempo of thinking; and reduced insight ($n = 7$). The development of a certain type of impaired mental state was specifically associated with the following: age, lung lesions according to computed tomography, saturation, respiratory rate, C-reactive protein level, and platelet count.

Conclusion: Anxiety and/or mood disturbances with psychomotor retardation as well as symptoms of impaired consciousness, memory, and insight may be considered as neuropsychiatric manifestations of COVID-19 and should be used for clinical risk assessment.

Keywords: SARS-CoV-2 infection, psychiatric disorder, mental status test, cluster analysis, COVID-19

INTRODUCTION

The neurotropic nature of severe acute respiratory syndrome with the coronavirus 2 (SARS-CoV-2) predetermines psychiatric disorders in some patients with coronavirus disease 2019 (COVID-19) (1–3). However, most publications on the psychological and mental impact of COVID-19 present the results of online and cross-sectional studies of the general population (4–6), some researches emphasize the healthcare service burden of clinics (7), and other studies present the post-recovery data of patients who have suffered the acute SARS-CoV-2 infection earlier (8–12). Even the clinical findings from previous coronavirus crises are mostly symptom- and dimension-oriented (13, 14).

The complex clinical picture and frequency of psychiatric syndromes in patients with current SARS-CoV-2 infection remain poorly understood (15, 16). A few studies present case reports of rare psychiatric conditions (17, 18). Some data were published about the existence of neurological disturbances in hospitalized patients with COVID-19 (19–21). Few studies are systematic assessments of the mental status of inpatients with COVID-19 (22, 23). These results are often obtained by non-psychiatric health professionals. At the same time, neuropsychiatric disorders are a COVID-19 death risk factor (23, 24), so they need to be diagnosed in a timely manner and appropriately treated. In this case, the lack of data on typical mental status variations in COVID-19 patients must be addressed because of the importance of this phenomenological information as a potential target for clinical screening and risk assessment by general practitioners.

At the same time, the extreme overload of healthcare systems around the world and the danger of infection have limited the ability of psychiatric researchers to obtain sufficient and reliable data on psychopathology in hospitalized patients with COVID-19. The relationship between severe infection and specific psychiatric syndromes remains to be explored. Back in the early days of psychiatry as a medical specialty, solving similar problems associated with syphilis and progressive paralysis took more than 100 years (25). Computational psychiatry is considered a promising methodology for assessing complex clinical events with a large number of factors and predictors that can lead to ambiguous clinical conditions in patients (26, 27). An important aspect of this approach is verification of the observed mental disturbances using certain pathogenetic indicators, such as inflammation and abnormalities of physiological functions (28).

The hypothesis of the study is as follows: nervous system damage caused by SARS-CoV-2 can have a variety of psychopathological manifestations in patients and must be associated with specific clinical parameters.

The aim of the study is as follows: to reveal the possibility of identifying the typology and frequency of psychiatric syndromes associated with acute COVID-19 using cluster analysis of discrete psychopathological phenomena.

METHOD

The assessment of the mental state of patients with COVID-19 requires specialized education and sufficient clinical practice of a physician. These requirements are unattainable in the real world of the COVID-19 crisis. During their mandatory general medicine practice in the northwest region of Russia, trainees of the National Medical Research Center for Psychiatry and Neurology obtained descriptive data on the mental state of 55 inpatients with COVID-19 (**Figure 1**). Between December 2020 and March 2021, resident psychiatrists, neurologists, and psychotherapists conducted semi-structured interviews with acute COVID-19 inpatients in infectious disease departments. Certain descriptors of psychopathological syndromes, laboratory results, and sociodemographic data of patients, as well as sources for their acquisition, are presented in **Supplementary Table 1**.

Young career physicians who had already completed their basic and advanced training courses in psychopathology provide enough quality in the process of data acquisition. To standardize the mental state assessment and to maximize inter-rater reliability, discrete psychopathological phenomena were pre-identified for raters. They used a scale from 0 to 1 point, where 0 = absence and 1 = presence of violations. The possible range of severity between 0 and 1 point should provide "artifact correction" during data acquisition, and k-means cluster analysis of quantitative variables coded from the main psychopathological symptoms allowed to perform classification of observed clinical phenomena. Quality control during data acquisition, artifact correction, and robust statistical algorithms are considered essential for computational technologies in psychiatry (29). The Student's *t*-test and the Mann–Whitney *U*-test with p-level of 0.05 were used to reveal cluster differences in parameters of inflammation and respiration function which were suggested as a physiological background of psychopathology in COVID-19 patients. Chi-square test was used for the assessment of cluster differences in socio-demographic parameters and presence of comorbidities. Clinical parameters of the patients were collected on the basis of the original medical records. Descriptions of subgroups were presented in means M[SD] or medians Me(IQR) depending on the results of distribution normality tests (Kolmogorov–Smirnov K-test). IBM SPSS Statistics (RRID:SCR_019096) was used.

The study design was controlled by the independent ethical committee. It was in conformity with the Helsinki Declaration and the standard of good clinical practice (GCP). It included collection of anamnestic socio-demographic data and clinical parameters based on the original medical records after the patients signed a voluntary informed consent, and their current mental state was tested.

The inclusion criteria were the following: (1) ability to read and understand and readiness to sign a voluntary informed consent to take part in the study; (2) a hospitalization due to COVID-19 diagnosis; and (3) ability to fulfill the study procedures.

The non-inclusion criteria were the following: (1) extremely high severity of the current condition with insufficient respiratory function and (2) age <18 years. Exclusion criterion

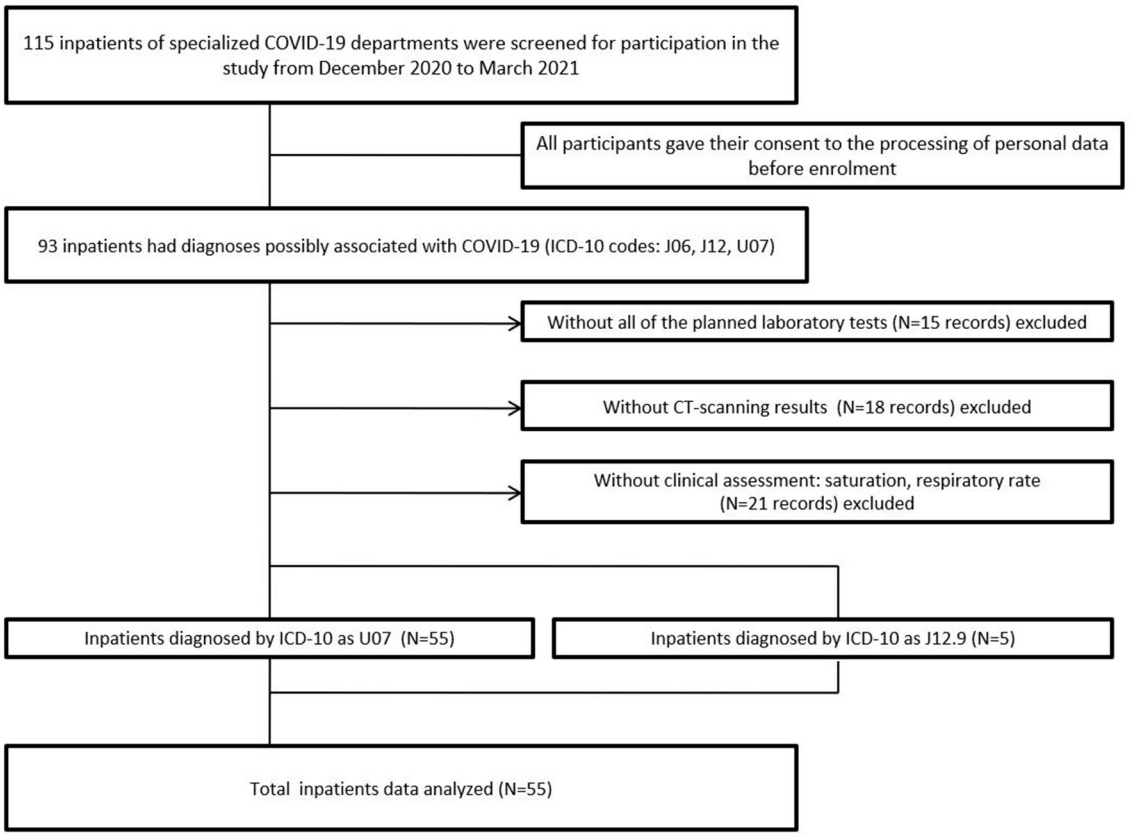

FIGURE 1 | Flowchart of participant recruitment.

was the following: refusal to comply with the study procedures at any stage of the study.

RESULTS

The sample of patients consisted of 21 men and 34 women, with a mean age of 51.5 [20.9] years. Higher and not completed higher education was characteristic of 30 patients (54.5%), secondary education of 11 patients (20.0%), and primary education of 14 patients (25.5%). The majority of the sample of patients were married people−33 (60%), and the smaller share was single persons−21 patients (38.2%). Also, the majority of the patients studied or worked full time−31 (56.4%), and the smaller share was unemployed−23 (41.8%). Data about the marital status for one patient (1.8%) and about the occupation for another one (1.8%) were missing (**Supplementary Table 2**). The most prevalent comorbidities were cardiovascular disorders −11 patients (20.0%), then endocrine disorders−6 (10.6%), gastrointestinal−5 (9.1%), and respiratory−2 (3.6%); renal and neurological disorders were the rarest—in 1 patient (1.8%) for each comorbidity. The mean percentage of lung lesions according to computed tomography data was 20.1% [19.1], and saturation lower than 95% was characteristic of 16 patients.

Three resulting clusters of patients were identified (without differences in gender and somatic and mental comorbidities) (**Figure 2A**). The first cluster [$n = 11$ (20%)] was of patients with anxiety; disorders of fluency and tempo of thinking, mood, attention, and motor-volitional sphere; reduced insight; and pessimistic plans for the future. The second cluster [$n = 37$ (67%)] was of patients without psychopathology. The third cluster [$n = 7$ (13%)] was of patients with disorientation; disorders of memory, attention, fluency, and tempo of thinking; and reduced insight (**Figure 2B**).

Representatives of cluster 1, in comparison with cluster 2 (without mental disturbances), had more lung lesions according to computed tomography: 20% (34) vs. 15% (18), $p = 0.018$. There were no significant differences in saturation, respiratory rate, and other laboratory parameters, as well as in age between patients from cluster 1 and cluster 2.

Other patients with mental abnormalities (cluster 3) were older: 76.9 [14.7] vs. healthy patients (cluster 2) 50.9 [17.8], $p = 0.001$, as well as vs. patients with anxiety and mood disturbances (cluster 1) 60.9 [24.3], $p = 0.027$. Cluster 3 patients, in comparison with cluster 2 (patients without mental abnormalities), were clinically different by a more severe course of the disease based on the results of laboratory

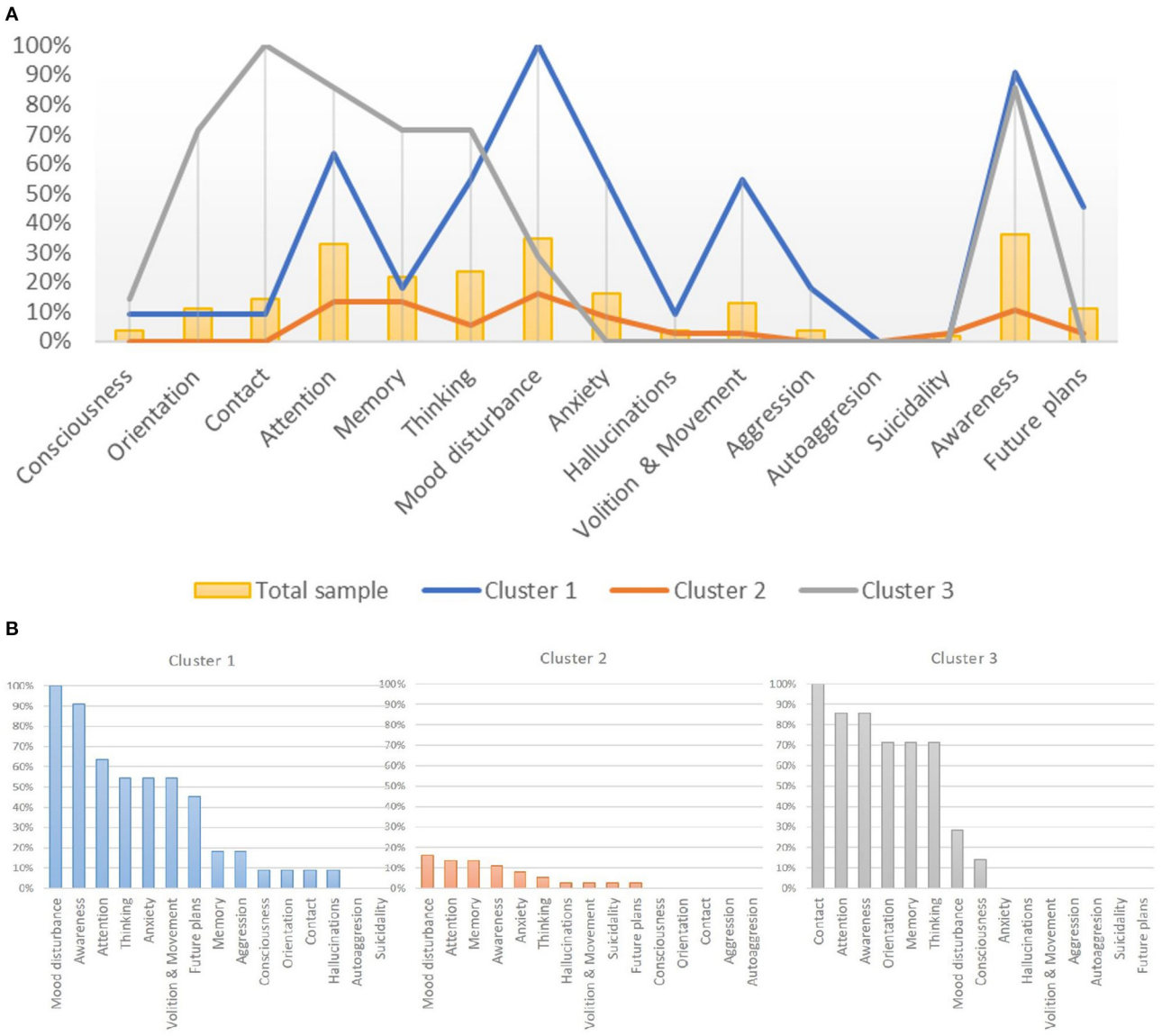

FIGURE 2 | (A) The frequency of psychopathological syndromes in patients with COVID-19 infection within three defined clusters. **(B)** Psychopathological profiles of inpatients with COVID-19 infection in each determined cluster.

and instrumental methods: a higher percentage of lung damage [31% (35) vs. 15% (18), $p < 0.001$]; higher level of C-reactive protein [126 mg/L (236) vs. 10 mg/L (21), $p < 0.001$]; lower saturation [89% (13) vs. 97% (4), $p < 0.001$]; and higher respiratory rate [21 (6) vs. 18 (4), $p < 0.001$].

Patients from cluster 3 vs. cluster 1 clinically differed: a higher percentage of lung lesions on computed tomography [31% (35) vs. 25% (34), $p = 0.029$], higher C-reactive protein level [126 mg/L (236) vs. 16 mg/L (88), $p < 0.001$], lower saturation [89% (13) vs. 95.5% (4), $p = 0.005$], higher respiratory rate [21/min (6) vs. 19/min (7), $p = 0.035$], and lower platelet count [139 * 10^9/L (129) vs. 322 * 10^9/L (129), $p = 0.006$].

DISCUSSION

To our knowledge, this is the first study performed using the computational psychiatry approach to assess the presence and typology of psychopathological syndromes in patients with acute COVID-19. The hypothesis of the study was confirmed: differences in the presence of psychopathology and the development of a certain type of impaired mental state were associated with specific clinical and laboratory parameters of patients. The combined representation of anxiety and/or mood disturbances with psychomotor retardation was characteristic of 20% of inpatients with acute COVID-19. Symptoms of impaired consciousness and memory, combined with impaired insight, were present in 13% of the sample.

The study had several limitations. Firstly, patients in extremely severe current condition with insufficient respiratory function were not included in the study, although they could have more pronounced mental disturbances. The second limitation was the small size of the sample due to the limited access to COVID-19 patients. Thirdly, standardized psychiatric diagnostic methods and tests or specific surveys (30) were not used because of the lack of time and acute infection process in the study participants. The structure of mental state examination traditionally used in Russian medical praxis founded mainly in German psychiatry was implied (31). The list of psychopathology dimensions used for assessment in the study is matched to British Medical Association guidance (2004). The slight modification of this list was made in accordance with the basic course in psychopathology (32). The fourth limitation was the issue of reliability of assessment performed by a general physician without psychiatric license. To minimize this possible weakness, in the study residents in psychiatry, neurology, and psychotherapy performed the assessment of the mental state within their competencies due to not only basic but advanced courses in psychopathology. This made data acquisition robust enough for further computational processing.

The results of the study should be used for better risk assessment of people with coronavirus infection and prediction of neuropsychiatric consequences as a marker of a more unfavorable course of the disease.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Independent Ethics Committee of V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

EZ and MS: conceptualization of the study, goals and aims, and resources. MS, EP, and AK: investigation. MS and AK: methodology, statistics, and writing (original draft). MS and MK: writing (review and editing). MS, EP, and EK: project administration. All authors read and approved the final version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.801135/full#supplementary-material

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Psychological Symptom Progression in School-Aged Children After COVID-19 Home Confinement: A Longitudinal Study

*Xinyan Xie, Qi Liu, Kaiheng Zhu, Qi Jiang, Yanan Feng, Pei Xiao, Xiaoqian Wu and Ranran Song**

Department of Maternal and Child Health and Ministry of Education (MOE) Key Lab of Environment and Health, School of Public Health, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China

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Daria Smirnova, Samara State Medical University, Russia

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Hamdi Chtourou, University of Sfax, Tunisia

***Correspondence:**
Ranran Song
songranran@hust.edu.cn

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Background: The long-term mental health effects of coronavirus disease 2019 (COVID-19) in children are rarely reported. We aimed to investigate the progression of depressive and anxiety symptoms among a cohort of children in the initial epicenter of COVID-19 in China.

Methods: Two waves of surveys were conducted in the same two primary schools in Wuhan and Huangshi, Hubei province: Wave 1 from 28 February to 5 March, 2020 (children had been confined to home for 30–40 days) and Wave 2 from 27 November to 9 December, 2020 (schools had reopened for nearly 3 months). Depressive and anxiety symptoms were estimated using the Children's Depression Inventory – Short Form (CDI-S) and the Screen for Child Anxiety Related Emotional Disorders (SCARED), respectively. ΔCDI-S and ΔSCARED scores between Wave 2 and Wave 1 were calculated and further categorized into tertiles. Multivariable linear regression and multinomial logistic regression models were then applied.

Results: A total of 1,224 children completed both surveys. The prevalence of mental health outcomes at Wave 2 increased significantly compared to Wave 1, specifically depressive symptoms (age-standardized prevalence rates: 37.5 vs. 21.8%) and anxiety symptoms (age-standardized prevalence rates: 24.0 vs. 19.6%). Higher ΔSCARED scores were observed in females and children in Wuhan, and children with experience of neglect had higher ΔCDI-S (β = 1.12; 95% CI = 0.67–1.58) and ΔSCARED (β = 6.46; 95% CI = 4.73–8.19) scores compared with those without experience of neglect. When the Δ scores were further categorized into tertiles, similar results were found.

Conclusions: The prevalence of depressive and anxiety symptoms after schools resumed was increased compared with that during the home quarantine period, even though the COVID-19 pandemic was under control. Females and children in Wuhan, and also children with experience of neglect were at increased risk of mental health disorders.

Keywords: depressive symptom, anxiety symptom, school-aged children, coronavirus disease 2019, longitudinal study

INTRODUCTION

Mental health has been increasingly seen as a major public health problem. It is estimated that between 10 and 20% of children and adolescents suffer from some type of mental health disorder (1). As most mental health disorders begin in childhood, a sensitive period of child development, early identification and treatment of mental health needs during this time is essential (2).

The coronavirus disease 2019 (COVID-19) outbreak was declared a pandemic by the World Health Organization (WHO), and COVID-19 emergency measures (i.e., city-wide lockdown) began in Wuhan, Hubei province on 23 January, 2020. This was eventually followed by other cities in Hubei province (3, 4). According to the Ministry of Education, the COVID-19 pandemic has caused long-term home restrictions for 180 million primary and secondary school students (5). In Hubei province, primary schools have been closed and shifted to home-based distance-learning models for the whole Spring semester. Hence, children did not have face-to-face learning until September 2020. Recent literature suggested that COVID-19 itself, along with school closures and home quarantine caused by COVID-19, has adversely affected children's mental health (6–9). COVID-19 has become a major global threat, impacting the mental well-being of children (10, 11). A series of studies from Effects of home Confinement on multiple Lifestyle Behaviours during the COVID-19 outbreak (ECLB-COVID19), an international online survey on mental health and multi-dimensional lifestyle behaviors during home confinement, have also highlighted the significant impact that home confinement has had on health, mental well-being, mood, life satisfaction, and multidimensional lifestyle behaviors (12–17). COVID-19 home confinement has negatively impacted mental health, with a greater proportion of people experiencing psychosocial and emotional disorders (14).

A range of mental health problems have accompanied the pandemic, such as depressive/anxiety disorders and post-traumatic stress disorder (PTSD) (18). For instance, isolated children had average PTSD scores that were four times higher than those of children who were not isolated (19). The mental health problems of children could continue into adulthood and adversely affect their physical and mental health (11). Depressive and anxiety symptoms are considered to be the early stages of major depressive disorder and anxiety disorder (20, 21), both of which could lead to poor academic performance, impaired cognitive function, social problems, and impaired psychosocial functions (20–22). The COVID-19 pandemic and the related measures against it, including self-isolation, quarantine, and social distancing, could have a detrimental impact on mental health. Individuals had to face significant changes in everyday life, possibly causing acute fight-or-flight responses (23). Uncertainty, fear, and discrimination toward infected people and their family members might generate psychological consequences that would need to be addressed by professionals and psychiatrists (24). The psychiatric problems that accompanied COVID-19 might therefore be a marathon rather than a sprint (25).

Until now, the majority of existing studies have focused on cross-sectional data, which cannot examine the long-term impact of COVID-19 over time (26–28). Our previous cross-sectional study conducted between 28 February and 5 March 2020 found that the prevalence of depressive (17.2%) and anxiety (18.9%) symptoms of children in Hubei province was higher than from other surveys in China (6). One longitudinal cohort study of children and adolescents in an area of China with a low risk of COVID-19 showed that the prevalence of psychological symptoms was higher after school reopening (on May 2020) than before the COVID-19 outbreak (29). Therefore, there is an urgent need for long-term follow-up studies on the psychological symptoms of school-aged children, especially those in the high risk area of the COVID-19 outbreak (30). We aimed to examine depressive and anxiety symptoms among a cohort of children after school reopening in Wuhan and Huangshi, Hubei province, China based on our previous study about the mental health status of children during the COVID-19 outbreak (6). We hypothesized that the impact of COVID-19 on the mental health of children may be long term and that the mental health status of children may worsen over time.

MATERIALS AND METHODS

Study Design

At Wave 1, we conducted the survey among children in Grades 2–6 at two primary schools in Hubei province from 28 February to 5 March 2020 through an online crowd-sourcing platform. At that time, children had been confined in their home for 30–40 days. Children took the online survey after their guardian agreed to the statement "I permit my child to participate in the survey" in the survey link. Detailed information were shown in our previous article (6).

At Wave 2, we conducted the second survey at the same schools between 27 November and 9 December 2020 on site. At that time, cities had been unsealed for nearly 7 months and schools had reopened for nearly 3 months. We obtained oral informed consent from parents by inquiring through head teachers. The investigators organized children to independently accomplish the questionnaires in class and encouraged them to complete the questionnaire as much as possible.

This study was approved by the Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology. Informed consent of the children and their guardians was obtained after the nature of the procedures had been fully explained. There was no disclosed information that might identify a particular person. All procedures performed in studies involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments.

Study Population

Wave 1

A total of 2,330 children in Grades 2–6 from two primary schools in Hubei province were invited to participate the survey and 1,784 participants completed the survey (675 children residing in Wuhan and 1,109 in Huangshi). The response rate was 76.6%. All questionnaires passed the quality audit, and the effective rate was 100.0%.

Wave 2

Children were promoted to the next grade in September each year, and all the children in the two primary schools were promoted at Wave 2. Therefore, the second survey started with children in Grade 3. As children in Grade 6 at Wave 1 were promoted from the primary school to the junior middle school, they were not included in the follow-up at Wave 2. A total of 2,245 children in Grades 3–6 from the same schools, including 698 from Wuhan and 1,547 from Huangshi, were invited to participate in the survey at Wave 2. Among these children, 2,211 completed the survey, with a response rate of 98.5%. After a quality audit, 2,209 questionnaires were further analyzed, with an effective rate of 99.9%.

Using student names and IDs, we matched the questionnaires from both waves. There was a total of 1,224 children who completed both surveys, with 689 (56.3%) male and 805 (65.8%) participats who resided in Huangshi. The data from those 1,224 children were used in all analyses.

Measures

In both surveys, the gender, grade, location of school, and depressive and anxiety symptoms of participants were collected. In China, children aged 6 enter primary school and are about 11 years old when they are in grade 6. Thus, the grade could be a good approximation of age. Detailed information was shown in our previous article (6). Depressive and anxiety symptoms were measured using the Children's Depression Inventory—Short Form (CDI-S) and the Screen for Child Anxiety Related Emotional Disorders (SCARED), respectively. Additionally, at Wave 1, COVID-19-related questions were collected. At Wave 2, the daily sleep time in the past week and experience of neglect in the previous year were measured and collected via five items in the Conflict Tactics Scales, Parent-child Version (CTSPC).

Depressive symptoms

Depressive symptoms were estimated using the CDI-S at Waves 1 and 2 (31). The CDI-S consists of 10 items, each with a score of 0–2. Each item requires respondents to rate the severity of each symptom of depression. The CDI-S has shown good internal consistency (Cronbach's $\alpha = 0.75$) in the study with Chinese children (32). The total score ranges from 0 to 20. A higher score indicates more severe depressive symptoms, while a CDI-S value of ≥ 4 is defined as depressive symptoms (33). The difference (Δ) in CDI-S score between Wave 2 and Wave 1 was calculated via subtraction, with a positive/negative change representing an increase/decrease of CDI-S score at Wave 2, respectively. Based on the tertiles of the ΔCDI-S score, it is further categorized into low (< 1), moderate (≥ 1, < 3), and high (≥ 3) change.

Anxiety Symptoms

Screen for Child Anxiety Related Emotional Disorders is a 41-item self-report instrument that was used to measure anxiety symptoms at Waves 1 and 2 (34). The questionnaire proved to have adequate reliability (retest reliability: 0.567–0.608; internal consistency: 0.890) and fair validity (correlation coefficients from 0.300 to 0.444) (35). Children rate each symptom on a three-point Likert scale: 0 (almost never), 1 (sometimes), and 2 (often). Total scores ranged from 0 to 82, and the accepted cut-off score for anxiety disorder is 23 (35). Children with higher scores have more severe symptoms of anxiety. The ΔSCARED score between Wave 2 and Wave 1 was calculated and was used to indicate an increase/decrease of SCARED score in Wave 2. Based on the tertiles of the ΔSCARED score, it is further categorized into low (< 0), moderate (≥ 0, < 11), and high (≥ 11) change.

Neglect

Five items covering neglect behaviors in the CTSPC were used to measure the experience of neglect (36). Children were asked to report their experience of neglect in the preceding year at Wave 2. Thus, children's experience of neglect at the time of the first survey was also covered. The affirmative responses to any item were used to represent self-reported exposure to neglect.

With regard to COVID-19, children were asked to answer two questions at Wave 1: 1) "Which are more likely the host of SARS-CoV-2?," with choices that include "wild animals," "domesticated animals," and "do not know," and 2) "Which of the following protective measures have you taken during the COVID-19 outbreak?," with choices that include "Reminding my family members to wear masks," "Convince my family members not to go out or gathering," "Ventilating the house frequently," and "Washing hands frequently." Children who chose wild animals and those who had taken all protective measures were deemed to know the host of SARS-CoV-2 and how to take protective measures during the COVID-19 pandemic.

Statistical Analysis

All analyses were performed in Statistical Package for the Social Sciences (SPSS) 22.0 and Microsoft Excel (2016). Both R (v3.2.5) and Microsoft Excel (2016) were used to generate the figures. Frequencies and percentages were summarized for categorical variables. Means and standard deviations were used to describe continuous variables. Age-standardized prevalence rates of depressive and anxiety symptoms were calculated based on the Chinese population from the 2020 China census data (37). We used McNemar's test to evaluate the trend in the prevalence of psychological symptoms between the two waves. We also performed multivariable linear regression models to examine the ΔCDI-S and ΔSCARED scores. Multinomial logistic regression models were applied to examine the tertiles of the ΔCDI-S and ΔSCARED scores. Multiple imputation with 20 times interpolation was carried out for independent variables that had a few nonresponses [daily sleep time (missing data, 20.5%) and neglect behaviors (missing data, 0.8%)]. Sensitivity analysis using the complete data was also performed to evaluate the validity of multiple imputation. The odds ratio (OR), β value, and 95% confidence interval (95% CI) were reported and p-values were two-tailed, with a significance level at 0.05.

RESULTS

Among 1,224 children who completed both surveys, 689 (56.3%) children were males and 805 (65.8%) resided in Huangshi. The average ages of children were 9.32 ± 1.10 years at Wave 1 and 10.07 ± 1.10 years at Wave 2, with 1.1% of children lacking

TABLE 1 | Demographic characteristics of children who completed both surveys.

Characteristic	*n*	Percentage (%)
Overall	1,224	100.0
Gender		
Male	689	56.3
Female	535	43.7
School location		
Wuhan	419	34.2
Huangshi	805	65.8
Grade		
Grade 3	337	27.5
Grade 4	292	23.9
Grade 5	340	27.8
Grade 6	255	20.8
Taking all protective measures during COVID-19[a]		
No	663	54.2
Yes	561	45.8
Knowing the host of SARS-CoV-2[a]		
No	356	29.1
Yes	868	70.9
Daily sleep time[b]		
< 8 h	309	25.2
≥8 h	664	54.2
Missing data	251	20.5
Parent-Child Tactics Scale Neglect-neglect behaviors[b]		
Neglect	854	69.8
Non-neglect	360	29.4
Missing data	10	0.8

[a] *The items were investigated at Wave 1.*
[b] *The items were investigated at Wave 2.*

TABLE 2 | Distribution of scale scores of children who completed both surveys.

		CDI-S	SCARED
Wave 1			
	Symptoms, No. (%)	250 (20.4)	232 (19.0)
	No symptoms, No. (%)	974 (79.6)	992 (81.0)
	Mean and standard deviation	2.22 (2.49)	13.86 (10.37)
Wave 2			
	Symptoms, No. (%)	487 (39.8)	406 (33.2)
	No symptoms, No. (%)	723 (59.1)	811 (66.3)
	Mean and standard deviation	3.57 (3.29)	18.98 (12.44)
	Missing data, No. (%)	14 (1.1)	7 (0.6)
Δ score			
	Mean and standard deviation	1.35 (3.68)	5.09 (14.31)
	1st tertile, No. (%)	539 (44.0)	414 (33.8)
	Δ score range	< 1	< 0
	2nd tertile, No. (%)	308 (25.2)	419 (34.2)
	Δ score range	≥ 1, < 3	≥ 0, < 11
	3rd tertile, No. (%)	363 (29.7)	384 (31.4)
	Δ score range	≥ 3	≥ 11
	Missing data, No. (%)	14 (1.1)	7 (0.6)

Δ score was change of scale scores from Wave 1 to Wave 2.
CDI-S, Children's Depression Inventory-Short Form; SCARED, The Screen for Child Anxiety Related Emotional Disorders.

age information. The percentages of participants in Grades 3–6 were 27.5% (337), 23.9% (292), 27.8% (340), and 20.8% (255), respectively. There were 45.8% of children who took all required protective measures during COVID-19 and 70.9% who knew the host of SARS-CoV-2 at Wave 1. Additionally, 54.2% of children had more than 8 h of daily sleep time and 69.8% showed that they had experience of neglect in the preceding year at Wave 2 (**Table 1**).

Age-standardized prevalence rates of depressive symptoms at Wave 1 and Wave 2 were 21.8 and 37.5%, respectively, and were 19.6 and 24.0%, respectively, for anxiety symptoms. A total of 20.4% (250) of participants had depressive symptoms at Wave 1 and 39.8% (487) at Wave 2. The average score of the CDI-S rose from 2.22 (2.49) for Wave 1 to 3.57 (3.29) for Wave 2. For the anxiety symptoms, 19% (232) of children were detected at Wave 1 and 33.2% (406) were detected at Wave 2. The average score of SCARED were 13.86 (10.37) and 18.98 (12.44), respectively (**Table 2**). The distributions of ΔCDI-S and ΔSCARED were shown in **Supplementary Figure S1**. The mean score of CDI-S and SCARED for the two waves was reported in **Supplementary Figure S2A**. For both scales, we found that the score was increased at Wave 2 compared with those at Wave 1 for each grade. The mean and standard deviations of ΔCDI-S and ΔSCARED were 1.35 (3.68) and 5.09 (14.31), respectively (**Table 2**). As shown in **Supplementary Figure S2B**, children in Wuhan had a higher change of SCARED score than those in Huangshi.

As shown in **Table 3**, the prevalence of mental health outcomes among children at Wave 2 significantly increased from those levels at Wave 1, specifically in depressive symptoms [39.8% (Wave 2) vs. 20.4% (Wave 1), $p < 0.001$] and anxiety symptoms [33.2% (Wave 2) vs. 19.0% (Wave 1), $p < 0.001$]. Further subset analyses for gender, grade, and school location showed similar results (all $p < 0.001$). **Tables 4**, **5** showed the OR and β for associations of Δ score and demographic characteristics in the regression models. Children with experience of neglect had higher ΔCDI-S scores (β = 1.12; 95% CI = 0.67–1.58) and ΔSCARED score (β = 6.46; 95% CI = 4.73–8.19) compared with those without neglect. Children with experience of neglect had higher odds in the 3rd tertile of the ΔCDI-S score (OR = 2.51; 95%CI = 1.82–3.47). Similar results were found for ΔSCARED score (2nd tertile vs. 1st tertile, OR = 1.37; 95% CI = 1.02–1.84; 3rd tertile vs. 1st tertile, OR = 3.46; 95% CI = 2.45–4.89). Females had significantly higher Δ score of SCARED than males (β = 1.83; 95% CI = 0.26–3.40) and children in Wuhan had significantly higher ΔSCARED score than those in Huangshi (β = 3.42; 95% CI = 1.77–5.07). Children in Wuhan had higher odds in the third tertile of ΔCDI-S score (OR = 1.38; 95% CI = 1.03–1.83) and the third tertile of ΔSCARED score (OR = 1.65; 95% CI = 1.22–2.25). We also found that students in Grade 4 and 5 had lower ΔCDI-S score compared with those students

TABLE 3 | Change of psychological symptoms outcomes among children at two surveys.

Characteristics	Depressive symptoms			Anxiety symptoms		
	Wave 1 Yes, n (%)	Wave 2 Yes, n (%)	*P*-value	Wave 1 Yes, n (%)	Wave 2 Yes, n (%)	*P*-value
Overall	250 (20.4)	487 (39.8)	<0.001	232 (19.0)	406 (33.2)	<0.001
Gender						
Male	145 (21.0)	276 (40.6)	<0.001	126 (18.3)	199 (29.1)	<0.001
Female	105 (19.6)	211 (39.8)	<0.001	106 (19.8)	207 (38.8)	<0.001
School location						
Wuhan	106 (25.3)	193 (46.2)	<0.001	79 (18.9)	176 (42.0)	<0.001
Huangshi	144 (17.9)	294 (37.1)	<0.001	153 (19.0)	230 (28.8)	<0.001
Grade						
Grade 3	48 (14.2)	124 (37.5)	<0.001	54 (16.0)	106 (31.8)	<0.001
Grade 4	63 (21.6)	107 (37.2)	<0.001	56 (19.2)	112 (38.6)	<0.001
Grade 5	80 (23.5)	145 (42.9)	<0.001	78 (22.9)	107 (31.5)	0.006
Grade 6	59 (23.1)	111 (43.9)	<0.001	44 (17.3)	81 (31.9)	<0.001

P-value was derived from McNemar's test.
Depressive symptoms were measured by the Children's Depression Inventory-Short Form.
Anxiety symptoms were measured by the Screen for Child Anxiety Related Emotional Disorders.

in Grade 3 ($\beta = -0.93$; 95% CI $= -1.50$ to -0.36; $\beta = -0.68$; 95% CI $= -1.23$ to -0.14). The sensitivity analyses that used complete data before multiple imputation showed similar results (**Supplementary Tables S1, S2**).

DISCUSSION

This study suggested that about 3 months after school reopening, the prevalence of depressive and anxiety symptoms among children in Hubei province remained elevated compared with that during the COVID-19 pandemic lockdown. When considering the ΔCDI-S and ΔSCARED scores, the risk factors for a high change from Wave 1 to Wave 2 were: the school in Wuhan, being female, and having experience of neglect.

The psychological and mental effects of major public health events could be long term (38–40). Lessons from the outbreak of severe acute respiratory syndrome (SARS) in 2003 indicated that the mental health of survivors did not improve over time and gradually deteriorated (41). The post-traumatic disturbance of residents in areas with high SARS prevalence, regardless of age, was more intense than in areas with low prevalence (42). A national mental health study among adolescents in China, administered separately in February and April 2020, showed that the prevalence of depression and anxiety significantly increased over time (43). In addition, surveys covering 5,285 adults in the USA found that the prevalence of adverse mental health symptoms during the later phase of the COVID-19 pandemic (September 2020) was higher than in June 2020 (44). Daly et al. found that a pronounced and prolonged deterioration of mental health occurred between April and June 2020 among participants of the nationally representative United Kingdom Household Longitudinal Study (45). Studies in Italy showed an increase in stress and depression among citizens along with a different time course of mental health problems between men and women (46, 47). Our results among children in Hubei province, China, were consistent with these findings. Although different socio-cultural contexts (i.e., tight and loose cultures) led to a varied response to a global pandemic (48), COVID-19 seemed to have a similar impact on the long-term consequences of mental health.

The significant increase in the prevalence of depressive and anxiety symptoms may be related to the fact that an online mental health service in the early phase of COVID-19 in China was not designed for children (49). Children who developed psychological symptoms at Wave 1 may persist with these symptoms until Wave 2 due to lack of effective intervention. For children with depressive symptoms, there will be considerable difficulties in resuming normal life after school reopening (50). The other important thing to note in this study was that we used screening criteria, rather than clinical thresholds, of the CDI-S (≥ 7) (51) and SCARED (≥ 25) (52). This was because we tried to screen out more children at high or potential risk from the aspect of early prevention, especially for the children in Wuhan who experienced the pandemic earlier and more severely. Although the sample size was limited and is not fully representative of the population in Hubei province, the evidence of increased depressive and anxiety symptoms suggested that there is a great need to provide timely psychological support to enhance resilience and reduce fear and anxiety (53). On a related note, timely mental health education and treatment should be available for these children (54).

Consistent with previous findings, females had higher SCARED scores in our study (43, 55). The gender difference in anxiety symptoms may be partly attributable to relationships between adrenarcheal hormones and functional connectivity of the amygdala according to an imaging study in children (56). Hormone levels in females were inversely associated with the connection from the right amygdala to the insula, but were positively associated with the connection from the left amygdala to anterior cingulate cortex in males. Furthermore, we found that children in Wuhan at Wave 2 had a higher ΔSCARED score than

TABLE 4 | Association between demographic characteristics and the difference in Children's Depression Inventory-short form (ΔCDI-S) score.

Characteristic	2nd tertile (≥ 1, < 3) OR (95%CI)	3rd tertile (≥ 3) OR (95%CI)	Linear model β (95%CI)
Gender			
Female vs. Male	0.81 (0.61,1.07)	0.94 (0.72,1.24)	0.20 (−0.21,0.61)
School location			
Wuhan vs. Huangshi	1.35 (1.00,1.82)	1.38 (1.03,1.83)	0.33 (−0.10,0.76)
Grade			
Grade 4 vs. 3	0.80 (0.54,1.19)	0.72 (0.49,1.05)	−0.93 (−1.50, −0.36)
Grade 5 vs. 3	1.02 (0.71,1.45)	0.77 (0.54,1.12)	−0.68 (−1.23,- −0.14)
Grade 6 vs. 3	0.94 (0.62,1.43)	1.07 (0.72,1.58)	−0.20 (−0.80,0.39)
Protective measures during COVID-19 (Wave 1)			
Yes vs. No	0.95 (0.71,1.26)	0.91 (0.69,1.19)	0.12 (−0.29,0.53)
Knowing the host of SARS-CoV-2 (Wave 1)			
Yes vs. No	0.90 (0.66,1.22)	1.15 (0.85,1.56)	0.32 (−0.13,0.77)
Daily sleep time (Wave 2)			
< 8 vs. ≥ 8 h	1.12 (0.83,1.53)	1.19 (0.85,1.67)	0.29 (−0.20,0.78)
Neglect (Wave 2)			
Yes vs. No	1.34 (0.99,1.83)	2.51 (1.82,3.47)	1.12 (0.67,1.58)

Ref, Reference; OR, odds ratios; CI, confidence intervals; CDI-S, Children's Depression Inventory-Short Form.
ΔCDI-S score was the change of scale scores from Wave 1 to Wave 2.
OR (95% CI) were derived from the multinomial logistic regression model and the first tertile was the reference group (score < 1).
β (95% CI) were derived from generalized linear regression.

TABLE 5 | Association between demographic characteristics and difference in Screen for Child Anxiety Related Emotional Disorders (ΔSCARED) score.

Characteristics	2nd tertile (≥0, < 11) OR (95%CI)	3rd tertile (≥ 11) OR (95%CI)	Linear model β (95%CI)
Gender			
Female vs. Male	1.03 (0.78,1.36)	1.30 (0.98,1.74)	1.83 (0.26,3.40)
School location			
Wuhan vs. Huangshi	1.47 (1.09,1.98)	1.65 (1.22,2.25)	3.42 (1.77,5.07)
Grade			
Grade 4 vs. 3	1.04 (0.70,1.54)	1.03 (0.69,1.54)	0.63 (−1.55,2.80)
Grade 5 vs. 3	1.02 (0.73,1.44)	0.71 (0.48,1.04)	−1.58 (−3.67,0.50)
Grade 6 vs. 3	1.01 (0.68,1.51)	0.91 (0.60,1.39)	−0.24 (−2.52,2.03)
Protective measures during COVID-19 (Wave 1)			
Yes vs. No	0.94 (0.71,1.23)	0.88 (0.66,1.17)	−0.51 (−2.08,1.06)
Knowing the host of SARS-CoV-2 (Wave 1)			
Yes vs. No	0.88 (0.65,1.19)	0.98 (0.71,1.35)	0.55 (−1.17,2.27)
Daily sleep time (Wave 2)			
< 8 vs. ≥ 8 h	1.25 (0.92,1.70)	1.27 (0.92,1.77)	0.62 (−1.14,2.37)
Neglect (Wave 2)			
Yes vs. No	1.37 (1.02,1.84)	3.46 (2.45,4.89)	6.46 (4.73,8.19)

Ref, Reference; OR, odds ratios; CI, confidence intervals; SCARED, Screen for Child Anxiety Related Emotional Disorders.
ΔSCARED score was the change of scale scores from Wave 1 to Wave 2.
OR (95% CI) were derived from the multinomial logistic regression model and the first tertile was the reference group (score < 0).
β (95% CI) were derived from the generalized linear regression.

those in Huangshi, which may be attributed to the fact that the epidemic in Wuhan was more severe than in Huangshi, and that children in Wuhan have been isolated at home for longer periods (57). Moreover, we found higher ΔCDI-S and ΔSCARED scores at Wave 2 in children with experience of neglect in the preceding year vs. those without neglect. The experience of neglect over the past year also included the children's experience at the time of the first survey. This may be partly attributed to the fact that children might have a decreased frequency of positive parent–child interaction after the school reopened, which increased the probability of neglect (58). Changes to daily family life due to financial hardship and social restrictions on parents may increase parental stress and lead to an increase in adverse childhood experiences (ACEs), including neglect (59). In this study, 69.8% of children reported experience of neglect in the preceding year at Wave 2, which was higher than a previous study among Chinese elementary students in Shanghai, China (52.26%) (60). ACEs, such as abuse and neglect, are associated with increased risk for depression, anxiety, and PTSD (61), along with elevated mortality rates (62). Although Chinese parents have a more democratic parenting style influenced by Western thoughts, the power disparity between parents and children in traditional Chinese culture may facilitate ACEs. Support for dealing with family difficulties and available child welfare services are needed.

Although we explored psychological problems among the cohort of children in Hubei province, China, there were several limitations. First, the results may be generalized only to children in school. We adopted a cluster sampling method and selected two primary schools for the surveys. The sample was therefore not necessarily representative of the whole population of children in China. Second, no information on household income or other types of ACEs was surveyed. The impact of the COVID-19 pandemic may be related to parental unemployment/loss of household income and high-stress home environments, thus increasing the likelihood of ACEs or emotional problems (63). We also did not collect information related to family functioning or family context. Third, children in higher grades were more likely to suffer from mental health problems (64). The students in

Grade 6 at Wave 1 were lost during follow-up due to promotion from primary school to junior middle school, which may lead to an underestimation of the prevalence of depressive and anxiety problems at Wave 2. Fourth, we did not collect information on learning styles. The learning styles were inconsistent between the two surveys (home learning vs. studying on campus), which may have an impact on the mental health of students. Furthermore, we used electronic questionnaires when students were confined to home and paper-based questionnaires when students were at school. Although we adopted some methods to ensure that students completed the questionnaires independently, we still need to unify the form of survey tools in future studies. Finally, we reported the symptoms rather than the clinical diagnoses because of the short follow-up period.

In conclusion, our study identified increased prevalence of depressive and anxiety symptoms among a cohort of children in Hubei province, China, despite the fact that the COVID-19 pandemic had been brought under control and schools had reopened. The mental health problems of children are warnings. There is a lack of knowledge on the long-term psychological impact of COVID-19 on children, and our results fill an important gap in the research. In addition, China is one of the early affected countries whose schools are now functioning normally. Our study, focusing on the progression of psychological symptoms in children who have experienced long-term home quarantine and have now resume school, may guide the mental health support plan in other countries (65). We anticipate that our results may be helpful to decision makers and that post-COVID-19 public health for mental health protection be given priority. Schools, which are the primary provider of mental health services for many children (66), should take timely action to mitigate the disruption of COVID-19 on children when they return to school, especially those who have experienced neglect within their families (2). For psychiatrists and healthcare professionals, they may participate in educational and media activities for children, parents, or educators about the mental health distress caused by physical distancing and quarantine. They should also alert policy makers of the long-term consequences of COVID-19 and the increased demand for mental health services (67). Continuing to follow-up these children and giving attention to their emotional problems is also necessary.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the data are not publicly available due to privacy/ethical restrictions: Requests to access the datasets should be directed to RS, songranran@hust.edu.cn.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology. Written/oral informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

XX and RS conceived the study. XX, QL, KZ, YF, and RS critically appraised the data. XX, KZ, QJ, XW, and PX prepared the initial manuscript. RS reviewed and edited the manuscript. All authors collected data for the study and critically reviewed and approved the final manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.809107/full#supplementary-material

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Religion and the Mediating Role of Alexithymia in the Mental Distress of Healthcare Workers During the Coronavirus Disease 2019 Pandemic in a Psychiatric Hospital in China

Fushuai Zhao[1†], *Hsuan Lung*[2†], *Po-Fei Chen*[3], *Mei-Chung Chang*[4] *and For-Wey Lung*[5,6,7,8*]

[1] *Anning Psychiatric Rehabilitation Hospital, Changchun Sixth Hospital, Changchun City, China,* [2] *Department of Dentistry, Kaohsiung Chang Gung Memorial Hospital and Chang Gung University College of Medicine, Kaohsiung, Taiwan,* [3] *Department of Psychology, Calo Psychiatric Center, Pingtung, Taiwan,* [4] *Department of Nursing, Calo Psychiatric Center, Pingtung, Taiwan,* [5] *Department of Medicine, Calo Psychiatric Center, Pingtung, Taiwan,* [6] *Graduate Institute of Medical Sciences, National Defense Medical University, Taipei, Taiwan,* [7] *International Graduate Program of Education and Human Development, National Sun Yat-sen University, Kaohsiung, Taiwan,* [8] *Institute of Education, National Sun Yat-sen University, Kaohsiung, Taiwan*

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***Correspondence:**
For-Wey Lung
forwey@seed.net.tw

[†] *These authors share first authorship*

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The outbreak of the coronavirus disease 2019 (COVID-19) has created unprecedented challenges to the healthcare system, religion, and alexithymic trait that impacts the psychological resilience of healthcare workers during the COVID-19 pandemic. This study aimed to investigate the role religion and alexithymia play in mental distress and the level of happiness of psychiatric hospital healthcare workers in China amidst the COVID-19 pandemic. Furthermore, whether symptom dimensions (anxiety, depression, hostility, inferiority, and insomnia) are associated with the level of happiness, and a 6-month follow-up was also investigated. A total of one-hundred and ninety healthcare workers were recruited from a psychiatric hospital in Jilin, China, and 122 were followed up after 6 months. All participants filled out the 20-item Toronto Alexithymia Scale, five-item Brief-Symptom Rating Scale, and the Chinese Oxford Happiness Questionnaire. The mental distress of healthcare workers decreased from 2.6 to 1.5% in 6-months. Religious belief was not associated with the mental distress or happiness of healthcare workers. Instead, for those whose anxiety decreased over 6 months, their social adaptation status increased. For those whose inferiority level decreased over time, their perceived level of psychological well-being and overall happiness increased. In over half a century of living in different societies, religion stabilizes the mental health of those in Taiwan amidst the stress of the COVID-19 pandemic, but not in China. However, both regions found healthcare workers with alexithymic traits experienced a higher level of mental distress, implying that the collectivist culture of Confucian philosophy continues to influence the emotional expression and alexithymic traits of healthcare workers in China and Taiwan. To ensure a healthy and robust clinical workforce in the treatment and control of the pandemic, the cultural impact on the psychological resilience of medical workers needs to be addressed.

Keywords: coronavirus disease 2019, healthcare worker, mental distress, alexithymia, religion

INTRODUCTION

The outbreak of COVID-19 has created unprecedented challenges to the health care system globally. Increased stress experienced by healthcare workers has caused high levels of anxiety, depression, sleep disorders, burnout syndrome, and post-traumatic stress disorders (1), with a prevalence of up to 25.8–67.55% of anxiety, 24.3–55.89% of depression, and 45–62.99% of stress in systematic reviews (2, 3). Although compared to frontline healthcare workers who have direct care and contact with patients with COVID-19, healthcare workers working in psychiatric departments showed lower levels of mental distress (4). However, with the 4% high fatality rate of COVID-19 in China (5), there is an increased risk of mortality in patients with schizophrenia spectrum disorder (6). Medical staff in psychiatric hospitals also need extensive knowledge and relevant training in COVID-19 care (7).

Resilience is the ability of an individual to withstand setbacks, adapt positively, and recover from difficulties (8). Since healthcare professionals play an important role in the treatment and control of the pandemic, their mental and physical health conditions, and psychological resilience when faced with the pandemic becomes vitally important. Religion can help people develop coping strategies during stressful life situations (9), for it can provide social support, a healthy lifestyle, and meaning in life (10), and also plays a protective factor for mental health amidst the pandemic lockdown (11). Similarly, a previous study in Taiwan found religion to impact the mental health and level of happiness of healthcare workers, playing a vital role in the psychological resilience amidst the COVID-19 pandemic (4). Different emotional reactions and symptoms may appear at different periods of the pandemic. A previous study found anger post-disaster can predict psychological distress at follow-up, and hostility is high immediately post-disaster, but dissipate in a year (12). The five-item Brief Symptom Rating Scale (BSRS-5) measures the five symptoms of anxiety, depression, hostility, inferiority, and insomnia, and has been used to assess the mental distress of healthcare professionals in psychiatric and general hospitals (4). Therefore, the individual items within the BSRS-5 can also reflect different reactions under stress and stress reactions at different stages of the pandemic.

Besides different symptoms reactions, the alexithymic trait has also been shown to play a mediating role between COVID-19 exposure, posttraumatic stress disorder, and depressive symptoms (13). People who have alexithymic traits include those who have difficulty in identifying their feelings, differentiating feelings, verbalizing feelings, and communicating feelings (14). Alexithymia modulates the cortisol level in response to stressful events (15) and can predict the development of psychopathology during the pandemic (16). General and psychiatric hospital healthcare workers showed similar alexithymia levels, however, those healthcare workers that had alexithymic traits were more likely to experience mental distress and lower level of happiness (4). Therefore, the alexithymic trait is also an important predictor of psychological resilience during the COVID-19 pandemic among healthcare workers.

Since China and Taiwan share common cultural roots, traditions, and ancestries, but have lived in different societies for over half a century. A study in Taiwan showed religion and alexithymic trait both impacts the psychological resilience of healthcare workers during the COVID-19 pandemic (4). Therefore, the aim of this study was to investigate the role religion and alexithymia play in mental distress and the level of happiness of psychiatric hospital healthcare workers in China amidst the COVID-19 pandemic. Furthermore, whether symptom dimensions (anxiety, depression, hostility, inferiority, and insomnia) are associated with the level of happiness, and at 6-month follow-up was also investigated.

MATERIALS AND METHODS

Participants

Healthcare workers, including administrative personnel, nurses, physicians, pharmacists, social workers, psychologists, radiologists, etc. from a psychiatric hospital in Jilin, China were conveniently recruited. The baseline questionnaires were collected from May 8th to June 1st, 2020 and followed up 6 months later (January 15th to February 1st of 2021). A total of one-hundred and ninety healthcare workers were recruited at the first stage and 122 (64.21%) at follow-up. Those who were unable to participate at the follow-up stage were due to the shifts of healthcare workers. The hospital has a total of 224 employees; thus our study had a response rate of 84.8%. The procedures performed in this study were approved by the Institutional Review Board of a teaching hospital in Taiwan, and informed consent was obtained from all participants after a detailed explanation of the study.

Measurement

All information collected was from participants' self-report. The participants filled out the 20-item Toronto Alexithymia Scale (TAS-20), five-item Brief-Symptom Rating Scale (BSRS-5), and the Chinese Oxford Happiness Questionnaire at baseline (time = 1) and 6-month follow-up (time = 2). All the surveys collected were in Chinese and were of participants' self-report.

Religion

The major religion in China includes Buddhism, Taoism, Protestantism, Islam, Catholicism, and folk religions (17). Therefore, the demographic information sheet included the religious faith choices of "Buddhism/Taoism," "Christian (Protestant)/Catholic," "Shamanism" (local folk religion), and "others."

Alexithymia

The Chinese version of the TAS-20 was translated from the original TAS-20 scale, developed to measure alexithymia in three dimensions: difficulty identifying feelings (DIF), difficulty describing feelings, and externally oriented thinking (18). Participants who scored ≧60 on the TAS-20 were considered to have alexithymia (19). Furthermore, those who score ≧21 in the DIF dimension have also been found to be at higher risk for psychiatric disorders (20). Therefore, the cutoff point of 60/61

for total TAS-20 and 21/22 for the DIF scale were both used in this study.

Mental Health Condition

The Chinese version of the BSRS-5 has been shown to be valid to screen for mental health conditions of psychiatric inpatients, general medical patients, and community residents in Taiwan (21). The BSRS-5 measures the mental health distress of participants in five symptom domains of anxiety, depression, hostility, interpersonal sensitivity/inferiority, and insomnia. The cutoff of 9/10 was valid to screen for healthcare workers who had higher psychological distress under the COVID-19 pandemic in Taiwan (4). Therefore, a cutoff of 9/10 was used in this study.

Happiness

The culturally modified seven-item Chinese Oxford Happiness Questionnaire was used to measure the self-perceived level of happiness of the healthcare workers. The culturally modified Chinese version of the happiness scale can be separated into two dimensions of social adaptation status (SAS; 4 items) and psychological well-being (PWB; three items) (22).

Statistical Analysis

Descriptive analysis was used to analyze the demographic information and TAS-20, BSRS-5, and Chinese Oxford Happiness Questionnaire scores of the healthcare workers at the beginning of the pandemic and at the 6-months follow-up. Additionally, generalized equation estimation (GEE) analysis was used to analyze the factors which influenced the psychological resilience of the healthcare workers during the pandemic. GEE exchangeable covariance structure was chosen, it is the most suitable method of analysis for the measurement of repeated data. Parsimonious GEE models were presented, which means that only statistically significant ($p \leq 0.05$) variables were presented. All analysis was processed using the Statistical Package for the Social Sciences (SPSS) 26.0 for Windows software (SPSS Inc., Chicago, USA).

RESULTS

The sociodemographic data, alexithymic traits, religion, psychological distress, perceived level of happiness of healthcare workers amidst the pandemic, and 6-month follow-up are shown in **Table 1**. Results showed a statistically significant difference in the total happiness scale between baseline and 6 months ($F = 4.84$, $p = 0.29$).

GEE was used to investigate which factors were associated with mental health distress level and perceived happiness, psychological well-being, and social adaptation status of these healthcare workers during the pandemic, and at 6 months follow-up. As **Table 2** shows, religion was not associated with the mental health and perceived happiness of healthcare workers.

The second GEE model investigated which factor was associated with the perceived happiness of the healthcare workers. Factors of interest included sex, age, religion, and mental distress level (BSRS total store). Since BSRS was the only factor associated with the perceived level of happiness of the healthcare workers, symptom domains of the BSRS (anxiety, depression, hostility, interpersonal sensitivity/inferiority, and insomnia) and its association with perceived happiness (including psychological well-being and social adaptation status) was further investigated in the second model. Additionally, symptoms domains that were shown to be associated with the perceived level of happiness, their interaction with time were also analyzed. The parsimonious results in **Table 3** show the perceived level of happiness increased after 6 months ($\beta = 0.68$, $p = 0.034$). Of the five dimensions of the BSRS-5, those who had higher hostility levels perceived lower levels of happiness ($\beta = -0.64$, $p = 0.002$), and the interaction of inferiority and time showed higher inferiority levels over time also decreased the level of perceived happiness ($\beta = -1.28$, $p = 0.001$).

Regarding the psychological well-being dimension of the happiness scale, GEE results showed healthcare workers perceived better psychological well-being after 6 months ($\beta = 0.37$, $p = 0.049$). However, those who had higher inferiority level over time perceived lower levels of psychological well-being ($\beta = -0.50$, $p = 0.009$). On the other hand, no statistically significant differences between the baseline and follow-up level of social adaptation status were reported in healthcare workers. However, those who perceived a higher level of anxiety over time, and those who perceived a higher level of inferiority perceived a

TABLE 1 | Socio-demographic and clinical characteristics of healthcare workers at baseline and 6-months follow-up ($N = 323$).

	Amidst the pandemic $n = 191$	**6-months follow-up $n = 132$**	
Variable	***n* (%)**	***n* (%)**	χ^2
Sex			0.11
Male	39 (20.4)	29 (22.0)	
Female	152 (79.6)	103 (78.0)	
Department			<0.01
Medical	162 (84.8)	112 (84.8)	
Administrative	29 (15.2)	20 (15.2)	
Married	88 (46.1)	67 (50.8)	0.69
Religious faith			
Buddhism/Taoism	10 (5.5)	6 (4.9)	
Christian/Catholic	4 (2.2)	3 (2.4)	
Shamanism	2 (1.1)	1 (0.8)	
Others	47 (26.0)	33 (26.8)	
No religion	118 (65.2)	80 (65.0)	
TAS-20 ≥61	5 (2.6)	5 (3.8)	0.36
TAS-DIF ≥22	13 (6.8)	3 (2.3)	3.41
BSRS-5 ≥10	5 (2.6)	2 (1.5)	0.44
Variable (range)	**Mean (SD)**	**Mean (SD)**	***F***
Age (21–74)	32.13 (10.0)	32.39 (9.0)	0.95
TAS-20 total score (20–80)	44.72 (8.8)	43.49 (8.9)	0.10
BSRS-5 total score (0–20)	2.60 (2.9)	2.56 (2.9)	0.03
Happiness Scale (11–28)	21.49 (2.8)	21.53 (3.4)	4.84*
Social adaptation status (5–16)	13.16 (1.7)	13.11 (2.0)	1.81
Psychological well-being (3–12)	8.34 (1.8)	8.42 (2.0)	2.34

*TAS-20, 20-item Toronto Alexithymia Scale; TAS-DIF, Difficulty identifying feelings dimension of TAS-20; BSRS-5, five-item Brief-Symptom Rating Scale; *p < 0.05.*

TABLE 2 | Generalized equation estimation model of the association of religion on the mental health and level of happiness of healthcare workers over time.

Dependent variable	Independent variable	ß	S.E.	95% C.I.	*p*
BSRS	Religion	−0.06	0.45	−1.0 to 0.83	0.877
Perceived happiness	Religion	−0.30	0.54	−1.36 to 0.77	0.587
Psychological well-being	Religion	−0.09	0.37	−0.81 to 0.64	0.818
Social adaptation status	Religion	−0.22	0.25	−0.70 to 0.27	0.379

BSRS-5, Five-item Brief-Symptom Rating Scale.

TABLE 3 | Parsimonious generalized equation estimation model of the factors associated with the level of happiness of healthcare workers over time.

Dependent variable	Independent variable	ß	S.E.	95% C.I.	*p*
Perceived happiness	Time	0.68	0.32	0.05 to 1.31	0.034
	BSRS- Hostility	−0.64	0.21	−1.05 to −0.24	0.002
	BSRS-Inferiority	0.93	0.69	−0.43 to 2.29	0.180
	BSRS-Inferiority * Time	−1.28	0.39	−2.04 to −0.51	0.001
Psychological well-being	Time	0.37	0.19	<0.01 to 0.75	0.049
	BSRS-Inferiority	0.18	0.32	−0.46 to 0.81	0.586
	BSRS-Inferiority * Time	−0.50	0.19	−0.87 to −0.12	0.009
Social adaptation status	Time	0.21	0.21	−0.19 to 0.62	0.307
	BSRS-Anxiety	0.46	0.40	−0.33 to 1.25	0.255
	BSRS-Anxiety * Time	−0.66	0.27	−1.19 to −0.14	0.013
	BSRS-Inferiority	−0.40	0.15	−0.70 to −0.11	0.007

*BSRS-5, Five-item Brief-Symptom Rating Scale; * interaction.*

TABLE 4 | Parsimonious generalized equation estimation model of the factors associated with the mental health distress level of healthcare workers.

Dependent variable	Independent variable	ß	S.E.	95% C.I.	*p*
BSRS	Time	−0.10	0.23	−0.55 to 0.36	0.679
	TAS-20 61	−2.49	0.84	−4.13 to −0.85	0.003
BSRS	Time	0.11	0.23	−0.34 to 0.56	0.625
	DIF 22	−4.37	1.27	−6.87 to −1.88	0.001

TAS-20, 20-item Toronto Alexithymia Scale; DIF, Difficulty identifying feelings dimension of TAS-20.

lower level of happiness at follow-up ($\beta = -0.66$, $p = 0.013$; $\beta = -0.40$, $p = 0.007$).

Finally, the third GEE model investigated the factors associated with mental distress level of healthcare workers. Factors of interest included sex, age, religion, and alexithymic trait (TAS-20 ≥61), and their interaction with time. The GEE model showed alexithymic trait was the only factor associated with the mental health distress level of the healthcare workers (**Table 4**). Those showing alexithymic traits (TAS ≥61) are at risk for higher levels of mental distress ($\beta = -2.49$, $p = 0.003$). Additionally, those who scored ≧22 in the DIF dimension of TAS-20 also experienced greater mental distress ($\beta = -4.37$, $p = 0.001$).

DISCUSSION

Our study showed, of the 191 healthcare workers in a psychiatric hospital in China, 2.6% reported having mental distress amidst the COVID-19 pandemic, and 1.5% at 6-months follow-up. Religion was not associated with mental distress or happiness in this group of healthcare workers. Instead, among the five symptom domains of anxiety, depression, hostility, inferiority, and insomnia, psychiatric healthcare workers who experienced higher hostility amidst the pandemic, perceived a lower level of happiness. The 6-month follow-up showed that inferiority decreased over time, which increased the perceived level of happiness and psychological well-being. In the same line, those who reported lower inferiority levels, perceived better social adaptation status. Besides inferiority, healthcare workers whose anxiety level decreased over the 6-month period, their social adaptation status also increased. Finally, those with alexithymic traits and/or who scored higher than 21 in the DIF dimension, experienced a higher level of mental distress compared to healthcare workers who did not have the alexithymic trait.

The level of mental distress amongst psychiatric healthcare workers was 2.6% amidst the pandemic, and lower (1.5%) at

6-months follow-up. This prevalence of mental distress is similar to the 2.96% reported in healthcare workers in psychiatric hospitals in Taiwan (4). However, this is much lower than the prevalence of 25.8–67.55% reported by healthcare professionals in systematic reviews (2), and 19.6 and 34.7% of anxiety and depression in the general public during the pandemic in China (23). The sampling period of the above systematic review and general population studies were earlier on in the pandemic, with the addition of information and experience of combating the pandemic from different countries, the level of distress of healthcare workers may have changed. Additionally, the distress level of healthcare workers also changes according to their regional incidence rates (24).

Amongst the symptoms of anxiety, depression, hostility, inferiority, and insomnia. Healthcare workers who reported a higher level of hostility perceived a lower level of happiness. The relationship between the level of hostile attribution and happiness is correlational (25), unhappy people may be prone to interpret ambiguous situations in an unfavorable way, which leads to negative emotions (anger) (26), and a lack of optimistic attributions may also lead to the low perceived level of psychological well-being (27).

This study also found those whose level of inferiority decreased over the period of 6 months, perceived better happiness and psychological well-being. In addition, those who reported lower inferiority levels, perceived better social adaptation status. This is in line with a previous study that found individuals with increased inferiority levels are more likely to self-concealment, which decreased their level of perceived happiness (28). Additionally, university students who spend more time participating in enjoyable activities of positive psychology reported lower levels of inferiority (29), which is associated with a higher level of subjective well-being (30).

The last symptom dimension associated with the happiness level of healthcare workers was anxiety. With healthcare workers whose anxiety level decreased over 6 months, associated with increased social adaptation status. Healthcare providers can generate remarkable stress and emotional turmoil during the outbreak of a pandemic like COVID-19 (31). Concerns about being infected and the possibility of putting the health of their family and friends at risk may cause healthcare workers to feel isolated and distressed (32). In addition, frontline medical personnel reports feeling less socially adapted compared with second-line medical personnel (33). Fortunately, a follow-up study in Taiwan also showed that the social adaptation status of healthcare workers increased over time (4).

No association was found between religion and mental distress or happiness in this group of healthcare workers. This result differed from a previous study that found religion as a psychological resilience factor among healthcare workers in Taiwan amidst the COVID-19 pandemic (4). These differences show that although China and Taiwan are of the same ethnic group, with common cultural roots, traditions, and ancestries. However, through the one-hundred-year process of social modernization in China (34), it was until the late 1970s that China adopted its policy of reform to open up political discourse and academic community on the topic of religion (35), as shown by less than ten percent of healthcare workers which reported to have religious faith in our study. In over half a century of living in different societies, religion stabilizes the mental health of those in Taiwan amidst the stress of the COVID-19 pandemic (4), but not in China. However, a previous study in China found a disparity in age and urbanization in the effect of religion on health, with religion significantly improving the health of urban residents and those over the age of 60 (36). However, another study also showed no association between religious belief and the health of elderly people (37). Showing inconsistent results in the impact of religion on health in China.

Although religious beliefs showed different impacts on the happiness of healthcare workers in China and Taiwan, however, both regions found healthcare workers with the alexithymic trait (TAS-20 $\geq$61) experienced a higher level of mental distress. This study further found those who scored over 22 in the DIF dimension of TAS-20 also experienced greater mental distress. This shows a collectivist culture of Confucian philosophy, encouraging the restraint of emotion, avoidance of interpersonal conflicts, and suppression of individual rights to maintain harmony with others continues to influence the emotional expression and alexithymic trait of healthcare workers in China and Taiwan. This cultural influence is also shown in the slower emotional development of children in a birth cohort study in Taiwan (38). Barella and Graffigna proposed that since healthcare professionals often have to deal with unexpected emotions from both patients and themselves, an emotional expression of healthcare providers may be considered unprofessional and inconvenient, implicitly encouraging clinicians' alexithymic traits to detach themselves from emotions (39). However, this alexithymic trait can influence the well-being of the healthcare providers, and the quality of medical care (40).

A limitation of this study was that data for this study were collected from one psychiatric hospital in China, therefore the generalizability of this study to other populations may be restricted. Especially since the psychological distress of healthcare workers in the epicenter of the pandemic were higher than those further from the epicenter (41), and the distress level of healthcare workers also changes according to the incidence rates in their region (24).

The strength of this study is that the mental distress and alexithymia levels of healthcare workers were followed-up over 6 months amidst the COVID-19 pandemic. Our follow-up study showed religious belief did not have an association with the mental distress of healthcare workers in China. Instead, the mental distress of healthcare workers decreased over time, and for those healthcare workers whose anxiety decreased over 6 months, their social adaptation status increased. Additionally, for those whose inferiority level decreased over time, their perceived level of psychological well-being and overall happiness increased. Healthcare workers with alexithymic traits were associated with a higher level of mental distress. Implementing strategies to assist healthcare workers with alexithymic traits in identifying their emotions and regulating their emotions can prevent or mitigate their mental distress. During a healthcare crisis, such as the COVID-19 pandemic, sharing emotions, concerns, and worries can make all those involved

in the crisis feel more responsible and aware of how much their behavior can contribute to effectively coping with the stressful consequences of the situation (42). The Confucian and collectivist cultural impact on emotional expression needs to be considered. To ensure a healthy and robust clinical workforce in the treatment and control of the pandemic, policymakers should address the mental health needs of medical workers by funding preventive and promoting psychological resources (43), including spiritual resources and values for coping with the pandemic (44).

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Kaohsiung Armed Forces General Hospital. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HL and F-WL conceptualized the study. FZ and M-CC overlooked the sampling and experimental procedures. P-FC and F-WL undertook the statistical analysis and interpreted the analysis. P-FC wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

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Development and Validation of a Questionnaire to Assess Social Participation of High Risk-Adults in Germany During the COVID-19 Pandemic

Dominik Schröder[1], Gloria Heesen[1], Stephanie Heinemann[1], Eva Hummers[1], Alexandra Jablonka[2,3], Sandra Steffens[2], Marie Mikuteit[2], Jacqueline Niewolik[2], Tobias R. Overbeck[4], Jonathan Kallusky[4] and Frank Müller[1]*

[1] Department of General Practice, University Medical Center, Göttingen, Germany, [2] Department of Rheumatology and Immunology, Hannover Medical School, Hanover, Germany, [3] German Center for Infection Research (DZIF), Partner Site Hannover-Braunschweig, Hanover, Germany, [4] Department of Hematology and Medical Oncology, University Medical Center Göttingen, Göttingen, Germany

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***Correspondence:**
Dominik Schröder
dominik.schroeder@med.uni-goettingen.de

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Background: Restrictions to contain the COVID-19 pandemic affect the social participation of people worldwide. Especially those at high risk for a severe disease tend to abstain from social gatherings. While there are a few questionnaires to measure social participation in elderly or chronic patients, a valid survey instrument that includes pandemic-related social participation is needed.

Methods: We developed a social participation questionnaire that aims to assess pandemic-related restrictions in social participation. Items were developed using a theory and literature-based approach and then compiled in a discursive process involving experts and lay people. This was followed by the validation of the questionnaire through a cross-sectional survey on 431 individuals. Items with low item-total correlations and low factor loadings using exploratory factor analysis [EFA] were excluded. Using EFA on the remaining items, the factor structure was retrieved and tested with a confirmatory factor analysis [CFA]. Internal consistency was assessed with Chronbachs α.

Results: Initially, 27 items were developed which were used for validation. 13 items were excluded due to low item-total correlations and factors loadings. EFA of the remaining 14 items revealed three factors which were identified as domains "active social participation," "wellbeing," and "restrictions". CFA showed an acceptable model fit using the three-dimensional structure. Chronbachs α of 0.81 and McDonalds Ω of 0.87 indicate good internal consistency. Correlation analysis showed an association between the developed questionnaire and previously-established participation and mental health scales.

Conclusion: This study suggests that our 14 item questionnaire is of high reliability and validity and can be used to measure social participation during a pandemic.

Keywords: social participation, pandemic questionnaire, COVID-19, SARS-CoV-2, quality of life, questionnaire validation, questionnaire development and validation

INTRODUCTION

The still ongoing coronavirus disease [COVID-19] pandemic affects various aspects of life worldwide (1–6). Especially with dynamic changes of social restrictions, vaccine progress and occurrence of infection, the effect on how people pursue everyday life and participate in social activity of any kind can also change dramatically.

Until recently, social participation was discussed primarily in connection with people with physical, mental or sensory impairments of physiological functions, especially in the elderly (7, 8). The concept of social participation used in medical research has been adopted from the fields of geriatrics, disability research and rehabilitation (9–11). In these concepts, it is assumed that individual illnesses, symptoms or aging processes change or even limit an individual's ability to engage in social participation. Vice versa, social participation is generally associated with positive health outcomes. Improving social participation is one of the key strategies to combat the challenges of an aging population (12, 13). Known interventions to enhance social participation, in addition to medical and rehabilitation interventions, are to provide accessibility in various services like public transportation (14). As social participation can be summarized as "a person's involvement in activities that provide interaction with others in society or the community" and is thus a broad concept which also applies to pandemic situations and the impact of the restrictions on daily life during the course of a pandemic. Existing survey instruments often reflect the domains of the International Classification of Functioning, Disability and Health [ICF] or surrogates and are used to assess how specific individual medical conditions impact social participation but not a pandemic threat (15–17). Thus, these instruments do not address social fields affected by the pandemic (e.g. safety of the own person in the public space). Additionally, existing survey instruments are mainly used for rehabilitation research. Therefore, the need for new, validated, pandemic-appropriate instruments has become apparent. This is supported by the fact that especially so far non-validated, unstandardized or not fit-for-purpose instruments are being used in pandemic research (18–22).

Here, we describe the development and validation of a new questionnaire which was used to assess social participation during a pandemic in persons with a high-risk for a severe COVID-19 infection.

MATERIALS AND METHODS

The methods used in the development and validation of the questionnaire are based on current best practices (23, 24).

Development of Items for the Pandemic Social Participation Questionnaire (PSP-Q)

The item development was performed in a discursive process following both deductive (literature review, assessment of existing scales) and inductive (group discussions on items with both experts and potential participants) approaches. Final refinement was undergone after pre-testing.

First, a theory- and literature-review using PubMed screening for articles on "social participation" and "quality of life questionnaire" in English and German language was undertaken. Additionally, we conducted a Google search for gray literature including national and international conventions and classification about social participation and rehabilitation. The purpose was to specify and identify domains and possible dimensions as well as assessment of existing scales.

The literature was fed back into a discursive process with authors and other experienced scientists from the Department of General Practice at University Medical Center Göttingen. We identified that existing questionnaires were based mainly on the International Classification of Functioning, Disability and Health [ICF] framework. The ICF, on the other hand, was considered hardly able to measure pandemic-specific impacts on social participation, as it assumes impairments to social participation only due to disease, as opposed to an external cause or hazard. Thus, emphasis was placed on identifying dimensions, that extend the existing framework of ICF. Following agreement in the group, we used the Annual Participation Report published by the German Federal Ministry of Labor and Social Affairs as the dimensional framework for social participation (25). This in turn is based in large parts on the United Nations Convention on the Rights of Persons with Disabilities (26). The framework includes the dimensions "Family and social network," "Education and training," "Employment and material life situation," "Daily living," "Health participation," "Leisure, culture and sports," "Security and protection of the own person," and "Political and civil participation" and thus domains that were not recognized by ICF. Items were then derived interpreting existing survey instruments on social participation (27, 28), quality of life (29, 30), and the ICF (31) with the aim to provide at least two items per dimension. This resulted in a pool of items that were subsequently reduced by excluding duplicate items. It was consented not to pose questions but to provide statements on which probands can rate on a five-point Likert scale, whether they agree or disagree. Since certain items cannot be answered meaningfully in some circumstances (e.g. items concerning work life by retired persons), an additional category "not applicable to me" was added (32). The development of the items was based on the principle of comprehensibility; specifically, items should be formulated positively and negation should be avoided. Clear, simple sentence construction without abbreviations or technical terms was used. Particular attention was paid to statements about intensity, which ideally should be avoided. In total, 30 questions were derived from this first process. Questions were assigned in random order and compiled into a preliminary questionnaire.

Next, the first version of the questionnaire was discussed item by item in five sessions with each two people at high risk for a severe COVID course. This group was recruited pragmatically since the media reported the begin of the study before the first participant was included in the study. As a result, numerous people under immunosuppression came forward and expressed interest in participating in the study. Some of these individuals were approached and asked if they would be available for an open discourse about study questionnaires and their

experiences during the COVID-19 pandemic. Group discussions were conducted as online video conferences in early spring 2021 when legal restrictions were in place on civil life. The group was given the task of speaking out loud about everything that comes to mind on each question and linking it to the participants' own current experiences, life situations, and expectations. As a result of this process, certain items were classified as too abstract (e.g., "I feel uncomfortable being close to others") and transformed into more lifelike episodes based on participants' vivid experiences ("I hug friends and relatives to greet them when they are important and close to me") (24). Additionally, the wording of the items was changed to be more precise and clear. In total, we developed 27 items during this phase. These items did not overlapped in every case with either ICF or the dimensional framework derived from the Convention on the Rights of Persons with Disabilities (26). However these items are needed to reflect the impact of the pandemic and we consented to use an *a posteriori* approach to identify domains.

For a pilot test of the PSP-Q, we asked 10 colleagues and their family members who are affiliated with the Department of General Practice but not involved in the questionnaire development to read and fill out the questionnaire. These persons were asked to provide feedback about the now article based questionnaire, regarding comprehensibility, and answerability, especially with regards to readability and layout. Additionally, we wanted to investigate how long it takes to complete the questionnaire. After this pilot test, the PSP-Q was finalized.

Study Design and Participants

This questionnaire development and validation project is part of the CoCo Immune Study (33). In the CoCo Immune Study, participants with a high risk of a severe COVID-19 illness due to immunosuppressive therapy (e.g., due to autoimmune diseases or cancer treatment) or due to older age (participants aged 80+) were recruited for a 12-months observational study following COVID-19 vaccination. No intervention, treatment or counseling took place. Only participants aged 18 years or older were recruited.

We followed different recruitment strategies. To begin, potential participants were informed by local media reports, posters and flyers in private practices, vaccination centers, clinics and hospitals in the Southern Lower Saxony Region. Participants who contacted the study team and fulfilled the inclusion criteria were subsequently enrolled. Additionally, patients were enrolled who fit to the inclusion criteria and attended the outpatient clinics of the Department of Rheumatology and Immunology of the Hannover Medical School or the Department of Hematology and Medical Oncology of the University Medical Center Göttingen. Thus, recruitment was based on a pragmatic sample (real life sample).

Data Collection and Management

At enrollment, participants completed a self-reported questionnaire on sociodemographic (age, gender, education level) and medical characteristics (diseases, pharmacotherapy), COVID-19 specific characteristics (previous SARS-CoV-2 infection, vaccine used for immunization) and the included scales. Data were entered into the EvaSys digital survey system (EvaSys GmbH, Lüneburg, Germany) and exported from there directly into SPSS data format. Only data from participants which completed all 27 items of the newly-developed questionnaire are used for statistical analyses.

Measures

PSP-Q

The PSP-Q evaluates social participation with 27 items. A five-point likert-scale was used in all items ranging from 1 = strongly agree to 5 = strongly disagree. Additionally, participants had the possibility to state that question is not applicable to them which was then rated with the highest social participation as either strongly agree or strongly disagree depending on the poling of the item. To calculate the total score, negative items were reversed and summed up with all included items. Higher scores indicate a higher social participation with scores ranging between 27 and 135.

Patient Health Questionnaire-4 (PHQ-4)

The PHQ-4 is a brief, validated, high reliable (Cronbachs α 0.85) measure of anxiety and depression symptoms (34, 35). This scale consists of two subscales PHQ-2 for depressive symptoms and GAD-2 for anxiety, consisting of two four-point Likert-type items (0–3) for each subscale, and also produces an overall psychological distress sum score ranging from 0–12 while higher scores indicates impaired mental wellbeing. A sum score of $\geq$3 on either subscale or $\geq$6 on the whole scale is considered the cutoff point for identifying possible symptoms of clinical relevant anxiety or depression. Compared to the Brief Symptom Inventory, the PHQ-4 has a specificity of 94.5% and sensitivity of 51.6% (36).

Index for the Assessment of Health Impairments (IMET)

The IMET is a questionnaire to measure social participation based on the International Classification of Functioning, Disability and Health [ICF] (27, 28). It was initially developed to assess participation and involvement for persons suffering from a chronic disease. The main field of application is in the area of rehabilitation science research. The IMET is uni-dimensional and consists of 9 items with a 11 (0–10) level Likert-scale where higher scores indicate lower social participation consistently across all items. The sum of all 9 items can be used to determine the overall social participation with a high internal reliability (Cronbachs α 0.90). Higher scores indicate a lower level of social participation. The IMET was used during the COVID-19 pandemic by Mergel & Schützwohl to assess social participation before and after the lockdown in participants with a mental disorder and participants from the general population (22, 37).

In addition to the PHQ-4 and IMET, the health-related quality of life and subjective health status of the last 2 weeks was assessed each with a single item on a seven-point Likert-scale. Higher scores indicate a poorer health status or a lower quality of life.

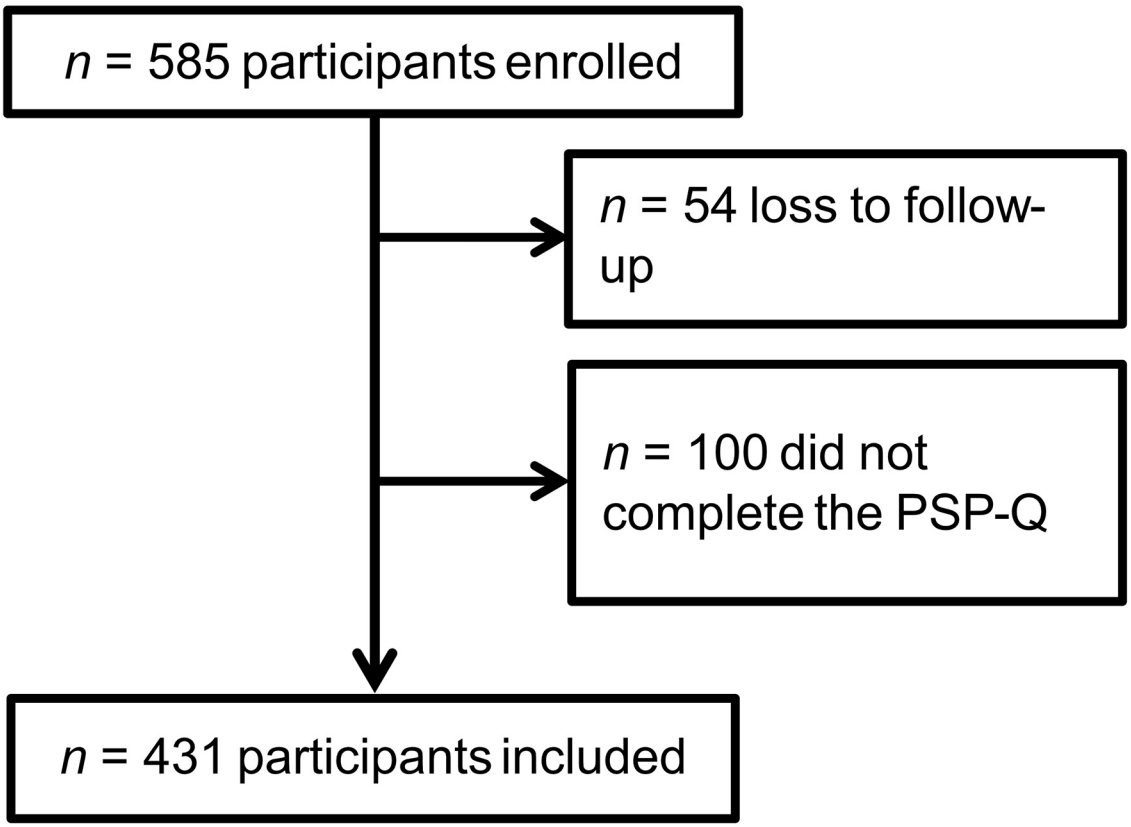

FIGURE 1 | Flowchart of participants included in the analysis.

Data Analysis

Data analysis was conducted using two independent random samples stratified by gender. One sample was used for item analysis and exploratory-factor-analysis [EFA] ($n = 215$) to select items and extract factors. The other sample ($n = 216$) was used in confirmatory factor analysis [CFA] to verify the extracted factor structure from the EFA and assess the internal consistency on independent data.

Item Analysis and EFA

The individual items of the PSP-Q were examined using the mean, standard deviation, and the item-total correlation. Items with an item-total correlation of <0.30 were excluded from the final questionnaire.

The set of items were checked for eligibility to conduct an exploratory factor analysis using the KMO [Kaiser-Meyer-Olkin-Criteria] index score and Bartlett's test of sphericity (38, 39). A KMO index score of 0.8 or greater and a statistically significant Bartlett's test of sphericity indicate the eligibility of the items to conduct a principal component analysis [PCA]. The number of extracting factors was examined using parallel analysis (40). A PCA with varimax rotation was used to extract the factors and factor loading. Items were excluded with a factor loading below 0.4 or when a cross-loading between the primary and alternative factor loading with a distance ≤ 0.1 occurred. If an item was excluded the PCA was conducted again without the excluded items.

Construct Validity

To verify the extracted factor structure from the EFA, a confirmatory factor analysis [CFA] was conducted. Several indices were reported to assess the model fit. Reported indices were: Comparative Fit Index [CFI], Tucker Lewis Index [TLI], Root Mean Square Error of Approximation [RMSEA] and Standardized Root Mean Square Residual [SRMSR]. A close Model fit was determined by cut-off thresholds of 0.95 for CFI and TLI, 0.05 for RMSEAR and 0.06 for SRMR (41, 42).

Pearson correlations between the newly-developed questionnaire and already established questionnaires measuring similar constructs were calculated.Value thresholds of 0.1, 0.3, 0.5 stand for a small, medium, and large correlation, respectively (43).

Internal Consistency

Cronbachs α and McDonalds Ω was used to assess the internal consistency of the questionnaire and between individual factors extracted from the EFA. As for Chronbachs and McDonalds Ω

TABLE 1 | Participants characteristics ($N = 431$).

Gender	
Female	241 (57.7)
Male	177 (42.3)
Age, years	
Mean (SD)	58,85 (16,52)
Median (IQR)	58 (23)
<40	60 (14.0)
40–65	210 (49.0)
>65	159 (37.1)
School education[a]	
Low	80 (19.2)
Middle	124 (29.8)
High	200 (48.1)
Other	12 (2.9)
Household*	
Parenting	74 (17.2)
Single parent	8 (1.9)
Living alone	105 (24.4)
Care of relatives	45 (10.4)
Morbidities*	
Hypertension	173 (40.1)
Heart failure	14 (3.2)
Diabetes type 2	31 (7.2)
Chronic obstructive pulmonary disease	14 (3.2)
Risk group*	
80+	57 (13.6)
Immunosuppressed	294 (70.3)
Active oncological treatment	94 (22.5)

*If not other stated data is n (%), *multiple selection possible, [a]school education is based on secondary school level; SD, standard deviation; IQR, Interquartile range.*

values $\alpha \geq 0.7$ can be interpreted as acceptable, ≥ 0.8 as good and ≥ 0.9 as excellent (44, 45).

Further scores of the PSP-Q are tested with the Kolmogorov-Smirnov and Shapiro-Wilk test for a normal distribution. A non-significant result indicated a normal distribution of the data. The excess kurtosis and skewness will be additionally reported where values between −2 and +2 indicated a normal distribution of the data (46).

The statistical analysis was performed using the statistic software SPSS Version 27 (IBM, Armonk, NY) and R (Version 4.1.1). R was used to conduct and visualize the EFA, CFA and calculate Chronbachs alpha using the packages lavaan, lavaanPlots, paran and psych (47–50). If not stated otherwise, results were considered statistically significant if the p value was ≤ 0.05.

Ethics

The study received approval by the Ethics Committee of the University Medical Center Göttingen (No. 29/3/21). All participants gave their written consent. The CoCo Immune Study is registered in the German Clinical Trials Register, an approved Primary Register in the WHO network (DRKS00023972).

RESULTS

In total, 585 participants were enrolled in the study of which 54 were lost to follow-up (9.2%). Of these persons, 431 participants completed PSP-Q with all 27 items and this data was used for further statistical analysis (**Figure 1**). This data results in an item to participants' ratio of 1:15.9. The first participant completed the survey on March 30, 2021 and the last participant on September 2, 2021. The included participants were mostly female (57.7%). The ages ranged from 18 to 97 years with a mean age of 58.9 years. Nearly half of the participants (48.1%) had a college preparatory school education level (**Table 1**).

Item-total correlations varied between 0.06 and 0.49, where eight items had an item-total correlation bellow 0.3 and were therefore excluded from further analysis. The remaining 19 items were eligible for an EFA with a Kaiser–Meyer–Olkin statistic of 0.82. The Bartlett's test of sphericity was also significant ($x2(171) = 936$, $p < 0.01$). Using parallel analysis adjusted eigenvalues ≤ 1 indicate three factors to extract in EFA. Using EFA four items had factor loadings <0.4 and one item had cross-loading with a distance ≤ 0.1. These five items were therefore excluded from further analysis. The EFA was recalculated without the excluded items and identified three latent constructs which explained 51.0% of the total variance (see **Figure 2**). The highest factor loadings on each item ranged from 0.48 to 0.74 (**Table 2**). The three extracted factors were interpreted by the researchers as domains of "wellbeing" (F1), "active social participation" (F2), and "restrictions" (F3).

The model fit indices of the three-factor model revealed by the EFA were: CFI = 0.94; TFI = 0.93; RMSEA = 0.054 (90% CI [0.036 – 0.070]) and SRMR 0.07 (**Figure 3**). Only RMSEA indicate a close model fit.

Significant negative correlations were found between the PSP-Q and all other included scales. A medium correlation could be found in the IMET, PHQ-4 and its sub-scales. Subjective health status indicates a small correlation and quality of life indicates a medium correlation with the PSP-Q. The second subscale interpreted as "active social participation" showed no significant correlation regarding the other included constructs (**Table 3**).

To measure the internal consistency of the PSP-Q, Chronbachs α and McDonalds Ω was calculated. The PSP-Q as a whole had an α 0.81 where the α of the individual factors ranged from 0.70 to 0.78. McDonalds Ω was 0.84 for the whole scale and between 0.76 and 0.72 on the individual factors (**Table 4**).

Sum scores of the PSP-Q ranged in the analyzed sample of 431 participants between 18 and 70 with a mean of 45.43 with a standard deviation of 10.64. Both, the Shapiro-Wilk test (p 0.58) and Kolmogorov-Smirnov test (p 0.13), yields a non-significant result which indicates a normal distribution of the questionnaire scores. Excessive kurtosis (−0.34) and skewness (−0.14) of the PSP-Q score distribution supports the Shapiro-Wilk and Kolmogorov-Smirnov test statistic with not crossing the cutoffs −2 or +2.

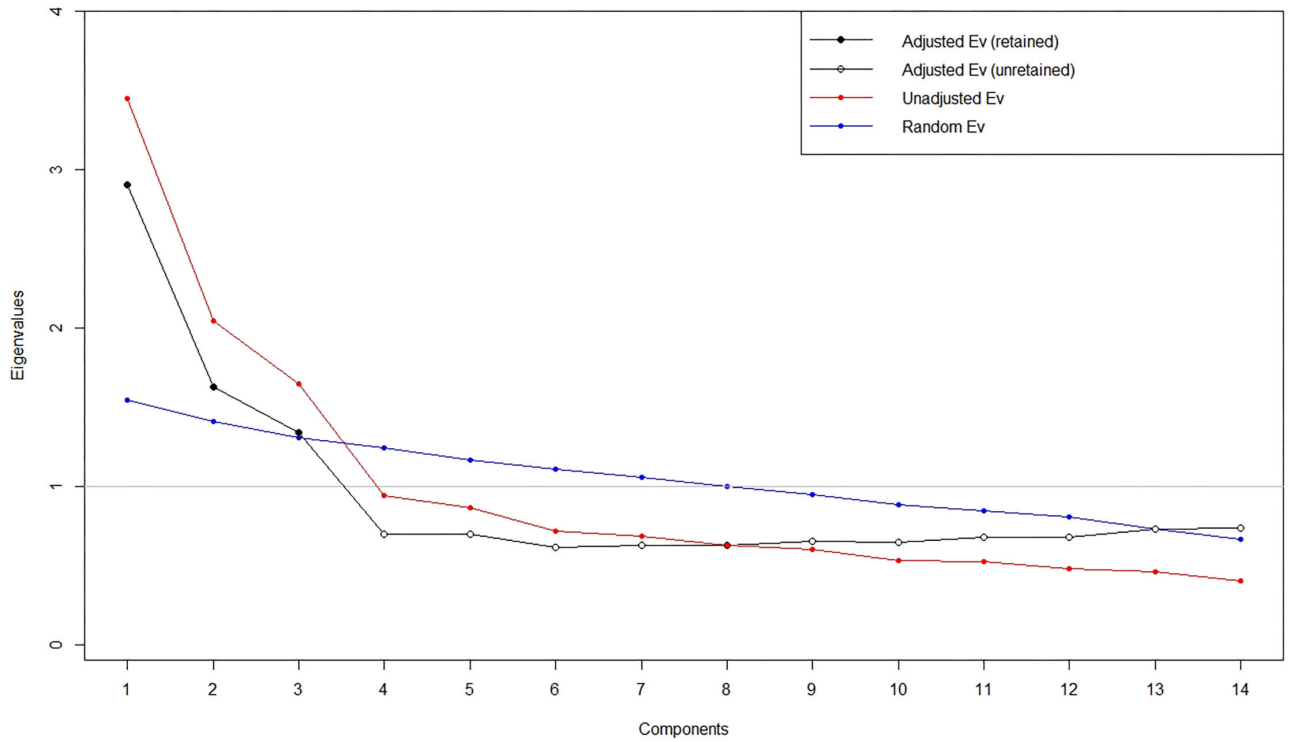

FIGURE 2 | Parallel analysis scree plot.

TABLE 2 | Factor loadings of the final items included in the PSP-Q.

	Factor 1	Factor 2	Factor 3
% of Varaince explained	**24.7**	**14.6**	**11.8**
Wellbeing 1	**0.52**		
Wellbeing 2	**0.48**		
Wellbeing 3	**0.55**		
Wellbeing 4	**0.57**		
Wellbeing 5	**0.52**		
Wellbeing 6	**0.61**		
Active social participation 1		**0.60**	
Active social participation 2		**0.74**	
Active social participation 3		**0.68**	
Active social participation 4		**0.56**	
Restrictions 1	0.36		**0.55**
Restrictions 2			**0.68**
Restrictions 3			**0.64**
Restrictions 4			**0.43**

Factor loadings < 0.3 are omitted. Bold values indicate the assigned factor for each item.

DISCUSSION

Summary of Main Findings

The COVID-19 pandemic presents us with new challenges. Previous (social) participation questionnaires were developed for use in rehabilitation studies and these instruments focus on health impairments, social and work integration. With the COVID-19 pandemic, additional dimensions need to be addressed such as close social contact with family and friends and social restrictions. To add these pandemic-relevant aspects to existing dimensions of social participation, we developed the PSP-Q consisting of 14 items. Our results show that the PSP-Q is of high reliability and validity and can be used to measure social participation during a pandemic.

Social participation is a key construct reflecting a person's interactions with others and is associated with other constructs reflecting various health outcomes. Any medical treatment should aim to maintain or restore social participation. The recent COVID-19 pandemic and the social implications of the public health restrictions to decrease the spread of the SARS-CoV-2 virus have still not been fully explored. In particular, persons with at high risk for a severe COVID-19 disease course are challenged with complicated risk assessments about how much they should abstain from meeting others and engaging in social activities. Many uncertainties arise also regarding vaccines and vaccinations. Social participation can be a good concept to assess the impact of these challenges and uncertainties on behavior. The PSP-Q also expands the perspective about the impact of COVID-19 restrictions, measuring dimensions beyond the sphere of mental symptoms.

Already published studies measuring social participation in the COVID-19 pandemic have used newly-developed

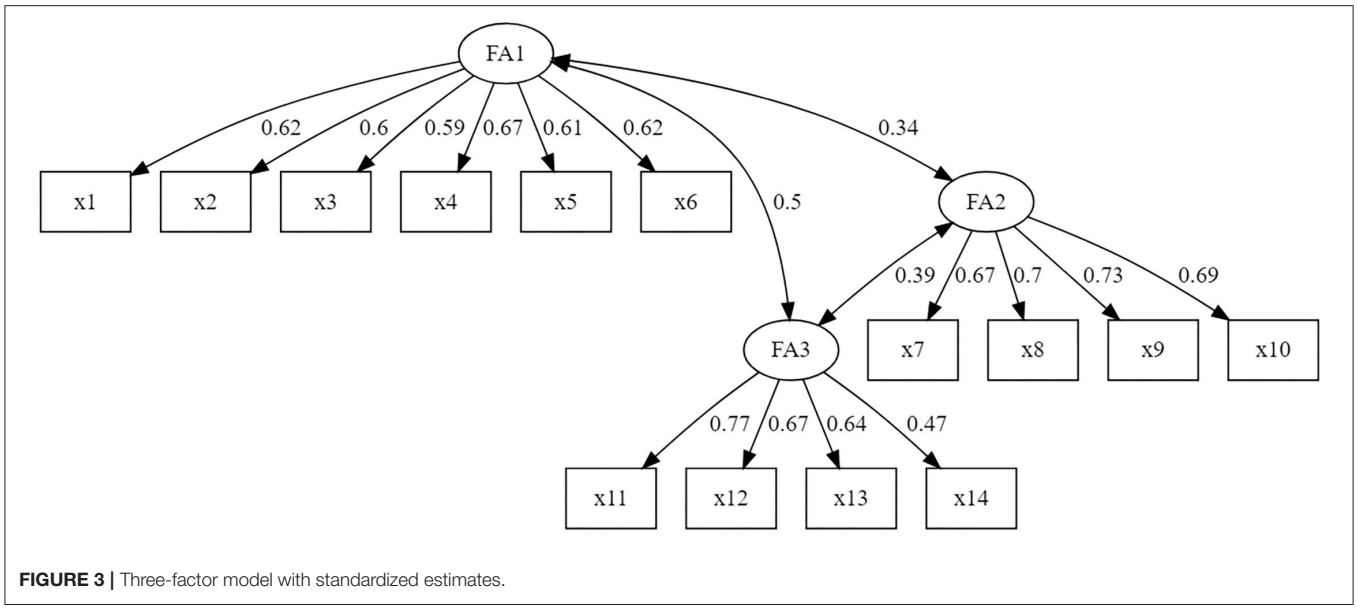

FIGURE 3 | Three-factor model with standardized estimates.

TABLE 3 | Correlation between the PSP-Q and its subscales.

	PSP-Q	PSP-F1	PSP-F2	PSP-F3
IMET	**−0.34**	**−0.47**	−0.01	**−0.27**
PHQ-4	**−0.43**	**−0.58**	−0.05	**−0.30**
PHQ-2	**−0.41**	**−0.59**	−0.05	**−0.36**
GAD-2	**−0.36**	**−0.47**	−0.05	**−0.29**
Subjective health status	**−0.21**	**−0.27**	−0.03	**−0.24**
Quality of life	**−0.30**	**−0.42**	0.01	**−0.26**

Bold indicates a significant association ($p < 0.05$); IMET, Index for the Assessment of Health Impairments; PHQ-4, Patient Health Questionnaire-4; PHQ-2, Patient Health Questionnaire-2; GAD-2, Generalized Anxiety Disorder Scale-2.

TABLE 4 | Chronbachs α of the PSP-Q and it subscales.

	Chronbachs α (95% CI)	McDonalds Ω
PSP-Q (14 items)	0.81 (0.78–0.85)	0.87
Factor 1 (6 items)	0.79 (0.74–0.83)	0.79
Factor 2 (4 items)	0.79 (0.74–0.83)	0.79
Factor 3 (4 items)	0.73 (0.67–0.79)	0.75

questionnaires or modified already existing scales that are not validated (19). Mergel and Schützwohl (22) used the IMET a participation scale developed to measure rehabilitation success to assess the effect of the pandemic lockdown in Germany on social participation (22). The PSP-Q could provide further insights regarding these research topics. Between the IMET and PSP-Q only a medium correlation was found. Further the subsscale "active social participation" shows no correlation with the IMET and other health-related measures. Our results show that the PSP-Q measures different aspects of social participation than the IMET and may reflect the social participation a pandemic more appropriate during. A comparison of these two measures in a longitudinal study evaluating different social restrictions during the pandemic is needed to reveal further differences between the two scales. Ammar et al. (19) found a negative impact of home confinement on social participation using a modified version of the Short Social Participation Questionnaire that was not validated (19). While the PSP-Q reflects the subjective agreement with a given statement the modified version of the Short Social Participation Questionnaire measures the actual social participation in a time frame.

The PSP-Q consists of 14 items which is on par with already existing multidimensional scales measuring participation (51–53). Further research should implement the PSP-Q in longitudinal studies to measure the influence of various population restriction measures and the effect of vaccination campaigns upon individual levels of social participation. One such policy example is the lifting of social restrictions in some countries (e.g., Denmark) with the COVID-19 pandemic still ongoing. Also, cultural differences need to be considered. In addition, the questionnaire was not exclusively designed for the current COVID-19 pandemic, but could also be used to measure social participation in other communicable diseases with pandemic or endemic dimensions. Possible implementation of the PSP-Q beyond the COVID-19 pandemic could include regional influenza epidemics. The PSP-Q is available in the **Supplementary Material** in German. An English translation of the questionnaire is included for reference, but this version was not used during the validation.

Limitations

The development and validation of the questionnaire comes with limitations. Due to the pandemic situation and high-risk adults as the target group, the study was done with a minimium of personal contact and was therefore carried out in a more pragmatic way. For example, in-person focus group discussions with target or expert groups were not possible during the development of the questionnaire.

Over 25% of the participants of the initial 535 participants were excluded due to loss-to-follow-up or missing items in the PSP-Q. A loss-to-follow bias cannot be prevented. Also, missing answers could not be completely at random and therefore biased. The items of the questionnaires are to date only available in the German language. Persons with a high risk for severe COVID-19 infection in our sample were mostly taking immunosuppressive medication (70.3%). Only 13.6% of the sample were 80 years or older. Only high-risk adults were included which is why the use of the PSP-Q on a different target group needs re-validation.

The total explained variance by the three latent factors was 51.0%. Items with a factor loading below 0.4 on the highest loading factor were excluded. In the literature, this value differs between 0.3 and 0.5 with no clear consensus. As reliability criteria, only internal consistency was used in this analysis. The retest reliability was not feasible because social participation would differ between different time points during a pandemic e.g., with changing restrictions regarding social gatherings and cultural events. Only RMSEA met the criteria for a close model, where the other model fit indicies were close to the the cut off values and can be intereted as acceptable model fit. The choice of cut-off values of model fit indices varies in the literature with no clear consensus.

CONCLUSION

The PSP-Q is a valid and reliable questionnaire with 14 items which assess social participation of high-risk groups during a pandemic. The sub-domains of the PSP-Q measure the dimensions "wellbeing," "active social participation," and "restrictions." The strong correlation between the PHQ-4 and the sub-domain "wellbeing" of the PSP-Q showed an association between social participation and mental health. Nevertheless, the dimension "active social participation" showed no correlation with other questionnaires, indicating a missing dimension in the existing instruments. The PSP-Q can be used to measure the effect of various interventions and changes during the pandemic with regards to the effects upon social participation (e.g., social restrictions and vaccination progress) in high-risk groups.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the University Medical Center Göttingen. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

FM and AJ: research design. FM, GH, JN, TO, and JK: data collection. DS and FM: data analysis, interpreting results, and writing first draft. SS and SH: english-language editing. All authors writing and contributing to writing of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.831087/full#supplementary-material

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Factors Associated With Depressive Symptoms in Individuals Who Have Experienced COVID-19 Self-Quarantine

Hye-Young Jang[1], *Young Ko*[2*] *and Song-Yi Han*[3]

[1] School of Nursing, Hanyang University, Seoul, South Korea, [2] College of Nursing, Gachon University, Incheon, South Korea, [3] Department of Nursing Science, Sunmoon University, Asan-si, South Korea

The purpose of this study was to identify the factors associated with depressive symptoms in individuals who have experienced self-quarantine because of coronavirus disease exposure or infection using Lazarus and Folkman's stress, coping, and adaptation theory, and George's Social Antecedent Model of Depression. This was a cross-sectional study that used data from the 2020 Korean Community Health Survey. A complex sample design was used to analyze the data. Descriptive statistics, the Rao-Scott X^2 test, and logistic regression analysis were conducted to identify factors associated with depressive symptoms. Approximately 5.3% of the subjects had depressive symptoms. The factors associated with depressive symptoms were age, level of education, household income, changes in daily life due to coronavirus disease, whether someone provided assistance during the self-quarantine, perceived health status, and hospital consultation due to depressive symptoms. The findings of this study will be utilized as basic data for the development of programs to alleviate and prevent depressive symptoms in self-quarantine individuals.

Keywords: coronavirus, COVID-19, COVID-19 measures, depressive symptom, self-quarantine

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***Correspondence:**
Young Ko
moodory@gmail.com

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INTRODUCTION

In March 2020, the World Health Organization declared coronavirus disease (COVID-19) a pandemic, in order to promote international cooperation and response. Many countries have established COVID-19 measures, such as social distancing and quarantining to prevent the spread of the disease (1).

In particular, proper management and control of individuals who are in contact with COVID-19 infected patients are of utmost importance to prevent the spread of COVID-19. In Korea and many other countries, infected patients and those who have been in close contact with infected patients are isolated for 2 weeks as a primary response (2–4). Individuals under self-quarantine are physically isolated and prohibited to make any direct contact with others and to share daily items with others for at least 14 days. Public health officers monitor them by the self-quarantine safety protection app (5).

Such physical isolation is effective in preventing the spread of COVID-19; however, self-quarantine measures not only limit the interactions of the quarantined individual, but also have negative economic, emotional, and social effects on him or her (6–8). Lee et al. (9) showed that

individuals practicing self-quarantine are highly likely to experience fear and uncertainty about infection and psychological withdrawal. In addition, interruptions in their social relationships lead to a sense of loss, depression, anxiety, stress, and fear of stigmatization, and isolation of their family members further causes psychological pain such as guilt and depression (6–8). Therefore, it is important to minimize the negative consequences of self-quarantine on mental health.

Previous studies on self-quarantine and depression due to infectious diseases found that 31.2% of those in self-quarantine due to severe acute respiratory syndrome showed depressive symptoms, and 3.0% of individuals who were in contact with patients with Middle East respiratory syndrome showed depressive symptoms after self-quarantine. In addition, the incidence of depression has been found to be 2.5 times higher in those who have experienced self-quarantine than in those who have not (3, 10, 11). A study on adults in the United States indicated that the prevalence of depression was three-folds higher during the COVID-19 pandemic than before the pandemic (12). In Korea, in 2020, 22.8% of adults aged 19 years or older were at risk for depression, which was six times higher than the 3.8% reported for 2018, before the COVID-19 pandemic (13). These findings suggest that depression experienced by those in self-quarantine results from the stress of adapting to sudden environmental changes. As the prevalence of depression is high in those practicing self-quarantine, it is necessary to systematically analyze the relationship between risk factors and depression in this group. Therefore, in this study, we applied Lazarus and Folkman's (14) stress, coping, and adaptation theory and George's (15) Social Antecedent Model of Depression (SAMD) to identify the factors of depression in individuals who have experienced self-quarantine because of coronavirus disease exposure or infection. The SAMD includes biological, psychological, and social factors rather than the fragmentary aspects of the cause of depression (15) and is ideal for the systemic evaluation of various factors related to depression in those who were in self-quarantine due to COVID-19.

Therefore, we identified the risk and buffering factors for depression in those who were in self-quarantine due to COVID-19 and provided basic data to improve our understanding of depression in this group and to seek adequate measures for treatment and prevention.

Conceptual Framework

To identify the factors of depression in subjects who had experienced self-quarantine during COVID-19, Lazarus and Folkman's (14) stress, coping, and adaptation theory, and George's (15) SAMD were used to establish the conceptual framework of the study (**Figure 1**). Lazarus and Folkman's (14) theory has been used as a theoretical framework in many previous studies on stress, coping, and adaptation by systematically and logically explaining the overall process of evaluation, coping, and adaptation and causal antecedents of stressful events. In addition, George's (15) theory explains the relationship between depression and various factors at different stages to systematically and comprehensively measure the factors affecting depression. The SAMD has six stages: (1) demographic factors; (2) early life events and achievements; (3) later life events and achievements; (4) social integration; (5) vulnerability and protective factors; and (6) provoking and coping efforts.

The conceptual framework used in this study was constructed by modifying the factors of each stage of the SAMD to consider the situational characteristics of self-isolated individuals during the COVID-19 pandemic. Contextual factors included general characteristics of the subjects (age, gender, education, occupation, economic status) and recent events (changes in daily life due to COVID-19). Factors related to individual cognition and coping included social integration (whether someone provided assistance during the self-quarantine), vulnerability factors (perceived health status), protective factors (marital status, living arrangement), and coping factors (hospital consultation due to depressive symptom). The negative outcome variable was depression.

MATERIALS AND METHODS

Research Design

This was a cross-sectional study that used data from the 2020 Korean Community Health Survey (KCHS) to identify factors associated with depressive symptoms among individuals who had experienced self-quarantine during the COVID-19 pandemic using Lazarus and Folkman's (14) stress, coping, and adaptation theory and George's (15) SAMD.

Participants and Data

This study analyzed data from the KCHS. Since 2017, the Research Ethics Review Committee (RERC) of the Centers for Disease Control and Prevention decided that the KCHS corresponds to a study conducted by the state for public welfare. Therefore, on the basis of the opinion that it is possible to conduct an investigation without the approval of the RERC, data were collected without review by the RERC. Written informed consent was obtained from all subjects before participation. The data were collected in accordance with the disclosure and management regulations of the Korea Disease Control and Prevention Agency. We conducted this study with the approval of the institutional review board of the Gachon University to which the researchers belong (No. 1044396-202109-HR-198-01).

The KCHS has been conducted annually since 2008 by the Korea Disease Control and Prevention Agency to provide population-based statistics for developing and evaluating national healthcare plans. The KCHS is a nationwide, community-based health survey and the target population is adults aged 19 years or older living in local communities across the country. The selection of survey households was carried out in a two-stage design. In the first stage, sample areas were extracted by the probability-proportional-to-size sampling, in the second stage, the households were extracted by the systematic sampling (16). A total of 765 trained interviewers (3 interviewers per 255 public health centers) who have received training related to the survey visited the sampled households and conducted one-on-one computer assisted personal interviews (CAPI). The data were collected from August 16 to October 31, 2020, and a total of 229,269 subjects participated in the 2020 KCHS, This

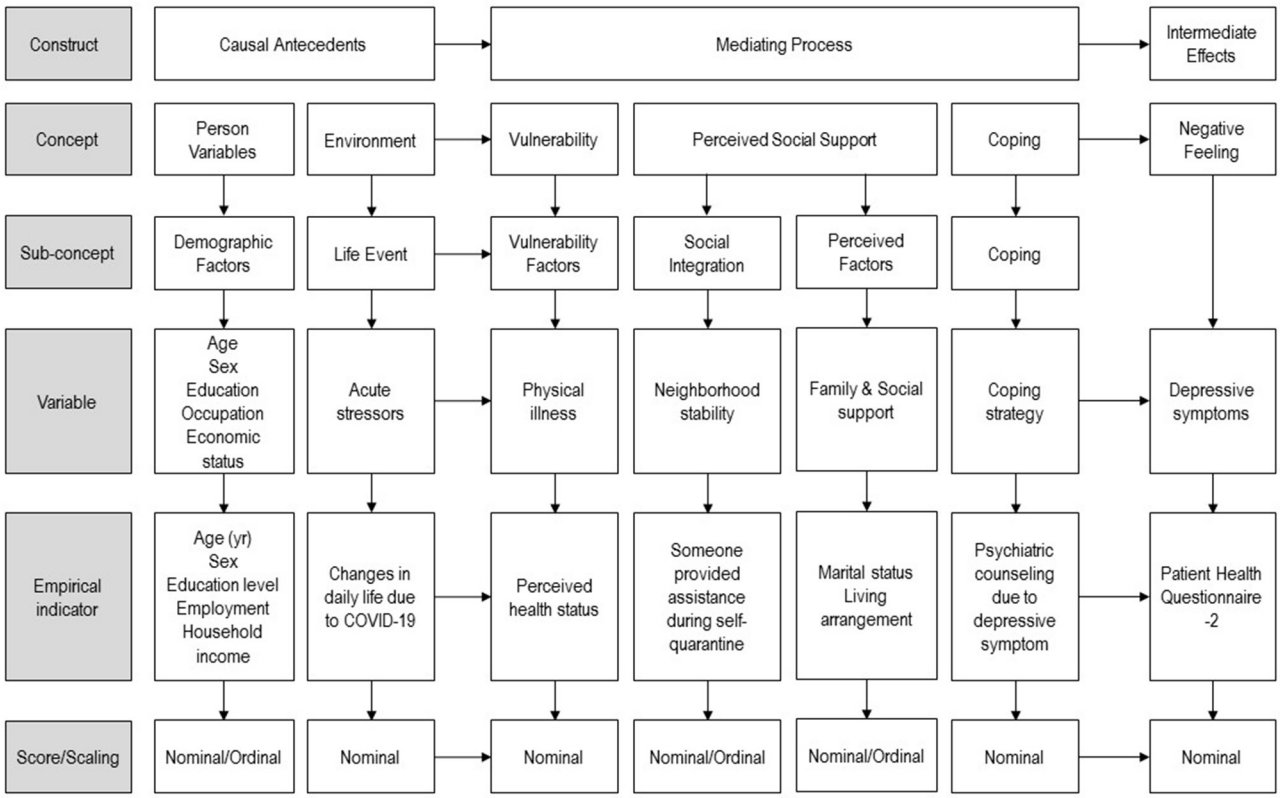

FIGURE 1 | Substruction model of the theory of this study.

study was conducted on 1,071 subjects who had experienced self-quarantine during COVID-19 among 229,269 subjects.

Study Variables

The following study variables were included, based on George's (15) SAMD:

Demographic Characteristics

The demographic characteristics of the study subjects included age, gender, education level, employment, and household income. Age was classified as <40 years, 40–64 years, and >65 years, and education level was classified as elementary school, middle school, high school, and college. Employment was classified as currently employed or unemployed, and household income was classified as <1 million won, 1–2.99 million won, 3–4.99 million won, and >5 million won.

Life Event

Life event referred to changes in daily life due to COVID-19. The state of daily life before the COVID-19 pandemic was considered 100 points, complete stoppage of daily life was assigned a score of 0, and no change was given a score of 100 points. Lower scores indicated greater changes in daily life.

Vulnerability

Vulnerability was determined by perceived health status, which was measured with the question "How do you usually feel about your health?" The question was scored on a scale ranging from 1 ("very good") to 5 ("very bad") points. A higher score indicated worse perceived health status. Perceived health status has good validity as a strong predictor of morbidity, mortality, and use of health care services among various subjects (17, 18) and reported good test–retest reliability (19).

Social Integration and Protective Factors

Social integration and protective factors were used to measure the level of family and social support. They included marital status, living arrangement, and whether another person provided assistance during the self-quarantine. Marital status was classified as married or not married (single, divorced, or widowed). Living arrangement was classified as living alone or living with others. The question on whether another person provided assistance during the self-quarantine was answered as "yes" or "no."

Coping

Coping was measured as consultations with psychiatrists for depressive symptoms, which was classified as "yes" or "no."

Depressive Symptoms

Depressive symptoms was measured using the Patient Health Questionnaire-2 (PHQ-2) (20). The PHQ-2 is a self-reporting test to screen for depression, which consists of questions 1 and 2 of the Patient Health Questionnaire-9. Among the diagnostic criteria for major depressive disorder listed in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders, it consists of two areas: depressed mood and decreased interest, which are core symptoms included in the PHQ-2. Responses are scored on a 4-point Likert scale, ranging from 0 ("not at all") to 3 ("almost every day"), with the total score ranging from 0 to 6. In this study, a total score of 3 or higher indicated that the subject had depressive symptoms.

Data Analysis

This study used raw data from the 2020 KCHS, which was a stratified sampling design rather than a simple random sampling design, so it is recommended to apply the complex sampling design for analysis (16). Therefore, we analyzed the data using a complex sample design by applying weights, stratification, and cluster. Descriptive statistical analysis was conducted on the measured variables, and the difference in depressive symptoms according to the measured variables was analyzed using the Rao-Scott X^2 test. Logistic regression analysis was conducted to identify the factors associated with depressive symptoms. The SPSS/WIN 22.0 program (SPSS, Chicago, Illinois, USA) was used, and the statistical significance level was set to $p < 0.05$.

RESULTS

General Characteristics of the Subjects

Of all the subjects, 53.4% were men and 46.6% were women. The average age was 40.01 years. In addition, 63.8% had a college or higher level of education, 42.7% of the household income was 5 million won or more, and 62.7% were employed. The average score for changes in daily life due to COVID-19 was 48.92 out of 100, and the average score for perceived health status was 2.26 out of 5. It was also found that 51.1% were married, and 13.7% lived alone. Eighty-seven of the subjects had someone who could help them during self-quarantine, and 2.1% of the subjects underwent psychiatric counseling for depressive symptoms (**Table 1**).

There were significant differences in depressive symptoms in terms of age ($\chi 2 = 79.59$, $p < 0.001$), household income ($\chi 2 = 11.16$, $p < 0.001$), changes in daily life due to COVID-19 ($\chi 2 = 4.93$, $p < 0.001$), perceived health status ($\chi 2 = -4.14$, $p < 0.001$), marital status ($\chi 2 = 14.52$, $p < 0.001$), living arrangement ($\chi 2 = 33.43$, $p < 0.001$), whether someone provided assistance during the self-quarantine ($\chi 2 = 8.76$, $p < 0.001$), and psychiatric counseling for depressive symptoms ($\chi 2 = 139.39$, $p < 0.001$) (**Table 1**).

Factors Related to Depressive Symptoms

Factors related to depressive symptoms were verified using logistic regression analysis. Being aged 40–64 years [odds ratio (OR) 0.35, 95% confidence interval (CI) = 0.24–0.51], being aged >65 years (OR 0.02, 95% CI = 0.01–0.05), having less than a middle school education (OR 1.98, 95% CI = 1.14–3.44), having a household income <1 million won (OR 5.71, 95% CI = 1.77–18.40), having a household income between 1 and 2.99 million won (OR 2.35, 95% CI = 1.29–4.29), having a household income between 3 and 4.99 million won (OR 2.13, 95% CI = 1.23–3.71), having had changes in daily life due to COVID-19 (OR 0.98, 95% CI = 0.96–0.98), with poor perceived health status (OR 1.49, 95% CI = 1.14–1.93), having not been provided with assistance during the self-quarantine (OR 1.79, 95% CI = 1.13–2.84), and having undergone psychiatric counseling for depressive symptoms (OR 5.00, 95% CI = 2.92–8.57) had statistically significant associated with depressive symptoms (**Table 2**).

DISCUSSION

We identified the factors associated with depressive symptoms in individuals who had experienced self-quarantine due to COVID-19 using Lazarus and Folkman's (14) stress, coping, and adaptation theory and George's (15) SAMD.

The prevalence of depressive symptoms identified in this study was higher than that observed in the 2019 KCHS conducted before the COVID-19 pandemic. In a study on adults in the United States, the prevalence of depressive symptoms increased by more than three-fold from 8.5% before the pandemic to 27.8% after the pandemic (12). In another study of 4,335 adults conducted in Germany (6), 31.1% of adults had depression during the pandemic. In addition, 307 (26.5%) out of 1,160 adults had depression during the pandemic in China (11). These results suggest that the COVID-19 pandemic negatively affects mental health. However, the prevalence of depressive symptoms in our study was low compared with other countries, and this may be attributed to the effects of national psychological prevention measures. In Korea, the Ministry of Health and Welfare has formed an integrated psychological support group to provide psychological support such as telephone and face-to-face counseling for the general public, infected individuals and their families, those in self-quarantine, and families of those who died due to COVID-19 infection (21). There is evidence that these measures have lowered the prevalence of depressive symptoms during the pandemic. In addition, according to a report from the Organization for Economic Co-operation and Development, the prevalence of mental health is affected by the strictness of a country's quarantine policies and the number of deaths due to COVID-19 (22). At the time of this study's data collection, the fatality rate due to COVID-19 was 2.03%-3.67% in the United States and Europe, 5.65% in China higher than 1.54% in Korea, which may have affected the prevalence of depression due to COVID-19 (23).

The contextual factors that related to depressive symptoms were age, level of education, and economic status. Consistent with previous findings, younger age and lower education levels were associated with greater depression (6, 11, 24–26). In addition, lower income was associated with higher levels of depression.

This finding corresponds with those of previous studies that indicated that financial problems cause serious socioeconomic distress and increase depression (2, 11, 12, 21, 26). Brooks et al.

TABLE 1 | General characteristics of subjects ($N = 1,071$).

Variable	Category	Total *n* (%) M ± SE	Depressive symptoms		Rao-Scott χ^2(p) /t(p)
			No *n* (%) or M ± SE	Yes *n* (%) or M ± SE	
Demographic factors					
Age (years)		40.01 ± 0.31	40.31 ± 0.33	34.43 ± 0.73	
	<40	501 (46.8)	465 (92.4)	36 (7.6)	79.59 (<0.001)
	40–64	414 (38.7)	397 (96.9)	17 (3.1)	
	≥ 65	156 (14.5)	152 (99.4)	4 (0.6)	
Gender	Men	572 (53.4)	538 (94.3)	34 (5.7)	0.81 (0.370)
	Women	499 (46.6)	476 (95.0)	23 (5.0)	
Level of education	≤Middle school	140 (13.1)	132 (94.4)	8 (5.6)	1.29 (0.268)
	High school	247 (23.1)	235 (95.9)	12 (4.1)	
	≥ College	684 (63.8)	647 (94.3)	37 (5.7)	
Household income (unit: KRW 10,000 won/ month)	<100	86 (8.0)	78 (86.3)	8 (13.7)	11.16 (<0.001)
	100–299	248 (23.2)	231 (91.9)	17 (8.1)	
	300–499	280 (26.1)	263 (93.3)	17 (6.7)	
	≥500	445 (42.7)	430 (97.1)	15 (2.9)	
Employment	Yes	671 (62.7)	640 (95.1)	31 (4.9)	1.14 (0.287)
	No	400 (37.3)	374 (94.0)	26 (6.0)	
Life event					
Changes in daily life due to COVID-19		48.92 ± 0.52	49.53 ± 0.53	38.12 ± 2.24	4.93 (<0.001)
Vulnerability factors					
Perceived health status		2.26 ± 0.02	2.25 ± 0.02	2.60 ± 0.08	−4.14 (<0.001)
Social integration and protective factors					
Marital status	Yes	578 (54.0)	557 (96.1)	21 (3.9)	14.52 (<0.001)
	No	493 (46.0)	457 (93.2)	36 (6.8)	
Living arrangement	Living with others	924 (86.3)	878 (95.2)	46 (4.8)	33.43 (<0.001)
	Living alone	147 (13.7)	136 (90.2)	11 (9.8)	
Whether someone provided assistance during the self-quarantine	Yes	932 (87.0)	889 (95.1)	43 (4.9)	8.76 (0.004)
	No	139 (13.0)	125 (91.5)	14 (8.5)	
Coping					
Psychiatric counseling due to depressive symptom	Yes	23 (2.1)	16 (68.3)	7 (31.7)	139.39 (<0.001)
	No	1,048 (97.9)	998 (95.1)	50 (4.9)	

(2) reported that individuals with low incomes are more likely to be affected by temporary income loss during self-quarantine than those with high incomes. Therefore, if possible, financial compensation should be provided to individuals with low income who self-quarantine, and policies should be developed to provide such compensation.

Our findings showed that changes in daily life due to COVID-19 had related to depressive symptoms, with greater changes in daily life being associated with higher depressive symptoms. Similar findings were observed in previous studies (6, 25, 27) in which changes in daily life, such as social distancing, working from home, delayed first day of school, and difficulties in using hospitals due to COVID-19, may lead to various psychological problems such as personal stress, anxiety, depression, fear, anger, and loneliness. Also, in a qualitative study examining the experiences of the older adults about the changes in their daily life due to COVID-19, similar findings were observed which complained of boredom, isolation, depression and anxiety while experiencing limited use of welfare centers for the elderly and job interruption (28). In particular, changes in daily life can lead to conflicts in various relationships. Increased time spent at home due to the COVID-19 pandemic has led to more family conflicts (21), and at school and work, conflicts in interpersonal relationships over prevention measures such as wearing masks have increased (29). Such mistrust and conflicts in relationships can lead to secondary traumatic experiences and severe depression (30–33). Therefore, to minimize the changes in daily life due to COVID-19 and to aid individuals in adapting and

TABLE 2 | Logistic regression ($N = 1,071$).

Variable	Category	OR (95% CI)	*p*
Demographic factor			
Age (years)	<40	1 (referent)	
	40–64	0.35 (0.24–0.51)	<0.001
	≥65	0.02 (0.01–0.05)	<0.001
Gender	Men	0.88 (0.63–1.22)	0.431
	Women	1 (referent)	
Level of education	≤Middle school	1.98 (1.14–3.44)	0.016
	High school	0.79 (0.37–1.68)	0.534
	≥College	1 (referent)	
Household income	<100	5.71 (1.77–18.40)	0.004
(unit: KRW 10,000 won/month)	100–299	2.35 (1.29–4.29)	0.006
	300–499	2.13 (1.23–3.71)	0.008
	≥500	1 (referent)	
Employment	Yes	1 (referent)	0.167
	No	1.42(0.86–2.32)	
Life event			
Changes in daily life due to COVID-19		0.98 (0.96–0.98)	<0.001
Vulnerability factors			
Perceived health status		1.49 (1.14–1.93)	0.003
Social integration and protective factors			
Marital status	Yes	1 (referent)	0.175
	No	0.78 (0.54–1.12)	
Living arrangement	Living with others	1 (referent)	0.084
	Living alone	1.58 (0.94–2.67)	
Whether someone provided assistance during the self-quarantine	Yes	1 (referent)	0.014
	No	1.79 (1.13–2.84)	
Coping			
Psychiatric counseling due to depressive symptom	Yes	5.00 (2.92–8.57)	<0.001
	No	1 (referent)	

CI, confidence interval; OR, odds ratio.

coping with new daily lifestyles, active countermeasures must be sought. Moreover, efforts are required to reduce the conflicts that may occur in various relationships.

We observed that the presence of someone who could help during self-quarantine was a protective factor against depressive symptoms. In this study, social support did not refer to the level of actual help, but perceived support that subjects could rely on someone for help when needed. This suggests that the perception of a social network rather than the actual exchange of social relationships may help alleviate depression (34). Previous studies showed that social support has positive effects, such as reducing depression through the actual exchange of resources (9, 35, 36), and based on these findings, measures focusing on offline-centered direct interactions through expansion of social networks have been mainly suggested. However, quarantine measures on social distancing limit the active implementation of such strategies. Therefore, our findings on the effects of perceived support may be significant for the reduction of depressive symptoms during the COVID-19 pandemic, in which prevention is heavily focused on social distancing. Perceived social support and mutual trust are strong protective factors for mental health and act as universal psychological safety nets (37). Thus, during the COVID-19 pandemic, which limits direct interactions between individuals, it is important to maintain a positive psychological bond with friends and neighbors using various resources, such as active communication by phone, e-mail, and social network services. In a qualitative study of college students' experiences of daily life changes due to COVID-19, psychological bonding was expressed as "the aesthetics of triviality," he said that when he was surrounded by feelings of isolation, the other person sensitively grasped it, paid attention to it, and was grateful for a simple call asking for his/her best regards (38). Such psychological bonding promotes emotional stability and self-esteem for psychosocial adaptation and enhances problem-solving ability, thereby having positive effects on mental health (39).

In our study, poor perceived health status was a vulnerability factor, leading to greater depressive symptoms. This finding is consistent with those of previous studies (9, 40). Perceived health status is more closely related to depressive symptoms

than chronic disease and functional status, which are objective indicators of physical health. Therefore, to help promote positive perceived health status, measures such as online health promotion, physical exercise, and health education programs are necessary during the COVID-19 pandemic.

Our data showed that depressive symptoms were higher in those who received psychiatric counseling for depression. In agreement with our findings, a previous study showed that experiences of counseling or treatment for depression are a behavioral coping style to overcome depressive symptoms and that more experiences of counseling or treatment lead to more depression (41). This means that the experience of treatment for depression is a positive coping behavior to overcome depression, and at the same time, it is a risk factor for exposure to depression or a risk of recurrence (40). Therefore, further in-depth studies should be conducted on the relationship between the experiences of depression treatment and depressive symptoms.

Implications for Public Health

We systematically and comprehensively identified the factors associated with depressive symptoms based on Lazarus and Folkman's (14) stress, coping, and adaptation theory and George's (15) SAMD. Among contextual factors, age, level of education, and economic status were factors related to depressive symptoms, suggesting that policies on COVID-19 measures should consider the characteristics of subjects. In addition, this study is significant as it identified the vulnerability and protective factors of depressive symptoms and provided basic data for the development of programs to alleviate and prevent depressive symptoms in self-quarantine individuals.

As the COVID-19 pandemic continues, long-term measures such as vaccination are being encouraged and efforts such as "With Corona" are being carried out to return to pre-COVID-19 pandemic daily life. However, self-quarantine remains an important preventive measure against the spread of the disease. Therefore, mental health should be a primary concern during self-quarantine. Systems to screen for those with vulnerable mental health before self-quarantine should be established and implemented, and mental health assessments should be regularly conducted even during self-quarantine. Thus, if a high-risk group or a person with symptoms related to mental health is found, active psychological support, such as referral to specialized mental health services, should be provided. In addition, systems to follow up and manage mental health after self-quarantine should be prepared as well, and various psychological support services should be developed to prevent the onset of mental health problems such as depression at an early stage and mental health should not deteriorate through continuous monitoring.

Limitations

Our study has some limitations. First, we used cross-sectional data, there is a limitation in that it is difficult to accurately identify a causal relationship. Second, the PHQ-2 used in this study has limitations as it is a screening tool, not a diagnostic tool. Third, in this study, only data on depression symptoms that occurred over the past 2-weeks were collected and used. Although the period between the end of self-quarantine and the time of the survey was not clearly known, the symptoms of depression after self-quarantine were investigated. Nevertheless, we could not exclude subjects who might have previously depressive symptoms. Fourth, we assessed daily life changes with a single item. However, the validity and reliability of the single item have not been reported in previous studies. In the future, it is suggested to verify the reliability and validity of the scale. Finally, we did not measure various coping strategies (e.g., use of medication, psychotherapy, and locus of control) that were proposed in SAMD (15). In the future, it is suggested to conduct research including various coping strategy variables.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by an Institutional Review Board of the Gachon University (No. 1044396-202109-HR-198-01). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

H-YJ and YK conceived and designed the study and analyzed the data. H-YJ and S-YH wrote the first draft. All authors contributed to revisions of the manuscript and critical discussion and have read and agreed to the published version of the manuscript.

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The Public's Preferences for Psychological Interventions During the COVID-19 Pandemic: A Discrete Choice Experiment

Hui-qin Li[1†], *Shu-xiang Liu*[1†], *Hui Xue*[2], *Hua Yuan*[1] *and Xiu-ying Zhang*[1*]

[1] *Department of Fundamental Nursing, School of Nursing, Jilin University, Changchun, China,* [2] *Department of Histology and Embryology, College of Basic Medical Sciences, Jilin University, Changchun, China*

Aims: To explore the public's preference for psychological interventions through a discrete choice experiment and to provide references for formulating psychological intervention policies and establishing psychological intervention procedures in response to public health emergencies.

Methods: This study is a discrete choice experiment. Attributes and levels were identified through literature reviews, in-depth interviews, focus group discussions, and expert consultations. Experimental design principles were applied to generate choice sets containing different attribute levels and develop a survey instrument. Convenience sampling was conducted nationwide, and 1,045 participants were investigated. A mixed logit model was used to evaluate the public's preferences.

Results: All attributes in our study were found to have a significant influence on the public's preferences for psychological interventions during the COVID-19 pandemic. The public's preferences for providers and duration were influenced by the public's levels of education and classifications. Furthermore, the most ideal scenario was found to be a one-on-one psychological intervention provided by family and friends through social network platforms, for which the frequency is twice per week, and the duration of each intervention is 0.5–1 h.

Conclusions: The public's preferences for psychological interventions during the COVID-19 pandemic are affected by the method, form, frequency, provider, and duration of interventions. Our findings provide references for the formulation of psychological intervention policies and the establishment of psychological intervention procedures in response to public health emergencies.

Keywords: public health, psychological health, health care, health policy, preferences

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Pedro Morgado,
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University of Portsmouth, United Kingdom
Masoud Amiri,
Erasmus Medical Center, Netherlands

***Correspondence:**
Xiu-ying Zhang
z_xy@jlu.edu.cn

[†]*These authors share first authorship*

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INTRODUCTION

COVID-19 has greatly endangered the health and life safety of the public and attracted attention from all countries and regions. According to a report from the World Health Organization (WHO) on 1 February 2022, the number of people infected with COVID-19 has exceeded 376 million, and the number of deaths totals 5.6 million (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/). At present, home quarantine is the main means through

which to prevent COVID-19 infection and the spread of the pandemic. However, the loss of face-to-face communication and other regular social interventions caused by quarantine have made the public experience stressful situations (1), and such short-term stressful situations may develop into adaptation disorders and posttraumatic stress disorder (PTSD) (2). In addition, during the COVID-19 pandemic, the threat of disease and the economic burden caused by the suspension of work have had a negative impact on the public's mental and psychological states, which have manifested as anxiety, depression, and stress (3–5). Many studies have assessed the psychological impact of COVID-19 and found high levels of psychological distress (6–12). Furthermore, the overflow of information about the COVID-19 pandemic has also triggered public panic, which may lead to extreme behaviors such as suicide (13). Therefore, it is necessary to provide effective psychological interventions for the public to prevent and/or alleviate mental and psychological problems.

Faced with the COVID-19 pandemic, various regions in China have implemented corresponding psychological interventions. However, some medical staff are unwilling to accept the current psychological interventions provided by some teams or individuals (14). Furthermore, some researchers have claimed that the mental health needs of COVID-19 patients, suspected patients with COVID-19, quarantined family members, and medical personnel have been poorly handled (5), which may be due to a lack of understanding about the public's mental health needs and preferences for psychological interventions. Understanding the public's preferences for psychological interventions is conducive to the formulation of more acceptable and targeted psychological intervention strategies to improve the effectiveness of such interventions.

A discrete choice experiment (DCE) is the most common and main preference measurement method (15); it can not only calculate the regression coefficient and willingness to pay (WTP) to reflect people's preferences but also simulate the influence of changes in influencing factors on these preferences (16, 17). In the field of health psychology, DCEs are often used to design patient-centered psychological care measures. Goodall et al. conducted a DCE to determine the preferred characteristics of psychosocial support services for adolescents and young people with cancer or blood diseases and their caregivers (18). Herman et al. used DCE to explore patients' preferences for mental health services provided to low-income Hispanics engaged in primary care (19). Lokkerbol et al. used a DCE to assess the preferences of patients with depression and anxiety for psychotherapy (20, 21). However, no research has explored the public's preference for psychological interventions during COVID-19 pandemic public health emergencies to provide a reference for the formulation of such intervention programs. Therefore, the purpose of this study is to explore the public's preference for psychological interventions during the COVID-19 pandemic through a DCE to provide a reference for the formulation of psychological intervention policies and the establishment of psychological intervention procedures in response to public health emergencies and to provide references for randomized controlled experiments to explore the differences in the effects of psychological interventions during public health emergencies.

METHODS

Design

This study used a DCE approach to understand the public's preferences for psychological interventions in COVID-19 pandemic public health emergencies. The main processes of this DCE include determining attributes and levels, experimental design, data collection, and data analysis, the details of which are shown in **Figure 1**.

Determining Attributes and Levels

Step I: Literature Review

We determined attributes and levels based on published recommendations (22, 23). First, the literature was searched through electronic databases, such as CNKI, Wanfang Database, PubMed, Web of Science, and Embase, and full-text articles, available before 31 July 2020, were reviewed. The search strategy was "COVID-19" OR "public health emergencies" AND "mentality" OR "psychology" OR "psychic." Then, we extracted the psychological status and its influencing factors of the public under COVID-19 and public health emergencies, the public's needs and expectations for psychological interventions, and the factors affecting the public's acceptance of psychological interventions. We identified 6 potential attributes based on the literature review, which we discuss later in our qualitative study.

Step II: In-Depth Interviews

Based on the literature review, an interview outline was developed, and one-to-one in-depth interviews were conducted by telephone due to the impact of COVID-19. The interview outlines were as follows: (1) the current psychological state of the interviewees, (2) the currently available psychological intervention strategies, (3) the accessibility of psychological intervention services, (4) the availability of emotional or economic resources, (5) the need for psychological intervention during the COVID-19 pandemic, and (6) interviewees' attitudes and suggestions concerning psychological intervention during COVID-19 and public health emergencies. Using purposive sampling, interviewees were chosen according to their location, age, and education level. Interviews were carried out until their content reached saturation. All interview data of the 12 interviewees were recorded and transcribed verbatim and analyzed with NVivo 12.0. Eventually, the list of potential attributes was expanded to nine, namely, place, mode, frequency, form, provider, continuity, content, total length of time of instruction, and duration of each instruction.

Step III: Focus Group Discussions and Expert Consultations

Focus group discussions were conducted by video conference after the in-depth interviews. Fifteen participants were included based on different regions, educational backgrounds, ages, and exposure to COVID-19, and they were randomly divided into 3 groups, with 5 participants in each group. During each discussion, participants were provided with 9 attributes obtained from the literature review and in-depth interviews and asked to add new attributes and discuss the definition of these attributes

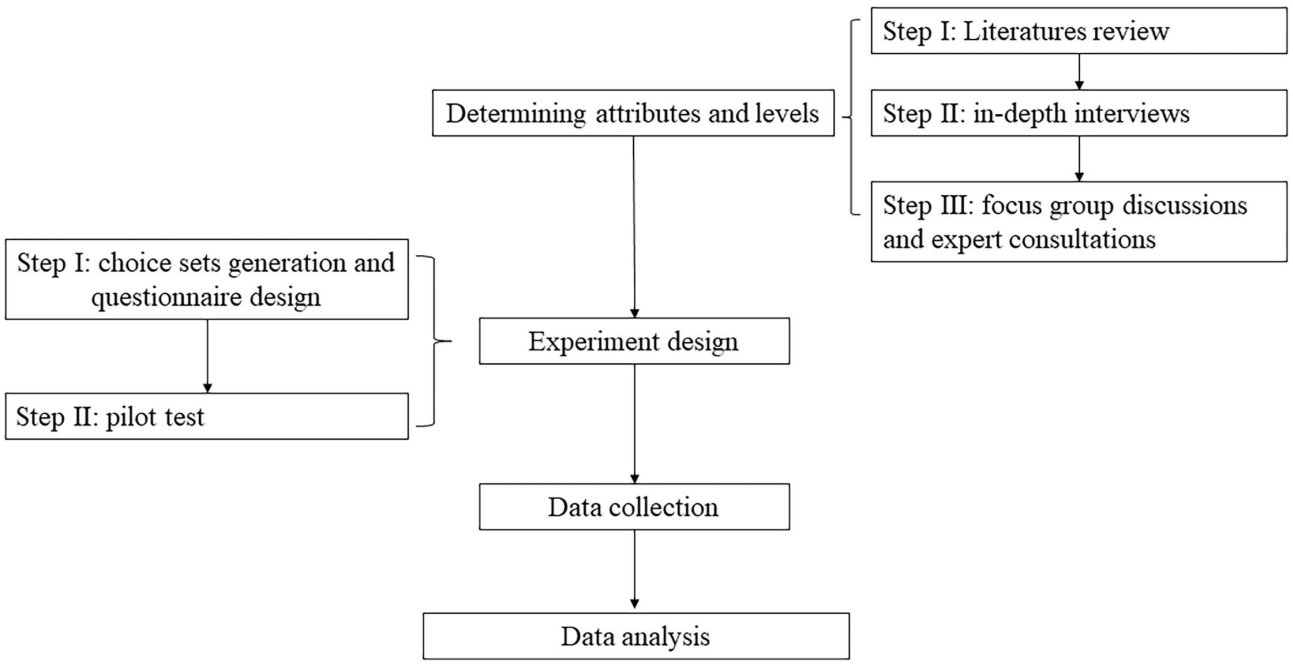

FIGURE 1 | The process of DCE.

and levels until they reached a consensus. Next, one-to-one expert consultations in Deyang city, Sichuan province, were conducted face to face. Experts included a health department staff member, a psychologist, and a doctor, all with more than 10 years of work experience, who were asked to add new attributes and revise inappropriate attributes, which ensured that the potential attributes and corresponding levels were appropriate under the current policy and medical background. Then, 15 respondents who participated in the focus group discussion were contacted *via* WeChat (a Chinese online social network similar to Facebook) and were asked to vote for each attribute with "most," "somewhat," and "least." According to the number of "most" votes, the attributes were sorted. In the field of health care, the number of attributes in most DCEs is 4–9, and the median number of attributes is 5 (24). Therefore, the top five attributes were included in this study, and their levels were developed, which are method, form, frequency, provider, and duration (refer to **Table 1** for details).

Experimental Design

Step I: Choice Set Generation and Questionnaire Design

In our study, three attributes have four levels, one attribute has three levels, and one attribute has two levels. According to the full factorial design, 384 ($4^3 \times 3 \times 2 = 384$) possible scenarios were generated, which in turn generated 1,47,072 (384×383) possible choice sets. The existence of too many choice sets results in respondents' high cognitive burden and consumes considerable labor, material resources, and time (25). Therefore, the fractional factorial design was needed to reduce choice sets down to a manageable level. In a DCE, the commonly used fractional factorial design mainly includes orthogonal design and efficiency design. The Ngene 1.2 USER MANUAL & REFERENCE GUIDE (http://www.choice-metrics.com) shows that an efficient design always outperforms an orthogonal design in the case of any information about the prior parameters (even if this information involves only the sign of the prior parameter), where the sign of the parameter can be known by reasoning alone, and a slight positive or negative value can improve the design. In our study, a D-efficient design was carried out in the Ngene software to generate the choice sets, in which a slight prior parameter value was added for each attribute and was adjusted several times to minimize the D-error value. Finally, 16 different choice sets composed of attributes and levels were generated. In the field of health care, the choice sets of a DCE usually total 8 (26). Thus, the 16 choice sets were randomly divided into two versions to further reduce the burden on respondents. To test the corresponding consistency, the second choice set in each version was repeatedly included as the ninth choice.

At the beginning of the questionnaire, the purpose of this study, the contents of the questionnaire, and the requirements for filling in the questionnaire were introduced. The first part of the questionnaire is a general data questionnaire, which includes sociodemographic characteristics such as gender, age, income, level of education, and classification of population. The second part is the DCE questionnaire, which contains nine choice tasks, each of which contains two alternatives and one exit item. In this section, the attributes and levels are described, and an example of a choice set is provided (e.g., refer to **Box 1**). Then, respondents were asked to select their most preferred option in each choice set.

Step II: Pilot Test

A pilot test was conducted among 50 respondents (25 respondents in each of the two versions). Most respondents who

TABLE 1 | Attributes and levels.

Attributes	Level	Description
Method	Face to face	A visit to a provider of psychological intervention where you would have a psychiatric evaluation and discussion about your mental and psychological issues.
	Phone	At a scheduled time, a provider of psychological intervention telephones you and you have a discussion about your mental and psychological issues and provides guidance and interventions on these issues.
	Social network platform	At a scheduled time, a provider of psychological interventions uploads mental health articles and videos on the Internet platform, or provides psychological guidance and interventions through social platforms such as WeChat and QQ.
Form	One to one	During the psychological intervention, a provider speaks to you individually about your feeling or opinions, or ask you questions about your mental and psychology, and provides guidance and interventions to you.
	One to many	During the psychological intervention, a provider speaks about public mental and psychology feeling, and provides guidance and interventions to other people besides you at the same time.
Frequency	Twice per week	Psychological interventions were provided twice a week.
	once per week	Psychological interventions were provided once a week.
	Once every 2 weeks	Psychological interventions were provided once every 2 weeks.
	No fixed time	Psychological guidance and interventions can be provided when you need them.
Provider	Psychologist	People who majors in psychology studies the human mind and tries to explain why people behave in the way that they do.
	Medical staff	Doctors or nurses who have undergone additional training in Psychological assessment, counseling and interventions
	Family and friends	Your family and friends who have received trainings about psychological knowledge.
	Volunteer	People who volunteer to participate in the prevention and control of COVID-19 and have undergone additional training in psychological assessment, counseling and intervention.
Duration, hours	<0.5	The duration of each psychological intervention was less than half an hour.
	0.5–1	The duration of each psychological intervention is between half an hour and an hour.
	≥1	The duration of each psychological intervention was more than 1 h.

BOX 1 | Description and an example of choice set.

You will be asked to answer nine questions about hypothetical psychological intervention Programs. Each questions contains two alternatives and an exit option for you to choose and each question can only choose one option. The features of the psychological intervention programs will differ in the following five aspects:
Method: How you mental health information and psychological guidance.
Form: In what from does the provider provide you will psychological intervention.
Frequency: How often appointments of psychological intervention would be.
Provider: Who provides you for psychological interventions.
Duration: Duration of each psychological intervention.
An example of choice set

Attributes	Programme A	Programme B
Method	Social network platform	Face to face
Form	One to one	One to many
Frequency	Random	Once every two weeks
Provider	Psychologist	Medical staff
Duration (h)	0.5–1	≥1

Which programme do you prefer:
Programme A Programme B Unwilling to receive psychological intervention.

participated in the pilot test considered the question length of the questionnaire to be "acceptable," "easy to understand," and "appropriate," and "the text is clear and easy to understand"; we revised the wording to improve the clarity of the questionnaire based on feedback from some of the 50 participants.

Participants

Nationwide convenience sampling was used to recruit eligible participants. Individuals with reading and comprehension abilities were considered potential participants of our study. At the same time, people with cognitive impairment, people who could not complete the survey due to certain reasons, people affected by psychiatric illnesses, and people who were unwilling to participate in this study were excluded. According to Johnson (27) and Orme (28), the calculation formula of the minimum sample size N is as follows:

$$n > 500c/(t \times a)$$

In this equation, t is the number of choice sets faced by an individual (excluding the choice set repeatedly included), a is the number of alternatives in each choice set (excluding exit items), and c is the number of analysis cells (when considering the main effect, c is equal to the maximum level number of any attribute). The minimum sample size needed in each version of the questionnaire is 125 ($t = 8$, $a = 2$, $c = 4$). We plan to mark the two versions of the questionnaire with 1 and 2. Considering that 30% of the recovered questionnaires may be invalid, the total

sample size is 358 participants to ensure that sufficient data are included in the analysis and to obtain wide representativeness.

Data Collection

Data were collected by conducting a questionnaire survey, which was performed by trained researchers. Participants were provided with hard-copy questionnaires as a priority, and for those participants who were not convenient to obtain a hard copy, electronic questionnaires were provided *via* WeChat or email. All questionnaires were completed by the participants themselves. In the questionnaires distributed, the versions were random, and the number of each version was the same. The data collection period was from 20 August 2020 to 25 November 2020.

Data Analysis

Data were double entered into Epidata 3.1 and transferred to Stata 15.0 for processing and analysis. Descriptive statistics were reported for participants' sociodemographic characteristics. A mixed logit model was used to evaluate the preferences of participants for the different levels of the psychological intervention attributes. The use of a mixed logit model makes it possible to explore the preference heterogeneity of respondents (29–31) and allows for multiple observations from each respondent who was presented with nine choice sets. All models included main effects without interaction terms. All variables were coded as dummy variables to better reflect their influence on respondents' preferences.

The main output of the mixed logit model is an estimation of the proportion of respondents who prefer each attribute level compared with the reference level for each attribute. For instance, for the attribute "method," the proportion of respondents preferring to intervene through social network platforms compared with face-to-face intervention can be estimated. A negative (positive) parameter sign indicates that the attribute level is not preferred (preferred) to the reference level of the attribute.

Adverse mental health status during the COVID-19 pandemic, such as stress, anxiety, and depression, has been affected by educational attainment (32). People with different educational attainment levels may have different needs for psychological interventions. Furthermore, the psychological pressure placed on people with different exposures to COVID-19 may also be different; thus, their needs for psychological intervention may also be different. Therefore, subgroup analysis was conducted based on levels of education and classifications of the population.

The sum of the model coefficients for each combination of attribute levels is the preference score (V_j), which is also known as the indirect utility score. P_j represents the probability that each combination of attribute levels is the most preferred scenario, the calculation formula of which is as follows:

$$P_j = \frac{exp(V_j)}{\sum_{k=1}^{J} exp(V_k)}$$

where $j = 1, \ldots, J$. In this article, only the top five scenarios with the highest rankings are considered.

Ethical Considerations

This study was approved by the University Ethics Committee and all other relevant organizations. Before the investigation began, the purposes of the study were explained to participants, and their informed consent was obtained. Furthermore, all information was anonymized, all data were used for research purposes only, and participants had the right to withdraw from the study at any time.

Validity and Rigor

Two people cross-checked the questionnaire for quality control to ensure the validity of the data. Invalid questionnaires were defined as follows and were excluded: questionnaires that (1) had not been completed, (2) failed the consistency test, (3) had the same options checked in the entire questionnaire, and (4) had regularly checked items in the questionnaire.

RESULTS

Characteristics of Respondents

A total of 1,200 people accessed the survey, 92 of whom did not complete the questionnaire and 63 of whom did not pass the consistency test. Finally, 1,045 people were included in the analysis, and the response rate was 87.08%. Among the 1,045 participants, 507 were men (48.52%), 538 were women (51.48%), and the majority of the respondents were between 20 and 59 years old (74.06%, which is equal to the sum of the proportions of those aged 20–39 and 40–59 years, which is 36.94 and 37.12%, respectively). The urban population accounted for 64.50%, and 53.11% of the respondents had a secondary school education (including junior high school and high school). Most people belonged to the third and fourth classifications, accounting for 34.74 and 34.35%, respectively. More details are presented in **Table 2**.

Discrete Choice Experiment Results

In **Table 3**, the mixed logit estimates for the total sample are reported. We found that all attributes have a significant influence on preferences for psychological interventions during the COVID-19 pandemic. The results show that the public demonstrated the strongest positive preferences for social network platforms, one-to-one form, twice-per-week visits (followed by alternating with no fixed time), family and friends as providers (followed by alternate medical staff and psychologists), and the duration for 0.5–1 h (followed by ≥1 h; all $p < 0.01$). The statistical significance of the SD coefficients for all but two of the attribute levels (phone and duration ≥1 h) confirm the existence of preference heterogeneity for most attributes.

Since it is assumed that the coefficients of all attribute levels are normally distributed, the mixed logit estimates relating to the mean coefficient and SD for each attribute level were applied to calculate the distribution of preference heterogeneity. For example, the coefficient (SD) of the "family and friends" level is 1.139 (0.856), indicating that 91% of respondents exhibited a preference for psychological interventions provided by family and friends. Similarly, the results showed that 80% of respondents

TABLE 2 | Respondent characteristics.

Characteristics	Respondent (n = 1,045)
	N (%)
Gender	
Male	507 (48.52)
Female	538 (51.48)
Age, years	
<20	133 (12.73)
20–39	386 (36.94)
40–59	388 (37.12)
≥60	138 (13.21)
Highest level of education	
Primary school and below	126 (12.06)
Junior high school	241 (23.06)
Senior high school	314 (30.05)
College degree and above	364 (34.84)
Classification of population	
First classification†	120 (11.48)
Second classification‡	203 (19.43)
Third classification§	363 (34.74)
Fourth classification	359 (34.35)
Location	
City	674 (64.50)
Country	371 (35.50)
Job	
Student	139 (13.30)
Office clerk	118 (11.29)
Famer	109 (10.43)
Individual operation	241 (23.06)
Medical staff	140 (13.40)
Civil servant	61 (5.84)
Teacher	87 (8.33)
Retirement	56 (5.36)
Other	94 (8.99)
Income (¥)	
<2,000	187 (17.89)
2,000–4,000	233 (22.30)
4,000–6,000	405 (38.76)
6,000–8,000	136 (13.01)
8,000–10,000	43 (4.11)
≥10,000	41 (3.92)

† *The first classification includes patients with infected COVID-19 and medical staff and managers at the front line of epidemic prevention.*

‡ *The second classification includes people who are quarantined at home or people with fever who visit hospitals.*

§ *The third classification includes people related to the first and second classifications, such as their family members, colleagues and friends, and those involved in the rear rescue response, such as onsite commanders, organization and management personnel, and volunteers.*

¥ *The fourth classification includes all populations affected by the COVID-19 except the first, second and third classification.*

would prefer to be provided with psychological interventions through social network platforms.

TABLE 3 | Mixed logit estimates for total sample (n = 1,045).

Attributes (reference level)	Level	Coefficient (S.E)	SD (S.E)
Method (face to face)	Phone	0.0530 (0.0649)	0.183 (0.201)
	Social network platform	0.882** (0.0732)	1.098** (0.0991)
Form (one to many)	One to one	0.209** (0.0544)	0.612** (0.0708)
Frequency (once every 2 weeks)	Once per week	0.0703 (0.0714)	0.583** (0.106)
	Twice per week	0.952** (0.0896)	1.498** (0.108)
	No fixed time	0.408** (0.0771)	0.719** (0.130)
Provider (volunteer)	Family and friends	1.139** (0.0710)	0.856** (0.0987)
	Medical staff	0.551** (0.0631)	0.772** (0.0899)
	Psychologist	0.389** (0.0664)	0.361* (0.148)
Duration, hours (<0.5)	0.5–1	0.802** (0.0745)	0.851** (0.0904)
	≥1	0.470** (0.0649)	0.158 (0.224)
Sample		1,045	
Log likelihood		−6440.3195	
Number of observations		25,080	

*$p < 0.05$, **$p < 0.01$.

The results of the subgroup analysis showed that the population with a primary school degree had a statistically significant preference for psychologists as providers, which is different from the population with a high school degree and college degree or above. Furthermore, the most important attribute level of the population with a primary school degree is that the duration of each intervention is 0.5–1 h (coefficient 1.064), while for the population with a middle school degree and college degree or above, the most important attribute level is that the frequency is twice per week (coefficients 1.530 and 1.409, respectively). When comparing the preferences of different population classifications, the most important attribute level of each population classification is that the frequency is twice per week. Different from other population classifications, the first classification showed a strong preference for psychologists as providers. Moreover, for the duration of each intervention ≥1 h, the preference of the first and second classification populations was not statistically significant, while that of the third and fourth classification populations was significant (refer to **Table 4** for details).

Predicting Choice Probabilities for Different Psychological Intervention Scenarios

Supplementary 1 presents the 5 most valued psychological intervention scenarios to illustrate respondents' preferences for the factors in combination. The most ideal scenario is a one-on-one psychological intervention provided by family and friends through social network platforms, for which the frequency is twice per week and for which the duration of each intervention is 0.5–1 h. In addition, the public would

TABLE 4 | The results of subgroup analysis.

(A) Group by educational level

Attributes (reference level)	Level	Primary school and below		Junior or Senior high school		College degree and above	
		Coefficient (SE)	SD (SE)	Coefficient (S.E)	SD (SE)	Coefficient (SE)	SD (SE)
Method (face to face)	Phone	0.689** (0.12)	0.00168 (0.201)	0.653** (0.0635)	0.395** (0.122)	0.900** (0.0832)	0.474** (0.146)
	Multimedia	0.914** (0.251)	0.00096 (0.358)	0.793** (0.121)	0.181 (0.217)	0.899** (0.154)	0.516** (0.128)
Form (one to many)	One to one	0.248* (0.0978)	0.0662 (0.546)	0.299** (0.0518)	0.386** (0.101)	0.372** (0.0691)	0.527** (0.11)
Frequency (once every 2 weeks)	Twice per week	0.800** (0.249)	0.00387 (0.204)	1.530** (0.122)	0.181 (0.267)	1.409** (0.153)	0.0729 (0.201)
	once per week	0.908** (0.142)	0.0154 (0.235)	0.562** (0.0702)	0.320* (0.149)	0.576** (0.0898)	0.310 (0.179)
	No fixed time	−0.275 (0.389)	1.294** (0.189)	1.294** (0.189)	0.263 (0.236)	1.033** (0.24)	0.0675 (0.546)
Provider (volunteer)	Psychologist	0.493* (0.238)	0.00368 (0.231)	0.0519 (0.116)	0.0193 (0.195)	0.0741 (0.152)	0.474** (0.168)
	Medical staff	0.0454 (0.262)	0.0668 (0.439)	1.010** (0.13)	0.00653 (0.223)	1.245** (0.164)	0.0372 (0.264)
	Friends and family	0.873** (0.307)	0.686** (0.22)	1.237** (0.145)	0.181 (0.271)	1.094** (0.182)	0.497** (0.161)
Duration, hours(<0.5)	0.5-1	1.064** (0.258)	0.0198 (0.181)	0.608** (0.124)	0.385** (0.119)	0.559** (0.156)	0.245 (0.204)
	≥1	0.559** (0.176)	0.0328 (0.302)	0.263** (0.0834)	0.266 (0.169)	0.159 (0.107)	0.172 (0.267)
Sample	N/A	126		555		364	
Log likelihood	N/A	−862.41486		−3708.3811		−2402.8721	
Number of observations	N/A	3,024		13,320		8,736	

(B) Group by classification of population

Attributes (reference level)	Level	First classification		Second classification		Third classification		Fourth classification	
		Coefficient (SE)	SD (SE)	Coefficient (SE)	SD (SE)	Coefficient (SE)	SD (SE)	Coefficient (SE)	SD (SE)
Method (face to face)	Phone	0.906** (0.14)	0.382 (0.284)	0.784** (0.105)	0.347 (0.213)	0.836** (0.0757)	0.000668 (0.295)	0.614** (0.0756)	0.218 (0.223)
	Multimedia	1.103** (0.264)	0.00296 (0.177)	0.683** (0.195)	0.0181 (0.288)	1.144** (0.147)	0.249 (0.203)	0.722** (0.15)	0.232 (0.21)
Form (one to many)	One to one	0.362** (0.106)	0.157 (0.551)	0.372** (0.0875)	0.420**(0.158)	0.326** (0.0621)	0.279* (0.159)	0.234** (0.0651)	0.457** (0.116)
Frequency (once every two weeks)	Twice a week	1.191** (0.262)	0.0644 (0.385)	1.811** (0.206)	0.520** (0.201)	1.472** (0.147)	0.00019 (0.288)	1.147** (0.149)	0.0898 (0.271)
	once a week	0.951** (0.157)	0.368 (0.32)	0.449** (0.118)	0.31 (0.251)	0.618** (0.0858)	0.115 (0.421)	0.749** (0.0908)	0.494** (0.135)
	No fixed time	−0.318 (0.396)	0.0331 (0.333)	1.388** (0.309)	0.0183(0.311)	1.196** (0.224)	0.00174 (0.225)	0.846** (0.233)	0.119 (0.406)
Provider (volunteer)	Psychologist	1.003** (0.254)	0.012 (0.282)	0.153 (0.194)	0.000363 (0.181)	0.227 (0.141)	0.0746 (0.303)	0.113 (0.146)	0.411* (0.181)
	Medical staff	0.226 (0.284)	0.536* (0.264)	1.325** (0.213)	0.0423 (0.307)	1.085** (0.161)	0.456** (0.158)	0.524** (0.162)	0.288 (0.21)
	family and Friends	1.115** (0.318)	0.393 (0.321)	1.539** (0.238)	0.351 (0.261)	0.916** (0.176)	0.277 (0.231)	0.990** (0.182)	0.512** (0.156)
Time, hours (<0.5)	0.5-1	0.781** (0.278)	0.137 (0.519)	0.485* (0.201)	0.293 (0.203)	0.831** (0.15)	0.0323 (0.336)	0.755** (0.156)	0.136 (0.194)
	≥1	0.363 (0.187)	0.317 (0.334)	0.0917 (0.135)	0.0168 (0.18)	0.220* (0.103)	0.311 (0.181)	0.359** (0.107)	0.381* (0.157)
Sample	N/A	120		203		363		359	
Log likelihood	N/A	−781.91903		−1330.121		−2350.5265		−2504.1709	
Number of observations	N/A	2,880		4,872		8,712		8,616	

*$p < 0.05$, **$p < 0.01$.
SD, standard deviation; SE, standard error.

prefer to increase the duration of each intervention from 0.5–1 to ≥1 h rather than change the method, frequency, and provider. However, with the same duration of each intervention (0.5–1 h), the rankings also showed that the public would accept alternating methods, frequencies, and providers.

DISCUSSION

To the best of our knowledge, this is the first study to explore the public's preferences for psychological interventions during the COVID-19 pandemic. In our study, the characteristics of psychological intervention programs were described by the method, form, frequency, provider, and duration. Our results demonstrated that family and friends were the most preferred providers. Furthermore, the public's preference for providers and duration was influenced by its level of education and classifications. The most ideal scenario is a one-on-one psychological intervention provided by family and friends through social network platforms, the frequency of which is twice per week, and the duration of each intervention is 0.5–1 h. Apart from the program outlined above, the public would also accept alternating social network platforms with phone calls, alternating frequencies such as twice per week with no fixed time, or alternating providers like family and friends with medical staff if the duration was not changed (0.5–1 h).

In China, the providers of psychological interventions are mostly mental health professionals (33). For example, psychological intervention teams, such as psychological intervention supervisors, psychological consultants, and psychiatrists, were established to prevent, deal with, and evaluate the potential and real mental crisis of injured people from the Lushan earthquake (34). However, in our study, most of the public (91%) during the COVID-19 pandemic has had increased preferences for family and friends as providers. This finding seems to verify the conclusion of a South Korean study, which showed that the response of patients with COVID-19 to their families is different from that of other populations (35). The reasons behind this finding may be as follows: on the one hand, COVID-19 is usually spread from person to person *via* respiratory droplets, which are expelled by speaking, sneezing, or coughing. The high risk caused by contact with strangers changes people's reactions to strangers. People are familiar with their family and friends and know with whom they have been in contact, which to some extent reduces the risk of infection. On the other hand, people who are anxious or depressed are often reluctant to seek psychological intervention due to the associated stigma (36, 37). In the study of Mythili et al. (38), one-third of respondents sought guidance for relatives and friends' psychological problems, which seems to indicate that it is feasible to provide psychological guidance to people's relatives and friends and make them a provider of psychological intervention.

At the same time, subgroup analyses revealed that the population with a low education level and the first classification population (mainly including patients with COVID-19 and medical staff and managers at the frontline of pandemic prevention) showed a strong preference for psychologists. We were unable to analyze the role of psychologists in a population with a low education level based on the current data. The study suggested that patients infected with COVID-19 and without psychiatric disorders may develop several psychiatric symptoms, including anxiety, fear, depression, and insomnia, after treatment with antiviral drugs (39). This finding may explain why psychologists are preferred by patients.

Medical staff and managers at the frontline of pandemic prevention interact directly with potentially positive or positive patients with COVID-19. They are not only working extremely hard, but they are also struggling to treat a new viral disease that is not well-understood. This situation creates a unique psychiatric burden. For instance, this study demonstrated that general distress was present in 72% of frontline healthcare workers, followed by symptoms of insomnia (34%), anxiety (45%), and depression (50%) (6). The management and scheduling of people, property, and materials are one of the main tasks for managers, such as government personnel and health administration departments, to respond to health emergencies. However, the WHO pointed out that due to the prevalence of COVID-19, the world is facing a chronic shortage of personal protective equipment, such as ventilators and masks, which brings about challenges to the work of frontline managers and may bring about an enormous psychiatric burden for managers. This psychiatric burden may lead to medical staff and managers' preferences for psychologists.

In terms of intervention methods, people are more willing to accept interventions through social network platforms or by phone than face-to-face interventions. Traditional face-to-face psychological intervention increases the risk of COVID-19 infection. Psychological interventions by telephone or through social network platforms can improve social security. One study confirmed that telehealth services are as effective as are face-to-face health services (40). In addition, Ning Wei et al. have achieved good results through internet-based integrated intervention for psychological intervention in patients with COVID-19 (41). The experience reported by Zhang et al. provides the basis for remote intervention, in which the providers of psychological interventions responded to the psychological crisis during the COVID-19 pandemic through WeChat, Huayitong, and psychological hotlines (1). The research of Mythili et al. shows that it is feasible to use a telephone to carry out psychological intervention among the public (38). Thus, social network platforms or phones should be feasible and effective in providing psychological interventions for the public during the COVID-19 pandemic with the development of 4G and 5G networks and the popularization of smartphones. The specific strategies and implementation of interventions through social network platforms or by phone should be further studied and evaluated.

The expansion of the built-up area of social network platforms lacks uniformity. For example, there are more urban internet users than rural internet users, and the number of urban users who use mobile phones to access the internet is 44% more than rural users (42), whereas almost every home in China has a telephone. Our study results showed that when ensuring the duration of each intervention (0.5–1 h), social network platforms can be alternated with phone calls, twice per week can be alternated with no fixed time, or family and friends can be alternated with medical staff. Thus, for the region or population that did not meet the most ideal scenario, our study provided choice probabilities that are predicted to be accepted by the public.

Based on the findings of our research and currently available literature, the following recommendations are made for providing psychological interventions during the COVID-19 pandemic:

1. Psychological intervention providers should include family and friends, medical staff, and psychologists. Psychological knowledge training should be carried out for people with high cognitive levels so that they can publicize psychological knowledge, guide family members and friends, and prevent the occurrence of psychological problems among the public. Psychological knowledge training for medical staff should be strengthened, and self-psychological training should be improved for people with fever or suspected infection. The ability to regulate and initiate psychological interventions should be considered, and psychologists should provide psychological guidance or interventions to people with cognitive impairment and those infected with COVID-19.
2. Remote intervention is the first choice, and network platform intervention should be effectively combined with telephone intervention.
3. One-on-one psychological interventions should be provided, the frequency of which is twice per week and the duration of which is 0.5–1 h. One-to-one intervention should be the main method, twice per week, for 0.5–1 h each time.

The findings of this study provide a reference for the formulation and revision of psychological intervention policies during the COVID-19 pandemic and the establishment of psychological intervention procedures for public health emergencies. The strengths of our study are that the sample not only is large in number ($n = 1{,}045$) but also was recruited from across China, which improves the objectivity of the results. This study also has certain limitations. First, like other DCEs, this study did not include all attributes. The attributes that were not included may also be very important and may affect the results to a certain extent. Second, our sampling method is convenience sampling rather than random sampling, which means that our results cannot be generalized to the whole population. Fortunately, our sample is not only large in number ($n = 1{,}045$) but also recruited from across the country, which alleviates this limitation to some extent. Third, in the subgroup analysis, there were certain differences in the number of people in each group, which may be due to a certain sampling bias, which in turn limits our interpretation of the results. Finally, because there are currently no studies on the preferences of the general public for psychological interventions, we cannot better compare the differences between what was available before the COVID-19 pandemic and what is currently available during the COVID-19 pandemic.

CONCLUSIONS

The public's preferences for psychological interventions during the COVID-19 pandemic are affected by the method, form, frequency, provider, and duration. People with different levels of education or different classifications of the population have different preferences. Some suggestions for psychological interventions were put forward to provide references for the formulation of psychological intervention policies and the establishment of psychological intervention procedures in response to public health emergencies.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding authors.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the School of Nursing of Jilin University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

H-QL: conceptualization, methodology, writing—reviewing, editing, and writing the original draft. S-XL: writing—reviewing and editing and proofreading. HX: data collection and data analyses, writing—reviewing, and editing. HY: data collection and data analyses, and writing—reviewing. X-YZ: conceptualization, methodology, writing—reviewing, and supervision. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.805512/full#supplementary-material

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Perceived Stress Positively Relates to Insomnia Symptoms: The Moderation of Resilience in Chinese Pregnant Women During COVID-19

Hongyu Zou[1,2†], Zhen Tao[1†], Yongjie Zhou[1], Zhiguo Zhang[3], Chunyan Zhang[1], Linling Li[3], Jiezhi Yang[4], Yanni Wang[5], Wei Huang[1] and Jianhong Wang[1]**

[1] Shenzhen Mental Health Center/Shenzhen Kangning Hospital, Shenzhen, China, [2] School of Psychology, South China Normal University, Guangzhou, China, [3] School of Biomedical Engineering, Health Science Center, Shenzhen University, Shenzhen, China, [4] Shenzhen Health Development Research Center, Shenzhen, China, [5] Department of Maternal, Child and Adolescent Health, School of Public Health, Lanzhou University, Lanzhou, China

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***Correspondence:**
Wei Huang
174580987@qq.com
Jianhong Wang
wangjianhong0755@163.com

†These authors share first authorship

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Background: The government's COVID-19 pandemic response lockdown strategy had a negative psychological and physical impact on individuals, which necessitated special care to pregnant women's mental health. There has been no large-scale research on the underlying relationship between perceived stress and insomnia symptoms in pregnant Chinese women up to this point. During the COVID-19 pandemic, we wanted to see if there was an association between perceived stress and insomnia symptoms, as well as the moderating impact of resilience for Chinese pregnant women.

Methods: This cross-sectional study examined 2115 pregnant women from central and western China using multi-stage sampling methodologies. A systematic questionnaire was used to collect information on sleep quality, perceived stress, and resilience using the Insomnia Severity Index, Perceptual Stress Scale, and Connor and Davidson Resilience Scale. To assess the moderating influence of resilience, hierarchical regressions were used.

Results: During the COVID-19 pandemic, 18.53% of respondents ($N = 2115$) reported experiencing sleeplessness. In pregnant women, perceived stress was positively linked with insomnia symptoms ($p < 0.001$). Furthermore, resilience significantly attenuated the influence of perceived stress on insomnia symptoms in Chinese expectant mother ($\beta_{interaction} = -0.0126$, $p < 0.001$).

Conclusion: Pregnant women with strong resilience were less influenced by perceived stress than those with poor resilience. The findings of this study might give empirical proof that health care professionals should identify the relevance of reducing perceived stress in pregnant women with poor resilience and provide better treatment and support when necessary.

Keywords: perceived stress, sleep quality, resilience, pregnant women, moderation effect

HIGHLIGHTS

- During the COVID-19 pandemic, according to the present study 18.53% of 2,115 pregnant women are having sleeplessness.
- We evaluated the influence of pregnant women's perceived stress and resilience on sleep quality during the fast spread of the COVID-19 pandemic.
- Resilience were negatively correlated with perceived stress and insomnia severity, while perceived stress was positively correlated with insomnia severity, indicating that higher perceived stress was associated with lower resilience and higher insomnia severity, whereas higher resilience was associated with lower insomnia severity.
- Resilience during COVID-19 may moderate the relationship between stress and insomnia symptoms, paving the way for future mental health treatments in public health emergencies.

INTRODUCTION

COVID-19 made its debut in December of 2019. It has resulted in a worldwide health catastrophe that is catastrophic. By the end of June 2021, there had been more than 17,277,958 confirmed cases globally, resulting in 3,711,711 fatalities. Coronavirus infection not only poses a serious threat to one's physical well-being, but it also has a number of long-term consequences, such as cognitive impairment, persistent tiredness, and discomfort (1). As a result, its influence on mental health, such as the high frequency of stress, anxiety, and depression, has been widely discussed (2). Researchers are paying increasing attention to the influence of social isolation under the Chinese government's home isolation policy to contain the spread of the virus. A related study has looked at the mental health of children who have been subjected to quarantine (3) and found that it is crucial to address the increasing anxiety and depressive symptoms in youngsters (4). Admittedly, only a few studies have focused on the insomnia symptoms of pregnant women during the pandemic in china's context (5, 6).

Because the transition to parenthood is already accompanied by numerous obstacles, including changes in psychological functioning, pregnant women may be at a higher risk of developing mental health problems during the pandemic. Pregnant women were considered to be more vulnerable to uneasy feelings. They are dealing with a variety of issues and stress, including constant nausea, exhaustion, and regular aches (7). Approximately 84% of women will experience stress throughout the antennal period of childbirth as a result of prior medical issues and sociocultural influences (8). Furthermore, most unfavorable life changes during pregnancy, such as financial difficulties, the death of a close family member, or worldwide events like the COVID-19 pandemic, can cause stress in the mother. Fear of contracting coronavirus and increased pressure to avoid negative health consequences for oneself or one's children can have a variety of negative consequences for mothers and children, including obstetric complications (9), lower birth weight (10), child development delays (11), postpartum depression and other mental health risks (12) all of which can lead to poor child outcomes (13). Therefore, it is necessary to actively pay close attention to pregnant women's mental health throughout the outbreak.

Additionally, during the pandemic, pregnant women are more likely to have sleep issues. According to many studies, approximately one-third of pregnant women in the United States reported receiving less sleep during the COVID-19 epidemic (14). On the other hand, any change in a pregnant woman's sleep quality may have an impact on her feelings about labor pains and taking on the maternal role. In addition, sleep deprivation is connected to negative maternal outcomes such as daily dysfunction, weariness, and lower psychological relaxation among pregnant women (15). It may also have a role in the initiation, aggravation, and recurrence of mood disorders (16). Given the detrimental consequences of poor sleep quality, identifying the causes of sleep disruption is critical, with the objective of improving sleep quality in expectant mother as a possible therapy goal.

Pregnant women were more vulnerable to stress than women who were not pregnant. The lack of access to expected prenatal care as a result of the lockdown policy might further exacerbate the problem. A high degree of perceived stress has been associated to a higher risk of unfavorable cardiac outcomes and a higher likelihood of cardiac-related death (17). Furthermore, Ko et al. proposed that sleep quality was influenced by perceived stress (18, 19). In a negative sense, the sleep quality of pregnant women might be linked to the stress level they obtained (20), which could be jeopardized by the looming infectious illness pandemic in response (21, 22). Based on an animal research, long-term stress exposure promotes undesired sleep structural alterations, including reduced slow-wave sleep and increased rapid eye movement (REM) sleep (23). Sleep quality is negatively influenced by a person's history of exposure to stressful life events, according to cross-sectional findings–both subjectively reported and objectively evaluated (24). For example, job stress might considerably increase the probability of experiencing irregular sleep disruption (25). To further, the deleterious effects of prenatal mother stress on poor sleep quality may be connected to an increased cortisol waking response and an overactive hypothalamus-pituitary-adrenal (HPA) axis (26, 27), all of which can have a variety of negative effects on sleep (28).

Resilience has been investigated as a possible moderator of the effect of stress exposure and negative consequence. People who have a higher level of resilience have a better psychological adjustment (29). In view of Rutter's proposed protective mechanism for psychological resilience, resilience should serve a protective role in reducing undesirable chain reactions (30). Resilience has been shown to protect against stress during prior viral pandemics. It was discovered that resilient individuals exhibited lower levels of SARS-related concern than those who did not survive the pandemic (31). Contrary to popular belief, resilience has a positive link with sleep quality. According to a recent study, resilience training helps medical students manage occupational stress throughout their clinical year (32). Among those who scored high on resilience had a decreased

chance of displaying poor sleep quality or using sleep medicines in the past month among HIV-positive people (33). As a result, it is suggested that resilience should be a crucial adjustment element for sleep quality even under stressful settings.

Amongst the small number of studies concerning the psychological outcomes of the lockdown policy during COVID-19, research on the association between perceived stress and sleep quality among pregnant women in China has not been conducted following the outbreak of COVID-19. The goal of this study was to see how perceived stress and resilience of pregnant women affected sleep quality when they were suffering from the COVID-19 pandemic. We further hypothesized that resilience during COVID-19 may moderate the association between stress and sleep quality, which might point to future avenues for psychological healthcare interventions during similar public health emergencies.

MATERIALS AND METHODS

Settings and Study Population

Between March 30th and April 26th, 2020, a cross-sectional survey was conducted utilizing a multi-stage sampling approach to recruit participants. For the first stage, Wuhan (Hubei Province's capital), Beijing, and Lanzhou (Gansu Province's capital) were chosen for the following reasons. To begin, participants from Wuhan City and another area might represent pregnant women who are more and less affected by the lockdown policy in this situation, respectively. Second, Hubei (Central China), Beijing (North China), and Gansu (Western China) are not contiguous, therefore the province-wide lockdown measures in Hubei will not have a spillover impact. We chose a regional mother and child health care facility in each Chinese city in the second round. The underlying reason is that professional mother and child health care services are concentrated in each city's regional hubs. Meanwhile, the income-related discrepancy in the healthcare-seeking process was generally overlooked by more than 95% of healthcare insurance coverage (34). As a result, regional clinics are the first choice for most women to seek prenatal care. We picked a regional mother and child health care center in each location to collect data from scattered populations. Convenience sampling was used in the third stage to enroll individuals from these two sites. We gave healthcare providers in charge of prenatal checkups at the study locations a QR code that led to an online questionnaire. When eligible pregnant women came in for their prenatal checkups, these healthcare providers offered them to participate in the study. Over 90% of Asian women had a gestation duration of fewer than 41 weeks, according to reports (35), which implies that the majority of Chinese women having a gestation period of more than 40 weeks would be those who were hospitalized and awaiting birth in China's context. Women who were up to 40 weeks pregnant or less were included (similar inclusion criteria were used by Özkan et al.) (36); and resided in the local community throughout the COVID-19 pandemic, since the goal of this study was to look into pregnant women's experiences at home instead of in a hospital facility. People with a history of mental illnesses were not allowed to participate. In this study, the gestational weeks of pregnant women ranged from 1 to 40 weeks, with an average gestational week of 26.19 weeks. 98% pregnant women are partnered, 2% pregnant women without partner. In line with the Declaration of Helsinki, the Ethics Committee for Scientific Research of the Chinese Academy of Sciences' Institute of Psychology granted ethical permission, permission number was H20003. All subjects gave written informed permission to participate in the study during the final recruitment.

Measures

Insomnia Severity Index

The Insomnia Severity Index (ISI) is an instrument widely used to assess the severity of insomnia symptoms. The ISI has demonstrated good reliability with a Cronbach's alpha of 0.9 (37). In the present study, the Cronbach's alpha was 0.93. The scale has been used to assess pregnant women's subjective sleep quality (38). Furthermore, compared to other scales, this one has fewer components and is more convenient. Scores vary from 0 to 28 on the ISI worldwide scale. A higher score indicates a poorer quality of sleep. A total score of 0∼7 means "no insomnia symptoms," while a total score of 8∼14 means "mild insomnia symptoms," the overall score of 15∼21 means "moderate insomnia symptoms," 22∼28 means "severe insomnia symptoms."

Perceived Stress Scale

The Perceived Stress Scale (PSS) is the most often used psychological tool for assessing stress perception. It is a metric for how stressful certain situations in one's life are regarded (39). The PSS was graded on a 5-point Likert scale ranging from not at all (0) to highly (4) depending on how often they occurred in the month leading up to the survey and is intended to capture how unpredictable and unmanageable respondents' lives are. The PSS scores are calculated by inverting the scores on four positive items, such as 0 = 4, 1 = 3, and 2 = 2. The overall score was then computed. The higher the score on the scale, the higher the subject's stress level. The lower the score on the scale, the less stressed the participants are. This scale has high validity and reliability, according to studies from several countries (40, 41). Cronbach alpha evaluated the scale's internal consistency at 0.85 (42). Cronbach's alpha was 0.72 in this research.

Resilience Scale

Resilience is the ability to recover from adversity, conflict, failure, and even positive events (43). The Connor and Davidson Resilience Scale (CD-RISC) (44)was used to assess resilience (including tenacity, strength, and optimism), which measures personal attributes that enable people to flourish despite being exposed to stress and trauma. The Connor-Davidson Resilience (CD-RISC-10), a 10-item measure derived from a 25-item scale. Each item is assessed on a 5-point Likert-type scale (from 0 to 4), with higher scores suggesting a higher level of resilience. The CD-reliability RISC-10's and validity are further demonstrated by its extensive use in a Chinese population (45). In this study, the Cronbach's alpha of the CD-RISC was 0.93.

Covariates

A total of 2,115 people were recruited in this study. Structured questionnaires were utilized by trained research workers to gather social-economic data as well as lifestyle information and other specific characteristics. Age, level of education (high school/college/undergraduate/post-graduate), annual household income (RMB 80,000/80,000−300,000/> 300,000), financial loss during COVID-19 (no financial loss/20,000/20,000−49,999/50,000), and whether they were infected with COVID-19 alone or in relatives and friends were all socioeconomic status variables. History of physical disease, mental diagnosis, drug use, smoking (never smoking/already stopped smoking/continuing smoking), and drinking behaviors (never drink: never drink alcohol in life/already quit drinking) were among the health behavior factors. The number of births, vomiting during pregnancy, daily monitoring of the fetus (Pregnant women answered these questions by recalling their daily attention to fetal movement during pregnancy and based on the actual situation), abdominal pain during pregnancy, pregnancy's influence on mobility (meaning that pregnancy may cause difficulty going to different locations), worries and fears about childbirth, and car accidents were all pregnancy-related variables.

In this study, smokers were defined as adults who had smoked 100 cigarettes in their lifetime and currently smoke cigarettes every day (daily) or some days (nondaily). Alcohol users were characterized as people who drank more than five drinks on a regular basis (rather than just sometimes). The occasional, light, and infrequent users were excluded from the study.

Statistical Analysis

Using SPSS version 25.0, descriptive analysis, correlation analysis, Mann–Whitney tests, and Kruskal–Wallis tests were performed after data collection. PROCESS version 3.5 was used to create the moderating model.

Harman's single-factor test was used to assess the common method variance in this study. The findings revealed that no one factor could account for the bulk of variation (the maximum component only explained 36.57 % of total variance), indicating that there was no common technique bias in this research. All results in this study indicated univariate non-normality for all measured variables. The variations in sleep quality, resilience, and perceived stress were tested using Mann–Whitney and Kruskal–Wallis tests in relation to categorical socio-demographic factors. The direction and magnitude of the correlations between perceived stress, resilience, and insomnia severity were also determined using Pearson Perceived stress was considered as the independent variable. Insomnia Severity was considered as the dependent variable. To see if resilience mitigated the connection between perceived stress and insomnia severity, researchers used SPSS 25.0 to run multiple linear regressions. We used simple slope analyses to compute the strength of the link between perceived stress and insomnia symptoms scores with high (1 SD above the mean) and low (1 SD below the mean) levels of resilience scale scores to assist interpret the interaction. To decrease multicollinearity, all continuous variables were centered before the analysis, and the interaction term was calculated using the centered variables.

RESULTS

Participants' Demographic Characteristics

In total, 2115 Chinese pregnant women were investigated. Education, annual household income, financial loss during COVID-19, whether they are afflicted with COVID-19, and/or whether they have COVID-19 family and acquaintances, smoking, drinking, number of births, vomiting during pregnancy, daily monitoring of the fetal abdominal discomfort, pregnancy's impact on mobility, anxiety and fears about birthing, and caregiver status are among the general demographic information included in the study. **Table 1** shows the correlation between Insomnia Severity and these variables.

During the COVID-19 pandemic, according to the present study 18.53% of 2,115 pregnant women are having sleeplessness,. The participants were 30.52 years old on average (*SD* = 9.67, range 19–47). 55.00% of the respondents had at least a bachelor's degree and 31.35% had a low average yearly household income (≤80,000 RMB), and 84.92% were primiparas. 2% pregnant women were single mothers and 98% with partner. The majority of those who were affected by the lockdown policy did not drink alcohol or smoke. Furthermore, the majority of pregnant women surveyed reported nausea and vomiting, stomachaches, daily observed fetal activity, were cared for, and had anxieties or anxiety about delivering. In general, those who were in Wuhan had already stopped drinking and smoking, suffered from nausea and vomiting during pregnancy, had daily fetal movement monitored, were concerned about childbirth, expected to have their first child, resulted in a greater financial loss, and had stomachache had a larger chance of experiencing insomnia symptoms than their peers. Furthermore, those who were in Wuhan and suffered from nausea and vomiting during pregnancy, were impacted by pregnancy on action, were not taken care of, were concerned about childbirth, had less education, were expecting to have their first child, had less annual household income, and had more financial loss as a result of COVID-19 were more likely to have lower resilience scores than their counterparts. Finally, those in Wuhan who suffered from nausea, vomiting, and stomachaches during pregnancy, did not daily monitor fetal movement, were impacted by pregnancy on action, were not taken care of, were concerned about childbirth, had less education, expected to have their first child, had less annual household income, and had more financial loss due to COVID-19 had a higher risk of perceiving stress than their counterparts.

The Correlation Relationship Between Perceived Stress, Resilience, and Insomnia Severity

Table 2 shows a Pearson correlation analysis of perceived stress, resilience, and insomnia severity. It was discovered that

TABLE 1 | Demographic status of the sample.

Variables (n = 2115)	Insomnia Severity		Resilience		Perceived Stress	
	Z/t	p	Z/t	p	Z/t	p
Age (years)	0.002	0.928	0.034	0.114	−0.023	0.289
From Wuhan (Yes = 0, No = 1)	−6.157	< 0.001	−3.742	< 0.001	−3.431	0.001
Drinking	11.350	0.003	5.180	0.075	2.097	0.350
Smoking	10.095	0.006	0.668	0.716	5.058	0.080
Nausea and vomiting during pregnancy	20.825	< 0.001	15.161	0.002	18.866	< 0.001
Daily attention to fetal movement	−2.857	0.004	−1.896	0.058	−2.972	0.003
Impact of pregnancy on action	141.740	< 0.001	26.881	< 0.001	22.471	< 0.001
Be taken care of	1.428	0.490	15.145	0.001	50.589	< 0.001
Any worries or fears about childbirth	−10.600	< 0.001	−7.117	< 0.001	−8.415	< 0.001
Degree of Education	6.440	0.092	63.549	< 0.001	85.410	< 0.001
First Child	−3.216	0.001	−3.283	0.001	−3.071	0.002
Annual Household Income	1.043	0.594	49.368	< 0.001	109.648	< 0.001
Financial Loss in COVID-19 (RMB)	40.047	< 0.001	27.326	< 0.001	32.138	< 0.001
Stomach ache	25.120	< 0.001	5.468	0.141	1.847	0.605
Relatives or friends are infected with covid-19	−0.292	0.771	−0.070	0.944	−0.257	0.797

The p-values were tested using the Pearson Correlation, Mann–Whitney tests, and Kruskal–Wallis tests.

resilience scores were negatively correlated with perceived stress ($r = -0.470$, $p < 0.001$) and insomnia severity ($r = -0.270$, $p < 0.001$), while perceived stress was positively correlated with insomnia severity ($r = 0.357$, $p < 0.001$), indicating that higher perceived stress was associated with lower resilience and worse sleep quality (higher insomnia severity), whereas higher resilience was associated with better sleep quality (lower insomnia severity).

The intensity of insomnia is related to perceived stress and resilience. Relationships between perceived stress and insomnia severity mediated by resilience are represented by regression lines (1 *SD* above and below the mean, two-way interaction). Slopes of low resilience ($\beta = 0.337$, $p < 0.001$) and high resilience ($\beta = 0.1392$, $p < 0.001$) are both significant.

Moderating Effects

Regression analyses were used to see if resilience might mitigate the negative consequences of perceived stress. **Table 3** shows the results of the regression analysis. To control the effect on the variables and to increase the overall R^2 to increase the power of the statistical test, Drinking, Smoking, Nausea and vomiting during pregnancy, Daily attention to fetal movement, impact of pregnancy on action, Be taken care of, Any worries or fears about childbirth, Degree of education, First Child, Annual household income, Financial loss in COVID-19 and Stomachache were controlled as covariates in the regression analysis. Perceived stress was found to be a positive predictor of insomnia severity in **Table 3**. The interaction term between perceived stress and insomnia severity was found to be significant, suggesting that the relationship between perceived stress and insomnia severity varied depending on resilience.

We displayed the relationship between perceived stress (1 *SD* above or below the mean) and insomnia severity at different degrees of resilience to better understand the nature of the interaction (**Figure 1**). According to simple slopes testing, the association between perceived stress and

TABLE 2 | Correlations among study variables (N = 2115).

Variables	Mean	SD	1	2	3
1. Perceived Stress	13.60	5.69	–	–	–
2. Resilience	29.90	7.84	−0.469**	–	–
3. Insomnia Severity	4.39	4.53	0.360**	−0.272**	—

$^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

TABLE 3 | Regression analysis examining the role of Perceived Stress in predicting Insomnia Severity.

Insomnia Severity	β	SE	Z	Two-tailed p-value
Covariates				
Drinking	−0.345	0.284	−1.215	0.225
Smoking	0.246	0.225	1.090	0.276
Nausea and vomiting during pregnancy	0.255	0.150	1.706	0.088
Daily attention to fetal movement	0.716	0.230	3.113	0.002
Impact of pregnancy on action	1.264	0.167	7.562	$p < 0.001$
Be taken care of	0.117	0.174	0.670	0.503
Any worries or fears about childbirth	0.900	0.194	4.637	$p < 0.001$
Degree of education	0.100	0.110	0.868	0.386
First Child	−0.425	0.247	−1.720	0.086
Annual household income	0.214	0.154	1.390	0.165
Financial loss in COVID-19	0.226	0.077	2.924	0.004
Stomachache Predictors	0.467	0.154	3.025	0.003
Perceived Stress	0.238	0.0183	13.000	$p < 0.001$
Resilience	−0.044	0.0315	−3.286	0.001
Interaction				
Perceived Stress and Resilience	−0.013	0.002	−6.034	$p < 0.001$

FIGURE 1 | Interaction of Perceived Stress Scores and Resilience Scores on Insomnia Severity Scores. PSS means Perceived Stress Scale, ISI means Insomnia Severity Scale.

insomnia intensity was statistically significant at various levels of resilience. The interaction between perceived stress and resilience was significant and negative on insomnia severity in the moderation model ($\beta = -0.126$, $p < 0.001$), implying that resilience mitigated the relationships between perceived stress and insomnia severity. Subgroup analysis conducted for the moderation of perceived stress and insomnia severity indicated that their effects differentiated the high resilience and low level of resilience. Pregnant women with low levels of resilience and high levels of perceived stress predicted higher insomnia severity ($\beta = 0.337$, $p < 0.001$). Pregnant women with high levels of resilience and high perceived stress also predicted higher insomnia severity ($\beta = 0.1392$, $p < 0.001$). Furthermore, the effect of perceived stress-related insomnia severity was less pronounced in the high resilience group than in the poor resilience subgroup.

DISCUSSION

The present study used hierarchical regression analysis to confirm the moderating impact of resilience on the relationship between perceived stress and sleep quality in Chinese pregnant women during COVID-19. Sleep quality, in particular, was found to be inversely related to stress perception. Furthermore, 18.53% of the individuals in this research reported having insomnia. Contrary to prior literature, the figure, 18.53%, is explicitly smaller compared to estimates of Chinese pregnant women prior to COVID-19, which was 49.4% (46). **Table 1** also shows that women with nausea and vomiting were more likely to have poor sleep quality, replicating FitzGerald and Davis' prior results that women with moderate/severe pregnancy-related nausea and vomiting were more likely to have sleep disturbance than those with none/mild sickness (47, 48). Such findings might be explained that the lockdown strategy enhanced pregnant women's resilience, therefore reducing the impact of perceived stress on sleep quality. To elaborate, family bonding might be reinforced even more when family members spent more time together, supported one another, and faced hardships together. Meanwhile, for pregnant women, their partners' mental health, the availability of social networks, and the companionship of family and friends all contribute to psychological resilience and emotional stress reduction.

During COVID-19, there was also a substantial negative association between felt stress and sleep quality, according to the current study. These findings back up previous findings from a study with pregnant women. Since the COVID-19 outbreak in December 2019, researchers have documented the pandemic's negative impacts on mental health, as well as the anticipated complicated impact on pregnant women. Hayase observed that in pregnant women, shorter sleep duration and increasingly worse sleep quality were linked to increased subjective stress (45). According to Carney et al. worrisome thoughts might prevent people from going asleep due to a lack of relaxation, interfering with circadian rhythms (49). Harvey also indicated that during the pre-sleep phase, stress enhanced cognitive and somatic arousal, affecting total sleep quality (50). According to the previous studies, a decrease in perceived stress was related to a significant improvement in sleep quality (51), this suggests that controlling and reducing prenatal mother stress might be an effective way to improve sleep quality.

The outcomes of the present study confirmed the moderation effect of resilience on perceived stress and insomnia symptoms. It indicated that increased resilience was significantly associated with improved sleep quality in pregnant women during COVID-19, which was consistent with previous research (52). The findings revealed that the association between stress and insomnia symptoms is less for persons with high levels of resilience than for those with low levels of resilience. To illustrate, individuals with high resilience have favorable characteristics (e.g., high cope self-efficacy, optimistic emotions, realistic optimism, and cognitive flexibility) that might enable them to positively get used to and keep good sleep quality when they are

confronted with acute or chronic stress (53). The moderation impact of resilience on stress and sleep quality demonstrated that pregnant women with more perceived stress and less resilience, subsequently, had poorer sleep quality. In contrast, pregnant women with less perceived stress and greater resilience, subsequently, had more favorable sleep quality. Because of the severe pandemic in Wuhan, individuals in Wuhan felt more stressed and had less resilience than those in other places, as seen in **Table 1**. As a result, individuals had increased sleeplessness symptoms. The current findings are consistent with a previous study, which found that the severity of perceived stress was negatively correlated with resilience, which was associated to psychological and physical health, including sleep quality. This finding is consistent with prior research indicating resilience is a protective feature that aids people in adapting to poor environmental quality (54). The existing literature has attached sleep quality with psychological resilience from a neurobiological perspective (55, 56). One potential explanation is that high resilience could sustain the HPA axis at an optimum level of activation; that is, high enough to get adjusted to danger but not so high as to trigger superfluous fear, anxiety, and depression, thus enabling the resilient individual to prevent psychosomatic disorders like sleep disturbance (57).

Further research is needed in this area in the future to better understand the molecular and psychological mechanisms. Resilience's moderating effect on perceived stress and sleep quality provides fresh insight into the components that influence sleep quality. Resilience, in particular, might be considered a component to be addressed in sleep quality enhancement programs for pregnant women (58, 59). On the other hand, local community and government agencies should provide more psychological service to individuals to cope with their stress. Pregnant women would feel more secure, and additional psychological support measures might help them feel less worried. As a result, even if they have a low degree of resilience, they may be able to have decent sleep.

LIMITATION

There are certain limitations to this study that should be mentioned. For starters, the cross-sectional design made study difficult to confirm the causal link between resilience, stress, and insomnia symptoms. To determine the causal influence of perceived stress on insomnia symptoms during pregnancy, longitudinal studies are required. Second, the current study only used self-report ratings, which might contribute to methodological variability (CMV). More study using a variety of approaches to measure sleep quality is needed. Third, We did not analyze the influence of the presence of partners on the mental health of pregnant women in this study because the majority of the pregnant women polled were pregnant women with partners. Future research should consider the crucial function of partners in our transition from individual to parent.

Nonetheless, there were a few positive aspects to this research. In COVID-19 pregnant women in China, this was the first study to indicate that resilience moderates the association between perceived stress and sleep quality, and the sample size was large: 2115 pregnant women were studied. These findings contribute to a better understanding of the relationship between resilience, perceived stress, and insomnia symptoms in pregnant women, and offer a new direction to develop interventions to advance sleep quality.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee for Scientific Research of the Chinese Academy of Sciences' Institute of Psychology. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HZ and ZT were responsible for writing-original draft preparation, reviewing and editing, methodology, and analyzed the data. YZ, ZZ, and LL were responsible for statistical analysis and manuscript revision. CZ, JY, and YW were responsible for data acquirement. WH and JW were responsible for study design and supervision. All authors have given final approval for its publication.

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A Positive Legacy of Trauma? The Role of Perceived Social Support on Mental Health Among Earthquake Survivors During the COVID-19 Outbreak

Dongfang Wang[1], Shuyi Zhai[2], Jiaqiao Chen[1], Yao Chen[1], Shiming Hua[1], Chengchen Wang[1], Fang Fan[1] and Xianchen Liu[3]*

[1] Guangdong Key Laboratory of Mental Health and Cognitive Science, Ministry of Education Key Laboratory of Brain Cognition and Educational Science, Centre for Studies of Psychological Applications, School of Psychology, South China Normal University, Guangzhou, China, [2] Faculty of Medicine, McGill University, Montreal, QC, Canada, [3] Center for Public Health Initiatives, University of Pennsylvania, Philadelphia, PA, United States

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***Correspondence:**
Fang Fan
fangfan@scnu.edu.cn

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Background: People with prior experience of severe trauma may be particularly vulnerable in the face of the COVID-19 pandemic. However, little is known about mental health problems among prior trauma survivors during the pandemic outbreak.

Methods: A total of 362 Wenchuan earthquake survivors were assessed using Patient Health Questionnaire, Generalized Anxiety Disorder Scale, as well as Multidimensional Scale of Perceived Social Support, as part of an online survey between February 3 and 10, 2020.

Results: Our results showed that 6.6 and 4.7% of the participants experienced depression and anxiety during the COVID-19 outbreak, respectively. Perceived social support was negatively associated with depressive and anxiety symptoms. Earthquake exposure has no direct effect on current depressive and anxiety symptoms, but it would moderate the direct relationship between perceived social support and psychological symptoms.

Conclusions: Our findings suggested that trauma exposure may lead to salutogenic outcomes. The protective effect of perceived social support on psychological symptoms was greater in people with a higher level of trauma exposure than in a lower one.

Keywords: perceived social support, depression, anxiety, trauma exposure, COVID-19

BACKGROUND

Numerous studies have shown that the COVID-19 pandemic leads to the development of mental health problems in public (1, 2). For some special groups, such as psychiatric patients (3), frontline healthcare workers (4), and even patients infected with COVID-19 (5), their mental health is even more likely to be affected by the pandemic. However, little attention has been paid to the mental health of another high-risk group during the pandemic: survivors of prior trauma.

Theoretically, prior trauma exposure and subsequent posttraumatic stress (PTS) symptoms may intensify one's vulnerability when facing additional stressors. By draining one's resources (6, 7) and coping capacity, trauma exposure and PTS symptoms heighten one's sensitivity to stress (8, 9). One late study in a sample of 976 adults indicated that history of trauma exposure and resultant PTS were associated with an elevated risk for psychological distress following COVID-19 (10). This finding leads us to suspect that whether individuals who experienced natural disaster (e.g., earthquake) could have greater risks of poor mental health during the COVID-19 pandemic.

Considered as an important disaster preparedness resource, social support is linked to better mental health outcomes for survivors after disasters (11). More specifically, it has been proposed that stronger social support can predict better mental health functioning (12, 13), enhance resilience to stress, and help protect against developing trauma-related psychopathology (14). Meanwhile, people who give and receive social support before the occurrence of disasters are significantly less likely to develop mental health problems (e.g., depressive symptoms) during the post-disaster time compared to those without support (15).

On the other hand, perceived social support is distinct from received social support, which is a better predictor of mental health and support utilization than other measures (16). People suffering from a greater degree of disaster-related traumatic stressors are more likely to seek and receive greater amount of actual support, which consists of a significant indirect path to reduce distress. Greater received support predicted greater perceived support over time, and greater perceived support in turn predicted greater reductions in distress over time, although perceived support tends to decrease over time (17–21). Furthermore, the level of perceived social support was negatively impacted by disaster-related stressors as well as subsequent life stressors in the aftermath of disasters (22). Accordingly, what about prior trauma survivors' perceived social support while facing a subsequent traumatic events such as the COVID-19 pandemic?

In the light of the foregoing discussion, we conducted the present study to examine the level of perceived social support and the prevalence of mental health problems among Wenchuan earthquake (2008) survivors during the COVID-19 outbreak. Three specific objectives were as follows: (a) to investigate depression and anxiety prevalence rates among 362 earthquake survivors during the pandemic outbreak; (b) to examine the effect of perceived social support in relation to depression and anxiety; and (c) to explore the differences in the relationship between perceived social support and mental health among survivors who suffer from different levels of earthquake exposure severity. It was hypothesized that perceived social support would be negatively associated with depression/anxiety. Earthquake exposure severity would moderate the direct association between perceived social support and mental health. Specifically, people suffering from greater degree of earthquake exposure are more likely to perceive greater social support, leading to fewer mental health problems.

TABLE 1 | Sample characteristics and trauma exposure.

Variables	Characteristics	*N*	%
Socio-Demographic			
Sex	Female	125	34.5
	Male	237	65.5
Age [years, M (SD)]	26.41 (0.65)		
Marital status (married)	Married	148	40.9
Family income (monthly)	<5,000 RMB	179	49.4
	5,000–10,000 RMB	122	33.7
	>10,000 RMB	61	16.9
History of mental disorders	Yes	3	0.8
Chronic physical illness	Yes	3	0.8
Smoking	Yes	71	19.6
Alcohol intake	Yes	134	37.0
Pandemic-Related factors			
Confirmed or suspected cases in the community or village	Yes	5	1.4
Relatives or friends being infected with COVID-19	Yes	7	1.9
Exposure to media coverage of the	<1 h/day	115	31.8
COVID-19	1–2 h/day	204	56.4
	>3 h/day	43	11.9
Earthquake exposure[a] [M (SD)]	11.22 (2.77)		
Family member injured or	Injured	54	14.9
killed/missing	Killed or missing	42	11.6
House damage	Moderate	176	48.6
	Severe	158	43.6
Property loss	Moderate	263	72.7
	Severe	75	20.7
Directly witnessed the disaster	Yes	178	49.2

[a] *Measured in November 2008.*

METHODS

Participants and Procedure

The 8.0-magnitude earthquake occurred on May 12, 2008, in Wenchuan county of Sichuan province, which has been the strongest earthquake over the past 50 years in China. The earthquake was devastating: 69,197 died, 374,176 were injured, and 18,222 were missing. Meanwhile, at least 4.8 million residents were left homeless due to their houses being destroyed by the earthquake. Fan et al. conducted a longitudinal study of mental health among adolescent survivors exposed to the Wenchuan earthquake in May 2008 (23). A total of 1,573 Wenchuan earthquake survivors completed assessments of mental health at 6 months after the earthquake (sampling time: November 2008) (23). Among these participants, 410 completed the web-based survey during the COVID-19 outbreak (sampling time: from February 3 to 10, 2020), and the response rate was 26.1%. To control the quality of the survey responses, exclusion criteria included was that "missing information >25%" and "response time <5 min." Finally, 362 participants were included in the subsequent analyses. The chi-square test and *t*-test were used

to compare the participants who participated in the web-based survey during the COVID-19 outbreak with those whose did not in major variables at baseline. There was no significant difference in age ($t = -1.05$, $p = 0.292$) and earthquake exposure ($t = -0.79$, $p = 0.431$) between these two groups. Men were less likely to participate ($\chi^2 = 15.90$, $p < 0.001$), mainly because they were more likely to drop out at school age. Among participants, 93.6% ($N = 339$) of the survivors lived in Sichuan Province during the survey period, which was a low infection risk area with <1,000 cumulative confirmed cases during the COVID-19 outbreak (24).

Researchers sent the informed consent and a specific web link or quick response (QR) code to participants through their contact information (e.g., QQ, WeChat, or SMS). Participants completed the online survey by clicking the questionnaire link or scanning the QR code of the questionnaire with mobile phones. This study was entirely voluntary; interested participants needed to sign an electronic informed consent form before the survey and could quit at any time. The ethics board of the South China Normal University (SCNU-PSY-2020-01-001) examined and approved the project. Participants were also provided psychological counseling from the School of Psychology, South China Normal University. If needed, participants can also assess free online psychological counseling service ("Xin-Qing"Hotline) from the School of Psychology of South China Normal University.

Measures

Sample Characteristics and Trauma Exposure

Sample characteristics included sex, age, marital status, family income, history of mental and physical illness, history of smoking, and alcohol use.

The main two trauma exposures in this study are Wenchuan earthquake and COVID-19 pandemic-related factors. Earthquake exposure was assessed using four items (25): I1: death, injury, and/or missing of family members; I2: house damage; I3: property loss; I4: witness or hearing of tragic scenes. Each item was rated on a five-point Likert scale with 1 representing the lowest level of exposure and five representing the highest. Summing up scores on all items generates a total score, indicating overall severity of earthquake exposure.

Pandemic-related factors were assessed using three questions: Q1: Are there confirmed or suspected cases in your community or village? (1 = yes, 0 = no); Q2: Do you have relatives or friends who have been infected with COVID-19? (1 = yes, 0 = no); and Q3: How much time are you exposed to news and information about COVID-19 on social media? (1 = <1 h/day, 2 = 1–2 h/day, 3 = >3 h/day).

Perceived Social Support

The Multidimensional Scale of Perceived Social Support (MSPSS) was used to assess participants' perceived social support (26). It consisted of 12 items addressing the following three domains: family, friends, and significant others. Each item was scored on a 7-point scale ranging from 1 (very strongly disagree) to 7 (very strongly agree), with a range of 12–84. A higher total score indicated greater level of perceived social support. Degree of social support can be determined by the following cuto? scores: 12–48 low social support, 49–68 moderate social support, and 69–84 high social support. The Chinese version of MSPSS was reported to have good reliability and validity (27). It also had satisfactory internal consistency in this study (Cronbach' $\alpha = 0.95$).

Depressive Symptoms

The 9-item Patient Health Questionnaire (PHQ-9) was used to assess participants' depressive symptoms over the past 2 weeks (28). Each item was answered on a 3-point Likert scale (0 = not at all, 1 = several days, 2 = more than half the days, and 3 = nearly every day), with higher scores indicating higher levels of depressive symptoms. The cutoff point of 10 was usually used for demonstrating clinically significant depression (29). The Chinese version of PHQ-9 has been reported to have good reliability and validity in the Chinese sample (30). In the current sample, Cronbach's α for PHQ-9 was 0.89.

Anxiety Symptoms

The 7-item Generalized Anxiety Disorder (GAD-7) was used to measure participants' anxiety symptoms over the past 2 weeks (31). Responders should provide a response for each item using a 6-point scale ranging from 0 (not at all) to 3 (nearly every day). Summing up scores on all items would generate a total score indicating the overall severity of anxiety symptoms. A preliminary study suggested that a cutoff score of 10 is the optimal threshold to indicate clinical level of anxiety (32). The scale of the Chinese version has demonstrated satisfactory psychometric properties in the Chinese population (33). In the present study, GAD-7 also demonstrated high internal consistency, with the Cronbach's α being 0.93.

Data Analyses

All statistical analyses were conducted using SPSS, version 23.0, and $p < 0.05$ were considered statistically significant for all two-tailed tests. Descriptive statistics were calculated for sample characteristics, pandemic-related factors, and earthquake exposure. To assess the differences between levels of perceived social support in relation to PHQ-9 and GAD-7, χ^2-test and one-way ANOVA were used, as appropriate. Pearson correlations were examined among earthquake exposure, MSPSS, PHQ-9, and GAD-7. Meanwhile, PROCESS was used to examine the mediation hypotheses, with 5,000 iterations to estimate the effect size of models (34). Harman's one-factor test was conducted to examine common method variance before regression analysis (35). The moderation effect was tested: MSPSS score was entered as the predictor, earthquake exposure was entered as the moderator, and PHQ-9 or GAD-7 score was entered as the outcome. Simple slopes were calculated for high, medium, and low levels of earthquake exposure (using the mean score and cutoffs either one standard deviation above or below the mean), to determine the level at which perceived social support starts to have a significant correlation with earthquake exposure. Sample characteristics and pandemic-related factors were also included in the current analyses as covariates.

TABLE 2 | Characteristics of participants enrolled to the study according to perceived social support status.

		Perceived social support status			*p*	Cramer's *V*
		Low ***N* = 52, 14.4%**	**Moderate** ***N* = 156, 43.1%**	**High** ***N* = 154, 42.5%**		
Sex [*N* (%)]	Female	31 (13.1)	96 (40.5)	110 (46.4)	$\chi^2 = 4.27$	0.109
	Male	21 (16.8)	60 (48.0)	44 (35.2)		
Age [years, M (SD)]		26.36 (0.61)	26.40 (0.66)	26.43 (0.65)	$F = 0.27$	$\eta^2 = 0.022$
Marital status (married) [*N* (%)]	Married	19 (12.8)	65 (43.9)	64 (43.2)	$\chi^2 = 0.48$	0.036
	Unmarried	33 (15.4)	91 (42.5)	90 (42.1)		
Family income (monthly) [*N* (%)]	<5,000 RMB	24 (13.4)	80 (44.7)	75 (41.9)	$\chi^2 = 1.29$	0.042
	5,000–10,000 RMB	17 (13.9)	50 (41.0)	55 (45.1)		
	>10,000 RMB	11 (18.0)	26 (42.6)	24 (39.3)		
History of mental disorders [*N* (%)]	Yes	0 (0)	1 (33.3)	2 (66.7)	$\chi^2 = 0.91$	0.050
	No	52 (14.5)	155 (43.2)	152 (42.3)		
Chronic physical illness [*N* (%)]	Yes	1 (33.3)	2 (66.7)	0 (0)	$\chi^2 = 2.44$	0.082
	No	51 (14.2)	154 (42.9)	154 (42.9)		
Smoking [*N* (%)]	Yes	15 (21.1)	35 (49.3)	21 (29.6)	$\chi^2 = 7.09^*$	0.140
	No	37 (12.7)	121 (41.6)	133 (45.7)		
Alcohol intake [*N* (%)]	Yes	39 (17.1)	98 (43.0)	91 (39.9)	$\chi^2 = 4.22$	0.108
	No	13 (9.7)	58 (43.3)	63 (47.0)		
Confirmed or suspected cases in the community or village [*N* (%)]	Yes	0 (0)	2 (40.0)	3 (60.0)	$\chi^2 = 1.10$	0.055
	No	52 (14.6)	154 (43.1)	151 (42.3)		
Relatives or friends being infected with COVID-19 [*N* (%)]	Yes	3 (42.9)	3 (42.9)	3 (14.3)	$\chi^2 = 5.37^*$	0.122
	No	49 (13.8)	153 (43.1)	153 (43.1)		
Exposure to media coverage of the COVID-19 [*N* (%)]	<1 h/day	17 (14.8)	51 (44.3)	47 (40.9)	$\chi^2 = 1.73$	0.049
	1–2 h/day	27 (13.2)	90 (44.1)	87 (42.6)		
	>3 h/day	8 (18.6)	15 (34.9)	20 (46.5)		
Earthquake exposure [M (SD)]	–	11.62 (2.73)	11.27 (2.92)	11.04 (2.62)	$F = 0.89$	$\eta^2 = 0.049$
PHQ-9 [M (SD)]	–	5.87 (5.43)	3.45 (3.81)	1.60 (2.41)	$F = 29.32^{***}$	$\eta^2 = 0.178$
Depression[a] [*N* (%)]	Yes	11 (45.8)	11 (45.8)	2 (8.3)	$\chi^2 = 24.84^{***}$	0.262
	No	41 (12.1)	145 (42.9)	152 (45.0)		
GAD-7 [M (SD)]	–	4.17 (4.63)	2.61 (3.39)	1.10 (2.01)	$F = 21.30^{***}$	$\eta^2 = 0.126$
Anxiety[b] [*N* (%)]	Yes	8 (47.1)	9 (52.9)	0 (0)	$\chi^2 = 21.26^{***}$	0.242
	No	44 (12.8)	147 (42.6)	154 (44.6)		

MSPSS, Multidimensional Scale of Perceived Social Support; PHQ-9, Patient Health Questionnaire; GAD-7, Generalized Anxiety Disorder Scale.

[a]*Depression calculated using the PHQ-9, with a clinical cutoff score of 10.*

[b]*Anxiety calculated using the GAD-7, with a clinical cutoff score of 10. *P <0.05; **P <0.01; ***P <0.001.*

RESULTS

This sample consisted of 362 Wenchuan earthquake survivors, 125 men and 237 women. Their age ranged from 25 to 28 years old, with the average age of 26.41 (SD = 0.65) years; 1.4% participants lived in the community or village with confirmed or suspected cases, and 1.9% reported that their relatives or friends have been infected with COVID-19. Other sample characteristics and trauma exposure are listed in **Table 1**.

Of the 362 participants, 24 (6.6%) had depression, with a mean PHQ-9 score of 3.01 (SD = 3.87). A total of 17 (4.7%) were shown to be positive for anxiety, with a mean GAD-7 score of 2.20 (SD = 3.29). In terms of perceived social support, only 14.4% ($N = 52$) had a low level, while 42.5% ($N = 154$) had a high level. The mean score of MSPSS was 63.98 (SD = 12.10).

Demographic characteristics along with the outcomes of interest were presented in **Table 2**, stratified by different levels of perceived social support. Compared to low perceived social support, participants who perceived a high level of social support were reported to have lower PHQ-9 and GAD-7 scores, as well as significantly lower proportion of depression and anxiety. Correlation analysis further showed MSPSS scores being negatively associated with PHQ-9 ($r = -0.41$, $p < 0.001$) and GAD-7 ($r = -0.37$, $p < 0.001$) scores. In addition, earthquake exposure was not associated with MSPSS ($r =$

TABLE 3 | Regression coefficients from analyses of moderating effect of earthquake exposure on the relationship between perceived social support and mental health status.

	b	SE	*t*	*p*	95% CI
Model 1[a]					
MSPSS	−0.40	0.05	−8.10	<0.001	−0.49, −0.30
EE	0.05	0.05	1.01	0.313	−0.05, 0.14
MSPSS × EE	−0.14	0.05	−2.86	0.005	−0.24, −0.04
Low EE	−0.28	0.06	−4.40	<0.001	−0.41, −0.16
Moderate EE	−0.38	0.05	−7.81	<0.001	−0.48, −0.29
High EE	−0.54	0.07	−7.93	<0.001	−0.67, −0.40
Model 2[b]					
MSPSS	−0.38	0.05	−7.70	<0.001	−0.48, −0.28
EE	0.04	0.05	0.66	0.511	−0.06, 0.13
MSPSS × EE	−0.14	0.05	−2.76	0.006	−0.24, −0.04
Low EE	−0.27	0.07	−4.16	<0.001	−0.40, −0.14
Moderate EE	−0.37	0.05	−7.42	<0.001	−0.47, −0.27
High EE	−0.52	0.07	−7.57	<0.001	−0.66, −0.39

Models both adjusted for sample characteristics (e.g., sex and age) and pandemic-related factors.
MSPSS, Multidimensional Scale of Perceived Social Support; EE, earthquake exposure; OR, odds ratio; CI, confidence intervals.
[a]*PHQ-9 score was the outcome.*
[b]*GAD-7 score was the outcome.*

−0.07, $p = 0.177$), PHQ-9 (r =0.07, $p = 0.186$), and GAD-7 (r =0.06, $p = 0.282$) scores.

As shown in **Table 3**, the moderation model with PHQ-9 score as outcome was significant with $F_{(14,347)} = 7.40$, $p < 0.001$, accounting for 23.0% of the total variance. Perceived social support had a negative main effect on depressive symptoms ($b = -0.40$, SE = 0.05, 95% CI = −0.49, −0.30). While earthquake exposure did not directly affect depressive symptoms ($b = 0.05$, SE = 0.05, 95% CI = −0.05,0.14), it moderated the relationship between perceived social support and depressive symptoms, $b = -0.14$, SE = 0.05, 95% CI = −0.24, −0.04, indicating that the indirect effect of perceived social support on depressive symptoms significantly differed at various levels of earthquake exposure. With simple slope analyses, a significant negative relationship between perceived social support and depressive symptoms was found at low ($b = -0.28$, SE = 0.06, 95% CI = −0.41, 0.16), moderate ($b = -0.38$, SE = 0.05, 95% CI = −0.48, −0.29), and high levels of earthquake exposure ($b = -0.54$, SE = 0.07, 95% CI = −0.67, −0.40) (see **Figure 1A**).

The moderation model with GAD-7 score as the outcome was also significant with $F_{(14,347)} = 6.40$, $p < 0.001$, accounting for 20.5% of the total variance. Similar to the results of depressive symptoms, earthquake exposure moderates the relationship between perceived social support and anxiety symptoms ($b = -0.14$, SE = 0.05, 95% CI = −0.24, −0.14). Simple slope analyses also found a significantly positive relationship between perceived social support and anxiety symptoms at low ($b = -0.27$, SE = 0.07, 95% CI = −0.40, −0.14), moderate ($b = -0.37$, SE = 0.05, 95% CI = −0.47, −0.27), and high ($b = -0.37$, SE = 0.07, 95% CI = −0.66, −0.39) level of earthquake exposure (see **Figure 1B**). These findings indicated that earthquake exposure is a moderator of perceived social support and mental health among earthquake survivors during the COVID-19 outbreak.

DISCUSSION

To our best knowledge, this was the first study to examine the mental health status of prior natural disaster survivors during the COVID-19 outbreak. Our findings suggested that earthquake survivors did not confer any increase in the prevalence of depression and anxiety during the outbreak phase of the pandemic. Meanwhile, higher prior earthquake exposure experience strengthens the protective effect of individual's perceived social support.

This study found that only 6.6% of the participants reported having depression and 4.7% reported having anxiety. In order to understand the meaning of our results, they are compared with data of the same type (the PHQ-9/GAD-7 cutoff of 10 or higher) on national and international surveys during the pandemic outbreak. Based on previous research, depression and anxiety rate in the current sample was lower than that of a similar study measuring Chinese adult citizens (12% depression, 7.1% anxiety) between February 9 and 20, 2020 (36). Several web-based studies found that the percentage of Chinese general public with depression was 13.6% between February 11 and 16, 2020 (37), and anxiety rate was 22.6% between January 31 and February 2, 2020 (38). Meanwhile, the general population from Jordan reported 32.1% depression and 22.8% anxiety between March 22 and 28, 2020 (39). Ettman et al. observed that the prevalence rate of depression was 27.8% in U.S. general adults during the COVID-19 outbreak (March 31–April 13, 2020) (40). Compared to these studies that have taken place in a similar phase of the outbreak, lower levels of depression and anxiety symptoms were observed in earthquake survivors.

Our study also found a higher level of perceived social support in earthquake survivors when compared to that of general college students in China during the same period (February 3–10, 2020). Our results showed that perceived social support of the present sample (mean score = 63.98, SD = 12.10) was higher than the level of college students (mean score = 59.8, SD = 11.7) living in the moderate-risk (Guangdong Province) and low-risk aeras (Jiangxi Province) (41). In the current sample, 42.5% of participants could be classified into the high social support group (scores from 69 to 84), which seemed to be significantly higher than the rate in the Lebanese public (20.8%) during the outbreak of COVID-19 with a consistent demarcation (42). Earthquake survivors having higher perceived social support in our study may be due to the solid financial and emotional support from both the government and the civilians in China (43), such as house reconstruction and better healthcare. In addition, perceived social support was observed to have a significant negative association with anxiety and depression. Higher levels of perceived social support were related to lower level of depression and anxiety outcomes, which was in line with previous literature (42, 44). It has been proposed that such social support could predict better mental health functioning and be regarded as a

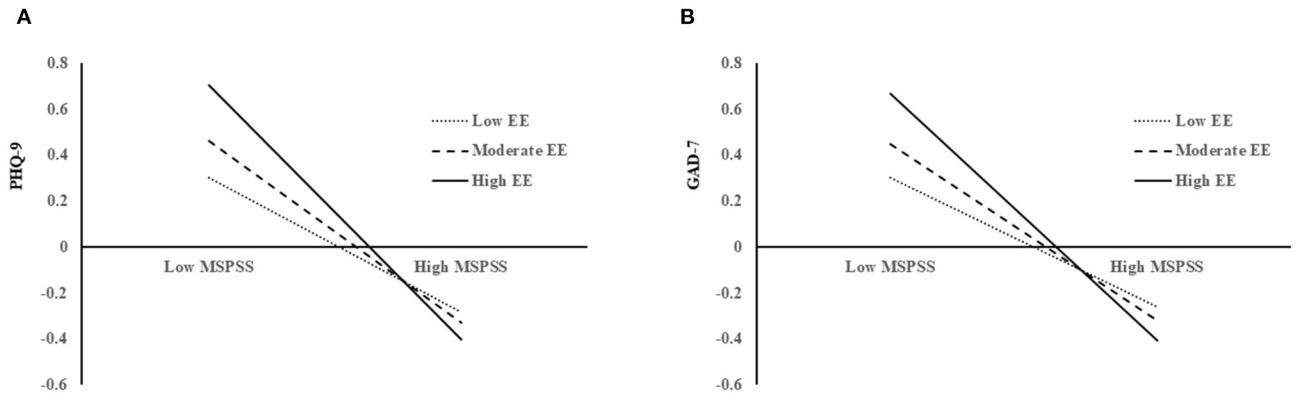

FIGURE 1 | Simple slope analyses. **(A)** The interaction between perceived social support and depression as moderated by earthquake exposure and shows that perceived social support was negatively associated with depression better with higher earthquake exposure. **(B)** The interaction between perceived social support and anxiety as moderated by earthquake exposure and shows that perceived social support was negatively associated with anxiety better with higher earthquake exposure. MSPSS, Multidimensional Scale of Perceived Social Support; EE, earthquake exposure; PHQ-9, Patient Health Questionnaire; GAD-7, Generalized Anxiety Disorder Scale.

protective factor against the onset of new mental health problems (12, 45). More specifically, social support could also enhance resilience to stress and reduce the development of trauma-related psychopathology (14).

Interestingly, prior earthquake exposure did not exhibit a direct effect on current depressive and anxiety symptoms, but it moderated the relationship between perceived social support and psychological symptoms. The effect of perceived social support on depression or anxiety significantly differed at varying levels of prior earthquake exposure. Specifically, social support had a stronger protective effect on mental health among survivors who had greater earthquake exposure. Although scholars proposed that trauma was a vital risk factor for individuals' mental health issues (46), prior trauma exposure might also have salutogenic effects. Recent evidence found that people with high trauma exposure were more likely to experience posttraumatic growth (PTG) (47), which denoted the tendency to report a positive transformation in the aftermath of a trauma exposure (48). Scrutinizing the empirical literature also found that participants with higher PTSD symptoms were more likely to grow from the impact of the trauma (49, 50). Theoretically, PTG might indicate perceived change rather than reflect actual growth (51). It could also be understood as a motivated positive illusion that served a protective function (52). We speculated that these improved personal resources and qualities [e.g., resilience (53)] that precipitated from past adversities acted as active protective factors that could be set in motion as one facing adversities again (e.g., COVID-19 pandemic).

Finally, several limitations must be considered. First, the present study was conducted on a sample of trauma survivors who experienced the 2008 Wenchuan earthquake. Before the disaster, they were both students of junior and senior school (Grades 7–12). Therefore, generalizations of our findings to sufferers of other traumatic experiences or of different age groups need to be done with caution. Second, there was a high attrition rate in the present study, which may lead to affect the accuracy of results. The time interval between the two surveys was more than 11 years, resulting in a high attrition rate. Although no significant differences were found for earthquake exposure between participants who followed up and those lost to follow-up, the results need to be interpreted with caution. Third, depression and anxiety variables relied on self-report questionnaires, which might cause potential reporting bias in the data collection. Meanwhile, other important factors that might affect the study findings, such as PTG or actual support, were not examined. In addition, depression and anxiety among the current sample needed to be further assessed longitudinally. Mental healthcare should still be provided to those prior trauma survivors at risk in the aftermath of the pandemic.

CONCLUSION

In conclusion, this study described the unique contribution of prior trauma exposure in explaining trauma-related symptoms among earthquake survivors during the COVID-19 outbreak. Earthquake survivors seemed to perceive higher levels of social support and exhibit lower mental health problems. They might also have a faster decline in mental health problems if they have been involved in greater prior trauma.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Board of the South China Normal University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

DW, FF, and XL: conceptualization. DW: methodology, formal analysis, and writing—original draft. DW, JC, YC, SH, and CW: data curation. SZ, FF, and XL: writing—review and editing. All authors contributed to the article and approved the submitted version.

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Intensive Care Unit Nurses in Iran: Occupational Cognitive Failures and Job Content

*Fatemeh Mehri, Amin Babaei-pouya and Mansoureh Karimollahi**

Department of Intensive Care Unit, Ardabil University of Medical Sciences, Ardabil, Iran

Background: Nurses in intensive care units (ICU) are under a lot of stress because of special conditions caused by the work environment and the high level of knowledge and skills required to work in these units, which can lead to cognitive failures. This study aimed to investigate the relationship between occupational cognitive failures (OCF) and job content (JC) in nurses in the ICU of Ardabil hospitals in 2020.

Methods: The present study was a descriptive-analytical cross-sectional study that was conducted in 2020. The study population included nurses working in the ICU of hospitals in Ardabil, from which 267 people who were eligible to enter the study were selected. OCF and JC questionnaires were used to collect data. Data were analyzed using SPSS software 23.

Results: OCF with work records in the ICU, total work records, and work records in the COVID-19 and non-COVID-19 units are significantly associated. OCF was inversely related to the JC subscales of skill discretion and decision authority. And directly related to other subscales of JC.

Conclusions: Develop job ability, reduce repetitive tasks, create diversity in work, create opportunities for creativity, have the authority and freedom to make decisions, facilitate work with new technologies, have enough time to do work, have a friendly work environment with colleagues, support by the supervisor, improving posture, especially for the upper body, feeling job security can help to reduce the cognitive failure of nurses.

Keywords: job cognitive failures, job content, nurse, ICU, Iran

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****Correspondence:***
Mansoureh Karimollahi
karimollahi@gmail.com

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BACKGROUND

Errors in the provision of health services are unsafe behavior and in some cases irreparable phenomenal. The nursing error means a failure to meet the standards of care that most of these errors occur when caring for patients so that annual nursing errors lead to increased length of hospital stay and increased medical costs (up to 9.14%) and even the death of thousands (1, 2). Annually, 44,000 to 98,000 people in the United States die due to medical errors, and deaths from preventable accidents in hospitals exceed the number of deaths attributed to vehicle accidents (3).

Nurses who are adapted to working conditions reduce errors and cognitive failures by focusing properly on their tasks. However, night work, long shifts, and unpredictable activities increase their fatigue can reduce their performance and physical capacity, and increase the likelihood of cognitive failures. Chronic drowsiness and fatigue are factors that affect the cognitive function of nurses and

cause patient care to be dismissed and not done properly or be delayed (4). Cognitive failure is simple mistakes in daily activities, such as forgotten commitments and difficulty concentrating, that can lead to human error (5). Cognitive failures occur daily in the process of information processing in the stages of perception, memory, and motor actions, and human errors due to cognitive failures may occur in one of three stages of perception, memory, and motor actions (6). The results of several studies have shown that occupational cognitive failure (OCF) can lead to decreased safety in job performance (7, 8).

Cognitive failures as mind-related errors are related to the job content (JC) subscale. Job content refers to the evaluation of psychological and social stress factors including skill discretion, decision authority, psychological job demand, physical exertion, physical isometric loads, job insecurity, supervisor support, and coworker support (5). The existence of JC refers to factors that are controlled by the person in his job, such as performance, cognition, and independence, which are directly related to the job (5) and are strongly influenced by work stress. Among nurses, especially nurses in ICU, the increased workload is one of the most important causes of stress that increases cognitive failures, reduces the quality of care and patient safety (9). If people's abilities do not match their job conditions, it causes job stress and increases cognitive failures (4). Nurses who did not have good general health will not be able to provide better physical and mental care to patients, and this will increase mistakes and occupational accidents, which will ultimately affect the nurse and the patient (8).

According to our literature review, the relationship between OCF and JC of nurses has not been studied. In addition, since a significant number of people lose their lives due to medical errors (3) and one of the factors affecting medical errors is OCF and JC; Identifying the factors affecting OCF and JC in nurses can be an important step to reduce medical errors of nurses. Therefore, the present study was conducted to determine the relationship between OCF and JC in nurses of ICU of Ardabil educational and social security centers. The results of such studies can be of great help in improving and controlling the health status of patients and nursing staff.

METHODS

Study Design and Participants

The present study was a descriptive-analytical cross-sectional study that was conducted in 2020. The study population included nurses working in intensive care units (ICU) of hospitals in Ardabil, from which all 267 people who were eligible to enter the study were selected. The study protocols were designed according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement, and it is approved by the Ardabil University of the medical sciences ethics committee.

Inclusion and Exclusion Criteria

The inclusion criteria were the nurses with a bachelor's degree and higher, having the experience of working in the ICU for at least 6 months, having no history of severe mental illnesses, not receiving any treatment for serious diseases, and consent to participate. The exclusion criteria, having no will to continue the participation.

Sample Size Calculation

According to enrolling all eligible individuals into the study, this is considered a consensus sampling.

Data Collection

Data collection tools included a three-part questionnaire. The first part included a demographic information sheet (age, gender, and work records, level of education, marital status, work shift, employment status, and history of mental disorders), the second part included the OCF Questionnaire and the JC Questionnaire.

OCF Questionnaire

The OCF Questionnaire was designed by Hassanzadeh Rangi et al. (10). This questionnaire has 30 questions and its answer range is of the 5-point Likert type, which is "I strongly disagree" with grade 1, "I disagree" with grade 2, "I have no opinion" grade 3, "I agree: with grade 4, and "I completely agree" with grade 5. Based on this questionnaire, the obtained scores are collected, and then the rate of OCF is judged based on the sum of scores. The minimum score is 30 and the maximum score is 150. A score between 30 and 60 indicates low cognitive failure. A score between 61 and 90 indicates moderate cognitive failure, and a score above 90 indicates high cognitive failure. Hassanzadeh et al. reported a content validity of 0.70 and its reliability by Cronbach's alpha method of 0.96 (10). in the study, Athar et al. this questionnaire by had used for hospital nurses (7).

JC Questionnaire

JC Questionnaire has been developed by Kazarak et al. to measure JC (11). Factor validity of this questionnaire has been confirmed by the developers. Also, its reliability has been reported by Cronbach's alpha coefficient method for skill discretion 0.43, decision authority 0.64, psychological job demand 0.60, physical exertion 0.65, physical isometric loads 0.85, job insecurity 0.32, supervisor support 0.87, and coworker support 0.76 (12, 13).

The guide to the JC questionnaire includes the number of items, calculation formula, maximum and minimum, and average scores are given in **Table 1**.

Interviews and Data Collections

After explaining the objectives of the research and the demand for cooperation in researching the nurses in the first session, emphasis was placed on accuracy and honesty in completing the questionnaires and it was ensured that the information obtained would be completely confidential. According to the census sampling method, the questionnaires were provided to all nurses working in ICU with frequent visits in different shifts. Due to the busy work of the nurses in these units, to encourage them to cooperate and increase the accuracy in answering the questions, after distributing the questionnaire, they were asked to complete the questionnaires during their free time. The questionnaire was received in the same shift or at the time of re-visit.

TABLE 1 | Guidance content questionnaire guide.

Variable	Number of items	Formula	Minimum score	Maximum score	Average score (cut point)
Skill discretion	6	[Q1 + Q3 + Q4 + Q5 + Q6 + (5-Q2)] × 2	12	48	30
Decision authority	3	[Q7 + Q9 + (5-Q8)] × 4	12	48	30
Psychological job demand	5	[(Q10 + Q11) × 3 + 15-(Q12 + Q13 + Q14)] × 2	12	48	30
Physical exertion	3	[Q15 + Q16 + Q17]	3	12	7.5
Physical isometric loads	2	[Q18 + Q19]	2	8	5
Job insecurity	3	[Q20 + Q22 + (5-Q21)]	3	12	7.5
Supervisor support	4	[Q23 + Q24 + Q25 + Q26]	4	16	10
Coworker support	4	[Q27 + Q28 + Q29 + Q30]	4	16	10

TABLE 2 | Demographic and basic characteristics of the participants.

Variables	Categories	No	%
Age (years)	Younger than 30	64	24
	30–39	136	50.9
	Older than 39	67	25.1
Gender	Female	246	92.1
	Male	21	7.7
Marital status	Married	210	78.7
	Single	57	21.3
Education	Bachelor's	247	92.5
	Master's degree	8	3
	PHD	12	4.5
Employment Status	Full-time	155	58.1
	Part-time	47	17.6
	Apprentice	37	13.8
	Contract based	28	10.4
Unit	Dialysis	28	10.5
	NICU	46	17.2
	ICU of emergency room	34	12.7
	ICU of COVID-19	93	34.8
	ICC of heart surgery	44	16.5
	CCU	22	8.2
Shift type	Fixed	28	10.5
	With rotations	239	89.5
History of non-severe mental illness	Yes	6	2.3
	No	261	97.7

TABLE 3 | Mean and standard deviations of job content and OCF scores.

Variable		Mean	SD	Minimum	Maximum
Job content	Skill discretion	34.28	7.96	12	48
	Decision authority	34.61	5.4	12	48
	Psychological job demand	46.67	9.49	12	48
	Physical exertion	8.29	2.72	3	12
	Physical isometric loads	4.87	1.94	2	8
	Job insecurity	7.06	1.42	3	12
	Supervisor support	10.06	3.83	4	20
	Coworker support	10.49	3.75	4	16
OCF		83.41	19.96	30	150

Statistical Analysis

Continuous variables were demonstrated as M ± SD, and categorical variables were described in count and percentage. Initial analyses did not show outliers, as assessed by a boxplot. The variables were confirmed for normal distribution with the Kolmogorov Smirnov test ($p > 0.05$); Also, the hypothesis of homogeneity of variances (sphericity hypothesis) was tested using the Mauchly test. The test results showed that the assumption of the equality of variance is established ($p > 0.05$). To evaluate the independence of categorical variables, a Chi-square test was used. The association between categorical and continuous variables was assessed using an independent samples t-test and one-way ANOVA. The correlation between continuous variables was investigated with Pearsons's coefficient. The statistical analysis was done using SPSS version 23 (SPSS Inc. Chicago, IL). A $p < 0.05$ was considered statistically significant in all tests.

RESULTS

The results showed that the mean age of the subjects was 34.6 ± 6.3 years. Most of the participants in this study were female (92.1%); The average work record was 10.45 ± 6.15 years. Other demographic information is present in **Table 2**.

As shown in **Table 3**, the M ± SD and range for scores of each subscale of JC and OCF are described.

Work records in the ICU, total work records, and work records in the COVID-19 and non-COVID-19 units are significantly associated with OCF and Skill discretion. In other words, with increasing work records, decision authority also increases.

Work in the COVID-19 ICU has a significant relationship with the psychological job demand, Physical exertion, and Physical isometric loads. In other words, the nurses who worked in the COVID-19 ICU experienced more psychological job demands, Physical exertion, and Physical isometric loads (**Table 4**).

TABLE 4 | Association between JC, OCF, and characteristics of participants.

Variable	Categories	OCF, Mean (SD)	*P*-value	Skill discretion, Mean (SD)	*P*-value	Decision authority, Mean (SD)	*P*-value	Psychologicl job demand, Mean (SD)	*P*-value	Physical exertion, Mean (SD)	*P*-value
Age (y)	Younger than 30	84.59 (19.29)	0.245	34.78 (7.55)	0.450	35.03 (3.98)	0.043*	47.84 (7.71)	0.319	8.26 (2.64)	0.487
	30–39	84.3 (19.3)		34.51 (7.92)		35.05 (5.22)		47.12 (10.36)		8.43 (2.66)	
	Older than 39	79.37 (21.56)		33.18 (8.498)		33.07 (6.47)		45.43 (9.28)		7.93 (2.95)	
Gender	female	82.83 (18.54)	0.345	33.71 (7.01)	0.548	34.61 (4.10)	0.996	46.88 (9.59)	0.767	8.22 (2.74)	0.436
	male	82.83 (18.63)		34.43 (8.22)		34.61 (5.70)		47.29 (9.21)		8.54 (2.64)	
Unit	COVID-19 ICU	86.95 (15.53)	0.022*	36.96 (6.79)	0.001*	35.23 (5.94)	0.144	48.53 (8.26)	0.041*	9.35 (2.82)	0.001*
	Non-COVID-19	81.49 (18.34)		32.81 (8.19)		34.29 (4.09)		46.13 (9.49)		7.68 (2.82)	
Work records (y)	Less than 7	79.1 (19.95)	0.001*	32.52 (8.16)	0.001*	33.46 (5.13)	0.013*	47.56 (8.65)	0.408	8.32 (2.72)	0.642
	7–15	83.29 (16.73)		33.87 (7.72)		34.59 (5.51)		47.23 (9.96)		8.41 (2.61)	
	More than 15	89.89 (17.34)		37.33 (7.39)		36.27 (5.49)		45.51 (9.80)		8.00 (2.96)	
Work recoeds in ICU (y)	Less than 5	80.11 (18.98)	0.002*	31.76 (7.42)	0.001*	34.51 (5.49)	0.781	47.64 (9.52)	0.233	8.11 (2.66)	0.260
	5 and more	87.23 (17.16)		36.68 (8.02)		34.71 (5.32)		46.26 (9.46)		8.48 (2.77)	

Variable	Categories	Physical isometric loads, Mean (SD)	*P*-value	Job insecurity, Mean (SD)	*P*-value	Supervisor support, Mean (SD)	*P*-value	Coworkers support, Mean (SD)	*P*-value
Age (y)	Younger than 30	5.01 (1.94)	0.678	6.98 (1.28)	0.371	10.10 (3.92)	0.782	10.48 (3.67)	0.412
	30–39	4.88 (2.00)		7.19 (1.58)		10.10 (3.69)		10.69 (3.60)	
	Older than 39	4.71 (1.84)		6.89 (1.19)		9.70 (4.03)		9.94 (4.10)	
Gender	female	4.88 (1.94)	0.881	6.99 (1.41)	0.124	9.89 (3.79)	0.186	10.34 (3.70)	0.236
	male	4.88 (1.94)		7.34 (1.42)		10.71 (3.96)		11.03 (3.90)	
Unit	COVID-19 ICU	5.46 (1.87)	0.001*	7.22 (1.49)	0.205	10.65 (3.83)	0.084	10.78 (3.82)	0.363
	Non-COVID-19	4.58 (1.87)		6.98 (1.37)		9.75 (3.81)		10.34 (3.72)	
Work records (y)	Less than 7	4.95 (1.89)	0.439	7.17 (1.39)	0.705	10.52 (3.96)	0.398	10.67 (3.72)	0.654
	7–15	4.95 (2.05)		7.01 (1.51)		9.77 (3.64)		10.55 (3.56)	
	More than 15	4.58 (1.78)		7.00 (1.29)		9.96 (4.02)		10.10 (4.19)	
Work recoeds in ICU (y)	Less than 5	4.87 (1.96)	0.997	7.00 (1.42)	0.448	10.33 (3.87)	0.262	10.81 (3.64)	0.153
	5 and more	4.87 (1.92)		7.14 (1.43)		9.78 (3.79)		10.15 (3.85)	

**Statistically significant.*

A one-way ANOVA or t-test was used as appropriate.

TABLE 5 | Correlation coefficients with Pearsons' r between JC subscales and OCF.

Variables	OCF	Skill discretion	Decision authority	Psychological job demand	Physical exertion	Physical isometric loads	Job insecurity	Supervisor support	Coworker support
OCF	1	−0.597**	−0.217**	0.520**	0.737**	0.542**	0.478**	0.783**	0.713**
Skill discretion		1	0.319**	0.196**	0.387**	0.447**	0.200**	0.540**	0.381**
Decision authority			1	0.283**	0.077	0.072	0.043	0.071	0.035
Psychological job demand				1	0.331**	0.276**	0.243**	0.388**	0.428**
Physical exertion					1	0.443**	0.558**	0.588**	0.428**
Physical isometric loads						1	0.227**	0.336**	0.383**
Job insecurity							1	0.556**	0.293**
Supervisor support								1	0.830**
Coworker support									1

*Significant at $p < 0.05$.
**Significant at $p < 0.01$.

According to the results of **Table 5**, OCF was inversely related to the JC subscales of skill discretion and decision authority, and directly related to other subscales of JC.

DISCUSSION

Most of the nurses working in the ICU had moderate levels of OCF. A review of literature in this area reveals different levels of occupational cognitive failure in nurses. The mean of cognitive failure in our study was higher than the mean reported in the study of Yousefzadeh et al. in nurses (1) and was consonant with the mean reported in the study of Mohammadi et al. in nurses. (14) and the study of Waltz et al. (15). Reisen (1997) has stated that job failure can be more due to failure in planning (mistakes) and implementation (cognitive failures). The work environment and the job of individuals, in general, can be the cause of occupational errors and cognitive failures in the individual (16), This is because the workload of nurses, especially nurses in the ICU, may cause problems and errors in the field of patient care because the ICU is a complex and stressful work environment (17), patients are more stressed (18), which may lead to occupational cognitive failures.

Nurses working in ICU in this study had high levels of skill discretion, decision authority, psychological job demand, physical exertion, supervisor support, and coworker support; on the other hand, the level of job insecurity and physical isometric loads was low.

According to the review of studies conducted in this regard, the results of the study of Gholami et al. (19) which was performed on 500 nurses of teaching hospitals in Hamadan, showed that the average component of freedom of decision is 64.67; psychological job demand 22.36; Social support 71.22; Job physical needs were 15.99 and job insecurity was 7.53, which was close to our study. Individuals' JC refers to factors that are self-controlled such as performance, cognition, independence, which are directly related to the individual's job (11) and affect the work stress of individuals. In general, job characteristics such as supervisor support for employees, job security, job independence, and the existence of a warm and friendly environment are among the factors that can affect the work aspects of people and lead to increased JC (20).

OCF was inversely related to the subscales of skill discretion and decision authority, and directly related to other subscales of JC. The skill discretion was directly related to all subscales of JC, and the decision authority was directly related only to the psychological job demand. The psychological job demand was directly related to all realms of JC. Also, the subscales of physical effort, isometric physical load, job insecurity, lack of supervisor support, and lack of coworker support were directly related to all subscales of JC except the decision authority subscale.

The results of the study of Hassanzadeh Rangi et al. (8) indicate a positive relationship between cognitive failures and workplace accidents which was consistent with the results of Park et al. (21), which showed a direct relationship between job stress and cognitive failure in nurses. However, it was not consistent with the results of the study of Barzideh et al. (22) which showed that there is no relationship between job stress and some job problems of nurses.

Work records in the ICU, and total work records, were significantly associated with OCF. In other words, nurses who worked in the ICU have experienced more job failures, and job failures also increase with increasing work records.

The study of Yousefzadeh et al. (1) showed that there was a significant correlation between cognitive failures with shift work, work records, and work departments (emergency, ICU); it also showed that there was no correlation between OCF and gender, the number of patients monitored, shift hours and rest hours. Moreover, the study of Mohammadi et al. (14) showed that there was no significant relationship between gender and job failures. However, the results of the study by Park et al. (21) showed that there was a significant relationship between nurses' gender and job failures.

It can be stated that the work records of the person in the COVID-19 ICU have caused stress and psychological pressure on medical team members, especially nurses, and dealing with critically ill patients also increases their fear, anxiety (22, 23).

Because cognitive failures as mind-related errors are directly related to job stressors, job stress is rooted in a person's inability

to perform their duties (5) and is strongly influenced by the work environment.

The results showed that among the subsets of skill discretion, decision authority, psychological job demand, physical exertion, physical isometric loads were significantly associated with work records. These results were in line with the findings of Alacacioglu et al. and Kanai-Pak et al. (24, 25).

Working in the ICU requires that the staff, especially the nurses in these units, have the ability to use skills and have a great deal of decision-making power. As Apker et al. (26), ICU nurses have the ability to make quick and accurate decisions. In the ICU, teamwork is very important, when inexperienced nurses are placed next to professional nurses, they can increase their professional skills (26).

ICU is a complex and stressful work environment that is due to the critical nature of hospitalized patients, advanced devices and equipment used in the unit, and the need for speedy action of nurses in inpatient care. The nature of the ICU inevitably affects the cooperation and communication of nurses and causes the need for active participation in patient care, nurses 'respect for each other, and increasing nurses' trust and expertise (17). As the results of the present study showed, there was a significant relationship between work records, work in the ICU, and COVID-19 ICU with decision authority, physical exertion, psychological job demand, and other components.

Also, there was no significant relationship between head nurse support, coworker support, and job insecurity with any of the demographic characteristics of nurses. The results of the study by Yaser et al. (27) showed that there was no significant relationship between cognitive involvement with gender, education, age, work records, social responsibility, and type of unit in nurses. It can be stated that the majority of nurses studied were formally and contractually employed, so they were safe in their jobs. Accordingly, no significant relationship was observed between job insecurity and any of the demographic variables (27). The results indicate the fact that there is an inverse relationship between job security and stress and work pressures, especially work in the ICU. Accordingly, the attention of officials to the type of employment, employment conditions, and security that they provide for this important and sensitive segment of the health and medical system in terms of work, can provide the basis for providing better services.

Also, the result obtained in coworker support with demographic characteristics was inconsistent with the findings of Moore et al. (28). The results of Moore et al.'s study showed that there was a significant relationship between social interaction and cooperation with demographic characteristics (age, gender, education, work history) of nurses (28).

The results of the study showed that OCF was inversely related to skill discretion and decision authority, and directly related to psychological job demand, physical exertion, physical isometric loads, job insecurity, supervisor support, and coworker support.

The results suggest that paying attention to skill discretion, decision authority, psychological job demand, physical exertion, physical isometric loads, job insecurity, supervisor support, and coworker support can reduce OCF, and also consequently improve their productivity.

CONCLUSION

The quality of nurses' activities is very important for patient safety, reducing the length of hospital stay and ultimately productivity. Human resource management should be done to reduce OCF.

To reduce the cognitive failure of nurses, the need to develop job ability, reduce repetitive tasks, create diversity in work, create opportunities for creativity, as well as have the authority and freedom to make decisions can help.

Other important things to reduce nurses' OCF are facilitating work with new technologies, having enough time to do work, having a friendly work environment with colleagues, supporting by supervisor and colleagues, improving posture, especially for the upper body, feeling job security.

For future studies, it is recommended to conduct a case study (using a control group) on the factors affecting OCF (Participant Characteristics, Professional ranks, Hospital level, Years of prior nursing experience...).

LIMITATION

The limitations of this study include the limited statistical population of this study with nurses in intensive care units, which can be problematic in generalizing the results to other nurses. As well as the small number of male samples can affect the research results and should be considered in interpreting the findings.

One of the strengths of this study is the appropriate sample size and considering the dimensions of JC and their relationship with OCF.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of Ardabil University of Medical Sciences. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

FM: data collection, analyzing data, and writing manuscript. MK and AB-p: research idea, research design, and writing manuscript. All authors contributed to the article and approved the submitted version.

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BRIEF RESEARCH REPORT
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"I Think the Mental Part Is the Biggest Factor": An Exploratory Qualitative Study of COVID-19 and Its Negative Effects on Indigenous Women in Toronto, Canada

Jerry Flores[1]*, *Kristen Emory*[2], *Xuan Santos*[3], *Angela Mashford-Pringle*[4], *Kati Barahona-Lopez*[5], *Keston Bozinovic*[2], *Jennifer Adams*[2], *Coco Chen*[1], *Yandy Zuo*[1] *and Diana Nguyen*[2]

[1] Department of Sociology, University of Toronto, Mississauga, ON, Canada, [2] School of Public Health, San Diego State University, San Diego, CA, United States, [3] Department of Sociology and Criminology and Justice Studies, California State University San Marcos, San Marcos, TX, United States, [4] Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada, [5] Department of Sociology, University of Wisconsin-Eau Claire, Eau Claire, WI, United States

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***Correspondence:**
Jerry Flores
jerry.flores@utoronto.ca

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This article explores the unique and understudied experiences of Indigenous women living in Toronto, Canada during the first year of the COVID-19 pandemic. The purpose of this study is to better document the impacts of COVID-19 on the mental health and wellbeing of Indigenous women in Toronto, Canada to better understand unmet needs, as well as lay the groundwork for more targeted research and potential interventions based on these needs. Using in-depth semi-structured interviews with thirteen Indigenous women, we shed light on the negative effects this pandemic has had on this population. We find that COVID-19 has negatively affected people's mental health, substance use and access to health services. This research speaks to the growing body of work that discusses the harmful effects of COVID-19 generally and how this pandemic has specifically affected Indigenous peoples.

Keywords: COVID-19 pandemic, Indigenous, qualitative study, urban, Toronto (Canada)

INTRODUCTION

The COVID-19 pandemic has had widespread negative effects on communities across the world (Levy Economics Institute, 2020). Additionally, COVID-19 has exacerbated existing inequalities (Hu, 2020). This is especially true for the most marginalized peoples (Luna, 2020). Currently, there is little research related to how COVID-19 has negatively affected these communities. Even less research looks at how COVID-19 has negatively affected Indigenous peoples in various ways (Howard-Bobiwash et al., 2021). Scientific evidence regarding the impact of COVID-19 on people's lives is limited and still emerging; the evidence that does exist often does not include an in-depth assessment of the impact on Indigenous populations. Lack of inclusion of Indigenous populations in scientific inquiry is particularly concerning as without documentation health equity concerns can go unnoticed by public health professionals as well as governmental offices in charge of funding population health work. There is consistent emerging evidence that in addition to the physical symptoms of COVID-19, the pandemic is also negatively impacting the mental health of populations across the globe (Dong and Bouey, 2020; Fiorillo and Gorwood, 2020; Passos et al., 2020; Sheridan Rains et al., 2021). This negative impact may be exacerbated for

historically marginalized populations, making it all the more vital that their perspectives are heard and addressed. They study of women (women of color in particular) is especially important given that research demonstrate that they have disproportionately suffered from mental and physical health issues compared to men since the start of this pandemic (Gomez-Aguinaga et al., 2021; Luo and Sato, 2021; Ornelas et al., 2021; Priebe Rocha et al., 2021).

The current study is an attempt to bridge this gap in the literature and provide a foundation for future scientific inquiry. Using in-depth semi-structured interviews with 13 Indigenous women in the Greater Toronto Area, we address the following questions in this paper: how did the first year of the COVID-19 pandemic affected the mental health of the 13 Indigenous women participants in Toronto, Canada? Furthermore, how has it negatively affected our participants' mental health and patterns of substance, alcohol, and tobacco use? The following paper shows how COVID-19 has adversely affected 13 Indigenous women. In the following sections, we review work on mental health and BIPOC (Black Indigenous People of Color) populations, mental health, and its effects on substance abuse among Indigenous peoples. We then discussed the methodological approach used in this paper and our main findings, which we divided into three small sections. We follow this with a discussion of our results and their implications for Indigenous peoples and future work related to COVID-19 and this community.

Mental Health and Black, Indigenous, and People of Color Communities

To better understand the impact of COVID-19 on the mental health of Indigenous women in Canada, it is important to understand the larger social context of mental health and related health equity concerns among diverse and often historically marginalized communities. Black, Indigenous, and People of Color (BIPOC) populations in the aggregate often experience disparate mental, physical, social, and economic risk factors and health outcomes, often due to structural and systemic inequity (Gee and Ford, 2011). Mental health is a particular concern as it impacts and is impacted by so many aspects of the human health and wellbeing experience.

Adverse mental health in the general global population was notably elevated during the COVID-19 pandemic (Czeisler et al., 2020). Subsequently, many people began or increased substance use to cope with economic stress, loneliness, and anxiety surrounding the virus in conjunction with pre-existing daily stressors (Czeisler et al., 2020). Communities that were previously at risk before the pandemic became particularly vulnerable during the pandemic due to social and health inequities (Abrams and Szefler, 2020). There was a notable increase in usage of alcohol (Pollard et al., 2020), nicotine and tobacco (Giovenco et al., 2021), opioids (Niles et al., 2021), and marijuana, along with other psychoactive substances (Borgonhi et al., 2021).

For communities of color, especially communities that are historically marginalized and colonized like the Black (Millett et al., 2020), Latinx (Macias Gil et al., 2020), and Indigenous (BIPOC) communities (Yellow Horse et al., 2020), their mental health was negatively impacted by intergenerational trauma, ongoing police violence (DeVylder et al., 2020), oppression related to poverty and racism, and the devastating burden of COVID-19 in these communities. For example, Black respondents reported increased rates of substance use and suicidal ideation (Czeisler et al., 2020). Hispanic/Latinx respondents reported a higher prevalence of anxiety disorder and depressive disorder symptoms, COVID-19 related trauma- and stressor-related disorder (TSRD), increased substance use, and suicidal ideation (Czeisler et al., 2020).

Indigenous communities in the US, American Indians/Alaska Natives (AI/AN), have had disproportionately higher rates of substance abuse (Dickerson et al., 2011; Statistics Canada, 2011; Wolfe et al., 2018; Gonzalez et al., 2019), which likely increased during COVID-19 in conjunction with other adverse mental health conditions. In addition, LGBTQ+ populations face the risk of worse COVID-19 health outcomes due to higher rates of comorbidities, working in affected industries as essential workers, being more likely to be low-income/affected by poverty, experiencing stigma or discrimination due to gender identity or sexual orientation, and lack of access to insurance and healthcare (Dawson and Golijani-Moghaddam, 2020). These inequities may also put LGBTQ+ populations at increased risk of stress and adverse mental health (Dawson and Golijani-Moghaddam, 2020).

As a whole, the impact of the COVID-19 pandemic has disproportionately affected BIPOC communities (Cheung, 2020). While they are systemically underrepresented in both research and government data collection, there is still clear evidence that racism is a risk factor for COVID-19 mortality (Wallis, 2020). Canadian health researchers have confirmed that structural inequalities related to race and gender, including healthcare, labor, and community affluence, influence the disproportionate impact of COVID-19 (Slaughter, 2020). Three key social issues have been identified as contributors to the interrelationship between racism and COVID-19 in Canada, leading to inequitable health outcomes in BIPOC communities: the healthcare system, occupation, and living conditions within the home and the community (Learning Network, 2021). Bias toward marginalized groups, including Indigenous populations, has been documented as a recurring problem in Canada's healthcare system, which results in lower quality of care, leaving communities vulnerable to potential cases of COVID-19 (Skosireva et al., 2014; Morris et al., 2019; Wylie and McConkey, 2019).

These contributing factors are further stratified among gender, especially since BIPOC women are overrepresented in jobs with a higher risk of exposure to COVID-19 while generally being in lower-paying positions (Learning Network, 2021). These systemic contributors to health inequity combined with higher rates of unemployment, incarceration, and substance use in BIPOC communities compound the harmful effects of COVID-19, often leading to more severe morbidity outcomes and higher rates of mortality (Dickerson et al., 2011). Further impacting the health outcomes related to COVID-19, it has been well documented that factors like low socioeconomic status, limited access to resources, and stigmatization can affect the likelihood

that a person will experience poor mental health or engage in substance use.

Mental Health and Corresponding Substance Use Among Indigenous Populations

The historical trauma of being oppressed by the Canadian government and being forced to civilize, assimilate, and eliminate their cultures has been detrimental to the mental health of Indigenous people (Boksa et al., 2015). Social determinants such as social exclusion, discrimination, poverty and unemployment have always played a significant role in the mental health challenges faced by the Indigenous population (Boksa et al., 2015). These mental health challenges worsened due to the COVID-19 pandemic. For example, Statistics Canada conducted a crowdsourcing data collection consisting of 1,400 Indigenous participants. The crowdsourced data showed that six in ten Indigenous participants reported experiencing a decline in their mental health since the onset of physical distancing due to COVID-19 (Statistics Canada, 2020). Compared to Indigenous men, Indigenous women reported experiencing higher stress and anxiety due to "multiple caregiving burdens, risks of gender-based violence, and economic vulnerabilities" (Statistics Canada, 2020, p. 4). Among the participants, 46% of Indigenous women and 32% of Indigenous men described their days during COVID-19 as being "quite a bit stressful" or "extremely stressful" and reported having symptoms of anxiety (Statistics Canada, 2020). Overall, higher proportions of Indigenous participants reported having poor mental health and higher stress and anxiety than non-Indigenous people. The COVID-19 pandemic exacerbated this dynamic.

METHODS

In March of 2020 the COVID-19 pandemic was in full swing. During this time the University of Toronto put a halt to all in person interviews and data collection. This meant that the ethnographic research we were conducting with Indigenous women in Toronto had to pause. During this time we began to wonder about the challenges Indigenous women faced during the pandemic? Given this interest and a small grant provided by the Sociology department at the University of Toronto Mississauga we decided to ask Indigenous women about their experiences during COVID-19. We decided to conduct follow-up interviews with individuals included in our larger study on Missing and Murdered Indigenous women in Toronto. In other words, we had established relationships with our participants and reached out again after the start of the COVID-19 pandemic. These relationships made including them in this study less challenging.[1] This is especially important given the negative history between researchers and Indigenous peoples in Canada and across the world (Wilson, 2008). When conducting research involving Indigenous people in Canada, it is crucial to be aware and cognizant of the traumatic history and ongoing harm and exploitation researchers can inflict on this community. We attempted to not contribute to this negative history during this research. Additionally, while we focused on women we already knew, we were also open to speaking with people other individuals who are respondents suggested we include.

During a period of 6 months, we conducted a series of semi-structured qualitative interviews with Indigenous women living in Canada.[2] We initially reached out via email or text message to gauge the interest of potential participants. Thirteen individuals returned our correspondence. We then conducted a series of hour-long interviews via phone and video call which took place during one of the various lockdowns that occurred in the city. Most of the interviews took place during the day and we used handheld records to document our conversations. We allowed respondents to choose their preferred method of communication for these interviews. During these calls, two researchers were present. One asked interview question, and another took field notes. After conducting these interviews, we mailed all participants a $50 gift card. Additionally, we informed them that they could change their mind about participating in this study and still keep their compensation.

All the women in this study self-identified as Indigenous from various nations in Canada. They ranged in age from 22 to 60. Most were experiencing economic hardship during the time, which was largely related to COVID-19. All research in this study was approved by the ethics board at our respective universities and received consent/assent from the interviewees. Fieldnotes and interviews were transcribed verbatim by authors. The authors then used *Dedoose,* a qualitative data analysis software package, to code these documents. During the coding process we looked for patterns or recurring themes in our interviews in notes. We then grouped these patterns into larger "themes." Themes that appeared the most became the foundation of the findings we describe later in the paper. This method of analyzing, organizing and coding ethnographic data follows the process described in Emerson et al. (1995). Apart from what we share in this paper women's problems with finances, home schooling children and themselves as well as access to transportation also emerged as a prominent theme and will form the basis of a separate publication. We included a **Table 1** with participants demographic information at the end of this document.[2] This is information our participants shared during the interviews.

Reflexivity

Reflexivity allows scholars to connect their experiences of oppression and privilege to their research activities (Rios, 2011; Flores, 2016; Flores et al., 2019). It reveals the tenuous lines involved during empirical research that include relations between researcher and self, researcher and participants, and researchers and their readers/audiences (Doucet, 2008). Both authors share a background in ethnographic training and a commitment to

[1]While we prefer doing interviews and fieldwork in person. Doing virtual fieldwork was not particularly challenging. We believe this was the case given our existing relationships with women we interviewed.

[2]All of the women we interviewed self-identified as Indigenous. For the parts of this chart were information is not available "N/A" this was due to respondents not sharing this specific information for personal reasons, reasons related to anonymity or they simply did not want to share this information.

TABLE 1 | Participants information.

Name	Ethnicity/nation	Age	Socioeconomic status	Education	Number of children
Susan	Algonquin	61	N/A	College graduate	0
Ciara	N/A	36	Middle	College graduate	4
Jenny	White Fish River First Nation	50	Low	N/A	2
Lina	N/A	54	Low	N/A	0
Gina	N/A	23	Low	University graduate	2
Alice	Ojibway	35	Low	Partial high school	6
Jennifer	Métis	40	Middle	University graduate	3
Patty	N/A	27	N/A	Partial high school	0
Laura	Six Nations	57	N/A	College graduate	3
Erin	N/A	60	Low	Partial high school	3
Robin	N/A	N/A	Low	High school graduate	1
Lana	First Nations	N/A	Low	Partial university	2
Jill	Mi'kmaq	25	Upper	University graduate	0

social justice. Additionally, the first author is an Indigenous Latino from working class background and the second author is white from a middle-class background. Despite this, we know we occupied a privileged position doing this work and attempted to be as sympathetic and helpful as possible. This included providing a list of local resources along with the compensation our participants received. Additionally, we had multiple organizations who had previously agreed to provide services if a crisis emerged. Throughout the analysis, we strived to represent women's narratives and ways of knowing, conscious of our privilege and with an unwavering commitment to their voices. Additionally, we shared our professional experience as well as information about our lives. Answering any questions participants had about us, our university affiliation, or the goals of our research.

Benefits and Risks of Study Participation

This study was conducted during a particularly difficult time for research, during the early stages of the COVID-19 pandemic. As such, there are multiple potential benefits and risks for the Indigenous women who participated in this study. To mitigate potential risks interviews were conducted remotely in order to product participant and project staff health and reduce any potential for COVID-19 exposure. An additional benefit of this approach was that participants could more easily schedule interviews around their schedules as well as it mitigated the need to arrange transportation to an interview location. A primary benefit being the potential therapeutic nature of having a venue to express and talk about one's experiences during times of high stress such as during tumultuous time of COVID-19. Alternatively, this same potential benefit may be a potential risk for participants if discussing the experience surrounding COVID-19 were to trigger unpleasant or stressful thoughts.

RESULTS

We describe the major themes that appeared in our research below in three small sections. The first addresses the negative effects COVID-19 had on the women we interviewed. The second deals with our participants and their inability to access health care during this time. Finally, we discuss how extended lockdowns and this pandemic resulted in women's increase use of drugs, alcohol, and tobacco.

Mental Health

Out of the thirteen Indigenous women we spoke to, one of the most prominent themes that emerged was a general decline in individuals' mental health. Almost all the respondents we spoke with discussed how the COVID-19 pandemic, regional lockdowns, and the closure of schools and services negatively affected their mental health. This was exacerbated by women's gendered responsibilities like providing caretaker responsibilities and helping children with online education. Additionally, the women we spoke to discuss the multiple economic challenges associated with this pandemic and how it exacerbated their mental health. Two respondents said the following:

> *I think the mental part is that is a big factor. [I got laid off] and there's been months where it's like, oh, my God, my rent, you know, my rent's expensive, I pay, you know, quite a bit amount of money on rent, right? And then it's like, "What do I do? Do I sacrifice my rent? Because we're going to go on another shutdown again, I need to buy groceries."… and then my son's like, I just wish this COVID would go away. You know, my daughter, you know, 16 wants to get out and about but can't get out and about… they're both isolated. And some days are rougher and tougher in school, you know what I mean? And, it's hard to watch my son trying to do his, excuse me, try to do his work. And I don't have the proper skills to teach him how to tell time, how to do division and multiplication and stuff like that, right? So, I try my best.* (Jennine)
>
> *Everything's really scary. My anxiety level is sky-high every time I go out or anything. I already had issues with my anxiety.* (Laura)

Jennine and Laura summarize the multiple challenges they have experienced during COVID-19. Jennine specially describes how these challenges have created additional stress in her life, resulting in her declining mental health. Her status as a single mother

also exacerbated these challenges. While previously she could access support from her family, the COVID-19 pandemic has prevented this type of contact. This has resulted in her taking on the responsibility of homeschooling her children, providing meals, and engaging in other household responsibilities. She noted how the additional responsibilities and the inability to rest, was severely affecting her mental health. The recent loss of her job also exacerbated her mental health decline. Laura describes how this pandemic has exacerbated her existing anxiety issues which are severely triggered when leaving her home which presents the elevated risk of contracting this virus. Respondents also describe existing mental health issues like anxiety and post-traumatic stress disorder becoming worse during multiple lockdowns. Jennine, Laura and the experiences of other women in our study are consistent with other work dealing with Indigenous peoples. This small body of research demonstrates that Indigenous communities more so than other populations were adversely affected by the lockdown measures, physical distancing, and the pandemic as a whole (Statistics Canada, 2020).

There is evidence in the existing literature base that the qualitative findings on the impact of COVID-19 on mental health are not limited to the current study population. One cross-sectional study in Canada indicated an increased mental health concern burden among Indigenous participants surveyed, compared to white or Asian study participants (Lawal et al., 2021). Previous research has indicated that financial stresses and "food worry" exacerbate COVID-19 related health concerns among Canadians; food worry was associated increased odds of participants feeling anxious or worried as well as increased suicidal thoughts, even after controlling for other factors (McAuliffe et al., 2021). Taken together there is increasing evidence that the COVID-19 pandemic has and is continuing to impact the mental health and wellbeing of persons across the globe, with Indigenous populations being disproportionately vulnerable due to historical and structural inequities.

Access to Health Care

The women we spoke to mentioned having a difficult time accessing health care during the pandemic. This included difficulty physically going to healthcare providers and issues accessing medical care remotely. For example, our respondents mentioned difficulty using online-based medical care. Our respondents mentioned feeling awkward or lost during these phone appointment conversations.

> *And then you know, I mean, it was only a five-minute call. I find my doctors a little bit dimwitted and a bit rushed. So, you know… You're on the phone. You're trying to think. I booked an appointment with my doctor, I booked it in September. And my virtual interview or whatever interview over the phone was a month later.* (Jenny)
>
> *It's hard to go to the doctors and stuff like that. So, I'm- sometimes when I even have to go and see my doctor it's hard for me to get down there.* (Alice)
>
> *I have taken 2 COVID tests... so far. But that's just to make sure that I'm safe… did go to… the Aboriginal Bus that kind parked somewhere, and if you need a COVID test, you can just go there and you don't have to make an appointment and wait a couple of days. You just gotta find the bus, where it's that day.* (Jennifer).

Both Jenny and Asley discuss the challenges they had accessing healthcare. Jenny mentioned the general challenges of using remote health services. She felt uneasy using these services, and it seemed as if the physician was rushed and, in a hurry, to end the call. Alice was unable to access medical care given their limited access to technology. So, the only option was to access services in person. However, at the start of the COVID-19 pandemic, Alice could not receive medical attention in person. In her case, she had bronchitis which made it difficult to wear a mask. With masks restrictions in Toronto and no access to a medical note, she has been home bound for approximately a year. The inability to gain medical care also extended to accessing mental health services. Jennifer was able to access medical services but only by relying on an Indigenous based mobile van. Taking this approach, she was able to speak to someone in person and without needing an appointment. However, she first needed to find this bus which she did via social media or by contacting her networks. Women unfamiliar with these services faced similar changes to those of Jen and Alice. These findings are even more jarring given the widely accessible health care system in Canada.

Changing access to healthcare due to COVID-19, including difficulty seeing a doctor in person and increases in telemedicine may prove problematic in a variety of ways, for example, one commentary in the Journal of Substance Abuse Treatment indicated a series of challenges including increased prescription flexibility, which at times helpful, might contribute to the illicit and harmful use of certain controlled substances such as opioids (Wendt et al., 2021). Further, there is evidence of high prevalence of mental health concerns (moderate- to high depression, anxiety, stress, and low levels of wellbeing) among Indigenous populations in Bangladesh (Faruk et al., 2021). It is possible that similar results are to be found in Canada and globally.

COVID-19 and Increased Substance Use

Our respondents discussed an increase in the consumption of alcoholic beverages. This was directly tied to the COVID-19 pandemic, lockdown measures and spending extended periods indoors. Ciara mentioned the following: "I just started drinking really heavily. I drink about a 12 pack a day now." When we asked Jenny about how COVID-19 has affected her drinking, she said, "I think it was excessive." For multiple respondents, their drinking became so acute that they began having problems paying for everyday living expenses like food and rent. With the general lack of medical, mental health and rehabilitation treatment, these problems have gone unchecked.

The people we spoke to also began to use drugs at higher rates than before. Most respondents began to use cannabis more frequently compared to other drugs. However, some respondents reported using other drugs like pharmaceutical pills and heroin. When we asked if her drug use had increased, Alice said the following: *"Yes, yes, yes. I smoke marijuana a lot now." (all drug use) Yeah, it's definitely gone up. Two other respondents said shared this during an interview:*

> *Well at the beginning of the pandemic, or whatever I kind of hampered down. Like a couple of years ago, I've never been into weed or marijuana or whatever you wanna call it, it was never something typically and I was never into drugs my whole life… And*

at the beginning of this whole thing, there was nothing to do and there were edibles and I could smoke. Whereas, in the past I've used it from my insomnia. (Robin, Age-N/A)
I smoke marijuana and I feel like I smoke more of everything since the start (of covid). (Gina)

The respondents included in this study shared similar sentiments to Robin, Alice and Gina. Most noted an increase in the use of drugs, with marijuana being the most widely used. However, the individuals we spoke to also reported using drugs in combination with other substances like alcohol. The increase was directly tied to COVID-19 and lockdown measures in their respective region.

Finally, our respondents also mentioned an increased use of tobacco products. This mostly included prepackaged cigarettes. With the lack of social interaction and the increased monotony of staying home, the individuals we spoke to began to fill their time with smoking on a more regular basis.

Yeah, it's definitely gone up, definitely. I noticed especially at the beginning of the pandemic I was smoking – I don't usually smoke at work, and I was finding myself going on break at work and buying a pack of cigarettes. (Patty)

Alice shared a similar sentiment:

…all the money that I get [goes] to my drinking and my weed smoking and my cigarettes take up all that money. It's mostly food. Like I don't know where to go get food.

Most of our respondents discussed an increase in the use of tobacco products. While some used vapor pens or e-cigarettes, most smoked traditional cigarettes. Although this initial increase began due to stay-at-home orders, it continued as the pandemic progressed. Given the already precarious financial status of many of our respondents, they often began to experience economic hardships due to their increased tobacco and substance consumption. While the existing evidence in Canada is limited, there is This troubling finding is in concordance with a study from the United Kingdom (U.K.), which documented not only increases in alcohol consumption from before the pandemic among study participants, but also a statistically significant relationship between alcohol use and mental health (Jacob et al., 2021).

DISCUSSION

In agreement with the limited existing scientific data and anecdotal data, our qualitative research suggests that COVID-19 has had a profound impact on the Indigenous women interviewed in terms of stress levels, mental health, and wellbeing, as well as corresponding increases in their substance use. There is evidence of increased mental health concerns due to COVID-19 across the globe (Dong and Bouey, 2020; Fiorillo and Gorwood, 2020; Passos et al., 2020; Sheridan Rains et al., 2021). Further, there is emerging evidence that some women may be at increased risk for adverse mental health concerns related to COVID-19; particularly in relationship with maternal health, pregnancy and increased domestic violence concerns (Almeida et al., 2020; Ayaz et al., 2020; Salehi et al., 2020; Sediri et al., 2020; Sharma et al., 2020). Further, a letter to the editor addresses the disparate need to address increased mental health concerns among Indigenous populations globally due to the impact of the COVID-19 on already marginalized populations (Júnior et al., 2020). This, coupled with a study in Canada indicating increased mental health concerns associated with the pandemic among Indigenous populations compared to white and Asian populations (Lawal et al., 2021) indicates an increased need for both research and prevention efforts.

According to respondents, COVID-19 related Mental Health concerns were exacerbated by stressors related to school closures and economic concerns associated with the pandemic. In addition, some respondents (10) reported losing their jobs or resorting to being self-employed, adding to the stress of an already stressful time. This had a particularly strong impact for women participants, given gendered norms and expectations of child-rearing, leaving one respondent feeling that she must choose between her children's education and paying rent, as well as helping to manage her children's stress and mental health concerns regarding the pandemic.

Further, contributing to stress and economic concerns, study respondents reported having difficulty accessing health care services (including much needed mental health services), despite much of medical care going online during the pandemic. Further, pre-existing health concerns limited some participants' ability to participate in in-person care even when it was available due to mask restrictions and inability to breathe.

There is evidence that there is a lack of sufficient mental health services to address reported increased mental health concerns among Indigenous populations due to the COVID-19 pandemic (Júnior et al., 2020), increased resources are needed to combat this important public health concern. There is a continued call to leverage the COVID-19 pandemic to decolonize and improve Indigenous health in Canada and globally (Júnior et al., 2020; Richardson and Crawford, 2020).

Regarding substance use our findings were in agreement the limited available literature demonstrating an increase in substance use during the pandemic (Jacob et al., 2021), the female participants indicated increases in commercial tobacco, marijuana and alcohol consumption, even among those who either infrequently or did not use substances before the COVID-19 pandemic. These observations are in line with widely held theories on stress, coping and substance use.

A great strength of this study is that we utilized existing community relationships to quickly identify some critical COVID-19 related stress, mental health and increased substance use issues among Indigenous populations in the Greater Toronto Area. This study is not without limitations. Our small sample size ($N = 13$) and the qualitative nature of the project means that we are unable to generalize to wider Indigenous populations in the Greater Toronto Area or the rest of Canada. However, this qualitative study gives us preliminary evidence to move forward with future research and partnerships with Indigenous peoples to better understand the current and future impacts of COVID-19 on the mental health and wellbeing of Indigenous populations. Future mixed-methods work is needed to confirm generalizability

and better understand these concerns both qualitatively and quantitatively.

Documenting health equity issues is one of the first steps in addressing health disparities. The current study has important implications for future research and policy surrounding COVID-19 and Indigenous health in Canada. It points to a need for increased resources targeted toward Indigenous populations. In particular, the study's findings document a need for not increased culturally appropriate mental health and financial resources, and funding of said resources, targeted to meet the needs of Indigenous populations in Canada. Community leaders, public health professionals, government officials and advocates can use study findings to better address social and policy gaps surrounding COVID-19, mental health and underlying risk factors for Indigenous communities in Canada and globally.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because participants did not give permission for the data to be public. Requests to access the datasets should be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Toronto Research Ethics Board (RIS Human Protocol Number: 36345). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Suicidality Related to the COVID-19 Lockdown in Romania: Structural Equation Modeling

Anca-Livia Panfil[1], *Diana Lungeanu*[2*], *Simona Tamasan*[1], *Cristina Bredicean*[3,4], *Ion Papava*[3,5], *Daria Smirnova*[6,7†] *and Konstantinos N. Fountoulakis*[8,9†]

[1] Liaison Psychiatry, "Pius Brinzeu" County Emergency Hospital, Timisoara, Romania, [2] Department of Functional Sciences, Center for Modeling Biological Systems and Data Analysis, "Victor Babes" University of Medicine and Pharmacy, Timisoara, Romania, [3] Discipline of Psychiatry, Department of Neuroscience, NEUROPSY-COG Center for Cognitive Research in Neuropsychiatric Pathology, "Victor Babes" University of Medicine and Pharmacy, Timisoara, Romania, [4] Psychiatry Compartment, "Dr. Victor Popescu" Emergency Military Clinical Hospital, Timisoara, Romania, [5] "Eduard Pamfil" Psychiatry Clinic, "Pius Brinzeu" County Emergency Hospital, Timisoara, Romania, [6] International Centre for Education and Research in Neuropsychiatry (ICERN), Samara State Medical University, Samara, Russia, [7] Department of Psychiatry, Narcology, Psychotherapy and Clinical Psychology, Samara State Medical University, Samara, Russia, [8] 3rd Department of Psychiatry, School of Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece, [9] Mental Health Section, Research Institute, Panhellenic Medical Association, Thessaloniki, Greece

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Umberto Volpe,
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Mikhail Sorokin,
St. Petersburg V. M. Bekhterev Psychoneurological Research Institute, Russia

***Correspondence:**
Diana Lungeanu
dlungeanu@umft.ro

† These authors share senior authorship

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Background: Suicidality is a serious public health concern at a global scale. Suicide itself is considered to be preventable death; worldwide, suicide rates and their trends are under constant scrutiny. As part of the international COMET-G cross-sectional study, we conducted a national level investigation to examine the individual disturbances (such as anxiety, depression, or history of life-threatening attempts) and contextual factors (such as adherence to conspiracy theories or Internet use) associated with suicidality related to the COVID-19 lockdown in a lot of Romanian adults.

Participants and Methods: One thousand four hundred and forty-six adults responded to an anonymous on-line questionnaire, with mean age ± standard deviation of 47.03 ± 14.21 years (1,142 females, 292 males, 12 identified themselves as non-binary). Data were analyzed using descriptive statistics and structural equation modeling (SEM).

Results: Univariate analysis showed strong significant correlation between anxiety and depression scorings among the respondents (Spearman R = 0.776, $p < 0.001$). Both the suicidality scorings and the Internet use correlated fairly with anxiety and depression, with two-by-two Spearman coefficients between R = 0.334 and R = 0.370 ($p < 0.001$ for each). SEM analysis substantiated the emotional disturbances, previous life-threatening attempts, and younger age as significant predictors for suicidality. The patterns of reality reading (including religious inquiries, Internet use, and beliefs in conspiracy theories) did not reach the statistical significance as influential factors in the suicidality of these respondents. There was no covariance between the Internet use and belief in conspiracy theories.

Conclusion: The study confirmed the suicidality risk initially hypothesized as being associated with the history of life-threatening attempts, increased depression within the

younger population, and higher anxiety during the first year of the COVID-19 pandemic and its related lockdown. National strategies for effective interventions at various levels of the healthcare system should be developed.

Keywords: suicide, suicidal ideation, SEM, anxiety, depression, self-harm behavior

INTRODUCTION

Suicidality is a serious public health concern at the global scale, affecting millions of people, their families, and society itself (1). The term "suicidality" includes suicidal ideation (SI, such as serious thoughts about taking one's own life), suicide plans, and suicide attempts (2). Significant resources and efforts have been focused on a better understanding of its underlying etiology, assessing the risks, and designing effective solutions at different levels of interventions (3). Suicide itself has been linked to the well-documented psychopathological risk predictors (such as suicidal behavior, history of self-harm and suicidal attempts), but there also are wide variations in suicidality indicators and suicide rates across countries and cultural environments (2, 4–13). Compared to other parts of the world, Europe is characterized by relatively high suicide rates, namely 10.5 (8.3–13.6) per 100,000 people per year (11, 12, 14). Depression has been acknowledged as a major risk factor for suicidality (15) and several studies have pointed toward anxiety as a major risk factor as well (16, 17). Demographic factors (e.g., young age, male gender, or ethnicity), social status (e.g., low income, income inequality, unemployment, low education, and low social support), social changes, neighborhood (e.g., inadequate housing, overcrowding, or violence), and adverse environmental events (e.g., climate change, natural catastrophe, war, conflict, and migration) were also linked to suicidality. Surprisingly, reported global trends for suicide rates and suicidal behavior demonstrated a stability not only before, but also in the early months of the COVID-19 pandemic (18).

On the other hand, the COVID-19 pandemic onset had a disruptive impact on societies, with global devastating consequences (19). As more and more countries instituted total lockdown, various reports pointed out that such measures exacerbated mental health issues, although the interventions were acknowledged as necessary and effective in stopping the spread of the virus (20–22). Some researchers focused on segments of the population at a higher risk, such as the youth or the frontline healthcare workers (23–26). Furthermore, the general population experienced exacerbated anxiety, with additional symptoms of depression, psychosis, panic attacks, trauma and suicidal ideation that seemed to exceed the experience in the previous SARS and MERS outbreaks (27). There were case reports of unusual neuropsychiatric manifestations like catatonia (28), but results regarding the rates of suicide behavior, attempts, ideation, and self-harm during the COVID-19 pandemic have varied and have been inconclusive (18, 29). The dramatic societal changes, serious environmental incidents, and a rise in family violence have been registered among the most influential factors highly correlated with the suicide risks during the period and after the COVID-19 total lockdown (30–32). Consequently, there were several warnings issued regarding the mental health in general (33) and suicidality in particular (34). In extraordinary times, such as the COVID-19 pandemic and the associated lockdown, suicide was rather unpredictable, with questionable dynamic rates. The suitable timeframe for assessing causal psychological changes and factors' inter-relationships arouse controversy over the gauging limitations, although memory-based retrospective assessment on behavioral and complex emotionality would offer the means to circumvent the distorting irrelevant momentary details and grant a respite for the emotions to settle and restructure (35).

Suicidality in Romania

In 2019, Romania reported an age-standardized suicide rate of 7.3 per 100,000 people per year, thus falling under the global age-standardized suicide rate of 10.5 per 100,000 people per year (14). Reported trends for suicide rates had been constantly decreasing since 2012, though with a consistent difference between sexes (i.e., females had a much lower rate than men) (36). To our knowledge, data on suicide risk factors in Romanian adult population has been scarce and of suboptimal quality.

On 16 March 2020, a state of national emergency was declared in Romania and total lockdown was instituted for 60 days, which brought a considerable burden of mental health consequences. A large community of migrant workforce in the Western Europe (over three million citizens), who massively returned home when the pandemic began, made Romania unique among the countries in European Union. Additional hurdles challenged the implementation of the protective measures: intrinsic weaknesses of the national healthcare system (e.g., aging infrastructure, low national health expenditure, and reported corruption), and one of the most religious populations in Europe (37, 38). Most Romanians identify themselves as Orthodox Christian, a highly conservative denomination, which was slow to react during this crisis (39). Notwithstanding these characteristics, psychological investigations in this period have reported the general population as being stable (40, 41), although actual information on suicide and suicidality is still too little.

Objective of the Study

In this paper we report the results of a national sub-set analysis comprised in the international COMET-G study (*COVID-19 MEntal health inTernational for the General population*) and based on the data from the Romanian population. In the pandemic context, the COMET-G study (22) aimed at investigating levels of depression, changes in anxiety, distress, suicidal ideation, and spreading of conspiracy theories in relation with a number of personal and interpersonal variables. Some

national level findings have already been reported (21, 23, 42–45) along with the comprehensive report of the international study (22).

The specific target of this national level investigation was to examine the individual and contextual factors associated with suicidality in the Romanian adult population in the context of the COVID-19 pandemic related lockdown, which provoked major societal turmoil.

The main objective was to investigate the association of suicidality with individual proximal disturbances (such as anxiety and depression) and a history of life-threatening events. We also hypothesized the following secondary aims to be scrutinized: (a) contextual factors such as adherence to conspiracy theories propagated through the classical media and the Internet would play a significant role in suicidality; in addition, traditional cultural factors such as religiosity would also influence the individual pattern of reality reading and subsequent suicidal ideation; (b) socio-demographic factors (such as age and level of education) would play a role in suicidality.

Figure 1 illustrates the main objective and the secondary aims of this analysis. The conceptual framework included: suicidality, emotional disturbances, life threatening attempts and reality reading patterns. Suicidality refers to the "*risk of suicide, usually indicated by suicidal ideation or intent, especially as evident in the presence of a well-elaborated suicidal plan*" (46). Emotional disturbances comprise of three theoretical dimensions: emotional disturbances, emotion intensity/regulation disturbances, and emotion disconnections (47). Emotion intensity/regulation disturbances were mostly captured in the COMET-G study. Life threatening attempts encompassed the suicide attempts and the history of self-harm. Reality reading patterns would arise from the philosophical debate over the nature of conscious experience (48). The notion of indirect realism was extended to the reality perception in regard to the arising conspiracy theories, Internet use, and change in religiosity during the unfolding pandemic.

MATERIALS AND METHODS

Participants and Procedures

The study followed the cross-sectional COMET-G study protocol (22). The anonymous questionnaires (available in the **Supplementary Material 1**) gathered demographic data, general health data, previous psychiatric history, current symptoms of anxiety, depression and suicidality, and data regarding the changes caused by the lockdown in sleep patterns, sexual life, family relationships, finances, eating behavior, physical exercising, and religiousness/spirituality. Beliefs regarding the COVID-19 outbreak, perceived efficacy of the lockdown measures, and conspiracy theories were also investigated.

The international questionnaire was translated into Romanian according to established standards (49). Independent translation and back translation were conducted by two Romanian- English speaking authors. Following the Delphi technique, a panel of professionals agreed upon the final version that was deployed.

Retrospective data were collected online from 1 June to 23 December, 2020 (total lockdown had been instituted in Romania from 16 March until 15 May, 2020). Participants were instructed to give answers referring to their state and mindset during the total lockdown. No identification information was collected. Participants were able to access the survey and complete their responses only after reading and acknowledging the information regarding the study (i.e., the cover story): aim of the research, organizations involved and their contact information, and planned use of collected data. This acknowledgment served as the on-line form of informed consent. Announcement and advertisements were placed on social media, and distributed *via* e-mail and other instant messaging Apps.

Ethical approval (no. 194/ 4 June, 2020) was issued by the Ethics Committee of the "Pius Brinzeu" County Emergency Clinical Hospital, in Timisoara, Romania.

Instruments for Data Collection, Measures

Symptoms of anxiety were evaluated with State-Trait Anxiety Inventory (STAI), the S-Anxiety scale (STAI-Y1) (50). The STAI consists of 20 items that evaluate the respondent's current feelings on a 4-point Likert type scale. It is often employed for general and clinical populations (51) and had been used in Romania (52, 53).

Depression was evaluated with the Center for Epidemiological Studies-Depression Scale (CES-D), a popular and widely used instrument, based on self-reporting (54–56). It consists of 20 items that cover affective, psychological, and somatic symptoms (57), and had also been applied in Romanian population (56, 58–60).

Suicidality was evaluated with the Risk Assessment Suicidality Scale (RASS) (61), a self-assessment instrument. The last two RASS items were separately analyzed: RASS_11, "*Have you ever hurt yourself in any way deliberately, during your whole life so far?*"; RASS_12, "*Have you ever attempted suicide, during your whole life so far?*". Each statement employed a 4-point Likert-type scale: 1 = not at all, 2 = a little bit, 3 = much, 4 = very much. An additional RASS-related item was included: "SI (Suicidal ideation) change," "*How much has your tendency to think about death and/or suicide changed, compared to before the outbreak of COVID-19?*". This instrument used a 5-point range: 2 = Very much increased, 1 = Increased a bit, 0 = Neither increased, nor decreased, −1 = Decreased a bit, −2 = Very much decreased. RASS had not been previously adapted for the Romanian population. Therefore, a confirmatory factor analysis (CFA) was conducted to verify its validity, based on the originally reported factors: "fear," "intention," and "life" (61).

Three additional Likert-type scales (designed for this study and included in the **Supplementary Material 1**) measured the extent of Internet use, belief in conspiracy theories, and the individual's religiosity. These scales underwent only face analysis prior to their deployment. CFA was conducted for the variables of Internet use and beliefs in conspiracy theories, which have been taken together as contributors to the patterns of reality reading.

Definition of Latent Variables Based on the Manifest Exogenous Variables

Suicidality (*S*) was inferred from the total score of the first 10 items of RASS (*RASS tot*) and from the change in suicidal ideation (*SI change*). Observable emotional disturbances (*ED*) were measured by the total score for STAI-Y1 (*STAI tot*) and total

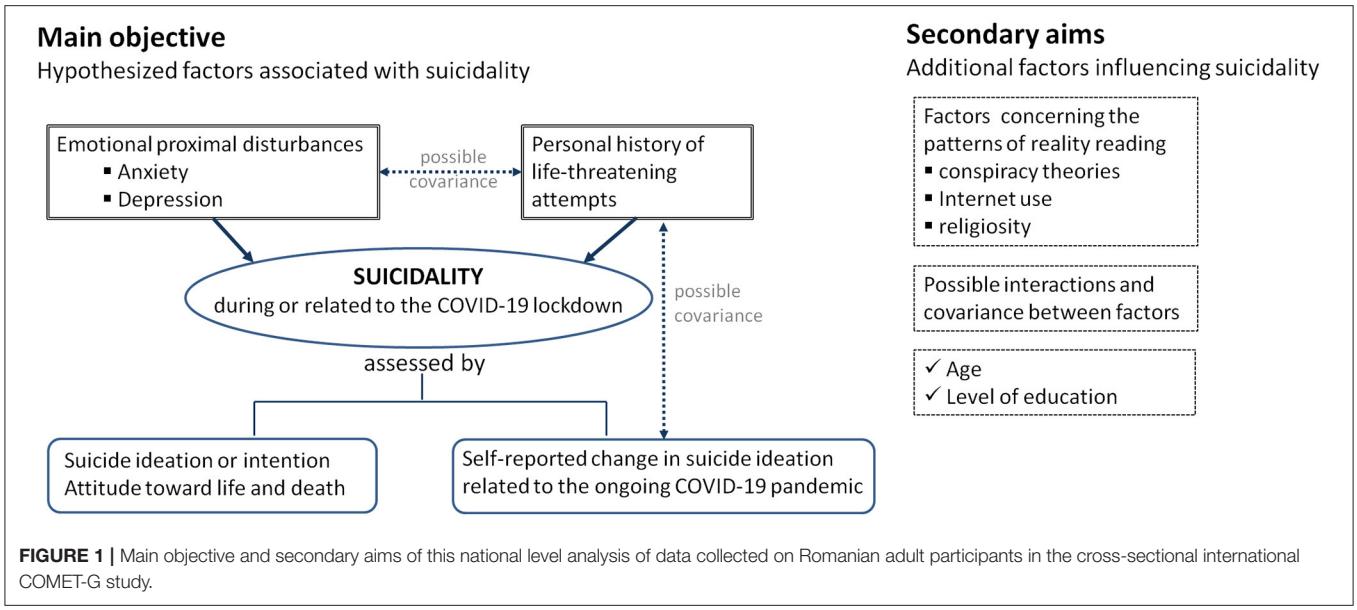

FIGURE 1 | Main objective and secondary aims of this national level analysis of data collected on Romanian adult participants in the cross-sectional international COMET-G study.

score for CES-D (*CES tot*). Life threatening attempts (*LTA*) was a latent variable based on the items of RASS_11 (*RASS 11 self-harm*) and RASS_12 (*RASS 12 suicide*). Reality reading patterns (*RRP*) were inferred from the change in individual's religiosity or spirituality inquiries (*Relig increase*), belief in conspiracy theories (*Consp theories*), and *Internet use*.

Data Analysis

Descriptive and Exploratory Statistics

Scale scores were treated as rank variables and described by the median (Inter Quartile Range). Descriptive statistics included the observed frequency counts (percent) for categorical variables or particular scales' selected items of interest. Normality of numerical variables was tested with the Shapiro-Wilk statistical test; these variables were described by the sample's mean and standard deviation (SD) when normally distributed, or by the sample's median (Inter Quartile Range–IQR) accordingly. The actual reliability of scale measurements was assessed based on the Cronbach's alpha: values >0.8 were considered to indicate good internal consistency, but scales with very few items were not discarded solely based on this coefficient. Cronbach's alpha actual values were reported for each scale with more than one item. The Harman's single factor method was applied to examine the amount of common method variance affecting the multi-item scales which had not undergone previous validation, other than face validation during the development stage. Harman's single factor method indicates possibly problematic common method bias (62). Separate application of the CFA marker technique to quantify the actual common method variance was unsuitable for scales taken in isolation, with possible additional issues related to the post-hoc choice of the marker (63). Non-parametric Spearman correlation approach was used to explore the covariances between various scales' scores employed in this study.

All reported probability values were two-tailed. A 0.05 level of significance was set, and highly significant values were also marked. Data were analyzed with the statistical software IBM SPSS v. 20.0 (Armonk, New York, USA) and the software packages R v. 4.0.5 (https://cran.r-project.org/).

Structural Equation Modeling and Confirmatory Factor Analysis

Based on the study specific target, structural equation modeling (SEM) was employed to investigate the structural connections between latent variables underlying the actual scores measured in the collected data. SEM was the method of choice for this analysis for its mathematical and statistical characteristics, i.e., a combination of model's structural features defined by equations, followed by their estimation across the available data based on the matrix algebra and generalized linear models. SEM is commonly used in the fields of social and psychological sciences for identifying hypothesized latent variables, which cannot be directly observed and measured. It also allows a simultaneous statistical estimation procedure, rather than separately estimating each part of a model, an approach which is believed to increase the overall accuracy (64).

We started with a nucleus model based on the main objective and its associated research hypotheses regarding the individual proximal disturbances (i.e., anxiety and depression) combined with a history of life-threatening attempts which would increase the suicidality related to the lockdown, thus including the endogenous latent variables of *ED*, *LTA*, and *S*. This model comprised previously validated scales as exogenous variables. In the following step, based on the secondary aims, we added the additional latent variable *RRP* in the model, which included the one-item change in individual's religiosity or spirituality inquiries, and the two multi-item scales for belief in conspiracy theories and Internet use (all three with only face validation). Furthermore, to this extended model we

added two additional variables describing socio-demographic individual characteristics as potential independent predictors in the regression with *S* as an outcome. This approach yielded three SEM models, reflecting the results with reference to the main objective and the two secondary aims, respectively.

For all observed variables included in the models, the min-max rescaling was applied in order to preserve the shape of the original distributions and to retain the importance of outliers. The features would range as [0, 1] for all observed variables except for the change in suicidal thoughts, which was rescaled in the range [−1, 1] such that "no change" would correspond to a nil score. For model fitting, the maximum likelihood (ML) with robust estimators was used, with adjustments for non-normality of some variables (64, 65). The non-linear box-constrained optimization using PORT routines (NLMIB) was employed as the optimization method. When defining the SEM models, we placed the focus on the theoretical basis and meaningfulness of the variables' inter-relations. Nevertheless, the models were compared regarding their fit statistics and the Akaike information criterion (AIC). The Vuong's closeness test based on likelihood ratio was applied for determining the statistical significance of the change in AIC values.

The CFA and SEM models' goodness of fit indices and their corresponding [cut-off] values were: model Chi-square test and the resulting *p*-value, [< 0.05]; Comparative Fit Index (CFI), [> 0.90]; Root Mean Square Error of Approximation (RMSEA), [<0.08 for a good fit, and up to 0.1 for marginal fit]; Standardized Root Mean Square Residual (SRMR), [<0.08].

The levels of statistical confidence and significance were 0.95 and 0.05, respectively, except for the RMSEA fit index, for which the confidence was explicitly specified to be 0.90. All reported probability values were two-tailed. We conducted the analysis with the statistical packages R v. 4.0.5 (including "*lavaan*" v. 0.6-9, "*semPlot*" v. 1.1.2, and "*nonnest2*" v. 2020-07-05).

TABLE 1 | Confirmatory factor analysis (CFA) for the first 10 items of the RASS scale based on the three factors originally identified (fear, intention, and life) and the newly developed scales for belief in conspiracy theories (7 items) and Internet use (3 items).

CFA model for the RASS scale			
Fear= ∼ RASS_1 *Intention = ∼ RASS_5 + RASS_6 + RASS_7 + RASS_8* *Life = ∼ RASS_2 + RASS_3 + RASS_4 + RASS_9 + RASS_10*			
Fit indices			
Chi-square test	**CFI**	**RMSEA**	**SRMR**
417.374 (df = 33) $p < 0.001$	0.941	0.090 90% CI (0.082; 0.098)	0.047
CFA model for the variables of the beliefs in conspiracy theories and the Internet use			
Consp = ∼ X.81_J1_ConspTheo_1 + X.82_J2_ConspTheo_2 + X.83_J3_ConspTheo_3 + X.84_J4_ConspTheo_4 + X.85_J5_ConspTheo_5 + X.86_J6_ConspTheo_6 + X.87_J7_ConspTheo_7 *Internet = ∼ X.88_K1_Internet_1 + X.89_K2_Internet_2 + X.90_K3_Internet_3* *Consp ∼∼ Internet*			
Fit indices			
Chi-square test	**CFI**	**RMSEA**	**SRMR**
3992.427 (df = 45) $p < 0.001$	0.910	0.085 90% CI (0.077; 0.093)	0.055

Items are coded according to the COMET-G protocol as they are presented in the ***Supplementary Material 1****.*

RESULTS

Confirmatory Factor Analysis and Harman's Test for the Scales at Their First Deployment in Romanian Population

CFA was conducted for the first 10 items of the RASS scale based on the three factors originally identified: fear, intention, and life. Results are presented in **Table 1**. All indices proved a good fit, except for the RMSEA, which was marginal. **Figure 2** illustrates the CFA path diagram and factors' loadings, confirming the balanced contribution of all items to the overall score, with reversed effect for items #3 and #9. The actual RASS scale measurements were confirmed as consistent with scale's hypothesized construct.

For the belief in conspiracy theories and Internet use, the Harman's single factor method resulted in 47.84 and 48.21%, respectively, of variance explained by one factor in exploratory factor analysis. These results on forced one factor model (namely less than 50% each) supported the further inclusion of the two scales in a SEM model. **Table 1** also includes the CFA results for these two scales. Similarly to the 10-item RASS scale, the fit indices were good, except for the RMSEA, which was marginal.

Descriptive Analysis of Socio-Demographic Characteristics, Self-Reported Health Data and Mental Disturbances of the Respondents

One thousand, four hundred and forty-six ($N = 1{,}446$) adults responded to the anonymous questionnaire: 1,142 were females (aged 46.83 ± 14.16 years), 292 were males (aged 47.64 ± 14.36 years), and 12 self-identified as "non-binary" (aged 51.58 ± 15.45 years). Details of the respondents' socio-demographic information, and data regarding education and employment are presented in **Tables 2A**,**B**, respectively. Additional self-reported health related data were included in **Supplementary Material 2**.

Table 3 presents the descriptive statistics for the scales' scoring totals, and the corresponding values of Cronbach's alpha for individual scales or RASS sub-scales (i.e., as they resulted from the CFA). Lower values of internal consistency can be noted for the three-item "Internet use" (alpha = 0.456). For the three individual RASS items (O11, O12, and O13), the median (IQR)

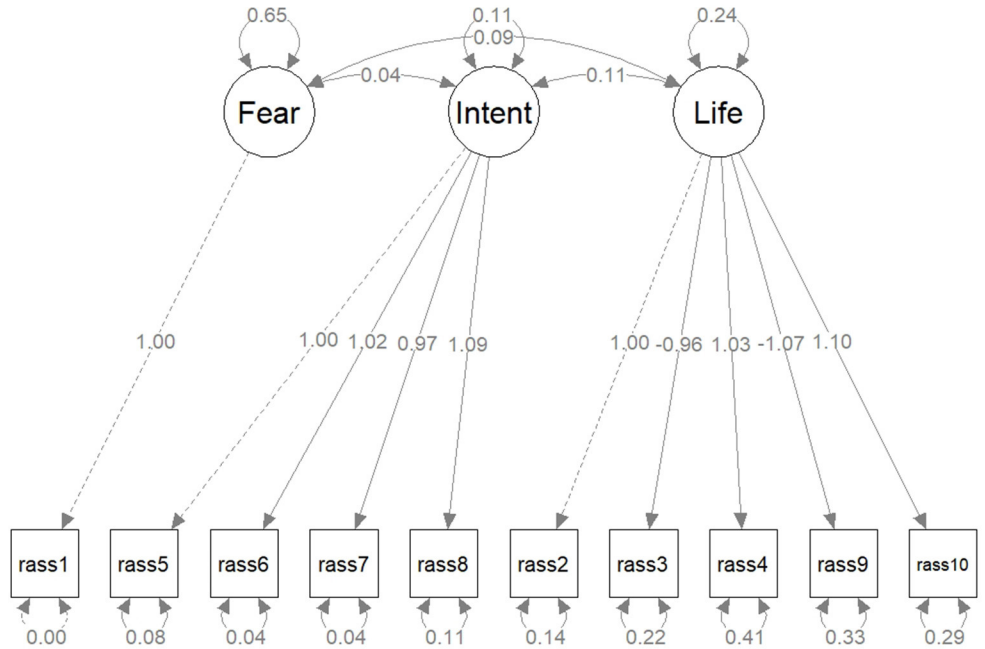

FIGURE 2 | The path diagram for the confirmatory factor analysis for the first 10 items of the RASS scale, based on the three factors originally identified: fear, intention, and life. Latent variables are drawn in circles and manifest variables are drawn in squares. The edge labels indicate the parameter estimates.

statistics were all nil. **Table 4** shows the distribution of the scores for these individual items and also includes the scoring distribution for the change in religious/spiritual inquiries, where the actual spread over the whole range is apparent.

Correlation between the scale scorings is presented in **Table 5**. The strong correlation between STAI and CES-D is noteworthy, although all scorings (except for the belief in conspiracy theories) were significantly two-by-two correlated. The belief in conspiracy theories showed a very weak or no relation to anxiety, depression, suicidality and Internet use.

Structural Equation Models

Table 6 shows the SEM models along with their statistical fit indices. We started with the nucleus Model 1, with reference to the main objective, which included three latent variables (*ED*, *LTA*, and *S*) and a regression (*ED* and *LTA* as predictors for S). In Model 2, we added an additional latent variable (*RRP*), which was included in the regression, as well. Model 3 kept the same latent variables, and also incorporated age and education as independent predictors in the regression. For all three models, we also investigated meaningful covariance. According to the Vuong's statistical test and the AIC, each model gave successively better description of the variables inter-relations, when compared to the previous one. For all three models, the fits indices reflected good reliability.

Table 7 presents the parameters for the SEM model 3 in detail. *ED* and previous *LTA* were significant predictors for *S*, while the *RRP* were not. In addition, the participants' age was a significant predictor (with negative regression coefficient), but the level of education was not. It is important to note the significant covariance between each of the three latent variables considered as predictors in the regression, namely *ED*, *LTA*, and *RRP*; there was a significant negative covariance between the previous *LTA* (RASS_11 and RASS_12 items) and the reported change in SI during the COVID-19 pandemic lockdown. There was no covariance between Internet use and beliefs in conspiracy theories.

Figure 3 shows the path diagrams for the SEM model 3. The latent variables are drawn in circles; the manifest variables are drawn in squares.

The parameters of the SEM model 1 and model 2, and their corresponding path diagrams are presented in **Supplementary Material 3**.

DISCUSSION

The present study on a lot of 1,446 Romanian adult participants in the international cross-sectional COMET-G study included persons aged between 19 and 84 years, with a mean of 47.03 years. More than 50% of the 1,446 respondents self-declared an increased level of religiosity and spiritual inquiries during the COVID-19 lockdown in the pandemic outbreak. Eighty-one percent self-reported no suicidality change, but more than 11% reported increased suicidal ideation during the lockdown. More than 10% of the 1,446 respondents admitted having a history of self-harm and more than 7% reported previous suicide attempts. In the structural models of suicidality, emotional disturbances and previous life-threatening attempts acted as significant predictors, while the patterns of reality reading were not.

TABLE 2A | Socio-demographic characteristics of the respondents.

Variable	Total *N* = 1,446	Female *N* = 1,142	Male *N* = 292	Non-binary *N* = 12
Age (years)				
mean ± std.dev.	47.03 ± 14.21	46.83 ± 14.165	47.64 ± 14.36	51.58 ± 15.45
(min–max)	(19–84)	(19–84)	(19–80)	(21–82)
Residence	*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
Rural area–village	262 (18.1%)	218 (19.1%)	40 (13.7%)	4 (33.3%)
Town (<20.000 inhabitants)	189 (13.1%)	148 (13%)	39 (13.4%)	2 (16.7%)
Town (20.000–100.000 inhabitants)	347 (24%)	278 (24.3%)	68 (23.3%)	1 (8.3%)
City (100.000–1 million population)	471 (32.6%)	357 (31.3%)	113 (38.7%)	1 (8.3%)
City > 1 million population	70 (4.8%)	62 (5.4%)	8 (2.7%)	–
Capital city	107 (7.4%)	79 (6.9%)	24 (8.2%)	4 (33.3%)
Marital status	*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
Single	224 (15.5%)	176 (15.4%)	46 (15.8%)	2 (16.7%)
Married (or in a civil partnership)	860 (59.5%)	657 (57.5%)	200 (68.5%)	3 (25%)
Divorced (or estranged)	98 (6.8%)	84 (7.4%)	14 (4.8%)	–
Live with someone without an official relationship	155 (10.7%)	128 (11.2%)	25 (8.6%)	2 (16.7%)
Widower	84 (5.8%)	80 (7%)	2 (0.7%)	2 (16.7%)
Other	25 (1.7%)	17 (1.5%)	5 (1.7%)	3 (25%)
Household people	*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
1	195 (13.5%)	166 (14.5%)	26 (8.9%)	3 (25%)
2	522 (36.1%)	401 (35.1%)	119 (40.8%)	2 (16.7%)
3	373 (25.8%)	294 (25.7%)	76 (26%)	3 (25%)
4	235 (16.3%)	187 (16.4%)	46 (15.8%)	2 (16.7%)
5	121 (8.4%)	94 (8.2%)	25 (8.6%)	2 (16.7%)
Children	n (% of N)	n (% of N)	n (% of N)	n (% of N)
0	416 (28.8%)	326 (28.5%)	88 (30.1%)	2 (16.7%)
1	494 (34.2%)	403 (35.3%)	87 (29.8%)	4 (33.3%)
2	414 (28.6%)	323 (28.3%)	88 (30.1%)	3 (25%)
3	79 (5.5%)	59 (5.2%)	19 (6.5%)	1 (8.3%)
4	43 (3%)	31 (2.7%)	10 (3.4%)	2 (16.7%)

Young age was also a significant predictor for suicidality. The construct of suicidality was based on the RASS total scoring and the change in suicidal ideation. Of the two, the change in suicidal ideation played a more consistent role. For emotional disturbances, both STAI-Y1 total scoring (anxiety) and CES-D total scoring (depression) contributed in a similar way. Previous life-threatening attempts were observed in terms of two items of the RASS scale regarding the self-harm and previous suicide attempts, both contributing to life-threatening attempts in almost equal terms. The patterns of reality reading encompassed the adherence to conspiracy theories, Internet use, and change in spirituality inquiries. The Internet use had the highest estimate and the conspiracy beliefs the lowest, although both had high statistical significance for reality reading patterns. Although the SEM models 2 and 3 which included them were significantly better compared to the nucleus model, their contribution to the suicidality proved insignificant. They might only indirectly contribute through their significant covariance with the emotional disturbances.

We compared the socio-demographic characteristics for our responders with the officially reported data on the general population of Romania (66–69): median age of 43.2 years, rural residence of 43.6% in the general population (compared to 18.1% among the respondents), 61.1% married (59.5% in our data set), 4.84% unemployed (1.1% in our data set), 51.4 % females (78.9% in our data set). Summing up, compared to the general population of Romania, the respondents in the present study were of similar age, higher urban representation, similar marital status, higher employment status, and higher female representation. In particular, the dissimilarities in females' proportion and unemployment rates could have an impact on the models' validity, due to their previously reported effect on suicidality. Despite these concerns, the rate of Internet users in Romania is high and 12 million people use social media in Romania, a country with 19.18

TABLE 2B | The respondents' education and employment data.

Variable	Total *N* = 1,446	Female *N* = 1,142	Male *N* = 292	Non-binary *N* = 12
Education	*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
Elementary school	46 (3.2%)	35 (3.1%)	6 (2.1%)	5 (41.7%)
High school (9–12 yrs)	366 (25.3%)	265 (23.2%)	99 (33.9%)	2 (16.7%)
Bachelor degree	652 (45.1%)	521 (45.6%)	128 (43.8%)	3 (25%)
University	89 (6.2%)	78 (6.8%)	11 (3.8%)	–
MA (MSc) degree	254 (17.6%)	216 (18.9%)	37 (12.7%)	1 (8.3%)
PhD	39 (2.7%)	27 (2.4%)	11 (3.8%)	1 (8.3%)
Employment	*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
Civil servant	463 (32%)	398 (34.9%)	63 (21.6%)	2 (16.7%)
Private clerk	314 (21.7%)	222 (19.4%)	88 (30.1%)	4 (33.3%)
Self-employed/freelancer	91 (6.3%)	67 (5.9%)	23 (7.9%)	1 (8.3%)
Retired	284 (19.6%)	215 (18.8%)	66 (22.6%)	3 (25%)
Unemployed	16 (1.1%)	10 (0.9%)	6 (2.1%)	–
Housekeeper	56 (3.9%)	55 (4.8%)	1 (0.3%)	–
Disability pension	21 (1.5%)	17 (1.5%)	4 (1.4%)	–
Allowance for health reasons	5 (0.3%)	4 (0.4%)	–	1 (8.3%)
University or college student	123 (8.5%)	100 (8.8%)	23 (7.9%)	–
Other	73 (5%)	54 (4.7%)	18 (6.2%)	1 (8.3%)
Health sector	*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
No	1,099 (76%)	837 (73.3%)	252 (86.3%)	10 (83.3%)
Doctor	67 (4.6%)	58 (5.1%)	9 (3.1%)	–
Nurse	201 (13.9%)	182 (15.9%)	19 (6.5%)	–
Other healthcare profession	55 (3.8%)	47 (4.1%)	6 (2.1%)	2 (16.7%)
Administrative staff in hospital	9 (0.6%)	6 (0.5%)	3 (1%)	–
Other hospital staff	15 (1%)	12 (1.1%)	4 (1%)	–

million citizens (66, 70), therefore we confidently chose the on-line means to promote the COMET-G study. Although the respondents' sample was not totally representative for the general population, the number of respondents was high, compared to other countries cited in the COMET-G project (22).

Suicidality and self-harm history are widely acknowledged as substantial predictors for suicidal risk (71, 72), but the evidence is largely based on data from high-income countries (18). Data regarding the Romanian population is particularly scarce. In our models, previous life-threatening attempts proved to be significant predictors for suicidality. An intriguing finding was that both factors – suicide attempts and self-harm history – were negatively correlated with the change in suicidal ideation, albeit the correlation was weak (but statistically significant).

There are published reports of decreased suicidal ideation in association with the pandemic outbreak in Europe and the United States (18, 73, 74). Suicidal ideation might decrease when people are confronted with immediate potentially existential dangers, such as the risk of illness and the sense of incertitude during the COVID-19 pandemic. There are established observations of this phenomenon in other situations of immediate threats, like the First World War or terrorist attacks (75, 76). Depression was long seen as a suicide-related factor, but the effect of anxiety has not been separately investigated until recently (77, 78). The context of the COVID-19 pandemic might have also mediated a more direct connection between the increased anxiety and suicidality, as it unmasked and developed multiple anxiety-generating factors such as the fear of contamination, general insecurity, fear for the loved ones' health, and subject's overexposure on the media. What seems especially intriguing in this specific context is that the suicide rates were stable and suicidality was reported as decreasing; in a context when the general rates of the risk factors for suicidality (such as depression, anxiety, contextual and social vulnerabilities) increased in most of the reports on the COVID-19 pandemic and the contribution of these factors is well-established in the literature, alerts for constant vigilance regarding the suicidal dynamic were issued (18).

Age is usually inversely correlated with suicidal risk (4), and our SEM model 3 also put younger people at a higher risk. Studies on Romanian population showed a significant rise in suicide for young people and the elderly, even before the pandemic crisis (79). Lower education levels is typically seen as a general risk factor for suicidality, but it loses influence when adding other dominant factors, such as preexisting mental health issues, ancestry information, and demographic factors (7, 80, 81). In our SEM model 3, the level of education was not a significant predictor for suicidality. On the other hand, this lack of education significance in our model might be due to the

TABLE 3 | Descriptive statistics and internal consistency of scale scorings for STAI, CES, RASS, belief in conspiracy theories, and internet use.

Scale Median (IQR)	Total *N* = 1,466	Female *N* = 1,142	Male *N* = 292	Non-binary *N* = 12
STAI total				
Sum (F1, F2,..., F20)				
Cronbach's alpha = 0.922 (20 items)				
STAI total	48 (39–55)	49 (40–56)	43 (36–52)	43.50 (29–53)
CES total				
Sum (G1, G2,..., G20)				
Cronbach's alpha = 0.927 (20 items)				
CES total	12 (6–24)	13 (6–24)	10 (4–19)	9.5 (2.5–26)
RASS total				
Sum (O1, O2,..., O10)				
RASS fear = {O1}				
RASS intention = {O5, O6, O7, O8}, Cronbach's alpha = 0.894 (4 items)				
RASS life = {O2, O3, O4, O9, O10}, Cronbach's alpha = 0.825 (5 items)				
RASS total	6 (6–8)	6 (6–8)	6 (6–7)	6 (6–7)
Consp total				
Sum (J1, J2,..., J7)				
Cronbach's alpha = 0.677 (7 items)				
Consp total	8 (4–12)	8 (4–12)	8 (4–12)	14 (10.5–18)
Internet total				
sum (K1, K2, K3)				
Cronbach's alpha = 0.456 (3 items)				
Internet total	4 (3–6)	5 (3–6)	4 (3–6)	3.5 (1.5–7)

Items are coded according to the COMET-G protocol as they are presented in the ***Supplementary Material 1****.*

disequilibrium in the level of education among the respondents: fewer than 30% of them did not graduate a form of post-high-school education. As these data were somewhat incongruous and unforeseen in the pandemic context, further investigations for long-term consequences in stationary societal circumstances are necessary, accompanied by national policies aimed at this public health issue.

There is a consensus that most people are quite resilient in face of negative changes or potentially traumatic events (82–84). Onset of societal or economic instability (for example, a recession) may have unstructured effects on suicide rates (85, 86). Nevertheless, vulnerability factors (such as previous mental health issues, suicide attempts, a history of self-harm, male sex, age, unemployment and belonging to disadvantaged social groups) may influence the life-long mental health risks, and indeed play an important role in the suicidality dynamics (77, 87–89). Religion generally plays a protective role regarding suicide (90), while religious turmoil is associated with a greater suicidal risk (91), albeit moderated by specific cultural differences (92). Responses to the COMET-G questionnaire showed that self-reported change in spiritual inquiries may have acted as a signal that previously successful coping mechanisms might have been exhausted, and the increased religiosity could thus be viewed as an attempt to regain emotional balance. Conspiracist ideation is also grounded on psychological mechanisms (93) and tends to increase during times of crises (94). Moreover, current media misinformation seems to generate a specific dynamic that exacerbates and promotes conspiracy thinking (95). These mechanisms were initially hypothesized to also work in the Romanian adult population, but in our structural models the conspiracy beliefs did not correlate with the degree of Internet use and did not demonstrate a significant influence on suicidality. This might be explained by the methodology we used that raises issues of consistency and common method bias for the variables related to the reality reading patterns. Both findings need further investigation and additional channels for proliferation of conspiracy theories should be considered. Specific scales, thoroughly validated, are also needed for clarification.

The pandemic context calls for consideration of new factors related to suicide. This implies that measures already established as being protective might require reconsideration and adjustment in the near future. For example, anxiety disorder and anxiety related distress emerged as a significant suicidality factor in the present study, thus needing deeper scrutiny in further research. We put forward a particular need for consolidation of the presently proposed structural models of suicidality.

Worldwide, several different studies have proposed vulnerability models for mental health issues (21, 42, 96) while suicide-related studies of the Romanian population

TABLE 4 | The scorings' distributions for the individual items on suicidality change, personal history of self-harm, and increase in religious/spiritual inquiries.

	RASS N (%)	Total *N* = 1,466	Female *N* = 1,142	Male *N* = 292	Non-binary *N* = 12
Subjective changes in suicidality (O11_Suicidality change)		*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
	−2	90 (6.2%)	67 (5.9%)	23 (7.9%)	–
	−1	20 (1.4%)	15 (1.3%)	4 (1.4%)	1 (8.3%)
	0	1,171 (81%)	918 (80.4%)	244 (83.6%)	9 (75%)
	1	105 (7.3%)	93 (8.1%)	12 (4.1%)	–
	2	60 (4.1%)	49 (4.3%)	9 (3.1%)	2 (16.7%)
History of self-harm (O12_RASS_11)		*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
	0	1,299 (89.8%)	1,020 (89.3%)	268 (91.8%)	11 (91.7%)
	1	77 (5.3%)	65 (5.7%)	12 (4.1%)	–
	2	41 (2.8%)	32 (2.8%)	9 (3.1%)	–
	3	29 (2%)	25 (2.2%)	3 (1%)	1 (8.3%)
History of suicide attempts (O13_RASS_12)		*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
	0	1,339 (92.6%)	1,055 (92.4%)	275 (94.2%)	9 (75%)
	1	79 (5.5%)	65 (5.7%)	12 (4.1%)	2 (16.7%)
	2	23 (1.6%)	19 (1.7%)	4 (1.4%)	–
	3	5 (0.3%)	3 (0.3%)	1 (0.3%)	1 (8.3%)
Changes in religiousness/spirituality (P1_RelSpir)		*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
	0	672 (46.5%)	482 (42.2%)	185 (63.4%)	5 (41.7%)
	1	419 (29%)	352 (30.8%)	65 (22.3%)	2 (16.7%)
	2	203 (14%)	171 (15%)	31 (10.6%)	1 (8.3%)
	3	152 (10.5%)	137 (12%)	11 (3.8%)	4 (33.3%)

Items are coded according to the COMET-G protocol as they are presented in the ***Supplementary Material 1****.*

TABLE 5 | Associations between the scales total scorings on anxiety, depression, suicidality, conspiracy beliefs and Internet use.

		STAI total	CES-D total	RASS total	Conspiracy total	Internet total
STAI total	R	1.000	**0.776****	**0.358****	0.085**	**0.334****
	p	.	<0.001	<0.001	0.001	<0.001
	N	1,446	1,446	1,446	1,446	1,446
CES-D total	R	**0.776****	1.000	**0.355****	0.119**	**0.370****
	p	<0.001	.	<0.001	0.000	<0.001
	N	1,446	1,446	1,446	1,446	1,446
RASS total	R	**0.358****	**0.355****	1.000	−0.019	0.211**
	p	<0.001	<0.001	.	0.477	<0.001
	N	1,446	1,446	1,446	1,446	1,446
Conspiracy total	R	0.085**	0.119**	−0.019	1.000	0.177**
	p	0.001	<0.001	0.477	.	<0.001
	N	1,446	1,446	1,446	1,446	1,446
Internet total	R	**0.334****	**0.370****	0.211**	0.177**	1.000
	p	<0.001	<0.001	<0.001	<0.001	.
	N	1,446	1,446	1,446	1,446	1,446

*Statistical significance **p < 0.01.*

N, number of observations; p, statistical significance; R, Spearman coefficient of correlation (non-parametric). Statistically significant R values over 0.3 are in bold.

have found it as atypical and therefore faced difficulties in applying models from other Eastern European Countries (97). Romania presents with a set of challenges regarding the medical system and with several cultural and socio-economic particularities, some of which are widely acknowledged as associating with higher suicidal risk. However, the national suicide rates have slightly declined over the past years, recently falling below the annual global age-standardized suicide rate (14). Precaution was recommended in regard to the pandemic consequences (98), but recent results showed a degree of psychological stability during the lockdown in Romanian population, and studies have indicated no change in suicide rates for some regions of Romania (99). However, little overall data is available, so the present results may bring valuable contribution toward moving forward with the novel understanding of suicidality.

TABLE 6 | The structural equation modeling of the multivariable relationships between the mental health indicators, beliefs and life changes.

SEM models	Fit indices			
	Chi-square test	**CFI**	**RMSEA**	**SRMR**
Model 1 *ED = ~ STAI total + CES total* *Suicidality = ~ RASS total + SI change* *LTA = ~ RASS_11 + RASS_12* *SI change~~ RASS_11 + RASS_12* *Suicidality ~ ED + LTA*	11.272 (df = 4) $p = 0.024$	0.997	0.035 90% CI (0.012; 0.061)	0.010
Model 2 *ED = ~ STAI total + CES total* *Suicidality = ~ RASS total + SI change* *LTA = ~ RASS_11 + RASS_12* *RRP = ~ Religion and spirituality + Conspiracy theories + Internet use* *SI change~~ RASS_11 + RASS_12* *Internet use ~~ Conspiracy theories* *Suicidality ~ ED + LTA + RRP* Vuong's test: z = 6.244; $p < 0.001$ (in favor of Model 2, compared to Model 1) 95% CI of AIC difference (−812.220; −414.567)	130.038 (df = 18) $p < 0.001$	0.959	0.066 90% CI (0.055; 0.076)	0.040
Model 3 *ED = ~ STAI total + CES total* *Suicidality = ~ RASS total + SI change* *LTA = ~ RASS_11 + RASS_12* *RRP = ~ Religion and spirituality + Conspiracy theories + Internet use* *SI change~~ RASS_11 + RASS_12* *Internet use ~~ Conspiracy theories* *Suicidality ~ ED + LTA + RRP + Age + Education* Vuong's test: z = 2.227, $p = 0.013$ (in favor of Model 3, compared to Model 2) 95% CI of AIC difference (−35.591; 1.475)	305.938 (df = 34) $p < 0.001$	0.906	0.074 90% CI (0.067; 0.082)	0.058

Limitations

The main limitation of this investigation is that the proposed SEM models of suicidality were generated based on anonymous self-reported data, which were retrospectively collected in regard to the COVID-19 lockdown, within a limited time window and based on natural self-selection of respondents. Its cross-sectional design with no previous baseline and no follow-up prevented us from obtaining the risk estimates. Nevertheless, the SEM procedure in data analysis allowed the combination of the structural features with a general linear model for regression, and increased the overall accuracy and subsequent reliability of the findings.

The common method bias (CMB) implied by the cross-sectional design and the one time single-administration questionnaire (with its associated actual effect of the common method variance, CMV) is a major concern that cannot be overlooked. On the other hand, appropriate procedural measures were taken and carefully observed to limit the shared variance and control the method biases: different scales (such as those corresponding to predictors and criterion constructs) were included in non-adjacent sections, separated by questions collecting factual data (e.g., about diet or physical exercising); the scales included both positively and negatively (i.e., reverse) worded items; the wording was kept clear, concise and accurate; at the beginning of the questionnaire, respondents were provided comprehensive information on the COMET-G study and were assured of the anonymity; different scale formats were alternated, such as 4-point and 5-point Likert-type scales, or even dichotomy items.

In addition to these preventative measures, we explored the CMB possible impact on the performance of the measuring instruments and subsequent results by the post-hoc statistical techniques. Moreover, the approach with three SEM models (the nucleus including only previously validated scales and widely acknowledged constructs) and the stability of these nuclei regression coefficients' estimates (i.e., proximal predictors) across the three models proved the robustness of the results: significant and balanced interrelationship between the nuclei constructs (i.e., emotional disturbances and previous life-threatening attempts on the one hand, and suicidality on the other hand). We acknowledge that CMV, as a systematic error variance, could have a confounding influence on empirical results and produce potentially misleading conclusions, but this issue was improbable in our case. In our data set, there was a weak and insignificant relationship between the beliefs in conspiracy theories and the use of Internet – an actual CMB issue should have resulted in a stronger relationship.

TABLE 7 | The parameters of SEM Model 3 examining the relationships between anxiety, depression, life-threatening attempts, suicidality, religion/spirituality, conspiracy theories, Internet use scorings, age, and education.

Model 3 parameters		Estimate (Std. err.)	z-value	*p*-value
Latent variables:				
ED = ~	STAI total	1		
	CES total	1.209 (0.044)	27.356	<0.001**
Suicidality = ~	RASS total	1		
	SI change	1.568 (0.261)	6.001	<0.001**
LTA = ~	RASS_11	1		
	RASS_12	0.753 (0.103)	7.341	<0.001**
RRP = ~	Religion and spirituality	1		
	Conspiracy theories	0.664 (0.125)	5.309	<0.001**
	Internet use	1.228 (0.227)	5.413	<0.001**
Regression:				
Suicidality ~	ED	0.168 (0.027)	6.251	<0.001**
	LTA	0.316 (0.063)	5.047	<0.001**
	RRP	0.036 (0.052)	0.678	0.497
	Age	−0.049 (0.013)	−3.865	<0.001**
	Education	0.014 (0.012)	1.142	0.253
Covariances:				
SI change~~	RASS_11	−0.007 (0.003)	−2.401	0.016*
	RASS_12	−0.007 (0.002)	−3.207	0.001**
Internet use ~~	Conspiracy theories	−0.00019 (0.002)	−0.088	0.930
ED ~~	LTA	0.007 (0.001)	6.423	<0.001**
	RRP	0.010 (0.002)	5.696	<0.001**
LTA ~~	RRP	0.002 (0.001)	3.457	0.001**

*Statistical significance *p < 0.05; **p < 0.01.*

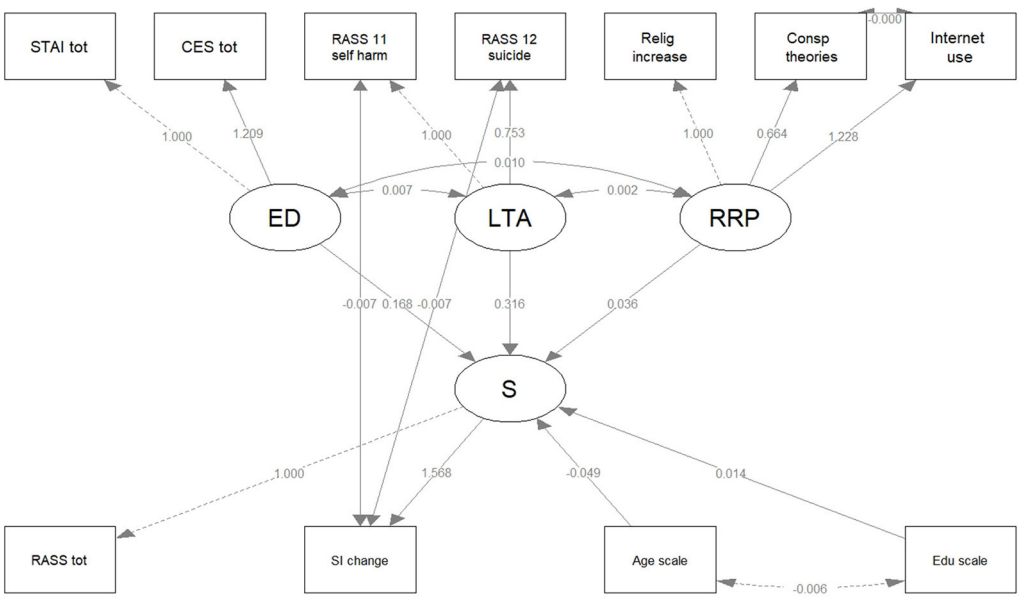

FIGURE 3 | The path diagram for the SEM Model 3. Latent variables are drawn in circles and manifest variables are drawn in squares. The edge labels indicate the parameter estimates. CES tot, Center for Epidemiologic Studies Depression Scale (CES-D), 20-item total; ED, Emotional Disturbances; LTA, Life Threatening Attempts; RASS 11 self-harm, 4-point score of RASS 11; RASS 12 suicide, 4-point score of RASS 12; RASS tot, Risk Assessment Suicidality Scale (RASS), 10-item total; S, Suicidality; SI change, Suicidal Ideation change; STAI tot, State-Trait Anxiety Inventory (STAI), 20-item total.

Additional concerns might arise from employing scales not previously applied in the Romanian population, such as the RASS scale. Not only was the translation endorsed following a Delphi technique, but the CFA did support the original structure of the scale. The scales comprised in the construct of reality reading patterns proved to be less consistent and this issue should be addressed more carefully in the future. In addition, certain recall bias was possibly included in the answers.

Furthermore, this cross-sectional survey of self-reported perceived changes selectively recruited respondents who habitually navigate on the Internet, so the response rate was difficult to estimate, and acceptable rate was also problematic to anticipate or gauge. Moreover, this approach in questionnaire distribution led to a certain bias toward the population favorable toward on-line instruments, and this might have affected their appreciation toward the information and communication technology, thus the inconsistency on the scale of Internet use (it might have been too simplistic for many respondents).

The lack of follow-up imposes limits on the proposed models' external validity. An additional caveat regarding the validity originates in the pronounced gender disequilibrium among the respondents, which presumably reflect the degree of Internet engagement, but would affect the models' cross-gender validity for the rate of suicide completion is greater among males.

CONCLUSION

Suicidality has specific particularities for each country, region, or cultural context and environment, and the results we report bring evidence toward improving the insights into the Romanian population. Suicidality also has a context related inner dynamic, but affective disturbances, history of suicide attempts and self-harm remain the main factors related to suicide risk even in the special context of the COVID-19 pandemic in Romania. The final suicidality construct we developed also related to the COVID-19 lockdown, for this was specifically mentioned in the cover story of the questionnaire.

Our results confirmed anxiety and depression as significant proximal predictors in suicidality. In spite of every effort we made to answer the secondary aims of this study, the issue of quantifying the reality reading patterns' influence on suicidality remains open and must yet be further investigated.

Because suicide has a disastrous impact on the immediate family, it brings trans-generational mental health vulnerability. This investigation contributes to a better understanding of suicidality in a specific context, and may thus serve as a guide for assessing risks and identifying effective interventions.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Pius Brinzeu County Emergency Clinical Hospital, in Timisoara, Romania. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.818712/full#supplementary-material

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ABBREVIATIONS AND NODES IN SEM MODELS

- *Age scale,* age on a 6-group scale of adult age;
- *CES tot*, Center for Epidemiologic Studies Depression Scale (CES-D), 20-item total;
- *Consp theories*, 7-item total of belief in conspiracy theories;
- *ED, Emotional Disturbances*, latent variable describing self-reported fear, anxiety, depression;
- *Edu scale*, level of education on a 5-item scale;
- *Internet use*, 3-item total of Internet use;
- *LTA, Life Threatening Attempts*, latent variable describing suicide-related personal history;
- *RASS 11 self-harm*, 4-point score of RASS 11 ("Have you ever harmed yourself in any way deliberately, during your whole life so far?");
- *RASS 12 suicide*, 4-point score of RASS 12 ("Have you ever attempted suicide, during your whole life so far?");
- *RASS tot*, Risk Assessment Suicidality Scale (RASS), 10-item total;
- *Relig increase*, 4-point score of increase of religious/spiritual inquiries ("Over the last two-three weeks, my religious/spiritual inquiries have been increased.");
- *RRP, Reality Reading Patterns*, latent variable describing personal vulnerabilities related to social and spiritual issues;
- *S, Suicidality*, latent variable describing suicidality;
- *SI change, Suicidal Ideation change*, 5-point score of change in suicidal ideation;
- *STAI tot*, State-Trait Anxiety Inventory (STAI), 20-item total.

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Anxiety and Coping Stress Strategies in Researchers During COVID-19 Pandemic

Patrícia Batista[1,2]*, *Anabela Afonso*[3,4], *Manuel Lopes*[5,6], *César Fonseca*[5,6], *Patrícia Oliveira-Silva*[1], *Anabela Pereira*[7]* and *Lara Pinho*[5,6]*

[1] Universidade Católica Portuguesa, Research Centre for Human Development, Human Neurobehavioral Laboratory, Porto, Portugal, [2] Universidade Católica Portuguesa, CBQF – Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Porto, Portugal, [3] Department of Mathematics, School of Science and Technology, University of Évora, Évora, Portugal, [4] Center for Research in Mathematics and Applications (CIMA), Institute for Advanced Studies and Research, Évora, Portugal, [5] S. João de Deus School of Nursing, University of Évora, Évora, Portugal, [6] Comprehensive Health Research Centre (CHRC), Évora, Portugal, [7] Education and Psychology Department, Campus Universitário de Santiago, University of Aveiro, Aveiro, Portugal

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Edited by:
Pedro Morgado,
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Syed Far Abid Hossain,
International University of Business Agriculture and Technology, Bangladesh

***Correspondence:**
Patrícia Batista
pbatista@ucp.pt
Lara Pinho
lmgp@uevora.pt
Anabela Pereira
anabela.pereira@uevora.pt

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The current COVID-19 pandemic has affected the whole world, leading to changes in one's personal and working life. Researchers have undergone extensive changes in their roles, mainly in the area of health care, with research into the virus now the priority.

Aim: To assess the anxiety, depression, stress, fears, and coping strategies of Portuguese researchers during the COVID-19 pandemic.

Participants and Methods: A total of 243 researchers, with an average age of 37.9 ± 9.6, participated in an online questionnaire. The study was performed between 1 June 2021 and 11 August 2021. The questionnaire included depression, anxiety, and stress (DASS-21), fear of COVID-19 scale (FCV-19S), and coping inventory for stressful situations (CISS).

Results: The findings suggest being female and younger seem to be related to more significant fears. Singles and younger researchers showed higher values of stress, depression, and anxiety. Research areas, such as medical and health sciences, presented higher levels in the DASS-21 depression and stress scale ($p < 0.05$). Also, the results showed a moderate or moderate strong significant positive linear relationship between the scales ($p < 0.001$): DASS-21 stress, DASS-21 anxiety, and DASS-21 depression ($r > 0.70$); CISS-21 emotional-oriented with DASS-21 stress ($r = 0.683$), DASS-21 depression ($r = 0.622$), and DASS-21 anxiety ($r = 0.557$); and emotional fear and cognitive fear ($r = 0.652$).

Conclusion: The findings of this study support the growing concern for the psychological well-being of researchers and the need for intervention with more extensive and diverse studies.

Keywords: COVID-19, researchers, anxiety, depression, stress, fear, coping strategies

INTRODUCTION

In December 2019, new pneumonia caused by a virus (SARS-CoV-2) of the coronavirus family emerged. It is thought to have originated in China, in Wuhan, and quickly spread worldwide (1–3). In March 2020, the World Health Organization (WHO) declared the existence of a pandemic situation. At that time, SARS-CoV-2 was already one of the biggest challenges to world health (2). The increasing number of infections and death related to the COVID-19 disease led to increased concern by health organizations, governments, and society.

These concerns have been substantially exacerbated by extensive media coverage and continuous social media (mis)information, factors that generate fear, anxiety, social panic, and suicide risk (4–6). The need to know more about the disease and the virus, the need for scientific evidence to make decisions, the constant search for strategies, and methodologies to combat the problem have caused science to evolve at an unprecedented pace, namely in the field of vaccine development (7, 8).

At this moment, society renewed recognition of the role of science in fighting the pandemic. Across the world, most governments repeated in most press conferences: "We are following the science" (9). This is one step in the recognition that science/scientific knowledge is necessary for the prevention and search for solutions when we face contemporary challenges. However, the crucial steps are funding/economic investment into research projects and hiring human resources (10–12).

In the most several areas, these professionals who work for science and the increase in knowledge also had to readap not only in personal terms but also at the work level. While some research work can be done at home, such as article writing, scientific research, others require data collection, field presence, laboratory trials, and clinical trials (13). For instance, computational research and review studies about several thematic, such as rethinking psychology and the microbiota-gut-axis (14), may not have been much affected (15). However, much of research within the basic sciences involves laboratory work or clinical research, for example, studies that aimed to evaluate adverse event profiles of drugs in advanced prostate cancer and which require recruitment of participants for evaluation (16), were very much affected because they had to be suspended (15). These are two simple examples of scientific work of extreme importance but using different research methodologies.

Scientists do distinct work ranging from research, planning experiments, collecting and analyzing data, writing papers, writing fundraising proposals, teaching, clinical practice, administrative, and editorial activities. Not surprisingly, many studies have already shown that most of the pandemic-related decisions have magnified disparities among these researchers (13, 17–19). For instance, the research work and the time devoted to it were massively affected during the pandemic. Many researchers had to readapt their schedules and commitments, and in some cases, change their working methods because the access to field/laboratory work was restricted by confinement measures (13, 20–22). Many clinical trials were suspended due to the need for social isolation and multiple research groups felt the need to change their research projects and/or develop new ones, focusing on strategies to respond to the pandemic (13, 20). Teleworking and supporting children and dependents were other necessary readjustments (15, 23–25).

Although the pandemic affected the researchers' work in general, some researchers were more affected than others depending on their research areas, careers, and gender. There are already some publications in this sense, which report that the areas of biological sciences, biochemistry, and chemistry were more affected compared to the areas of mathematics and computer sciences (13). Similarly, studies have shown that early-career researchers (13, 26, 27) were also more conditioned by the pandemic, as well as the female gender (28, 29).

These labor and personal struggles in several areas are factors that increase the level of stress and anxiety and impact mental health significantly. However, few studies have been carried out at the level of this professional class, to understand the impact of the pandemic on the researchers' mental health, with particular emphasis on the anxiety during the lockdown (30).

Several studies have been exploring the anxiety of health professionals (31–35), academics (2, 36, 37), and the general population (38, 39). The levels of depression and anxiety were significantly higher during the outbreak and there was a need to study this topic. However, the concern with researchers is scarce (40–42) and it is urgent to cover this gap. Some studies, just prior to COVID-19, have been reported that researchers present high levels of stress (40, 43, 44). This shows that this problem existed even before COVID-19 and needs to be addressed.

On the other hand, in the attempt to resilience this problem it is necessary to implement adequate prevention or rehabilitation strategies. It is important to know positive and protective strategies to deal with this problem. Several studies have been carried out to develop and/or apply strategies to fill this gap in the population in general and in specific groups, in particular, but once again, the literature is scarce at the level of the researcher group. For example, in health professionals, several strategies were outlined, as include work-hour regulation programs, and the implementation of strategies to reduce the pressure of difficult decision-making (39). Some authors suggest interventions by the employer to improve the mental health of workers, such as providing the development of self-efficacy, resilience, promotion of social support, and guaranteeing quality and safe care (33, 45, 46).

Getting to know researchers better, motivating them, and promoting physical and mental well-being will bring benefits to their health, as well as to their role as researchers, contributing to the increase of scientific knowledge, fundamental for the improvement of the quality of life of our population. Thus, considering the health challenges for this understudied professional group, the aim of this study is to assess the levels of anxiety, depression, stress, fears, and coping strategies in Portuguese researchers during the COVID-19 pandemic. This knowledge is central to the development of intervention plans for these professionals, in the future.

METHODS

Study Design and Participants

The target population was researchers working and living in Portugal. Inclusion criteria were to be a researcher in any scientific area and agree to participate in the online survey. This was a quantitative cross-sectional study that used a convenience sample ($n = 243$) of the Portuguese population recruited *via* e-mail (on professional networks). All participants gave their voluntary and informed consent, which was obtained electronically before recording any data from the participants.

Measures

Data Collection

From 1 June 2021 to 11 August 2021, survey data were collected through an online questionnaire. The survey was constituted of 60 questions that took around 10 min to be completed. The questionnaire covered socio-demographic and professional information (e.g., age, sex, marital status, academic qualifications, research area, and professional activity), health-related data (general health perception and history of COVID-19 diagnosis), depression anxiety stress scale (DASS-21), fear of COVID-19 scale (FCV-19S) and coping inventory for stressful situations (CISS-21). Before the application, the questionnaire was validated by a senior researcher's panel, and then, it was transposed to Qualtrics software for final validation.

The online platform QualtricsTM software (Provo, UT, USA) was chosen because of the facilitation in the distribution and completion of surveys, according to the recommendations imposed on social distance. In addition, only the researchers directly involved in the study could access the data, thereby maintaining the confidentiality of research subjects and research data (47, 48).

This study was approved by the ethical committee, and data confidentiality was ensured by assigning a code to each participant. No identifiable data were collected from the participant.

Depression Anxiety Stress Scale (DASS-21)

The DASS-21 was a scale developed to explore the symptoms of depression, anxiety, and stress. In this study, we used the scale validated for the Portuguese population (49). The DASS-21 instrument comprises 7-item for each subscale. The responses were collected on a 4-point scale of severity/frequency that assesses the extent to which the individual experienced each state in the previous week.

Fear of COVID-19 Scale (FCV-19S)

The FCV-19S was developed with the intent to identify and early intervene, psychologically, in people with high values of fear of COVID-19 (50). Ahorsu et al. (50) have proposed this scale, with 7-items, that assesses distinct physiological reactions of fears related to COVID-19. In this study, we used the Portuguese version of the Coronavirus Anxiety Scale (CAS) (51).

Coping Inventory for Stressful Situations (CISS-21)

The CISS-21 was developed by (52) by a psychometrically valid and reliable self-reporting instrument to identify and assess coping skills (51, 53). There are two versions (21-items and 48-items), but the shorter version has been the most widely used (51, 53). In this specific case, we use the Portuguese version already validated by Pereira and Queirós (54).

Statistical Analysis

Descriptive statistics were used to describe the study sample. The Pearson linear correlation was used to assess the linear correlation between age and scale, as well as between scales. The Shapiro–Wilk test was used to assess normality. The Levene test was used to assess variance homogeneity. The *t*-test was used to assess significant differences in scales by gender or type of contract. The Wilcoxon Mann–Whitney was used when the normality assumption was violated. To compare the scales by marital status or research area, the analysis of variance was used: the *F* test when both normality and homoscedasticity assumptions were verified, the Kruskal–Wallis test when only normality assumption was violated, or the Games–Howell test when the assumption of homogeneity of variances was violated.

Multivariate linear regression analyses were performed using the scores of the questionnaires as dependent variables, and gender, age, marital status, type of contract, and research area as the exploratory variables. These models allowed us to assess associations and check for confounders. It was used the forward

TABLE 1 | Sociodemographic and health characteristics.

Variável	Categorias	*n*	%
Sex	Male	74	30.5
	Female	169	69.5
Marital status	Single	122	50.2
	Non-marital partnership	42	17.3
	Married	68	28.0
	Widower	3	1.2
	Separated/ divorced	8	3.3
Academic Qualifications	Undergraduate	10	4.1
	Master's Degree	110	45.3
	PhD	123	50.6
Type of contract	Research fellow	144	59.3
	Researcher with contract	99	40.7
Research Area	Medical and Health Sciences	27	11.1
	Exact Sciences	18	7.4
	Natural and Agricultural Sciences	82	33.7
	Engineering and Technology	30	12.3
	Social Sciences	53	21.8
	Humanities	16	6.6
	Other	17	7.0
General health perception	Poor/Low	21	8.6
	Good	163	67.1
	Very good	59	24.3
Has been/is infected with COVID-19	No	225	92.6
	Yes	18	7.4

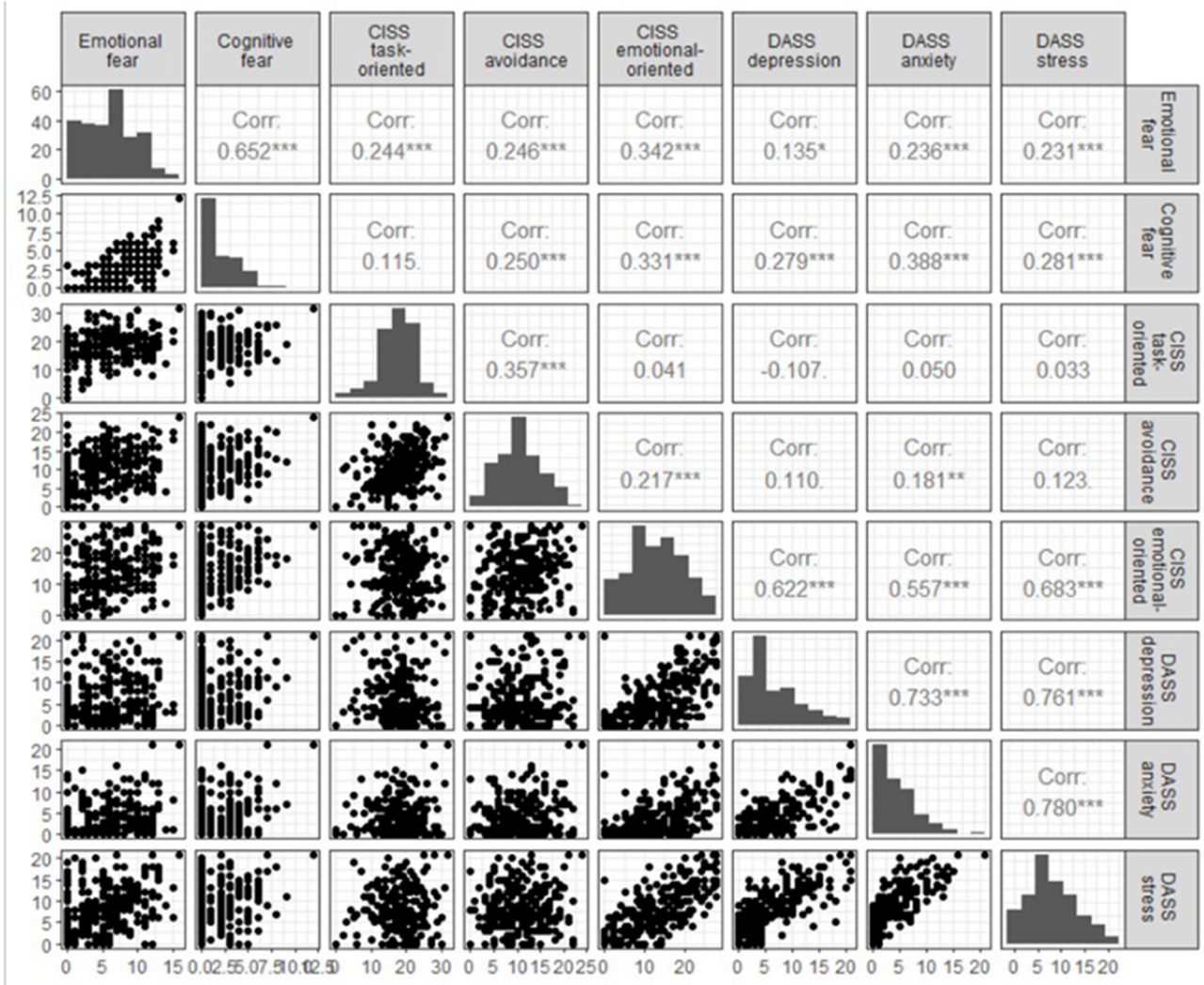

FIGURE 1 | Empirical distribution of scales and Pearson's linear correlation coefficient between the scales $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.001$.

and backward methods to select the variables. Normality and homoscedasticity assumptions were checked.

R program version 4.0.4 (R Core Team, Austria) for Windows was used to perform the statistical analyses. A significance level of 0.05.

RESULTS

Sociodemographic and Health Characteristics

The sample used consisted of 243 participants, 69.5% female. The participants' age ranged between 21 and 72, being an average age of 37.9 ± 9.6 years. When analyzing the professional activity, 40.8% presented a contract with the institution/center of research, 44.1% presented no contract (research fellowship), and 15.2% answered "other situation." The study included participants from various research areas, with the majority being in the "Natural and Agricultural Sciences" (33.7%) and the "Social Sciences" (21.8%).

Most of the participants perceive their health as good (67.1%) and 7.4% have been infected with COVID-19.

Table 1 shows the sociodemographic and health characteristics of the sample.

When the scales selected for this study were analyzed, the low values stand out for the cognitive fear scale [Med = 0, IQR = (0, 3)], DASS-21 depression [Med = 4, IQR = (2, 9)], and DASS-21 anxiety [Med = 3, IQR = (1, 6)] (**Figure 1**). In the CISS-21 task-oriented (18.13 ± 5.67) and CISS-21 avoidance (10.58 ± 5.10) scales, intermediate values predominate. In the CISS-21 emotional-oriented (13.47 ± 7.39), emotional fear (5.95 ± 3.98), and DASS-21 stress (8.16 ± 5.09) scales there is great heterogeneity in the values observed. On the CISS-21 emotional-oriented scale there appears to be a similar frequency of responses across the range of possible values (uniform distribution).

TABLE 2 | Pearson's correlation coefficient (*r*), and *p*-value (*p*), between age and scales.

Scale	R	*P*
Emotional fear	−0.080	0.213
Cognitive fear	−0.171	0.008
DASS-21		
Depression	−0.336	<0.001
Anxiety	−0.374	<0.001
Stress	−0.340	<0.001
CISS-21		
Task-oriented	0.051	0.428
Avoidance	−0.161	0.012
Emotion-oriented	−0.352	<0.001

The results showed a moderate or moderate strong significant positive linear relationship between the scales ($p < 0.001$, **Figure 1**):

- DASS-21 stress, DASS-21 anxiety, and DASS-21 depression (all $r > 0.70$);
- CISS-21 emotional-oriented with DASS-21 stress ($r = 0.683$), DASS-21 depression ($r = 0.622$), and DASS-21 anxiety ($r = 0.557$),
- Emotional fear and cognitive fear ($r = 0.652$).

Analysis of Scale by Sociodemographic Characteristics

The differences between the scales and some variables, such as gender, age, professional activity, and research area, were studied.

Genders

Significant differences were only detected on the emotional fear scale between women and men ($W = 5{,}160$, $p = 0.030$); women [Med = 6, IQR = (3, 9)] had higher values than men [Med = 4.5, IQR = (2, 8)]. In the remaining scales, there were no significant differences between genders ($p > 0.05$).

Age

When age and scales were compared, there was a significant but weak negative linear relationship between age and the scales CISS-21 emotional-oriented, DASS-21 depression, DASS-21 anxiety, and DASS-21 stress (**Table 2**, $p < 0.001$). These data were indicators of the existence of a tendency for the higher values of these scales to be associated with younger researchers and for the lower values of these scales to be associated with older researchers.

The negative linear relationship between age and the cognitive fear and CISS-21 avoidance scales, although significant, is almost insignificant.

Marital Status

For the marital status analysis, the widowed and separated/divorced categories were joined, since there are only three widowers. We detected that cognitive fear, emotional-oriented CISS-21, and all the DASS-21 scales differ significantly between marital status (all $p < 0.05$, **Table 3**). Single people had higher values than married people on all these scales (all $p < 0.05$).

Type of Contract

No significant differences were found on any scale by type of contract of the researchers (all $p > 0.05$).

Research Area

There were significant differences in DASS-21 depression ($p = 0.020$) and DASS-21 stress ($p = 0.042$) scales between research areas (**Figure 2**). Researchers in the medical and health sciences had higher scores than those in the social sciences on the DASS-21 depression scale ($p < 0.1$). The multiple comparisons test did not detect which pairs of research areas significantly differed in the DASS-21 stress scale, but by the graphical analysis, researchers in the social sciences area seem to have lower values than those in other areas.

All the adjusted models for the several scores of the questionnaires allowed us to check the inexistence of confounders in most of the bivariate analyses presented in the previous sections on the emotional fear scale. However, the explanation power of the adjusted models was small (in all, $R^2_{\text{Adj}} < 0.2$). The adjusted models for scores in emotional fear and CISS task-oriented did not fit the data. Older researchers had significantly lower scores in cognitive fear, CISS avoidance, CISS emotional-oriented, DASS depression, DASS anxiety, and DASS stress. The multivariate models revealed that women had significantly lower scores than men only in DASS depression ($b = -0.362$, $p = 0.006$). Also, researchers in exact sciences ($b = -0.811$, $p = 0.021$) and in agriculture and natural sciences ($b = -0.585$, $p = 0.020$) had significantly lower scores in cognitive fear than researchers in medical and health sciences.

DISCUSSION

This study seeks to understand the anxiety, stress, and depression researchers' perception during the pandemic period and the coping strategies that they were developed.

Sociodemographic and Professional Characteristics

Regarding sex, differences are only observed in the emotional fear scale where women have higher values than men. Another author concludes that the higher fear reported by female gender can be explained by their higher sensitivity to stress when compared to the male gender (55). However, in our study, there are no differences in anxiety, stress, and depression between the sexes. These results are not consistent with most studies that report that women have higher levels of stress, anxiety, and depression (33, 55–57). These results may be due to having a sample of only researchers who may have a different response to these variables. It is important to note that regarding gender balance, women

TABLE 3 | Median (1st quartile, 3rd quartile), or mean and standard deviation, for each scale by marital status of the researchers and *p*-value from analysis of variance [(1)parametric ANOVA, (2)Kruskal–Wallis test, (3) Games–Howell test].

Scale	Single	Maried	Non-marital partnership	Separated/divorced/widowed	*p*
Emotional fear	6 (3, 9)	5 (3, 8.25)	5 (3, 10)	5 (3, 7.5)	0.546(2)
Cognitive fear	1^{b} (0, 3)	0^{b} (0, 2)	2^{ab} (0, 3)	0^{ab} (0, 3)	(3)
CISS task-oriented	19 (15, 22)	19 (15.75, 22)	18 (14.25, 21)	17 (16, 19.5)	0.806(2)
CISS avoidance	11.14 (5.21)	10.06 (4.47)	10.17 (5.21)	9.27 (6.84)	0.367(1)
CISS emotional-oriented	15^{b} (9, 20)	10^{a} (7, 15.25)	15^{ab} (9, 19.75)	12^{ab} (5.5, 16)	0.001(2)
DASS depression	6.5^{b} (3, 11)^{a}	3^{a} (1, 5.25)	4^{ab} (2, 9)	4^{ab} (2,5)	0.001(2)
DASS anxiety	4^{b} (1, 6)	3.5^{a} (1, 6.75)	3.5^{ab} (1, 6.75)	0^{a} (0, 3)	0.001(2)
DASS stress	9^{b} (6, 13)	6^{a} (3.75, 8.25)	7^{ab} (6, 11)	4^{a} (3, 8.5)	0.001(2)

Medians or means not sharing superscript letters, in the same row, differ significantly at $p < 0.05$ as indicated by the post-hoc test.

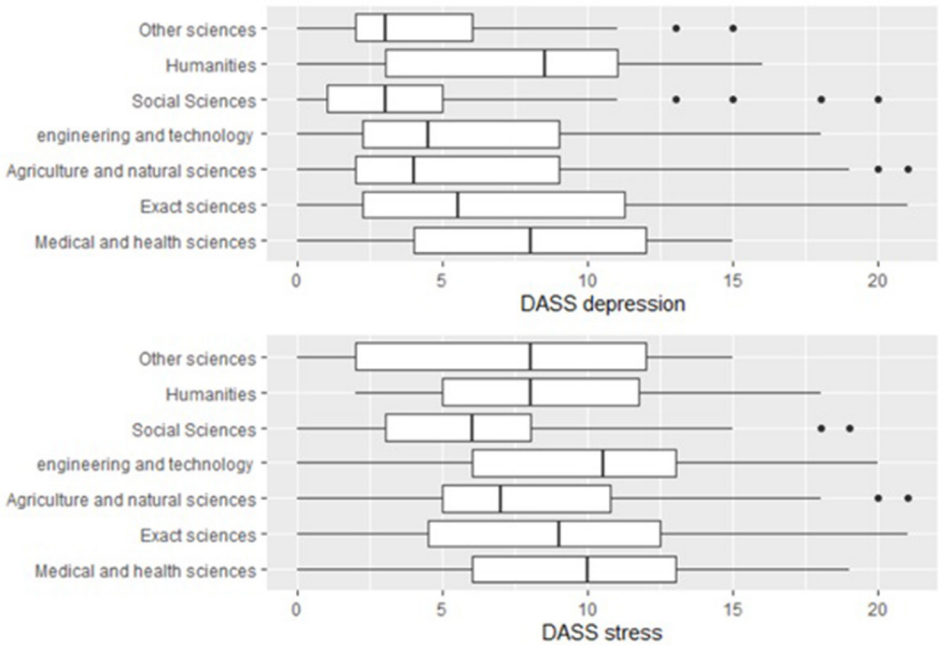

FIGURE 2 | Empirical distribution of DASS-21 depression and DASS-21 stress scales by research area of the researchers.

tend to be overrepresented in this profession as well as among such frontline service workers (58).

Younger researchers showed higher values of stress, depression, anxiety, and fears related to COVID-19 when compared to older researchers. Studies in the general population support these results by confirming that younger age groups are more vulnerable to symptoms of stress, depression, and anxiety (59, 60). As well as, when analyzing the fear toward COVID-19, the older researchers showed lower levels (55). However, it may be that older people may consider that they have little to lose as they have already had relatively long lives and had a stable labor situation. For their part, the younger people are worried about the future consequences and economic challenges caused by the pandemic, as they are the most affected by their employment stability, may watch and listen to much more negative news on social media (2, 61, 62). Nevertheless, additional evidence is needed to examine such speculation.

Single participants had higher scores of stress, depression, and anxiety than those who are married. Other studies have obtained similar results (59). Studies suggested that being married can be a protective factor for stress and anxiety (63).

Researchers in the medical and health sciences have higher levels of depression than those in the social sciences. Although we do not have identical studies with researchers from different fields to compare these results, several studies indicate the high prevalence of stress, anxiety, and depression in health care workers (64). Medical and health sciences researchers have had to change their research projects to give priority to pandemic-related research. Also, being their field, they are

more awake to the pandemic health consequences, so these factors may be contributing to higher levels of depression. Social science researchers also have lower stress scores than researchers from other areas. Perhaps researchers in the social sciences are more prepared for changes in society, since they study social and collective behaviors, and this is the reason for lower stress levels. However, more studies are needed to draw conclusions.

Anxiety, Stress, and Depression

In our study, analyzing the results of the DASS-21, we found that stress is the dominion with the highest mean (8.16 ± 5.09), followed by depression (6.01 ± 5.37), and anxiety (3.88 ± 4.09). These results are like a study in an Indian population with respect to the order of severity of the domains (65). However, the Indian study obtained higher values for the 31 researchers in the sample in all domains: stress (14.71 ± 9.89), depression (10.65 ± 8.72), and anxiety (9.81 ± 6.88).

Coping Stress Strategies

The results showed that there is a significantly positive and moderately linear relationship between the anxiety levels and emotional-oriented coping strategies, i.e., general researchers with low (/high) anxiety values also have low (/high) emotional-oriented coping strategies. However, there is no significant linear relationship between the anxiety levels, and the task-oriented and avoidance coping strategies. These results corroborate another study that showed that depressive symptoms were positively correlated with emotional coping (66). We also verified that the stress levels are significantly positively and moderately linearly related to the emotional-oriented coping strategies, but it is not linearly related to the task-oriented and avoidance coping strategies. The depression levels are significantly related in a positive and moderate linear fashion with the emotional-oriented coping strategies and in a very weak negative linear fashion with the task-oriented coping strategies, but it is not linearly related to the avoidance coping strategies.

The task-oriented coping strategies were not supported but the relationship between the use of the emotional-oriented coping strategies was found. Although some studies report that emotion-focused and problem-focused strategies play role in reducing and increasing mental health (67), the unexpected event of COVID-19 pandemic can be may have triggered a more intense emotional response, indicating the need for further studies on this pandemic. But, their use can be inappropriate (66).

In this study, we did not find the results shown in other studies that showed that people that experienced psychological distress who used more task coping strategies experienced low levels of depression, anxiety, and stress (68).

The cognitive and emotional fears of COVID-19 pandemic situations also influence coping strategies or defensive mechanisms (69). In Huang and collaborators' study, it was found that fears were significantly positively related to problem-focused coping and emotion-focused coping. Therefore, the more problem-focused coping, the more fear (46). When analyzing the FCV-19S scale the data by emotional fear scale showed significantly related in a very weak positive linear way with CISS-21 emotional-oriented, task-oriented, and avoidance domains. On the order hand, the cognitive fear scale is significantly related in a very weak positive linear fashion to the emotional-oriented and avoidance coping strategies. There is no significant linear relationship between cognitive fear and task-oriented coping strategies.

Limitations

This study presents some limitations, such as the cross-sectional nature of the study, which conditioned the monitoring of the effects and strategies adopted. Longitudinal studies are needed. Also, the methodology adopted, an online survey, may contribute to non-response bias in the study results. On the other hand, we do not know how many researchers there are in Portugal, because there are several contracting modalities, and many researchers are not in the career and presenting research grants (without contractual ties). So, it was not possible to calculate the sample size to ensure that the sample was representative.

CONCLUSION

The findings of this study support the growing concern for the psychological well-being of researchers and the need for intervention. Being a female seems to be related to greater fears. Research areas, such as medical and health sciences, presented higher depression and stress levels. Also, significant differences were found between depression and emotional-oriented coping strategies, and the type of contract. The anxiety, depression, and stress levels were significantly related positively to emotional-oriented coping strategies.

This study intended to assess the levels of anxiety, depression, stress, fears, and coping strategies in Portuguese researchers during the COVID-19 pandemic. There is a gap in the literature in terms of scientific studies on these professionals, and this knowledge is central to the development of intervention plans for these professionals, in the future. However, this study suggests more extensive and diverse studies on the improvement of mental health and the reduction of anxiety/depression and stress in researchers. It is fundamental to investigate and intervene to promote the health of these professionals and their work performance, highlighting the importance of coping strategies. It is important to prioritize essential competencies, set goals, and coping strategies that increase health and performance.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Comissão de Ética da Universidade de Évora. The patients/participants

provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

PB, LP, and AP were responsible for the concept and design of the study, interpretation of results, writing, and critical review of the manuscript. PB and LP were responsible for data collection and analysis and writing—the original draft. PB, LP, and CF were responsible for the interpretation of the results. AA was responsible for statistical analysis. AP, PO-S, and ML were responsible for writing, reviewing, and editing the manuscript. All authors contributed to the article and approved the submitted version.

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Investigating Frontline Nurse Stress: Perceptions of Job Demands, Organizational Support, and Social Support During the Current COVID-19 Pandemic

Haneen Ali[1]*, *Yasin Fatemi*[2], *Duha Ali*[2], *Mohammad Hamasha*[3] and *Sa'd Hamasha*[1]

[1] Department of Industrial and Systems Engineering and Health Services Administration Program, Auburn University, Auburn, AL, United States, [2] Department of Industrial and Systems Engineering, Auburn University, Auburn, AL, United States, [3] Department of Industrial Engineering, Faculty of Engineering, The Hashemite University, Zarqa, Jordan

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Edited by:
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National Hospital Organization Kyoto Medical Center, Japan

***Correspondence:**
Haneen Ali
hba0007@auburn.edu

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Background: While frontline nurses employ coping alternatives to help deal with occupational stress resulting from unprecedented challenges during the COVID-19 pandemic, their access to necessary resources is unclear.

Objective: This study aims to explore nurses' mental health in Alabama hospitals during the COVID-19 outbreak and investigate the impact of organizational and community support on nurse stressor levels, physio-psychosocial responses, and coping strategies employed.

Methods: A cross-sectional survey was developed to bridge our understanding of stress, support, and coping mechanisms and distributed to nurses working with COVID-19-infected patients in hospital settings in Alabama. A total of 232 frontline nurses responded to 79 items in four domains (stressors, physio-psychosocial symptoms, coping, and support) between May 6, 2020, and June 30, 2020. A two-way ANOVA, regression analysis, and mediation of effects were used to analyze the data.

Results: This study found that both social support and use of coping strategies contributed to the reduction of physio-psychosocial symptoms. Differences were found in how older frontline nurses perceived the efficacy of social support and certain coping strategies. This study provides further evidence of the importance of organizational support in addressing the harmful physio-psychosocial symptoms experienced by nurses.

Keywords: nursing staff, COVID-19, supervisor support, social support, coping strategies

CONTRIBUTION OF THE PAPER

What Is Already Known

- The COVID-19 pandemic has impacted the health and psychological wellbeing of nursing staff working with infected patients.
- While additional support is crucial during pandemics, little is known about the impact of organizational resources and supervisor and community support on nurses' stress levels, physio-psychosocial responses, and coping strategies.

What This Paper Adds

- An understanding of nursing staff stressors, resulting physio-psychosocial symptoms, and coping mechanisms employed.
- An understanding of the impact of social support and coping support on the reduction of physio-psychosocial symptoms.
- A better understanding of how the generational context affects nurses' perceptions of various approaches and levels of support.

BACKGROUND

Frontline Nurse Challenges

As of August 21, 2021, the number of COVID-19 cases in the United States had reached over 37 million confirmed cases and over 625,000 deaths, with more than 788,000 healthcare professionals infected, and more than 3,000 dead (1). The COVID-19 pandemic has significantly impacted healthcare professionals' psychological health (2–4). Evidence suggests that during the pandemic, nurses struggle with psychological problems and suffer adverse mental and emotional symptoms, such as depression and stress (2, 5, 6). Previous studies reported sources of stressors and the emotions of nursing staff resulting from the pandemic (2, 7–9), others reported the psychosocial impact and coping strategies employed by nurses (2, 6, 9, 10). Other studies reported the effects of work stress on nursing staff burnout (8, 11–15). However, only few studies investigated the effects of organizational and community support in addressing the adverse psychological effects of COVID-19, and its relationship to the coping strategies deployed by the nursing staff (16–19).

The pandemic in Alabama provides frontline nurses with challenges, not only due to a greater workload from infections, but also additional adverse psychological effects that local hospitals may be ill equipped to address (2, 20, 21). Failure to address these problems could negatively impact healthcare workers and cause short- and long-term psychological injuries (22, 23).

Support from workplaces, friends, family, and colleagues could balance and sustain this emotional stress and provide nursing staff with coping mechanisms that safeguard their wellbeing and mental health (6, 24). Organizational resources are designed to help reduce uncertainty caused by shortages, such as personal protective equipment (PPE), ventilators, medical countermeasures, and health care providers (2, 20, 25). Organizational support is meant to reducing mental and psychological health deterioration resulting from the pandemic. Organizational support can involve providing mental health resources and a clear flow of information, which can alleviate uncertainty and fear (26, 27). Studies suggest that nurses' fears and anxiety symptoms could be addressed through strong, clear communication with nursing staff and regular updates on the COVID-19 outbreak (2, 20, 25). Studies have also found that nurses tend to feel more emotionally exhausted when they do not receive adequate supervisory support (2, 20, 28). Supervisor support plays a crucial role in reducing frontline nurse stress resulting from working in a hectic environment, which may lead to emotional exhaustion and can affect their health and wellbeing (2, 20, 29).

Social support from family and friends can reduce emotional exhaustion and stress and protect against physio-psychosocial symptoms (9, 30). It has been reported that social relationships and support from friends have a mediating effect on stress and physio-psychosocial symptoms, and can help mitigate the stress and anxiety from working as a frontline nurse (2, 5, 20, 24, 30, 31). Social support is reported to help nurses by allowing them to relate personal experiences to each other (2). This interpersonal and self-affirming aspect of social support may help explain how nurses in Alabama use transference as a coping strategy, despite never using psychological counseling (2). Organizational and social support could reduce occupational stress and improve psychological wellbeing by providing a protective layer against anxiety, stress, and depression, and impact the coping mechanisms employed by nursing staff (5, 20, 30).

Stress-Symptom-Support-Coping Framework

Figure 1 illustrates this study's proposed framework, which examines a diverse array of coping mechanisms and the resulting approach nurses take to address sources of stress and physio-psychosocial symptoms. Coping mechanisms are not considered positive or negative, but rather "effective" or "ineffective" at reducing the psychosocial symptoms and stressors experienced by the nurse (32). Scholars familiar with stress and coping studies will note the similarities to studies by researchers such as Folkman et al. (33), specifically the concept that organizational support can theoretically influence other domains simultaneously (24, 34, 35). These models suggest that the psychosocial symptoms and stressors experienced by nurses, mediated by organizational support, influence how nurses cope with their stress. As coping mechanisms are effectively a nurse's sense-making process when working in a stressful environment, this model relates stress appraisal as an ongoing process that connects stressors and symptoms to appropriate coping mechanisms. Because nurses can anticipate the impact of stressful experiences based on previous experiences, the model considers how nurses pursue coping strategies before experiencing physio-psychosocial symptoms.

This paper seeks to bridge our understanding of stress, support, and coping mechanisms by examining frontline nurses in Alabama (2, 10, 20, 33). It aims to explore nurses' mental health in Alabama hospitals during the COVID-19 outbreak and the impact of organizational and social support on

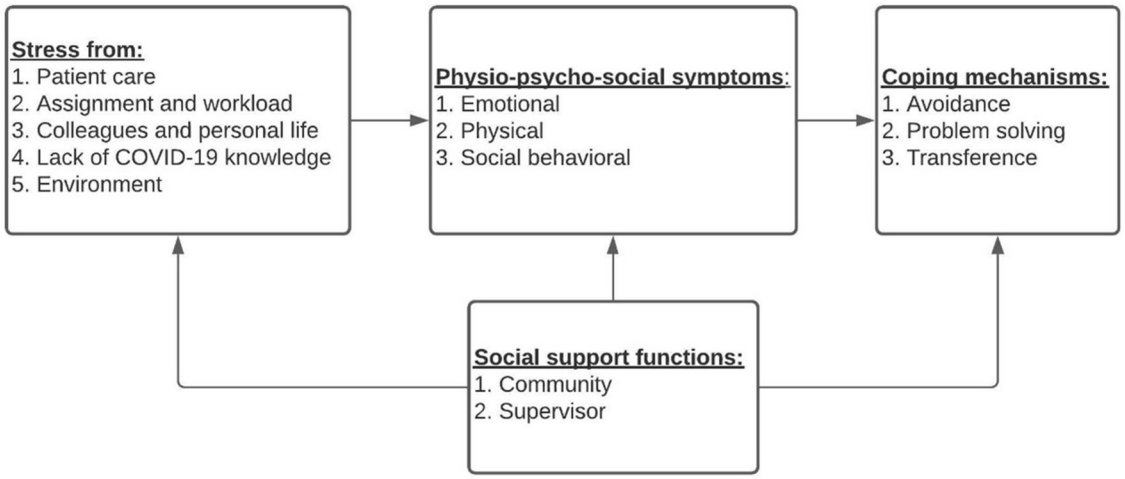

FIGURE 1 | Stress-symptom-support-coping framework for frontline nurses during the COVID-19 pandemic.

nurse stress levels, physio-psychosocial responses, and coping strategies employed.

METHODS

A cross-sectional survey was developed and distributed to nurses working with COVID-19-infected patients in hospital settings in Alabama. A total of 232 frontline nurses responded over the period of May 6, 2020–June 30, 2020. Nurses were invited to participate through information posted about the study on social media platforms, such as LinkedIn, and by encouraging nurses to share information about the study. An online link to the survey was shared with nurses who showed interest. The study's inclusion criteria specified only Alabama nurses working directly with COVID-19 patients in the 3 months prior to the data collection start date.

Ethical Considerations

This study was approved by the Ethics Committee of XX University in accordance with the Declaration of Helsinki (IRB protocol reference: 20–238 EX 2005). Participants were notified about the aims of the project and the risks that might be associated with the survey on the first page, and a consent form was provided. Participants were notified that no identifiable information would be collected, and they agreed to participate in the study by completing the survey, and participants were compensated for their time if they choose to continue and take the survey ($20).

Questionnaire Development

Principal items were developed based on a questionnaire designed by Lee et al. (36) to investigate medical staff during the 2003 SARS epidemic. Further, pandemic-specific questions were taken from an instrument by Cai et al. (37) that was used to examine frontline nurses in China. Finally, the questionnaire is a continuation of instruments created by Ali et al. (2) and Cole et al. (20), who investigated major psychological stressors and organizational resources that impact the stress and turnover intentions of frontline nurses in Alabama.

A total of 79 items were developed for the four domains: stressors, physio-psychosocial symptoms, coping, and support, see **Figure 1**. This list of questions was distributed to a group of experts in the field with research experience (four ICU nurses, two general nurses, two nursing faculty, one public health expert, and two nurse managers). After 1 week, a virtual focus session was conducted with a group of experts to discuss the preliminary list of items. In response to the experts' feedback, the social support items were revised for clarity.

The questionnaire instrument included *demographic and work-related questions* (9 items). *Stress from working as a frontline nurse* was captured using 29 items divided into five constructs: stress from taking care of patients, stress from assignments and workload, stress from colleagues and personal life, stress from a lack of knowledge about COVID-19, and stress from the environment. *Frontline nurse perceptions of physio-psychosocial symptoms* were captured using 15 items divided into three constructs: emotional symptoms, physical symptoms, and social behavioral symptoms. *Nurse perceptions of social support* was captured using 14 items divided into two constructs: community/social support and supervisor support. Finally, *coping strategies employed by nurses* were captured using 12 items divided into three constructs: avoidance, problem solving, and transference. The perception items were measured on a five-point Likert scale (from strongly disagree to strongly agree). A questionnaire template is provided in this study.

The survey instrument was pilot tested with 15 nurses working in local nurses who were invited through personal connections. Reliability was assessed using Cronbach's alpha, which reflects the interrelatedness among the items in each construct. A Cronbach's alpha of the constructs' values was within the acceptable range ($\alpha > 0.70$; see **Table 2**).

Operationalization of Domain Constructs

Stressors

Stress From Taking Care of Patients

Stress related to taking care of COVID-19 patients is well documented (2, 20, 24, 37). These questions are designed to capture aspects of stress resulting from working directly with patients infected with COVID-19.

Stress From Assignments and Workload

The COVID-19 pandemic requires nurses to provide various levels of healthcare to highly infectious patients. These assignments and tasks may not directly involve COVID-19, but are certainly impeded by the social distancing requirements and patient acuity resulting from the patient's infection (2, 20, 24, 37). This construct is used to capture the stress resulting specifically from patient assignment and the resulting workload.

Stress From Colleagues and Personal Life

Frontline nurses are not only afraid of working with COVID-19 patients, they are also afraid of getting their colleagues infected (2, 20, 24, 37). These questions are used to assess stress related to the fear of COVID-19 infections that negatively impact their colleagues and personal lives.

Stress From a Lack of Knowledge About COVID-19

Specific factors can exacerbate the difficulty of providing treatment (2, 20). However, due to the lack of information during the initial months of the pandemic, nurses experienced periods of time when information was scarce, healthcare standards were rapidly changing, and media coverage provided pessimistic outlooks on health capacity (2, 20). Questions related to this construct were designed to capture the uncertainty nurses felt in relation to stress from a lack of knowledge during the pandemic.

Stress From the Environment

Constant media coverage of certain topics, such as PPE shortages and ventilator shortages, may cause nurses to feel more anxious about their next or current shift (2, 20, 24). Items related to this construct were designed to capture the stress caused by nurses who perceived gaps in their work environments.

Physio-Psychosocial Symptoms

Emotional Symptoms

The fear, anxiety, and stress reported by nurses during the pandemic have been well documented (2, 20). This construct was designed to capture the mental and emotional experiences of working as a frontline nurse during the pandemic.

Physical Symptoms

Studies related to nurse occupational stress suggest that high levels of stress can cause adverse physical symptoms (2, 20). Intense anxiety, insomnia, poor diet, and headaches can all be triggered or exacerbated by stressful experiences related to working during the pandemic (2, 20, 24, 37). This construct was designed to capture the adverse physical symptoms reported by frontline nurses.

Social Behavioral Symptoms

Due to the social distancing requirements of the COVID-19 pandemic, there is both public and professional pressure to avoid becoming infected. This causes nurses to fear becoming infected, as they might pass on the virus by working as an asymptomatic carrier (2, 20, 24, 37). This construct was designed to capture the perception of adverse social conditions while working as a frontline nurse.

Support

Supervisor Support

Supervisor support is defined as the informal support and professional guidance frontline nurses receive from their supervisors to cope with stressful situations (38). This construct was designed to capture the extent to which supervisor support contributes to the reduction of stress and physio-psychosocial symptoms.

Community Support

Community support is defined as the organized or informal support received by frontline nurses from family members, friends, neighbors, religious organizations, community programs, cultural and ethnic organizations, and other support groups or organizations outside their workplace (24). This construct is used to measure the extent to which frontline nurses rely on social support from outside the hospital to mitigate physio-psychosocial symptoms.

Coping

Avoidance

Avoidance refers to a coping strategy used by frontline nurses to distance themselves from the source of their stress (2, 6, 24, 31, 33, 35, 39). Avoidance is used to measure the extent to which frontline nurses attempt to avoid rather than engage with their sources of stress.

Problem Solving

Problem solving refers to the coping strategy that involves frontline nurses engaging in a series of deductive steps to understand how to address and mitigate the source of their stress (2, 6, 24, 31, 33, 35, 39). Problem solving is used to measure the extent to which frontline nurses attempt to "figure out" and address their stress as a coping strategy.

Transference

Transference refers to a coping strategy that involves frontline nurses engaging in interpersonal communication with a professional therapist (2, 6, 24, 31, 33, 35, 39). Transference is used to measure the extent to which frontline nurses attempt to seek psychological therapy to address their stress as a coping strategy.

RESULTS

The statistical analysis included descriptive statistics of the demographic factors examined in the survey. Next, a two-way ANOVA, Pearson's correlations of the constructs, and regression analysis were used to analyze the domains and constructs.

Finally, the direct and indirect effects of the domains tested were analyzed to determine the influences of social support and coping mechanisms on occupational stress and associated physio-psychosocial symptoms.

Descriptive Statistics of Demographic Variables

Table 1 provides the descriptive statistics of the demographic variables. The results show that respondents were relatively young, with 43.5% ($n = 101$) under 30 years old. They suggest that slightly over half 50.9% ($n = 118$) of nurses were less experienced while 10.8% ($n = 25$) were senior. Further, there is a roughly even proportion of married nurses at 47.0% ($n = 109$) compared to the 44.8% ($n = 104$) who have never married. It should be noted that 68.1% ($n = 158$) of our respondents had at least one child, while roughly 31.9% ($n = 78$) had no child. Overall, most nurse respondents were female 90.9% ($n = 211$). Lastly, a third of the nurse respondents specialized as general nurses (30.6%; $n = 71$), making up the largest single specialization in the sample.

TABLE 1 | Descriptive statistics.

	Respondents	Percent ($N = 232$)
Age		
1 = < 30	101	43.5
2 = > 30	48	20.7
3 = > 40	29	12.5
4 = > 50	54	23.3
SD	1.21	
Gender		
1 = M	21	9.1
2 = F	211	90.9
SD	0.288	
Ethnicity		
1= White	211	90.9
2 = African American (non-Hispanic)	21	9.1
SD	0.288	
Marital status		
1 = Married	109	47
2 = Divorced	19	8.2
3 = Single (never married)	104	44.8
SD	1.92	
Have children?		
1 = No	158	68.1
2 = Yes	78	31.9
SD	0.467	
Seniority		
1 = < 10 years of experience	118	50.9
2 = > 10 years of experience	89	38.4
3 = > 15 years of experience	25	10.8
SD	0.677	
Specialty		
1 = General nurse	71	30.6
2 = ICU	64	27.6
3 = OR	35	15.1
4 = ER	30	12.9
5 = Other	32	13.8
SD	1.399	
Shift		
1 = Morning	158	68.1
2 = Evening	74	31.9
SD	0.467	

ANOVA: Analysis of Demographic Variables and Constructs

Appendix 1 (see Section 1) provides the results of the two-way ANOVA between the demographic variables and the domain constructs.

Stressors

Stress From Taking Care of Patients

The analysis of variance between the demographic variables and stress from taking care of patients showed that gender ($p < 0.01$), having children ($p < 0.01$), and specialty ($p < 0.01$) were all statistically significant predictors of patient care-related stress for frontline nurses. Nurses between the ages 41–50 ($p < 0.01$) and nurses with over 10 years of experience showed significantly lower stress levels ($p < 0.05$). In general, more than 65% of the nursing staff reported high stress levels due to taking care of patients infected with COVID-19.

Stress From Assignments and Workload

Gender ($p < 0.01$), marital status ($p < 0.01$), and specialty ($p < 0.05$) all demonstrated significant relationships with stress from assignments and workload. Nurses aged 31–40 ($p < 0.01$), nurses aged 30 and younger ($p < 0.01$) and nurses who had no children reported significantly higher stress levels ($p < 0.05$). Nurses with more than 10 years of experience showed significantly lower mean stress levels ($p < 0.05$), and more than 80% of respondents reported high stress levels due to assignments or workload in general.

Stress From Colleagues, Staff, and Personal Life

It was found that marital status ($p < 0.01$), having children ($p < 0.01$), and specialty ($p < 0.05$) were all significantly related to stress from colleagues, staff, and personal life. Female respondents showed significantly higher mean stress levels ($p < 0.01$). Nurses aged 50 and older ($p < 0.01$) and nurses with over 10 years of experience reported lower stress levels ($p < 0.01$). Overall, around 70% of respondents reported higher stress (>3) resulting from worry or concern about colleagues or family members.

Stress From a Lack of Knowledge About COVID-19

It was found that gender ($p < 0.01$), seniority ($p < 0.01$), and specialty ($p < 0.01$) were all significantly related to stress from a lack of knowledge about COVID-19. Nurses that were never married reported significantly higher mean stress levels ($p < 0.01$). Nurses aged 41–50 reported significantly lower mean stress levels ($p < 0.01$). Overall, around 70% of nurses in the study reported stress levels higher than 3 on the Likert scale.

Stress From the Environment

It was found that seniority ($p < 0.01$), and specialty ($p < 0.01$) were statistically significant predictors of stress from the environment. Female nurses showed significantly higher stress levels than their male counterparts ($p < 0.01$). Nurses aged 50 and older ($p < 0.01$), as well as married nurses ($p < 0.01$), reported significantly lower stress levels. Around 77% of nurses in the study reported a high level of stress resulting from their environment.

Physio-Psychosocial Symptoms

Emotional Symptoms

The analysis of variance between the demographic variables and emotional symptoms showed that gender ($p < 0.01$), marital status ($p < 0.01$), seniority ($p < 0.01$), specialty ($p < 0.01$), and shift ($p < 0.05$) were all statistically significant characteristics of frontline nurses. Nurses aged 50 and older reported significantly lower emotional symptoms ($p < 0.01$).

Physical Symptoms

It was found that age ($p < 0.01$), seniority ($p < 0.01$), specialty ($p < 0.01$), and shift ($p < 0.05$) were all related to physical symptoms. Female nurses (3.33, $p < 0.01$) and nurses who were never married (3.46, $p < 0.01$) reported significantly higher mean physical symptom levels.

Social Behavioral Symptoms

It was found that marital status ($p < 0.01$), seniority ($p < 0.01$), and specialty ($p < 0.01$) were all related to frontline nurse social behavioral symptoms. Nurses aged 50 and older reported significantly lower mean social behavioral symptoms ($p < 0.05$). Nurses aged 31–40 years ($p < 0.05$) and female nurses reported significantly higher mean social behavioral symptom levels ($p < 0.01$).

Coping

Avoidance

The analysis of variance between the demographic variables and avoidance as a coping strategy showed that gender ($p < 0.01$) and specialty ($p < 0.01$) were significant predictors. Nurses aged 50 and older reported significantly lower mean avoidance usage (0.35, $p < 0.01$).

Problem Solving

It was found that specialty ($p < 0.01$) was significantly related to frontline nurses' tendency to use problem solving as a coping strategy. Nurses aged 31–40 ($p < 0.01$), respondents who had never been married ($p < 0.01$), and female respondents ($p < 0.01$) showed significantly higher mean problem-solving usage.

Transference

It was found that age ($p < 0.05$), marital status ($p < 0.05$), specialty ($p < 0.05$) having children ($p < 0.05$), and shift ($p < 0.05$) were all statistically significant predictors of frontline nurses' tendency to use transference as a coping strategy. Nurses with over 10 years of experience reported significantly lower mean transference usage ($p < 0.01$).

Support

Supervisor Support

The analysis of variance between the demographic variables and supervisor support found that specialty ($p < 0.05$) was a statistically significant predictor of frontline nurses' supervisor support. Nurses aged 30 and younger ($p < 0.01$) and nurses with morning shifts reported significantly higher mean levels of supervisor support ($p < 0.05$). Respondents that had been divorced showed significantly lower mean levels of supervisor support ($p < 0.05$). Overall, only 37% of the respondents reported receiving support from their supervisors.

Community Support

It was found that specialty ($p < 0.05$) and shift ($p < 0.05$) were statistically significant predictors of reliance on community support. Nurses aged 50 and older ($p < 0.01$), and nurses who had been divorced showed higher levels of community support ($p < 0.05$). Nurse respondents with more than 10 years of experience reported significantly lower mean levels of community support ($p < 0.01$). In general, around 44% of nurses reported a high level of community support.

ANOVA: Analysis of Demographic Variables and Domains

Appendix 1 (see Section 2) provides the results of the two-way ANOVA between the demographic variables and domain scores.

Stressors Domain

The analysis of variance between the demographic variables and the stressors domain showed that gender ($p < 0.01$), marital status ($p < 0.01$), and specialty ($p < 0.01$), were all statistically significant predictors of stress for frontline nurses. Nurses aged 41–50 ($p < 0.01$), nurses aged 50 and older ($p < 0.01$), and nurses with more than 10 years of experience reported significantly lower levels of stress ($p < 0.01$).

Physio-Psychosocial Symptoms Domain

It was found that specialty ($p < 0.01$), and shift ($p < 0.05$), were all statistically significant predictors of frontline nurse physio-psychosocial symptoms. Nurses aged 50 and older ($p < 0.01$), nurses who had been divorced ($p < 0.01$), and nurses with over 10 years of experience ($p < 0.01$) reported significantly lower mean levels of physio-psychosocial symptoms.

Coping Domain

It was found that specialty ($p < 0.01$), and shift ($p < 0.05$), were statistically significant predictors of frontline nurse coping habits. Nurses aged 31–40 ($p < 0.01$) and female respondents ($p < 0.01$) reported significantly higher mean use of coping strategies. Nurses that were divorced ($p < 0.01$) and nurses with over 10 years of experience reported significantly lower mean coping strategy usage ($p < 0.01$).

Support Domain

It was found that nurses aged 31–40 ($p < 0.01$) and nurses with over 10 years of experience showed significantly lower mean levels of support ($p < 0.05$). Nurses who had never married reported significantly higher mean levels of support ($p < 0.01$).

TABLE 2 | Pearson correlations between domain constructs.

		M	SD	∞	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Stress from patients	3.27	0.92	0.732	1												
2	Stress from workload	3.63	0.66	0.81	0.656**	1											
3	Stress from personal life	3.53	0.89	0.769	0.644**	0.715**	1										
4	Stress from lack of knowledge	3.53	0.82	0.856	0.692**	0.655**	0.575**	1									
5	Stress from environment	3.62	0.83	0.782	0.590**	0.596**	0.686**	0.653**	1								
6	Emotional symptoms	2.7	0.95	0.887	0.515**	0.514**	0.522**	0.613**	0.573**	1							
7	Physical symptoms	3.31	0.76	0.708	0.502**	0.376**	0.552**	0.465**	0.560**	0.655**	1						
8	Social behavioral symptoms	2.41	0.96	0.774	0.427**	0.395**	0.472**	0.336**	0.544**	0.508**	0.507**	1					
9	Supervisor support	2.71	0.75	0.76	0.05	0.121	0.064	0.035	0.082	−0.065	−0.117	−0.092	1				
10	community support	2.8	0.64	0.794	−0.008	0.029	−0.197**	0.006	−0.067	−0.11	−0.166*	−0.152*	−0.017	1			
11	Coping strategy avoidance	1.03	0.94	0.78	0.258**	0.348**	0.428**	0.295**	0.397**	0.248**	0.119	0.262**	−0.029	−0.059	1		
12	Coping strategy problem solving	2.67	1.34	0.699	0.433**	0.333**	0.428**	0.606**	0.606**	0.450**	0.424**	0.424**	0.028	−0.130*	0.389**	1	
13	Coping strategy transference	1.84	0.74	0.72	0.009	0.085	0.078	0.007	−0.165*	0.133*	0.161*	0.138*	−0.042	−0.109	0.013	0.016	1

*M, Mean; SD, Standard deviation; α, Cronbach's Alpha reliability. *p < 0.05 and **p < 0.01.*

Correlation Analysis

Pearson correlations were checked (**Table 2**) to investigate the correlations between this study's domain constructs. With the largest correlation coefficient, stress from nurses' personal lives correlated significantly and positively with stress from task workload ($r_{(4)} = 0.715$, $p < 0.001$). Stress from a lack of knowledge correlated significantly and positively with stress from workload ($r_{(4)} = 0.692$, $p < 0.001$). Stress from the environment correlated strongly and positively with stress from personal life ($r_{(4)} = 0.686$, $p < 0.001$), stress from patients correlated significantly and positively with stress from workload ($r_{(4)} = 0.656$, $p < 0.001$), and stress from lack of knowledge correlated significantly and positively with stress from workload ($r_{(4)} = 0.655$, $p < 0.001$).

Regression Analysis of Demographic Variables and Domains

Appendix 1 (see Section 3) provides the regression analyses of demographic variables and domain scores.

Stressors Domain

Age was found to be statistically significant in two ways: stress was highest among nurses aged 31–40 years old ($p < 0.01$) and lowest among nurses aged 41–50 years old ($p < 0.05$). Being female corresponded to a significant increase in stress, by almost a whole unit ($p < 0.01$). Respondents who reported being divorced had significantly lower stress ($p < 0.01$), while never having married corresponded with high stress ($p < 0.01$). Nurses with more than 10 years of work experience reported higher stress ($p < 0.01$), and lower stress levels were reported by nurses who worked in the operating room ($p < 0.05$), emergency room ($p < 0.05$), and other ($p < 0.01$).

Physio-Psychosocial Symptoms Domain

Physical and psychosocial symptoms were higher among nurses aged 31–40 years old ($p < 0.01$) and lower among nurses aged 41–50 years old ($p < 0.05$). Being female corresponded to significantly higher (more than one unit) symptoms ($p < 0.01$). Divorced nurses reported less symptoms ($p < 0.01$). Nurses who had more than 10 years of work experience reported more symptoms ($p < 0.01$), while those with <15 years of experience had lower symptoms ($p < 0.01$). Nurses working in operating rooms ($p < 0.01$), and "other" specialties ($p < 0.01$) had significantly lower symptoms, and working the night shift was related to higher physio-psychosocial symptoms ($p < 0.05$).

Coping Domain

Around 67% of nurses reported using at least one avoidance coping mechanism, 84% reported using problem-solving coping techniques, and 95% reported a form of transference coping mechanism. However, no one of the respondents reported seeking help from a psychologist as a coping mechanism. Nurses working in operating rooms ($p < 0.05$), emergency rooms ($p < 0.05$), and other ($p < 0.01$) reported lower use of coping strategies, as did nurses working on the night shift ($p < 0.05$). Being female corresponded to a significantly higher (more than one unit) usage of coping strategies ($p < 0.01$), as did being African American ($p < 0.01$). Being divorced corresponded with significantly lower use of coping strategies ($p < 0.01$). Overall, single (never married) nurses reported a significant and higher use of coping mechanisms ($p < 0.01$), and more problem solving coping.

Social Support Domain

The perceived importance of social support was lower among nurses aged 31–40 ($p < 0.01$) and higher among nurses aged 41–50 ($p < 0.05$). Nurses with more than 15 years of work had significantly and married nurses reported significantly higher social support ($p < 0.05$).

Mediational Analyses

Table 3 reports the results for the direct and indirect effects of support on nurses' coping strategies. **Figure 2** provides an illustration of the framework in light of the empirical results.

TABLE 3 | Bootstrapping results for the direct and indirect effect of domains.

Direct effect	*coeff*	*se*	*t*	*p*-value	*LLCI*	*ULCI*
Support→Stressor	0.0298	0.0935	0.3183	0.7505	−0.1544	0.2140
Support→Symptoms*	−0.3140	0.0691	−4.5457	<0.001	−0.4501	−0.1779
Stressor→Symptoms*	0.7480	0.0487	15.3569	<0.001	0.6520	0.8439
Support→Coping	−0.3104	0.2344	−1.3242	0.1868	−0.7724	0.1515
Symptoms→Coping*	0.5918	0.2148	2.7550	0.0063	0.1685	1.0150
Stressor→Coping*	1.2207	0.2256	5.4117	<0.001	0.7762	1.6651

Level of confidence for all confidence intervals in output: 95%.

Indirect effect	*Effect*	*BootSE*	*BootLLCI*	*BootULCI*
Support→Stressor→Coping	0.0363	0.1186	−0.1917	0.2766
Support→ Symptoms→Coping*	−0.1858	0.0693	−0.3302	−0.0601
Support→Stressor→ Symptoms→ Coping	0.0132	0.0451	−0.0827	0.1032

*N = 232; LL, Lowe limit; UL, Upper limit; *p < 0.05.*

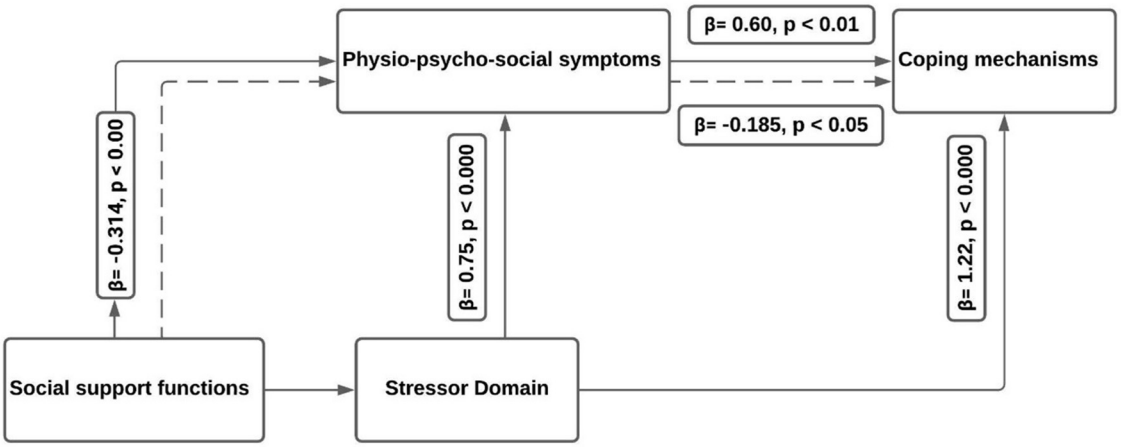

FIGURE 2 | Revised framework for frontline nurse stress, symptom, support, and coping.

Direct Effect

This analysis shows the direct relationship between independent and dependent variables. **Table 3** shows that there is no direct effect between the independent variable (support) and dependent variable (coping strategies) ($P = 0.1868$). In other words, the "c" coefficient is not statistically significant. It also reports that the direct effect between support and symptoms is $\beta = -0.3140$ ($P < 0.001$). In other words, "m1" coefficient is statistically significant. It demonstrates that direct effect between mediators (stressor and symptoms) is $\beta = 0.7480$ ($P < 0.001$). The direct effect between mediators (Symptoms and stressor) and coping strategies are $\beta = 0.5918$ ($p = 0.1685$) and $\beta = 1.2207$ ($P < 0.001$), respectively. So, "b1" and "b2" coefficients are statistically significant.

Indirect Effect

This part of the results tests the indirect relationship between independent and dependent variables. The symptom is the only mediator who mediates the relationship between support and coping strategies. The indirect effect is equal to−0.1858 with a 95% bootstrap confidence interval; that is, the indirect effect is statistically significant at alpha 0.05 ($P < 0.05$).

DISCUSSION

This study aimed to investigate the relationships between frontline nurse stress, physio-psychosocial symptoms, and coping behaviors employed by nursing staff during the COVID-19 pandemic. Additionally, this study aimed to examine the relationships between coping strategies and social support on adverse symptoms and their related stressors. The study's results ultimately reflect the age and occupational differences in how frontline nurses perceive and engage in support and coping to reduce physio-psychosocial symptoms. Furthermore, the results reflect how certain stressors and symptoms are associated with specific coping behaviors. Finally, the results suggest a causal

relationship in which nurses appraise their stress prior to symptoms and choose their coping strategies based on the symptoms felt.

Age and Specialty: Frontline Nurse Stress, Coping, and Support

This study found that factors related to aging significantly contributed to stress from personal life, emotional symptoms, physical symptoms, and social symptoms. For example, being over 50 years old was associated with a significant positive relationship with social support. It seems clear from this data that age differences at least partially determined frontline nurses' preferences in how they coped with occupational stress factors. This finding is consistent with Ali et al. (2). This is perhaps why older nurses preferred social relationships and transference over more individual forms of coping, such as problem-solving (6, 33, 35, 40). Overall, these results indicate that age differences influence how nurses perceive the efficacy of coping strategies and social support.

According to the results of this study, the specialty was found to be a significant demographic factor affecting stress, symptoms, and coping strategy usage. The results show that nurses in specialties such as OR, ER, and pediatrics reported having significantly lower stress, physio-psychosocial symptoms, and use of coping strategies than general nurses. Interestingly, specialties such as ICU and OR reported requiring substantially more support than general nurses. These findings suggest that specialties requiring less patient exposure result in greater stress levels, which is consistent with Ali et al. (2) and Cai et al. (37).

Specialties involving more technical procedures, such as OR, and those involving more uncertain and volatile patients, such as ICU, seem to require more social support (2, 24).

Gender: Frontline Nurse Stress, Coping, and Support

The results indicated that female nurses have significantly higher stress and Physio-psycho-social emotional symptoms than male nurses. Female nurses reported a higher level of anxiety, sadness, and depression, but a higher score for problem-solving techniques was reported by female nurses. In general, female nurses indicated higher use of coping strategies than their male counterparts. This is consistent with Ali et al. (2) and Huang et al. (41), who reported that female nurses are more likely to suffer from psychological problems and report a higher level of stress (42, 43). This might be because female nurses spend more time and effort communicating and providing mental support to patients and their life and family responsibilities (41, 42). In addition, female nurses reported a higher community and organizational support level. This observation might be because females generally have more social responsibilities and engage in social and family activities more than males. Also, related to Hamdan-Mansour et al. (44), female nurses report significantly higher stress. Therefore, they may be more in need of community and organizational support.

Seniority: Frontline Nurse Stress, Coping, and Support

Although stress seems problematic for all nurses' specialties, little is known about nursing seniority differences. López-López et al., (45) reported that professional seniority variables contribute to burnout and stress development in nurses. More experienced nurses have reported less stress levels, which may be related to having more years of training and dealing with patients' related stress. In addition, these nurses reported significantly lower mean levels of physio-psychosocial symptoms and needed support.

This study shows that nurses with over ten years of experience reported significantly lower mean coping strategy usage. With experience, nurses may have developed greater emotional and mental resilience out of job necessity (2). Younger nurses reported a higher level of organizational and social support. They are mostly less experienced and request more support from supervisors due to a lack of confidence than their counterparts. In addition, Kath et al., (46) declared age had a significant positive relationship with autonomy. Another reason could be that the younger nurses work with an older ones (46). These could be the reasons for reporting more support levels among younger nurses. In contrast, Laal and Aliramaie, (47) reported that junior and senior staff had no difference in applying positive or negative responses to cope with stress.

Marital Status: Frontline Nurse Stress, Coping, and Support

In general, all nurses reported using a sort of problem-solving coping strategy. More than 62% of younger nurses reported thoughts of leaving their job. In contrast, single nurses reported using avoidance coping strategies more than married ones. In conclusion, married nurses were indicated to have lower stress levels during the COVID-19 pandemic. This is consistent with Ali et al. (2) findings. Unsurprisingly, transference coping strategies were considered more by married nurses. This could be related to the support they receive from their partners and the ability to transfer and redirect the stress to their partner.

These results help to understand better why nurses feel the need for additional social and organizational support in light of greater uncertainty and why some specialties require more support than others in pandemic circumstances. However, further research into the differences among nurses' perceptions of support, in general, is needed to highlight potential gaps in how current and future nurses perceive the efficacy of social support.

Stressors, Physio-Psychosocial Symptoms, Support, and Coping

Figure 2 provides an updated framework that considers the insights from the bootstrapping results. As expected, stressors have a significant direct effect on harmful Physio-psychosocial symptoms. Further, harmful symptoms have a significant positive impact on the need for coping strategies. The direct effects provide a practical illustration of the ways stress leads

to symptoms and how symptoms lead to coping strategies. Additionally, it suggests that nurses can appraise their stress more quickly than scholars have theorized, as stress and symptoms (24, 33). Finally, greater social support may reduce nurses' reliance on coping strategies.

CONCLUSION

This study found that both social support and physio-psychosocial symptoms contributed to the use of coping strategies. This study reveals that nurses who experience a higher level of stress are more likely to experience poor physio-psycho-social symptoms and negatively cope with the stress. This study demonstrates that organizational and social support could reduce stress intensity and improve the physio-psycho-social status by reducing the harmful symptoms.

This study provides further evidence of the importance of organizational support in helping alleviate the harmful physio-psychosocial symptoms experienced by nurses. The study helped identify unique patterns related to nursing support during the pandemic. However, this study lacked sample diversity, such as gender. Gender-related findings could not be generalized because of the relatively small sample size of male participants in this study.

DATA AVAILABILITY STATEMENT

The raw data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Auburn University IRB Review Committee (IRB protocol reference: 20–238 EX 2005). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HA and DA designed the study and collected the data. HA, YF, and SH analyzed the collected data and MH helped with the data analysis. All authors drafted the manuscript, made necessary changes and revisions to the manuscript, and approved the final version.

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SUPPLEMENTARY MATERIAL

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Health Action Process Approach (HAPA) as a Framework to Understand Compliance Issues With Health Protocols Among People Undergoing Isolation at Emergency Hospital for COVID-19 Wisma Atlet Kemayoran and RSCM Kiara Ultimate Jakarta Indonesia

Khamelia Malik[1,2]*, *Nurmiati Amir*[1], *A. A. A. A. Kusumawardhani*[1], *Petrin Redayani Lukman*[1], *Rhapsody Karnovinanda*[1], *Leslie Melisa*[1], *Lidya Purnama Dewi*[1] *and Agnes Lasmono*[1]*

[1] Department of Psychiatry, Faculty of Medicine, Cipto Mangunkusumo National Referral Hospital, Universitas Indonesia, Jakarta, Indonesia, [2] Neuroscience and Brain Development Research Cluster, Faculty of Medicine, Indonesia Medical Education and Research Institute, Universitas Indonesia, Jakarta, Indonesia

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Hong Kong Baptist University, Hong Kong SAR, China

***Correspondence:**
Khamelia Malik
khameliapsi@gmail.com
Agnes Lasmono
agnes.lasmono@hotmail.com

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Introduction: This study aims to identify the psychosocial determinants and examine the mediation mechanisms of the compliance with COVID-19 health protocols among people undergoing isolation in health facilities that specifically treat COVID-19 cases in Jakarta, Indonesia.

Methods: This is a cross-sectional study which used socio-cognitive approach, known as the Health Action Process Approach (HAPA), to understand the complexity of issues related to compliance with health protocols. A total of 1,584 subjects participated in this study, including 865 men and 719 women over the age of 18 years old during the data collection period (October 19–26, 2020). The data were collected using questionnaire that was developed by a team of experts from the Faculty of Medicine, Universitas Indonesia—Dr. Cipto Mangunkusumo General Hospital, and survivors. The data that has been collected were then analyzed using Structural Equation Modeling, a multivariate data analysis technique.

Results: The final research model in this study fulfills the criteria for a good model fit. This study found that individuals who have strong self-efficacy regarding their ability to implement behaviors and overcome obstacles will have stronger intent to comply in the future. The study also found that stronger intent will lead to stronger planning, and planning was found mediating intention and compliance with health protocols.

Conclusion: This research model is comprehensive and useful in understanding compliance with health protocols among people undergoing isolation in health facilities for COVID-19 (Wisma Atlet and RSCM Kiara Ultimate). Having intent (related to the risk perception, outcome expectancies, and self-efficacy) and having a plan can

positively influence the behavior of people undergoing isolation, resulting in better compliance to health protocols. The understanding gained from this study can be used to improve strategies related to compliance with health protocols against COVID-19 in the communities.

Keywords: Health Action Process Approach, COVID-19, compliance with health protocols, isolation in health facility, Indonesia

INTRODUCTION

The COVID-19 pandemic that has occurred over the last 2 years around the world presented great challenges not only to health workers, but also to the economy, government, education, and many other sectors in society (1, 2). Based on the latest data from WHO as of the time of writing (April 13, 2022), there have been 499,119,316 confirmed cases of COVID-19, with a total of 6,185,242 deaths. Indonesia has recorded 6,036,909 confirmed cases of COVID-19 and 155,746 deaths (3). The high transmission rate of COVID-19 continues to be a concern, especially the Delta and Omicron variant which was found to have a much higher transmission rate than the first strain encountered at the beginning of the pandemic. Due to its high transmission rate, various interventions to prevent the transmission of COVID-19 are also continuously being developed. These include physical distancing, self-isolation, quarantine, and health protocols. Vaccination program has also been implemented and is one of the main strategies currently used to control the COVID-19 pandemic. Although the vaccination program will run continuously until the transmission rate in the community decreases, prevention strategies in the form of health protocols, such as regularly washing hands, wearing masks, maintaining distance, avoiding crowds, as well as limiting mobility and interaction, still need to be carried out regularly. The CDC also recommends that vaccinated people should continue to comply with health protocols to prevent transmission (4, 5). Dewi and Probandari (6) also found a significant association between compliant behavior to health protocols, such as wearing masks and physical distancing outside the home and at the workplace, and the COVID-19 rapid test results.

Due to the importance of health behavior in the prevention of disease, various forms of health promotion continue to be conducted to achieve behavior change in terms of compliance with health protocols at the community level. However, community compliance level to the health protocols remains low in Indonesia. Based on a survey on community compliance with health protocols conducted by AC Nielsen with UNICEF, in six major cities in Indonesia, there were only 31.5% of respondents who performed all health protocol behaviors (including wearing masks, maintaining distance, and washing hands) in a disciplined manner. Others performed two of the three health protocol behaviors (36%), one of the three health protocol behaviors (23.2%), or did not comply with the health protocols at all (9.3%) (7). Fuady et al. (8), who conducted a study in Indonesian youths, also found that despite having good knowledge and attitude, in practice the results were significantly different. Fuady et al. (8) found that in Indonesian youth, the non-compliance rate to the health protocols was high, suggesting that knowledge and attitude alone are not enough to make a person perform health behaviors, particularly related to preventive strategies against COVID-19.

To achieve effective behavioral changes, it is necessary to identify the behavioral determinants that can be potentially modified and used as targets for intervention. Common obstacles that often keeps people from doing behavioral changes, let alone doing it consistently, are whether or not there is an intention to do the behavior and the gap between having intent and doing the behavior. A socio-cognitive approach, known as Health Action Process Approach (HAPA), can be used to understand the mechanism for someone to have intents and understand the gap between intent and behavior. HAPA helps to bridge and look for more specific determinant factors on how intent emerges into sustained behavioral change. HAPA distinguishes the two processes leading to health behavioral change, namely the pre-intentional motivation process and the post-intentional volitional process. In the motivational phase of HAPA, three socio-cognitive components influence the emergence of intent to change behaviors. The three components consist of expectations of the desired outcome, self-efficacy to make behavioral changes, and perception of personal risk. Expectations of the desired outcome may be in the form of social, physical, or emotional outcome expectancies. Self-efficacy is a person's belief in his capacity to perform the desired behavior. Risk perception is the identification and interpretation of a person's health risks, whether as specific diseases or non-specific conditions. In the volitional phase, two main components implicate the change after the intent emerges, which include planning and self-efficacy (both for maintaining behavior and recovery). Planning consists of two things: planning for actions, such as when, where, and how to act, and planning for coping that will be performed if there are obstacles encountered. Self-efficacy in the volitional phase includes a person's belief in one's capacity to maintain new behaviors through various coping mechanisms in dealing with the obstacles, as well as to reconduct the expected behavioral change if one fails. Moreover, there is action control that may also influence the behavioral changes, which is a self-regulatory strategy done when the behavior has already taken place and been continuously evaluated (9–15).

This study used HAPA to understand the complexity of compliance issues to health protocols. Previously, HAPA has also been used in several studies on health behaviors related to COVID-19, such as study conducted by Lao et al. (16) that

found both motivation and volitional factors included in HAPA might improve compliance with several health protocols related to COVID-19, i.e., wearing facemask and handwash. Hamilton et al. (17) also used HAPA to assess social distancing behavior during the pandemic, and found that both processes from HAPA can be used to understand the behavior. Beeckman et al. (14) who also used HAPA as the framework for the study found the same results. Another study by Duan et al. (15) also identified some social-cognition determinants by integrating the theory of planned behavior, health knowledge, and HAPA on three health behaviors related to COVID-19. The study found that intents might be predicted by motivational self-efficacy, attitude and subjective norms, while behaviors might be predicted by health knowledge and action control, and also mediated by planning from volitional self-efficacy (15).

Although several studies have been found examining HAPA on health behaviors related to COVID-19, until this writing was made, no studies were found examining HAPA in the specific population, namely people who are undergoing isolation in health facilities, especially in Indonesia. In Indonesia, the government has provided some isolation facilities where people might undergo isolation and were guaranteed that they will receive masks, available handrub, be supervised continuously, and share appropriate rooms with some distance with other people. With the condition that all the supplies needed were available, this study tried to learn about the mechanism related to the compliance behavior in that specific population. Therefore, this study was conducted, aiming to identify the psychosocial determinants and examine the mediation mechanisms of the compliance with COVID-19 health protocols among people undergoing isolation in health facilities that specifically treat COVID-19 cases in Jakarta, Indonesia. The understanding are important to be known and may be used in developing future programs that targeted the compliance with health protocols of COVID-19 more specifically.

In this study, it was hypothesized that in people undergoing isolation in health facilities related to COVID-19 where the facilities needed where provided, there can be found direct association between self-efficacy in taking actions, outcome expectancies, and risk perception with intents. Moreover, this study also hypothesized that having intents has direct association with planning, planning has direct association with compliance to health protocols, and self-efficacy in maintaining behavior has a direct association with compliance and planning. Moreover, this study also hypothesized that planning mediate intention and compliance to health protocol.

MATERIALS AND METHODS

Study Design

This is a cross-sectional study, that used HAPA to understand the process leading to behavior change, i.e., compliance with health protocols. There were eight hypotheses tested in this study, as listed in **Figure 1** below, including H1: Self-efficacy in taking actions has a direct association with intents; H2: outcome expectancies have a direct association with intents; H3: risk perception has a direct association with intents; H4: intents have a direct association with planning; H5: planning has a direct association with compliance; H6: Self-efficacy in maintaining behavior has a direct relationship with planning; H7: Self-efficacy in maintaining behavior has a direct association with compliance. Furthermore, this study also hypothesized that planning will mediate intention and compliance to health protocol, filling the intention-behavior gap in this community (H8).

Participants

This study included individuals who had been confirmed of having COVID-19, and were undergoing isolation at the health facilities for COVID-19 in Jakarta, Indonesia (Wisma Atlet Kemayoran and Kiara Ultimate RSCM Jakarta) during the data collection period (October 19–26 2020). The inclusion criteria for this study was all people who were undergoing isolation at the health facilities for being confirmed of having COVID-19. The exclusion criteria was the subjects who were in a bad condition that affecting their understanding about the study and having difficulties filling out the distributed questionnaire. The *a-priori* sample size was determined based on the calculation formula for Structural Equation Modeling (SEM), with anticipated effect size 0.1, desired statistical power level 0.8, number of latent variables 7, number of observed variables 5, and probability level 0.05. Based on the calculation formula (19), the minimum sample size required to detect the effect is 1,808 samples, with a minimum of 805 samples for the model structure. In this study, subjects who met the inclusion and exclusion criteria were included until the time limit was over (the data collection period for this study was limited to 8 days). As many as 1,584 subjects completed the study, including 865 men and 719 women over the age of 18 years old.

Procedures

The medical staffs worked in Wisma Atlet Kemayoran and Kiara Ultimate RSCM Jakarta were included to explain about the study to the respondents during the data collection period. The respondents who were selected based on the inclusion and exclusion criteria listed above were being informed about the aim of the study, steps to fill the questionnaire distributed, and the confidentiality issues. All of the participants who agree to join in this study have given the permission by signing in the online form of the informed consent form. The questionnaire in this study was distributed using an electronic form, following the regulations of the health facility where the study was conducted, to avoid COVID-19 transmission. When completing the questionnaire, respondents were accompanied by the research team.

Research Instrument

To test the hypotheses, a survey questionnaire adapted from the questionnaire made by Schwarzer (11) was used in this study. The questionnaire was developed by a team of experts from the Faculty of Medicine, Universitas Indonesia—Dr. Cipto Mangunkusumo General Hospital, and survivors. The development was conducted by first creating, distributing, and collecting data using a pre-test questionnaire, followed by modifications to develop a formal questionnaire which was then distributed for study data collection. The developed

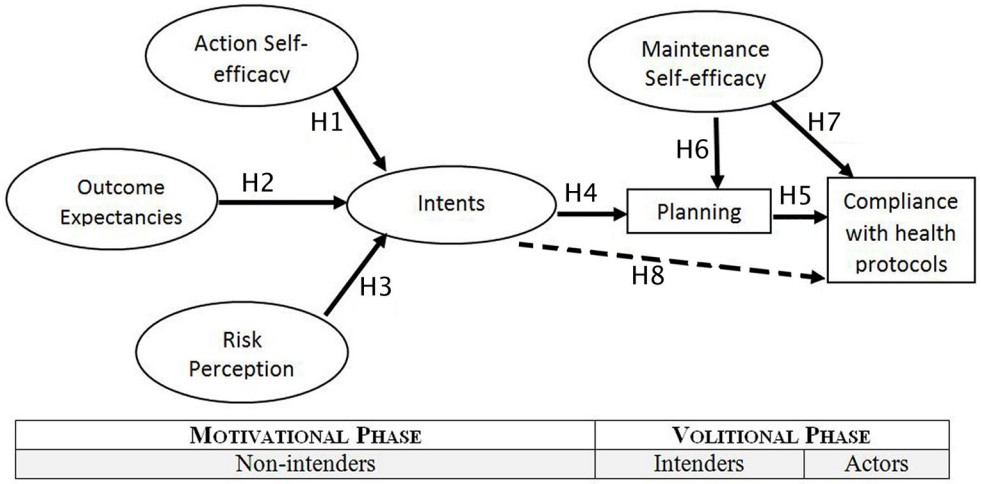

FIGURE 1 | Hypothesis model in this study, adapted from Schwarzer (18), with permission.

questionnaire contains several questions on how often respondents follow quarantine guidelines and is scored using a 5-point Likert scale. Score is calculated based on the respondents' answers, with a score of 1 given if the respondent answered 'never' up to a score of 5 if the respondent answered 'always' on the statement item for the behavior. The distributed questionnaire consists of three parts, covering the characteristics of the interviewees (gender, age, and level of education), measurements of risk perception, outcome expectancies, self-efficacy, intent, planning, and compliance, as well as scores given by respondents (**Appendix A**). The questionnaire distributed may need ∼15–20 min to be fulfilled.

Statistical Analysis

This study used the SEM multivariate data analysis technique. There are two types of variables in structural equation modeling: latent and measured variables. Latent variables are variables that cannot be observed or measured directly. In this study, the latent variables that were assessed included risk perception, outcome expectancies, self-efficacy, intent, planning, and compliance. Measured variables, also known as indicators, are variables that can be observed or measured directly (20, 21).

The structural equation modeling consists of measurement/outer model and structural/inner model. The measurement model is used to explain the association between measured variables and latent variables, while the structural model describes the association between latent variables. In the structural/inner model, there are exogenous latent variables that can predict other variables and endogenous latent variables that are predicted by other variables and show their effects. An approach that can be used for SEM is Partial Least Squares (PLS) which is a path modeling approach without any assumptions about the data distribution. PLS-SEM has several advantages such as being suitable when the sample size is limited, when the data distribution is skewed/asymmetrical, as well as when the prediction accuracy is desired. The PLS-SEM approach can be performed using the SmartPLS application software (20–23). This study also assessed the relationship between demographic factors of the participants (education and sex variables) as control variables and the compliance behaviors.

Measurement/Outer Model

The analysis of the outer model is important because the validity and reliability of the association in the inner model are also determined by the outer model. The outer model analysis assesses internal consistency reliability, indicator/measured variable reliability, convergent validity, average variance extracted (AVE), and discriminant validity. Internal consistency reliability analysis based on the association between the variables observed in this study was performed using Cronbach's alpha and composite reliability measurements. A value closer to one indicates better reliability. In this study, Cronbach's alpha and composite reliability values of >0.7 are acceptable. Indicators with outer loading values >0.7 were accepted, while those <0.4 were omitted (24, 25).

Loading factor indicator, composite reliability, and AVE were observed to assess convergent validity. An AVE value >0.5 is considered adequate for convergent validity, and can also be used to assess discriminant validity. Assessment of discriminant validity was performed to ensure that the latent constructs used in this study are truly unrelated and do not measure the similar construct as other variables (24–26). In this study, discriminant validity was calculated using the Fornell and Larcker criterion and the Heterotrait-monotrait (HTMT) criterion from Henseler (26, 27). According to the Fornell-Larcker criterion, the latent variables should be better at explaining the variance of their indicator variable than other latent variables and are indicated by a larger square root of the AVE value. According to the HTMT criterion, a value closer to 1 indicates a lack of discriminant validity (25, 26).

TABLE 1 | Demographic characteristics and difference in perceived compliance to health protocol among subjects (n = 1,584).

Group	Descriptive		Compliance to health protocol	
	Frequency	%	Mean	SD
Age (years old)				
18–35	1,038	65.49	4.333	0.045
36–55	492	31.17	4.235	0.071
>55	54	3.68	4.122	0.223
Sex variables				
Man	865	55%	4.193	0.057
Woman	719	45%	4.262	0.051
Education				
Junior high school	150	9%	4.219	0.113
High school	970	61%	4.218	0.058
Bachelor's degree	405	26%	4.261	0.071
Master's/Doctoral degree	59	4%	3.791	0.215
Marital status				
Unmarried	666	42%	4.161	0.049
Married	847	53%	4.274	0.066
Divorced or widow/widower	71	5%	4.272	0.155

Structural/Inner Model

Analysis of the inner model quality includes an assessment of the coefficient of determination (R^2), path coefficient, and effect size (f^2). R-square (R^2) or the coefficient of determination is used to assess the predictive power of the model proposed in the hypothesis and see the combined effect of the exogenous variables on endogenous variables. The R^2 values range from 0 to 1, with a value closer to one indicating a better model (24).

Analysis of the path coefficient can describe the association between variables in the hypothesis. The path coefficient values range from -1 to $+1$, with a coefficient closer to 1 indicating a stronger association, whether the association is positive or negative. The significance can then be obtained through standard error using bootstrapping technique. P-Value of <0.05 indicates a significant prediction between independent and dependent variables. The effect size (Cohen's f^2) was determined by assessing the change in the coefficient of determination when a specific variable in the model was omitted, as well as by estimating two PLS path models (the complete model that fits the hypothesis and model with some exogenous variables that have been omitted). The effect size of each association was determined as follows: 0.02 (small effect), 0.15 (medium effect), and 0.35 (large effect) (24).

Goodness of Fit

The Goodness of Fit of the models can be measured by using SmartPLS (23). The measurements include Standardized Root Mean Square Residual (SRMR), Normal Fit Index (NFI), and Root Mean Square Theta (RMS_theta). SRMR shows how big the difference of root mean square between observed and expected correlations is. The recommended SRMR value is <0.10 or 0.08 in the conservative version. In this study, the SRMR value limit used was 0.08. The RMS_theta values (root mean square residual covariance) were also assessed with a value <0.12 indicating a well-fitting model, and a higher value indicating a lack of fit in the model. The expected NFI value is ≤ 1, with a value closer to 1 indicating a very good fit, and a value <0.9 usually representing an acceptable fit (28, 29).

Mediation Analysis

Mediation analysis was made to know the process or "how" the relation between the two variables, to better understand the mechanism the effect happens. In this study, mediation analysis were made with smartPLS with the variables: intention, compliance and planning (23, 30). The total effect, direct and indirect effect will be presented in the table with the coefficient and significance value.

Ethical Approval Statement

This study has obtained ethical clearance from the Faculty of Medicine, Universitas Indonesia on April 27, 2020, with reference number KET-444/UN2.F1/ETIK/PPM.00.02/2020.

RESULTS

Demographic Characteristics of Participants

Table 1 shows the demographic characteristics of the participants in this study. The participants consisted of 55% males and 45% females with the majority (61%) having completed secondary high school. Most of the participants were in the range of 18–35 years old (65.49%). The marital status of the participants were 53% married, 42% unmarried, and 5% divorced. For control variables, there were no significant relationship found to the compliance behaviors ($P = 0.365$ for education; $P = 0.263$ for sex variables).

TABLE 2 | Research variables and measurement indicators.

Variables	Missing	Min	Max	Mean	SD
Risk1	0	1	5	1.871	1.309
Risk2	0	1	5	2.153	1.401
Risk3	0	1	5	1.921	1.331
Risk4	0	1	5	2.174	1.449
Risk5	0	1	5	1.437	0.895
Expectancy1	0	1	5	4.643	0.931
Expectancy2	0	1	5	4.622	0.975
Expectancy3	0	1	5	4.621	0.952
Expectancy4	0	1	5	4.588	0.961
Expectancy5	0	1	5	4.542	0.981
EfficacyAction1	0	1	5	4.657	0.841
EfficacyAction2	0	1	5	4.559	0.919
EfficacyAction3	0	1	5	4.580	0.912
EfficacyAction4	0	1	5	4.612	0.893
EfficacyAction5	0	1	5	4.598	0.887
EfficacyAction6	0	1	5	4.448	0.981
EfficacyAction7	0	1	5	4.333	1.058
Intent1	0	1	5	4.722	0.757
Intent2	0	1	5	4.740	0.793
Intent3	0	1	5	4.658	0.846
Intent4	0	1	5	4.568	0.905
Intent5	0	1	5	4.679	0.835
Plan1	0	1	5	4.380	1.031
Plan2	0	1	5	4.388	1.043
Plan3	0	1	5	4.522	0.941
Plan4	0	1	5	4.613	0.899
Plan5	0	1	5	4.568	0.938
Plan6	0	1	5	4.398	1.035
Plan7	0	1	5	4.493	0.966
Plan8	0	1	5	3.965	1.245
EfficacyMaintn1	0	1	5	4.114	1.183
EfficacyMaintn2	0	1	5	4.088	1.169
EfficacyMaintn3	0	1	5	4.280	1.099
EfficacyMaintn4	0	1	5	4.526	0.958
EfficacyMaintn5	0	1	5	3.958	1.294
Adherence1	0	1	5	3.600	1.376
Adherence2	0	1	5	4.410	1.012
Adherence3	0	1	5	4.485	0.968
Adherence4	0	1	5	4.720	0.768
Adherence5	0	1	5	4.297	1.300
Adherence6	0	1	5	4.266	1.064
Adherence7	0	1	5	4.549	0.898
Adherence8	0	1	5	4.037	1.209

Research Variables

Table 2 describes the variables and the measurement indicators used in this study. There was no missing data during the data collection phase, with each variable having a minimum value of 1 and a maximum value of 5.

Measurement Model

Internal Consistency Reliability

Table 3 below shows the Cronbach's alpha and composite reliability value of the variables. For compliance, intent, outcome expectancies, planning, perception of risk, and self-efficacy in action and maintaining behaviors, all of the Cronbach's alpha and

TABLE 3 | Reliability and convergent validity of the whole measurement model.

	Cronbach's alpha	Rho_A	Composite reliability	AVE
Compliance behavior	0.877	0.879	0.907	0.621
Intention	0.932	0.932	0.949	0.787
Outcome expectancy	0.939	0.940	0.954	0.804
Risk perception	0.808	0.818	0.864	0.561
Self-efficacy for action	0.934	0.936	0.947	0.718
Self-efficacy for maintenance	0.869	0.877	0.906	0.658
Planning	0.941	0.943	0.951	0.711

composite reliability values are above the expected value (0.7), indicating good internal consistency.

Reliability Indicator

Table 4 shows the results of the indicator reliability of the measurement model as a whole with outer loading values of more than 0.7. Initial analysis found outer loading values that were below 0.7, thus did not fulfill the expected limits, and some variables were removed from the construction model. The variables removed include "adherence1" and "adherence5."

AVE and Convergent Validity

The AVE value was between 0.621 and 0.804, which is above the expected value (0.5). The composite reliability and AVE values show sufficient convergent validity in the measurement model created.

Discriminant Validity

Table 5 below describes the correlation between latent variables by comparing the square root of each AVE with the correlation coefficient of other latent variables. The square root of each variable's AVE in this study was larger than the correlation with other latent variables, thus the discriminant validity is accepted, based on the Fornell Larcker Criterion. The HTMT criterion was also used to calculate discriminant validity. In **Table 6** revealed an issue with collinearity between the latent variables intent, and self-efficacy for action, indicating that there is overlap between the two latent variables. There was no overlap between other items.

Structural Model

Determination Coefficient

Table 7 shows the determination coefficient or strength of the predictive model created for behavior, intent, outcome expectancies, planning, and risk perception. The model could explain the variations in 61.5% of compliance, 76.8% of intent, and 58.1% of planning.

Path Coefficient

Table 8 shows the path coefficient for all paths proposed in the study model. All seven path coefficients proposed in this study were significant. The results in **Table 8** show that and self-efficacy for action, outcome expectancies, and risk perception is related to intent, supporting H1 ($\beta = 0.705$; $P = 0.000$; T-value = 19.602), H2 ($\beta = 0.243$; $P = 0.000$; T-value = 6.467), and H3 ($\beta = 0.023$; $P = 0.048$; T-value = 1.981). Furthermore, intent has a significant effect on planning, and planning has a significant effect on compliance to with health protocols, supporting H4 ($\beta = 0.465$; $P = 0.000$; T-value = 11.533) and H5 ($\beta = 0.519$; $P = 0.000$; T-value = 11.435). Additionally, self-efficacy in maintaining behaviors was also found to have a positive effect on planning and compliance to health protocols which supports H6 ($\beta = 0.378$; $P = 0.000$; T-value = 10.062) and H7 ($\beta = 0.334$; $P = 0.000$; T-value = 7.590). Compared to results by Hamilton et al. (17), this study found the same results in how self-efficacy may predict intention and having intents predicted behavior [in Hamilton et al., (17) the results were $\beta = 0.314$, $P < 0.001$ and $\beta = 0.261$, $P = 0.026$, respectively]. However, Hamilton et al. (17) did not found that risk perception may predict intention significantly ($\beta = 0.150$, $P = 0.077$) (17).

The final path coefficient from compliant behaviors to health protocols is described in **Figure 2**. The figure was obtained from SmartPLS software (23). **Table 9** describes the direct, indirect and total effects of the variables in the HAPA model. The total effect of a latent variable on the HAPA model is the combination of direct and indirect effects. The results showed that self-efficacy action had the greatest direct effect on intention ($\beta_{total} = 0.705$, $P < 0.000$) and self-efficacy maintenance had the greatest total effect on compliance ($\beta_{total} = 0.531$, $P < 0.000$). Higher level of intention and self-efficacy maintenance gave rise to the higher level of planning, and planning also had a high effect on compliance ($\beta_{total} = 0.519$, $P < 0.000$). Self-efficacy action and intention had a moderate total effect on compliance ($\beta_{total} = 0.170$, $P < 0.000$ and $\beta_{total} = 0.241$, $P < 0.000$). Outcome expectancy had a small total effect on compliance ($\beta_{total} = 0.059$, $P < 0.000$).

Effect Size

Table 10 shows the effect sizes of H1-H7. A medium effect size was found for H2 (outcome expectancies to intents), H4 (intents to planning), H6 (self-efficacy in maintaining behavior to planning), and H7 (self-efficacy in maintaining behavior to compliance). A large effect size was found for H1 (from self-efficacy for action to intent) and H5 (planning to compliance).

Goodness of Fit

Table 11 shows the results of the model fit measurement, including the saturated model and estimated model. In this study, the SRMR value was 0.045 which is below the expected value of

TABLE 4 | Indicator reliability/outer loading.

	Compliance behavior	Intention	Outcome expectancy	Risk perception	Self-efficacy for action	Self-efficacy for maintenance	Planning
Adherence2	0.745						
Adherence3	0.801						
Adherence4	0.802						
Adherence6	0.817						
Adherence7	0.832						
Adherence8	0.726						
EfficacyAction1					0.829		
EfficacyAction2					0.818		
EfficacyAction3					0.871		
EfficacyAction4					0.866		
EfficacyAction5					0.879		
EfficacyAction6					0.853		
EfficacyAction7					0.811		
EfficacyMain1						0.785	
EfficacyMain2						0.818	
EfficacyMain3						0.872	
EfficacyMain4						0.845	
EfficacyMain5						0.728	
Expectancy1			0.877				
Expectancy2			0.890				
Expectancy3			0.903				
Expectancy4			0.916				
Expectancy5			0.897				
Intent1		0.870					
Intent2		0.903					
Intent3		0.910					
Intent4		0.861					
Intent5		0.891					
Plan1							0.818
Plan2							0.838
Plan3							0.859
Plan4							0.862
Plan5							0.871
Plan6							0.880
Plan7							0.878
Plan8							0.729
Risk1				0.766			
Risk2				0.754			
Risk3				0.731			
Risk4				0.757			
Risk5				0.735			

0.08. Therefore, it can be concluded that the model fulfills the criteria for a good model fit. The RMS_theta value also had a value below 0.109, indicating a well-fitting model. The NFI value was also close to 1, which indicates an accepted fit (28).

Mediation Analysis

The total effect which is the effect of having intents on compliance without the involvement of planning was significant (β = 0.716; P = 0.000). Moreover, further analysis also found that having intents also have a significant impact on compliance in the presence of planning as the mediator (β = 0.382; P = 0.000) and significant impact of having intents on compliance through planning (β = 0.334; P = 0.000). These results can be seen in **Table 12**. **Figure 3** shows that planning partially mediates an effect from intent to be compliant toward health protocols significantly.

TABLE 5 | Discriminant validity- Fornell-Larcker criterion.

	Compliance behavior	Intention	Outcome expectancy	Risk perception	Self-efficacy for action	Self-efficacy for maintenance	Planning
Compliance behavior	***0.788***						
Intention	0.713	***0.887***					
Outcome expectancy	0.535	0.686	***0.897***				
Risk perception	−0.080	−0.082	−0.126	***0.749***			
Self-efficacy for action	0.777	0.856	0.633	−0.106	***0.847***		
Self-efficacy for maintenance	0.683	0.631	0.510	−0.076	0.720	***0.811***	
Planning	0.744	0.704	0.503	−0.076	0.771	0.672	***0.843***

Bold and italics, the square root of AVE.

TABLE 6 | Discriminant validity—Heterotrait-monotrait ratio (HTMT).

	Compliance behavior	Intention	Outcome expectancy	Risk perception	Self-efficacy for action	Self-efficacy for maintenance	Planning
Compliance behavior							
Intention	0.786						
Outcome expectancy	0.588	0.734					
Risk perception	0.094	0.091	0.143				
Self-efficacy action	0.858	**0.915**	0.674	0.120			
Self-efficacy maintenance	0.779	0.694	0.559	0.095	0.794		
Planning	0.819	0.749	0.533	0.090	0.822	0.739	

Collinearity issue between the latent variables intent and self-efficacy for action, indicating that there is overlap between the two latent variables.

TABLE 7 | Determination coefficient (R^2).

	R square	R square adjusted
Compliance behavior	0.615	0.614
Intention	0.768	0.768
Planning	0.581	0.614

DISCUSSION

This study was conducted to fill the gap by trying to look more specifically about the behavioral change, i.e., compliance to health protocols, in people who are undergoing isolation in the health facilities for COVID-19 in Indonesia. The participants in this study include confirmed COVID-19 cases. Indrayathi et al. (31) found that COVID-19 test histories, either with PCR or rapid antibody test, and also knowing someone who had been confirmed positive or died from COVID-19 were related significantly with adherence to prevention measures. In people undergoing isolation which mean that they have been confirmed of having COVID-19, it may be suspected that they will be more comply to the health protocols. They will see their surroundings who are using full health protocols in the health facilities, in which human behavior will be influenced by the culture, including how they perceive other people will think about them, and also how they see people around them behaving (32). So, this condition in the health facilities may influence them to be more motivated and planning to comply to the behaviors. However, it was still unclear because they may also feel as they have experienced COVID-19, they will be more free and feel careless to comply. On the other hand, the health facilities where the isolation takes place were also providing the facilities needed, such as continuous observation, handrub, and they will be more exposed to information/education related to COVID-19. The behaviors assessed in the study including not going out to do activities outside the quarantine area, and it is a must in healthcare facilities. They will also separate themself or keep some distance from other people as the bed were organized to be in some safe distance. They will also have to wear a mask all the time when there are other people in the room, and the behaviors will

TABLE 8 | Result of final model hypothesis.

	Beta coefficients	Standard deviation	*T* statistics	*P*-value
H1: Self-efficacy for action → Intention	0.705	0.036	19.602	0.000
H2: Outcome expectancy → Intention	0.243	0.038	6.467	0.000
H3: Risk Perception → Intention	0.023	0.012	1.981	0.048
H4: Intention → planning	0.465	0.040	11.533	0.000
H5: Planning → compliance to protocol	0.519	0.045	11.435	0.000
H6: Self-efficacy for maintenance → Planning	0.378	0.038	10.062	0.000
H7: Self-efficacy for maintenance → Compliance to protocol	0.334	0.044	7.590	0.000

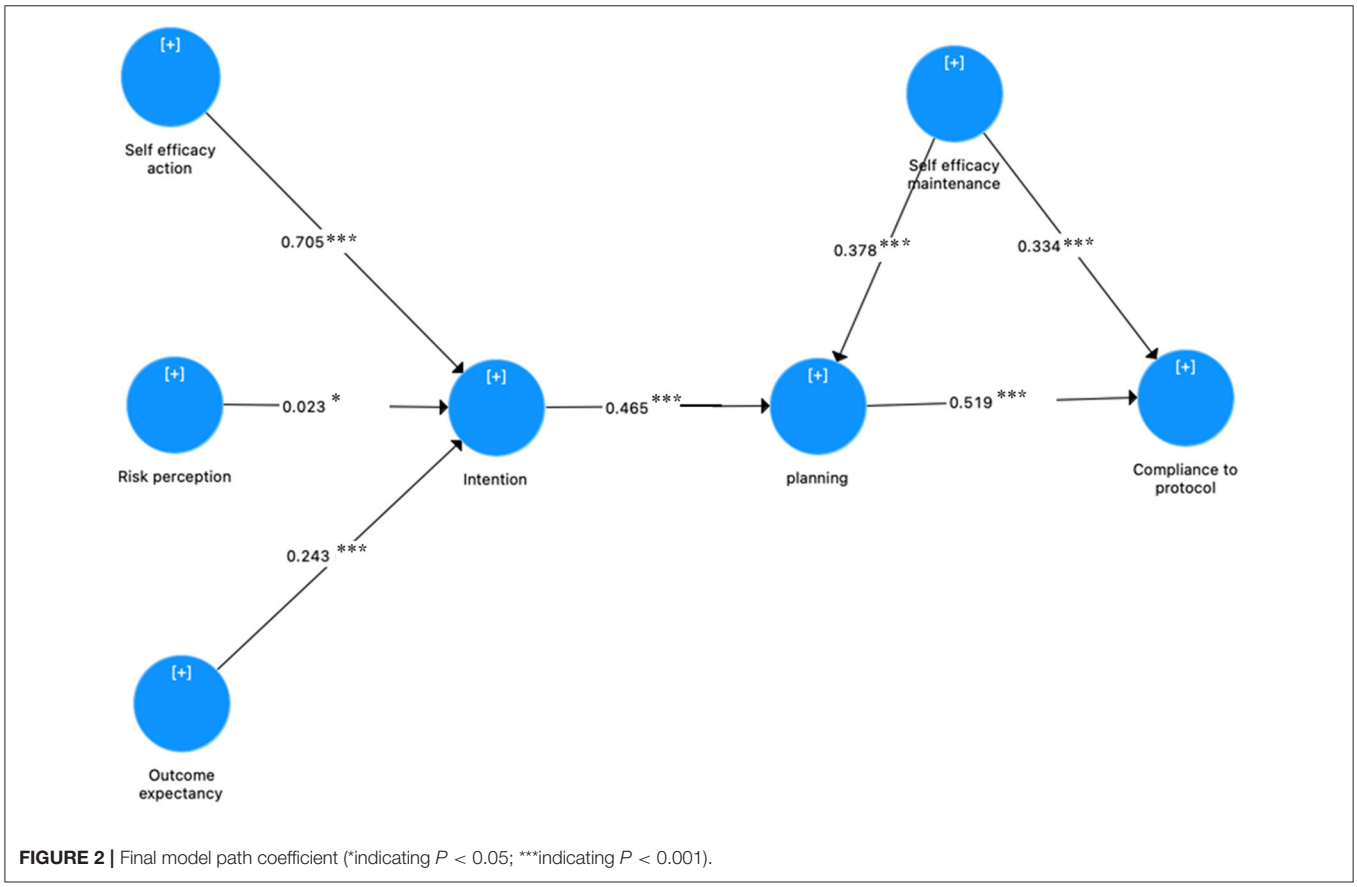

FIGURE 2 | Final model path coefficient (*indicating $P < 0.05$; ***indicating $P < 0.001$).

be confirmed and reminded when the medical staffs visit them in the daily round. In the health facilities, they will not also share personal tools with others as they may usually do in their daily life outside the isolation place and they will also be assessed daily for the body temperature and symptoms. This study was conducted to look more closely on the behavior changes in these conditions, aiming to provide information about the mediating mechanisms and determinants of compliance with health protocols in people who have been provided by the facilities needed.

This study found that the model proposed is a good fit, and may explain the determinants for behavioral changes among people undergoing isolation in COVID-19 healthcare facilities (Wisma Atlet and RSCM Kiara Ultimate), starting from one's risk perception to COVID-19 transmission, their expectation of the outcome, and their confidence of their own capability to comply, thus allowing them to form intent, plan, and start acting to comply to health protocols and to continuously maintain such compliance. Luszcynska et al. (33) who also used HAPA as the framework to assess compliance to handwashing behavior, found that risk perception and outcome expectancies were linked but only indirectly to the expected behavior. That study found that self-efficacy and self-monitoring or action control are more consistent in predicting expected health behavior (33). Unfortunately, in this study, the action control were not assessed. However, the results for the risk perception and outcome expectancies were also found to be the same in this study, and the self-efficacy's result is also consistent. Based on the results of this study, both forms of self-efficacy (to perform and maintain

TABLE 9 | The direct, indirect and total effects of the variables in the HAPA model.

Latent variables	Direct effects	Indirect effects							Total effects						
		SEA	RP	OE	IT	PL	SEM	CL	SEA	RP	OE	IT	PL	SEM	CL
Self-efficacy action	0.705***	–	–	–	–	0.327***	–	0.170***	–	–	–	0.705***	0.327***	–	0.170***
Risk perception	0.023*	–	–	–	–	0.011	–	0.006		–	–	0.023**	0.011	–	0.006
Outcome expectancies	0.243***	–	–	–	–	0.107***	–	0.113***	–	–	–	0.243***	0.113***	–	0.059***
Intention	0.465***	–	–	–	–	–	–	0.241***	–	–	–	–	0.465***	–	0.241***
Planning	0.519***	–	–	–	–	–	–	–	–	–	–	–	–	–	0.519***
Self-efficacy maintenance	0.334***							0.196***	–	–	–	–	0.378***	–	0.531***

SEA, self-efficacy action; RP, risk perception; OE, outcome expectancy; IT, intention; PL, planning; SEM, self-efficacy maintenance; CL, compliance.
**Indicates $P < 0.05$.*
***Indicates $P < 0.01$.*
****Indicates $P < 0.001$.*

TABLE 10 | *F*-square.

	Compliance to protocol	Intention	Planning
Intention			0.310
Outcome expectancy		0.152	
Risk perception		**0.002**	
Self-efficacy for action		1.283	
Self-efficacy for maintenance	0.159		0.206
Planning	0.384		

*Risk perception has a F2 effect size of 0.002, which is smaller than the Cohen's proposed lower limit of 0.02 (24). The low F2 effect size, combined with the near non-significance of the intention effect at **Table 8** indicated that risk perception and intention might have a linear relationship in our dataset.*

TABLE 11 | Goodness of fit—structural/inner model.

	Saturated model	Estimated model
SRMR	0.045	0.060
d_ULS	1.713	3.097
d_G	0.661	0.722
Chi-square	6615.444	6985.731
NFI	0.878	0.871
RMS theta	0.109	

behaviors) have a permanent effect on health behaviors and play an important role. In those with strong self-efficacy regarding their ability to perform the behavioral change, they also tend to have bigger intent toward compliance. This study also found that stronger intent will trigger stronger planning.

This result is also in-line with the statement from Bandura (34) regarding cognitive social theory in the effort to promote health and prevent diseases. Bandura (34) stated that among all determinants, confidence in self-efficacy plays an important role in personal change because it is needed to overcome obstacles faced in changing behaviors and becomes the foundation for self-motivation and action. This study is also in-line with a study of Isa et al. (35) that found inverse relation between self-efficacy scores to intent-behavior gap. They found in children with intention-behavior gap, they tend to have lower self-efficacy (35). Beeckman et al. (14) also found that self-efficacy were related to adherence to physical distancing as the behavior measured in the study, along with outcome expectancies, having intents and planning. However, in this study, the relation between outcome expectancies to compliance were not found to be large enough. Luc PT (36) which found no direct relation between outcome expectancies to intention in social entrepreneurial, suggested that outcome expectancies are flexible, related to others' support and recognition of the opportunities.

At the intender phase, an individual is already planning to change behaviors. Differ to study by Lao et al. (16) and Hamilton et al. (17) which found that planning did not mediate having intents to behavior change, this study found that planning mediate the two processes and may be used to understand the intention-behavior gap that often found when someone want to do behavior changes. After the behavior has been started, maintaining the behavior is almost as challenging as beginning to do the behavior (37, 38). It is unclear whether the changes in behavior can be maintained in the long term. However, self-efficacy in maintaining behavior are related to the compliance and is related to various factors, including personal factors such as age and level of education, as well as environmental factors such as obstacles and social support. To maintain self-efficacy for the long term, modifiable factors such as continuous social support are needed (39–41).

From the behavioral model proposed in this study, potential improvements can be identified in several points that have high benefits for change, thus the community can become more compliant toward health protocols to prevent COVID-19 transmission. With this knowledge, interventions can be implemented through various strategies targeted at increasing self-efficacy. Individuals who are doubtful toward self-efficacy can be given support and input through consultation. Those with low self-efficacy can be given a structured program to develop a strong sense of confidence in implementing or maintaining behaviors. Additionally, other strategies such as education, reflection on previous experiences, provision of behavior models, or interventions through mental imagery can also be performed. Programs to improve self-management abilities may also be beneficial, such as creating target behaviors that need to be

TABLE 12 | Mediation analysis.

Total effect (intention to compliance)		Direct effect (intention to compliance)		Indirect effects of intention on compliance				
Coefficient	***P*-value**	**Coefficient**	***P*-value**		**Coefficient**	**SD**	***T*-value**	***P*-value**
0.716	0.000	0.382	0.000	H8: I -> P -> C	0.334	0.039	8.506	0.000

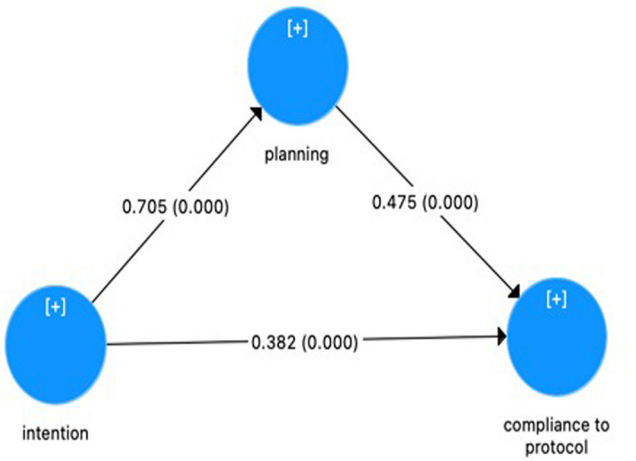

FIGURE 3 | Mediation analysis.

achieved, assessing the situation when the behavior has been performed, and obtaining feedback or appreciation for each behavior that is following the target. The intervention strategies can vary between individuals, depending on each individual's preparedness toward change (10, 34, 42).

Limitations

This study has some limitations. First, this study was limited to subjects undergoing isolation in healthcare facilities. Second, the instrument used in this study was self-reported, and it may affect the results because of the social desirability bias. The participants may also report their condition during their isolation (after being exposed to COVID-19) or report about their behavior usually before being exposed to COVID-19 and underwent the isolation in the facilities where the study was taken place. Third, the cross-sectional data used in this study also reduce the power of the study in forming a conclusion, as it may not give temporal relationship between the factors being hypothesized. With the cross-sectional study design, some recall bias may also be considered as limitation. Fourth, this study also did not portray the subject's past lifestyle or previous exposure to COVID-19 infection and/or other infectious diseases. Therefore, future studies may gather data longitudinally to investigate the effect of change and reciprocals between the construct models, comparing between individuals undergoing isolation in healthcare facilities and at home, and perform experimental studies that target changes in the HAPA construct individually. Future studies may also include more psychosocial determinants, such as psychosocial wellbeing, lifestyle, or social support, that were found related to difficulties in adherence behavior in a study conducted by Beeckman et al. (14). Moreover, although action control, which can be found in the original HAPA model suggested by Schwarzer et al. (12), was something crucial, but it was not included in the hypothesis or the path model in this study. This study also simplified the coping and action planning as "planning," which includes both action and coping planning (13, 18). More specific HAPA construct which include action control and specify planning into action and coping planning may also be done in the future research.

CONCLUSION

This study was conducted to fill the gap by trying to look more specifically about the behavioral change in the population who were undergoing isolation in health facilities related to COVID-19, especially in Indonesia. It can be concluded that intent, which related to the perception of risk, expected outcome, and self-efficacy has a positive influence on people undergoing isolation in healthcare facilities regarding their compliance with health protocols. Planning was also found mediates intention and compliance with health protocols. The understanding gained from this study can be used to improve strategies related to compliance with health protocols against COVID-19 in the communities, such as providing education, support, and consultation when needed.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

This study obtained ethical clearance from the Faculty of Medicine, Universitas Indonesia on 27th April 2020 under ethical clearance number KET-444/UN2.F1/ETIK/PPM.00.02/2020. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

KM, NA, AK, and PL conceptualized and designed. KM supervised the study and analyzed the data. KM, RK, LM, and LD collected the data. KM and AL wrote the manuscript and review. All authors have read and approved of the publication manuscript.

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APPENDIX

APPENDIX A | Overview of variables and psychometric data.

Variable	Mean score ($n = 1,584$)
Risk perception	
I think the rules during quarantine are too much, it's enough to just wear a mask	1.871
I think the reason for imposing quarantine on myself is not clear, there are still many people out there who are more deserving of quarantine	2.153
I went into quarantine because of social pressure, I was asked by people to do it while I didn't feel the need to do it myself	1.921
If asked to choose between doing quarantine or making a living, then I choose to make a living	2.174
I tend to disobey quarantine rules because they are too many and complicated	1.437
Outcome expectancies	
By doing quarantine I help the government reduce the number of COVID-19 infections in Indonesia	4.643
If I keep my distance or separate myself from family members, I am protecting my family from contracting COVID-19	4.622
By doing quarantine, I can rest and recover my health	4.621
By doing quarantine, I feel calm because it prevents other people from close contact and meeting	4.588
If I routinely monitor daily symptoms during quarantine, I can monitor my condition and seek medical help at the right time	4.542
Intention	
I am willing to obey the quarantine rules	4.722
I intend to always cover my nose and mouth when I cough or sneeze	4.740
I intend to use and clean my own personal tools such as cutlery, toiletries, bed sheets	4.658
I intend to always clean the surfaces of objects I touch such as cell phones, desks, door handles	4.568
I intend to always wash my hands with soap and running water or hand washing liquid after touching the face or object surface	4.679
Action Self-efficacy	
I'm sure I can do quarantine according to the required time	4.657
I'm sure I can undergo quarantine even though there are important obligations and responsibilities at this time	4.559
I feel sure I can wear a mask even if it's uncomfortable	4.580
I truly believe that I am capable of not sharing the usage of personal tools such as cutlery, towels and sheets with other people even though it is more difficult to do so	4.612
I seriously say I can always wash my hands with soap and running water or hand sanitizer, even if my hands become dry or sore	4.598
I'm sure that I can clean the surface of things that I often touch, such as tables, cell phones, doors	4.448
I certainly believe that I can monitor daily temperature, and cough and cold symptoms even though I have to fill the form	4.333
Planning	
I make a positive daily activity plan that can be done in quarantine	4.380
I make arrangements for the quarantine to be able to keep my distance or separate myself from other people	4.388
I plan to provide a mask and always wear a mask when there are other people in the room	4.522
I have a plan so that I don't forget to cover my mouth and nose when I cough or sneeze	4.613
I am planning a way to separate personal items such as cutlery, towels and bed linens so that they are separated from other people's belongings	4.568
I plan ways and schedules to clean the surfaces of objects that I touch frequently, such as tables, cell phones, doors	4.398
I have a plan on how to provide handwashing equipment and when to do it	4.493
I schedule to monitor the body temperature and symptoms daily, at 7 a.m. and 7 p.m.	3.965
Maintenance Self-efficacy	
I'm sure I can continue doing quarantine again although there are some reasons that holding me back	4.114
When I start not to go outside to do activities outside the quarantine place, I'm sure I can continue it even though some time ago there was a need that made me have to go out	4.088
I believe that I can start again to keep my distance or separate myself from family members, although I have been tempted to break it	4.280
I mean it, that from now on I can start to use mask again all the time whenever I meet other people, even though I have taken it off	4.526
I have ever forgotten to monitor daily symptoms, such as body temperature, fever, and cough; however, I'm sure I can keep doing it	3.958
Behavior	
I don't go out to do activities outside the quarantine area	3.600
I separate myself or keep my distance from other people	4.410
I wear a mask all the time when there are other people in the room	4.485
I cover my nose and mouth when I sneeze or cough	4.720
I don't share personal tools with others	4.297
I clean the surface of the things I touch	4.266
I wash my hands with soap and running water or hand sanitizer	4.549
I do daily monitoring such as body temperature and cough and cold symptoms	4.037

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Lockdown Policies, Economic Support, and Mental Health: Evidence From the COVID-19 Pandemic in United States

*Haitang Yao, Jiayang Wang and Wei Liu**

Business School, Qingdao University, Qingdao, China

During the COVID-19 pandemic, various lockdown policies were put in place by the governments in different countries and different levels, which effectively curbed the spread of the virus, but also cause substantial damage to the mental health of local residents. We use statistics provided by the Household Pulse Survey and OxCGRT between 23 April 2020 and 30 August 2021 to analyze the impact of lockdown on overall mental health levels in US states during the COVID-19 pandemic at the macro level. The results show that the lockdown policies implemented by the state governments lead to a deterioration in psychological conditions, and this relationship varies to some extent depending on the level of high-quality economic support, that the state governments implement to alleviate the symptoms of depression and anxiety associated with the lockdown. Therefore, we argue that although lockdown policies are necessary during the COVID-19 pandemic, further government efforts are needed to give high-quality economic and mental health support to mitigate the negative effects of lockdown on mental health.

Keywords: COVID-19, lockdown policies, mental health, anxiety, depression, economic support

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****Correspondence:***
Wei Liu
wei.liu@qdu.edu.cn

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INTRODUCTION

As of mid-December 2021, more than 27 million people worldwide have been diagnosed with pneumonia caused by COVID-19, resulting in more than 5.37 million deaths (1). In most countries severely affected by the pandemic, governments have taken measures to impose lockdowns and restrictions on outings to deter the uncontrolled spread of the virus, limit infections and deaths, and reduce the pressure on healthcare systems and healthcare providers. In the United States, most states and counties began implementing the lockdown policies in late March 2020, which were adopted by the local governments to reduce the spread of the virus under the pressure of unpredictable uncertainties posed by the pandemic (2).

In this study, what we concern about are the lockdown policies including stay-at-home orders, quarantine, social distancing, and isolation of confirmed patients associated with high risk. Studies have shown that government administration and public cooperation do lead to better control of pandemics like COVID-19 (3, 4). However, such lockdowns directly lead to reduction in social interaction and have negative impacts on individuals' mental health (5). For example, not only do people experience increased anxiety and stress about future income and employment (6), but they also face an immediate fear of infection, for themselves, their family or friends (7). Factors such as the incubation period of a pandemic and the time required for isolation may also lead to anxious

emotional reactions (8). Restrictions on activities, loss of daily life and reduced social activities also result in feelings of boredom, depression, and isolation (9).

Numerous studies have shown that the COVID-19 pandemic caused severe psychological problems in the population (10–12), and we focused our research on the impact of lockdown policies on mental health. Existing research has explored the psychological effects of lockdown at the individual level and demonstrated that the mental health of individuals is influenced by a number of factors, such as work status, income, gender, and relationship status (13), as well as the length of lockdown, how and where they are imposed (14). Scholars have also found that lockdown affects different individuals in different ways and to different degrees. Many of them have compared the level of various mental health indicators measured in cross-sectional surveys conducted in the general population (15), Child (16), adolescents (17), adults (18), older adults (19), new mum (20), university students (21), and college students (22). For example, Yildirim (19) identified the psychosocial status, attitudes, and experiences of individuals aged 65 and older confined in their homes during the COVID-19 outbreak in Turkey, and concluded that lockdown applied specifically to older adults forced them to establish new routines and made them aware of some values; however, they asserted that they were stigmatized and isolated, their fear of COVID-19 increased, and they were treated unfairly. Olson et al. (22) conducted a photographic survey of college students' experiences during lockdown and found that students frequently reported deterioration in mental health. Non-academic aspects of students' lives, such as work and home environments, contributed significantly to perceived stress.

However, from a higher perspective, the lockdown policies developed by policymakers must have had a significant impact on individuals' mental health, and we argue that the interregional heterogeneity of such policies is an important but currently overlooked key factor. In this study, we discuss the impact of lockdown policies on overall American mental health at the state level, to provide policy recommendations for state governments to balance lockdown policies and individuals' mental health during the COVID-19 pandemic. Stress process theory suggests that adequate resources (e.g., high-quality social support) can prevent or mitigate the effects of stress on mental health (23–25). In particular, economic support as a positive intervention can reduce the impact of negative events on individuals, and therefore we consider the possible impact of government economic support policies on mental health.

We investigate such impact based on the statistical analyses provided by the Household Pulse Survey and the Oxford Covid-19 Government Response Tracker (OxCGRT) from 23 April 2020 to 30 August 2021. To our knowledge, this is probably one of the first study to track the mental health-related effects of state government lockdown policies at the macro level. Compared to other short-term studies at the individual level, our study better conveys the true effects of the "lockdown," with the aim to provide a theoretical consideration for improving the adverse effects of lockdown policies on mental health and to contribute practical implications for improving individuals' mental health during the lockdown period.

METHODS

Sample and Data Sources

We used the National Center for Health Statistics (NCHS) and the Census Bureau's ongoing Household Pulse Survey as our primary data sources. To detect changes of individuals' mental health during the COVID-19 pandemic, the NCHS, in collaboration with the Census Bureau, set up this survey dataset, which includes individual-level information on age, gender, race and ethnicity, educational attainment, and location, administered electronically to adults aged 18 years and elder in each U.S. state through an Internet-based questionnaire supplemented by email and text messaging. The survey began on 23 April 2020 and continues to date. Based on the survey data, we collected data from April 23, 2020 to August 30, 2021 and created panel data with a 12-day statistical period with a total sample of 1,734. In addition, we added data on government lockdown policies adopted during the COVID-19 pandemic from the OxCGRT. Our state-level control variables, such as the number of hospital beds, was obtained from the Statista database; the average hourly wage was from the Federal Reserve Economic Database (FRED); GDP and unemployment rates were from the US Bureau of Labor Statistics; all other control variables were from the OxCGRT.

Measures

Dependent Variable

The dependent variable in this study is the degree of individuals' mental health. We used the estimates of depression and anxiety disorders published by the NCHS and the Census Bureau as proxies for measuring mental health, which has been shown to be an important measurement in previous studies (26–28). Higher estimates of depression and anxiety represent more severe mental health conditions.

Independent Variables

The independent variable is the government lockdown policies during the COVID-19 pandemic. We carefully selected the stringency index developed by the OxCGRT to measure the intensity of lockdown policies implemented by each state government (29). Specifically, the stringency index records the stringency of lockdown policies that restrict individuals' behavior, and is a composite measure consisting of eight restrictive indicators: school closures, workplace closures, cancellation of public events, restrictions on gatherings, public transport closures, stay-at-home requirements, restrictions on internal movement, and international travel controls.

Moderating Variables

In this study, the economic support policies adopted by the government during the COVID-19 pandemic are used as a moderating variable. This variable is also derived from the OxCGRT, from which we selected the economic support index to measure the intensity of economic support policies implemented by the government in each state (29). The index records the governments' economic policies and is also a composite measure that includes four indicators: income support, debt relief, fiscal measures, and international support.

Control Variables

We controlled for a number of regional pandemic and macroeconomic factors that may affect the estimates. We first controlled for the severity of the COVID-19 pandemic, measured as the number of confirmed cases in each U.S. state (30). The amount of available health care resources in each state may have an impact on individuals' mental health, and inadequate resources may cause panic and anxiety, thus we controlled for health care resources, measured as the natural logarithm value of the number of total hospital beds in each state. We then controlled for the intensity of vaccine policy implementation in each state, assigning values from small to large based on the range of people covered by vaccination (29). In addition, we controlled for some macroeconomic factors, including state GDP, average hourly wages, and unemployment rates for each state. Finally, we added regional dummies to control for unobserved heterogeneity across states.

Estimation Models

We mainly considered two dependent variables, depression and anxiety disorders, in this study, and therefore two regression equations were included in our estimation models. The first equation examines the effect of government lockdown policies on individuals' depression and the moderating role of government economic support. The second equation examines the effect on individuals' anxiety and the moderating role of government economic support. In summary, the following OLS models were developed for the baseline regressions:

$$\boldsymbol{Depression} = \boldsymbol{\alpha_0} + \boldsymbol{\alpha_1}\ \boldsymbol{Lockdown_{it}} + \boldsymbol{\alpha_2}\ \boldsymbol{Lockdown_{it}} \times \boldsymbol{Economic\ Support_{it}} + \sum \boldsymbol{Control_{it}} + \boldsymbol{\delta_t} + \boldsymbol{\mu_{it}}$$

where $i =$ state, $t =$ year, μ_{it} is the standard error term, and δ_t is the regional fixed effect.

$$\boldsymbol{Anxiety} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\ \boldsymbol{Lockdown_{it}} + \boldsymbol{\beta_2}\ \boldsymbol{Lockdown_{it}} \times \boldsymbol{Economic\ Support_{it}} + \sum \boldsymbol{Control_{it}} + \boldsymbol{\gamma_t} + \varepsilon_{it}$$

where $i =$ state, $t =$ year, ε_{it} is the standard error term, and γ_t is the regional fixed effect.

RESULTS

Descriptive Statistics and Correlation Results

Panel A of **Table 1** shows the descriptive statistics and correlation results for all variables, except for the region dummies. To ensure that multicollinearity did not affect the estimation results, we calculated the variance inflation factors (VIFs), which are indicators of covariance between predictors. The results show that the VIFs for all variables are below 5.21 (mean = 2.49), well below the generally accepted threshold of 10.0 (31). We also tested the correlation coefficients between the variables, with a maximum value of 0.598, which is less than the acceptable value of 0.700 (32). Therefore, multicollinearity is not an important concern in our study.

Empirical Tests

Panel B of **Table 1** presents the OLS estimation results of the government lockdown policies and individuals' mental health. Models 1–3 test the impact of government lockdown policies on depression. Model 1 is a baseline model only including control and moderating variables. In Model 2, we added the independent variable, government lockdown policies (*Lockdown*), and the results suggest a significantly positive relationship between government lockdown policies and depression ($\alpha_1 = 0.041$, $p < 0.01$), in line with our expectation. We argued that the government economic support can mitigate the depression brought about by the lockdown, representing a negative moderating role. As shown in Model 3, the coefficient on the interaction term between government lockdown policies and government economic support (*Lockdown* × *Economic support*) is negative and significant ($\alpha_2 = -0.007$, $p < 0.05$), which supports our expectation. To gain more insight into this interaction, we plotted these relationships in **Figure 1A** (33). The figure shows that the positive relationship between the lockdown and depression is weaker as the intensity of government economic support is high, and stronger as the intensity of government economic support is low.

Models 4–6 examine the impact of government lockdown policies on anxiety disorders. Model 4 is a baseline model only including control and moderating variables. Similarly, we added the independent variable (*Lockdown*) in model 5 to examine the relationship between government lockdown policies and anxiety disorders. The results show a significantly positive relationship ($\beta_1 = 0.034$, $p < 0.01$), in line with our expectation that lockdowns will lead to more severe mental health problems. Model 6 examines the moderating effect of government economic support, and the results show that the coefficient on the interaction term (*Lockdown* × *Economic support*) is negative and significant ($\beta_2 = -0.010$, $p < 0.05$), suggesting that the relationship between the lockdown and anxiety disorders is weakened by higher levels of government economic support. Similarly, we plotted the slope of the simple regression reflected in Model 6. **Figure 1B** depicts the slope of the relationship. As can be seen, the slope of the line associated with lower economic support is significantly higher than the line associated with higher economic support.

DISCUSSION

The aim of this study is to examine the impact of the intensity of the lockdown policies imposed by the state governments on the mental health of U.S. individuals during the COVID-19 pandemic. We investigated our analyses based on the following two questions: (1) do government lockdown policies lead to a worsening of individuals' mental health? (2) to what extent does the relationship between lockdown policies and mental health vary across states depending on the level of government economic support? Specifically, we find that government lockdown policies are associated with increases in

TABLE 1 | Estimation results.

(A) Descriptive statistics and correlations

Variables	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Depression	24.883	4.422	1.000						
(2) Lockdown	46.054	15.276	0.106	1.000					
(3) Beds	9.479	1.024	0.239	−0.084	1.000				
(4) Confirmed cases	11.319	1.884	0.133	−0.507	0.598	1.000			
(5) Earnings	28.154	3.224	−0.184	0.296	−0.037	0.120	1.000		
(6) Unemployment	7.693	3.441	0.028	0.500	0.124	−0.364	0.204	1.000	
(7) Vaccination	1.446	2	−0.333	−0.550	−0.006	0.571	0.056	−0.336	1.000
(8) Economic support	41.814	23.393	−0.085	0.316	−0.075	−0.152	0.352	0.195	−0.089

(B) OLS regression results of the relationship between lockdown and mental health

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Variables	**Depression**	**Depression**	**Depression**	**Anxiety**	**Anxiety**	**Anxiety**
Beds	0.058	0.074	0.192	−1.096**	−1.061**	−0.902*
	(0.374)	(0.381)	(0.386)	(0.455)	(0.460)	(0.464)
Confirmed cases	1.529***	1.627***	1.602***	2.043***	2.107***	2.074***
	(0.120)	(0.125)	(0.125)	(0.133)	(0.135)	(0.135)
Earnings	0.156	−0.084	−0.078	0.040	−0.151	−0.143
	(0.184)	(0.191)	(0.191)	(0.196)	(0.205)	(0.206)
Unemployment	−0.102**	−0.135***	−0.135***	−0.169***	−0.199***	−0.199***
	(0.044)	(0.045)	(0.045)	(0.046)	(0.047)	(0.047)
Vaccination	−1.614***	−1.498***	−1.478***	−2.287***	−2.185***	−2.158***
	(0.064)	(0.070)	(0.070)	(0.068)	(0.075)	(0.076)
Economic support	0.003	0.000	0.014	0.005	0.002	0.020**
	(0.006)	(0.006)	(0.009)	(0.007)	(0.007)	(0.009)
Lockdown		0.041***	0.043***		0.034***	0.036***
		(0.009)	(0.009)		(0.010)	(0.010)
Lockdown ×			−0.007**			−0.010**
Economic support			(0.004)			(0.004)
Constant	7.065	10.837*	9.344	21.129***	24.05***	22.04***
	(6.221)	(6.258)	(6.351)	(6.786)	(6.852)	(6.89)
Observations	1309	1305	1305	1309	1305	1305
R-squared	0.565	0.572	0.574	0.602	0.608	0.610
State dummies	Yes	Yes	Yes	Yes	Yes	Yes

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$; Standard errors are in parentheses.*

post-lockdown estimates of depression and anxiety disorders across states. Depending on the spread and infection of COVID-19, state governments have implemented different levels of lockdown policies. The most common types of lockdown are those requiring self-isolation and home quarantine of patients and close contacts, even urban closures in areas with severe outbreaks. Lockdowns appear to be the most effective way to deteriorate the spread of the virus, but it can lead to very serious mental health problems. It is well-documented that lockdowns trigger anxiety and insecurity (34, 35) and alter sleeping habits. During the lockdown, people sleep later than usual, stay in bed longer and sleep poorly (36). At the same time, anxiety and insecurity may be exacerbated by concerns about economic stress and major changes in daily life such as social isolation, possible viral infections, loss of loved ones, and home-schooling children (37). In addition to these phenomena, lockdowns can create social isolation and that people usually feel lonely after severe social isolation, and it is obviously that both loneliness and social isolation negatively affect mental health (38). Furthermore, we found that younger individuals in our sample were more likely to feel depressed and anxious than older ones, with emerging adults (aged 18–29) being the group most sensitive to the mental health impact of the COVID-19 pandemic. Emerging adulthood is a developmental period characterized not only by positive role transitions into full autonomy (e.g., living independently, entering the labor market, getting married), but also by high-risk behaviors such as heavy episodic drinking (39).

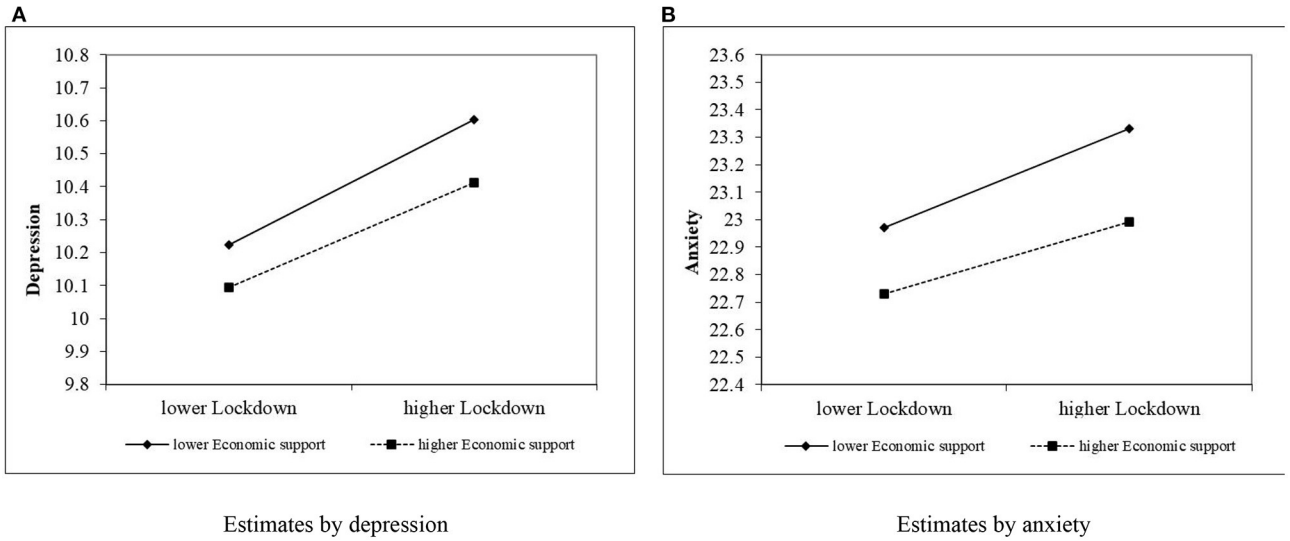

FIGURE 1 | Moderating effect of economic support on the relationship between lockdown and mental health. **(A)** Estimates by depression, **(B)** Estimates by anxiety.

Secondly, our study also shows that economic support from the government alleviates the symptoms of depression and anxiety associated with the lockdowns. Another important source of stress is economic hardship (40), and economic support as a positive intervention can mitigate the impact of negative events on individuals. Lockdown brings social isolation and anxiety, where any unexpected event such as illness or accident becomes a psychological threat and burden to individuals, while a wealthy economic base will greatly increase the individuals' ability to resist physical and psychological risk. In addition, the economic downturn caused by the COVID-19 pandemic leads to a period of economic instability during which people face unemployment and low income and develop negative perceptions about their future lives, which lead to anxiety and depression. It has been shown that a reduction in income is the greatest predictor of the development of psychological disorders during the recovery period after the SARS outbreak (41). Therefore, high-quality economic support from the government during the pandemic may enable individuals to escape from their psychological conflict-induced anxiety state, to better adapt to their environment and cope with stress, and to increase resilience.

CONTRIBUTIONS AND PRACTICAL IMPLICATIONS

This study makes several important contributions to the relationship between government lockdown policies and mental health during the COVID-19 pandemic. First, our study uses the data from the Household Pulse Survey and OxCGRT, takes the mental health values of all 50 states in the United States as the research samples, to examine the actual impact of government lockdown policies on mental health at the macro level, whereas most of the existing research on the relationship between lockdowns and mental health has been conducted at the individual level using first-hand survey data (7, 42, 43). Second, we found that most of the literature related to the pandemic lockdown to date has been dominated by short-term studies (8, 44), with a statistical time span of about 1 month, which does not allow for long-term tracking of the impact of lockdown policies implemented after the pandemic on mental health. Since our study covered nearly 2 years after the pandemic, we examined the impact of the government lockdown from 23 April 2020 to 30 August 2021, which better conveys the true effects of the lockdown than previous studies.

Furthermore, by exploring the relationship between the lockdown and mental health during the COVID-19 pandemic and the moderating effect of economic support, we aimed to provide a theoretical lens for ameliorating the negative impact of the lockdown on mental health and to provide practical strategies for improving the mental health of the population during the lockdown. On the one hand, from the government perspective, the implementation of lockdowns is necessary to deteriorate the spread of the pandemic (45). Although it can be effective in reducing the speed and extent of the pandemic, our study shows that it can be a significant threat to individuals' mental health. We have also demonstrated that government economic support can alleviate anxiety and depression, and we therefore suggest that the government should provide appropriate policy care for the isolated, such as income and debt support, unemployment subsidies for residents, and accelerate the establishment and improvement of an economic support system for the isolated to give them the courage to face the pandemic. Only with these measures can they face their study, work and life during the pandemic. On the other hand, from the individual's point of view, the quarantined can gain moral support and material care by confiding in or seeking help from colleagues, relatives and friends, thus enhancing their confidence in facing the

tremendous pressure brought by the pandemic and relieving negative emotions and psychological stress.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

There are several additional limitations to this study that need to be addressed. The first limitation relates to our measurement of regional mental health in the lockdown situation. We used only two measures of mental health, anxiety, and depression, in this study. Although these two measures are probably the most important indicators of mental health, subsequent studies will need to design and use tailored measures for psychosocial characteristics of different populations, such as loneliness and sleeping quality. In addition, due to the limitations of the dataset we used, we were unable to control for individual-level characteristics, which may have led to some bias in our results. Further research is expected to measure and compare in depth the effects of variables such as age, gender, education, work, and health conditions on mental health, providing more detailed and accurate information.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding authors.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.857444/full#supplementary-material

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Prevalence and Related Factors of Anxiety Among University Teachers 1 Year After the COVID-19 Pandemic Outbreak in China: A Multicenter Study

Wenning Fu[1], *Xiaotong Han*[2,3], *Yifang Liu*[1], *Li Zou*[7], *Jing Wen*[1], *Shijiao Yan*[2,4*†] and *Chuanzhu Lv*[5,6*†]

[1] School of Nursing, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, [2] Department of Emergency Medicine, Hunan Provincial People's Hospital/The First Affiliated Hospital, Hunan Normal University, Changsha, China, [3] Clinical Research Center for Emergency and Critical Care in Hunan Province, Changsha, China, [4] School of Public Health, Hainan Medical University, Haikou, China, [5] Emergency Medicine Center, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [6] Key Laboratory of Emergency and Trauma of Ministry of Education, Hainan Medical University, Haikou, China, [7] Department of Neurology, Zhongnan Hospital of Wuhan University, Wuhan, China

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***Correspondence:**
Shijiao Yan
2848036052@qq.com
Chuanzhu Lv
lvchuanzhu677@126.com

[†]These authors have contributed equally to this work

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Objectives: This study aimed to evaluate the prevalence of anxiety among university teachers 1 year after the onset of the coronavirus disease 2019 (COVID-19) pandemic and provide empirical evidence of psychological intervention.

Methods: A multicenter study was conducted to examine the prevalence of anxiety among 10,302 teachers in 21 Chinese universities from February 12 to April 23, 2021. The generalized Anxiety Disorder 7-item Scale (GAD-7) was used to assess symptoms of anxiety. Multivariate logistic regression models were used to analyze the relationship between potential influence and anxiety symptoms.

Results: The overall prevalence of anxiety was 40.0% 1 year after the onset of the COVID-19 pandemic, which was found to be higher in women than in men (41.32% vs. 38.22%; $p < 0.0001$). The multivariate logistic regression showed that being the female (*OR* = 1.207; *95%CI*: 1.103–1.318), age ≥60 years (*OR* = 2.004; *95%CI*: 1.128–3.560), being married (*OR* = 1.319; *95%CI*: 1.150–1.513), and poor family economic status (*OR* = 1.580; *95%CI*: 1.321–1.891) were significantly associated with anxiety. Participants with moderate, slight, or no impact of COVID-19 on life (*OR* for moderate, 0.557; *95%CI*, 0.508–0.611; *OR* for slight/no, 0.377; *95%CI*, 0.323–0.439) showed a reduced risk of anxiety compared to those who reported a significant effect.

Conclusions: Symptoms of anxiety were found in about two-fifths of Chinese university teachers 1 year after the outbreak of the COVID-19 pandemic. Our findings suggest that the government should improve the dynamic tracking of mental health and adopt long-term intervention strategies.

Keywords: COVID-19, university teachers, anxiety, China, mental health

INTRODUCTION

The Coronavirus disease 2019 (COVID-19) was first reported in China, becoming a global pandemic in March 2020 (1). However, it has not yet been completely controlled, even though it has been more than a year since the outbreak. COVID-19 and quarantine policies have spread anxiety throughout the population (2–4). According to the Global Burden of Disease Study (GBD) 2019, anxiety disorder is a disabling mental disorder and the leading cause of death (5). A previous study showed that approximately 34% of the general population reported moderate or above anxiety symptoms at the start of the pandemic in China (6).

Many countries adopted school closures as an effective measure to mitigate the spread of the pandemic (7). This accelerated shifts in educational approaches, leading to adverse effects on the mental health of teachers (8, 9). Prior to the COVID-19 pandemic, the prevalence of anxiety among teachers was only 4.98% in 2013 (10), which reached 13.67% in the first wave of the pandemic (February 4, 2020, to February 12, 2020) (11). As sociocultural populations, university teachers have borne the dual pressure of teaching and research and have been at a higher risk of psychological distress (10, 12). The spread of the pandemic might also change the psychological health status of university teachers. However, to the best of our knowledge, studies have not been conducted on the anxiety status of university teachers 1 year since the outbreak of the pandemic. Hence, this was the first and largest multicenter study to explore the prevalence of anxiety and related factors among teachers at 21 universities 1 year after the onset of the COVID-19 pandemic in China. Considering that humans would have to coexist with viruses for a long time, our study could provide clues for promoting the psychological health of teachers in this context.

METHODS

Sample and Data Collection

This multicenter study was conducted 1 year after the outbreak of the COVID-19 pandemic worldwide (February 12–April 23, 2021). The study was approved by the Haikou Research Ethics Committee of Hainan Medical University. In this study, the structure of the questionnaire included a cover letter, instructions, questions and answers, and coding. Questionnaires for the online survey were sent put anonymously using the Questionnaire Star (https://www.wjx.cn). All respondents signed an electronic informed consent form before participating in the study. In addition, logic checks were built into the background system to ensure the quality and integrity of the study. The answers to all valid questionnaires were automatically entered into a data file and then checked by two independent researchers. Participants were not allowed to answer the questionnaire repeatedly, and each device (such as a mobile phone or computer) was only eligible for one response per question. The informed consent page presented two options (yes/no). Only participants who chose "yes" were taken to the questionnaire page. The questionnaire included questions about general demographic characteristics, concerns about COVID-19, the impact of COVID-19 on life, social support, and anxiety symptoms.

The formula for estimating the sample size of the survey rate is $n = (Z_{\alpha/2}/\delta)^2\ \pi\ (1\text{-}\ \pi)$. According to literature reports, the prevalence of anxiety among Chinese adults over the age of 18 is 4.98% (10), that is, $\pi = 0.0498$, $Z_{0.05/2} = 1.96$, $\alpha = 0.05$, $\delta = 0.00498$, then $N = 7{,}330$. Taking into account the invalid questionnaires, the sample size was set at 10,500. Based on the calculation results of sample size, in this study, the sampling process included two stages. In the first stage, 21 universities in Hainan Province were randomly selected based on a simple random sampling principle. In the second stage, online questionnaires were sent to the faculty and staff of the 21 selected universities through the Department of Academic Affairs and other departments. The inclusion criteria were participants who: (1) aged 18 years and older; (2) university teachers; (3) have provided informed consent electronically prior to registration. Exclusion criteria were participants who: (1) have been suffering from baseline psychological diseases; (2) offered the questionnaire with logical errors. Finally, 10,302 valid questionnaires were collected, with a response rate of 98.11%.

Measurements

The Generalized Anxiety Disorder 7-Item Scale (GAD-7) was used to assess the degree of anxiety symptoms. The GAD-7 scale developed by Spitzer (13) was confirmed to have good factorial validity and reliability for the assessment of anxiety in the Chinese population (14). The scale contained seven items, with each item scored from 0 to 3, and the total scale score ranged from 0 to 21. According to the total score range, 0–4 points, 5–9 points, 10–14 points, and ≥15 points were considered as exhibiting no anxiety, mild anxiety, moderate anxiety, and severe anxiety, respectively. In the present study, the GAD-7 demonstrated high internal consistency (Cronbach's $\alpha = 0.94$).

Social support was assessed using the Multidimensional Scale of Perceived Social Support (MSPSS) (15). The scale consisted of 12 items, with response options ranging from 1 (very strongly disagree) to 7 (very strongly agree). The MSPSS is used to assess the quality of social support from family, friends, and significant others in three categories. The scoring rule was as follows: the total scores ranged from 12 to 84, with higher scores representing higher levels of social support. The MSPSS scores of 12–36, 37–60, and 61–84 were considered to be low, medium, and high-level support, respectively. The MSPSS showed good factorial validity and reliability among teachers (16). Cronbach's alpha for the MSPSS was 0.97 in this study.

Statistical Analysis

A descriptive analysis was conducted on the sociodemographic characteristics of teachers using frequency and percentage. The Chi-square test was used to compare demographic data, levels of social support, and prevalence of anxiety among the different groups. Additionally, multivariate logistic regression models were used to explore the influencing anxiety symptoms. All statistical analyses were performed using SPSS (version 21.0; SPSS Inc., Chicago, IL, USA). Furthermore, $p<0.05$ (double-tailed) was considered statistically significant.

RESULTS

General Sample Characteristics

A total of 10,302 university faculty and staff participated in the survey; of them 4,542 were men (44.09%) and 5,760 were women (55.91%). Most of them were aged 31–60 years (67.79%). In addition, some were aged ≤ 30 years (31.53%) and very few were aged ≥ 60 years (0.68%). In the level of social support, most perceived to have low support (71.11%), moderate support (27.74%), and high support (1.15%).

The Prevalence and Differences of Anxiety Among University Teachers 1 Year After the COVID-19 Outbreak

The prevalence of anxiety was 40.0% 1 year after the COVID-19 pandemic, and it was higher in women than in men (41.32% vs. 38.22%, $p < 0.05$). Additionally, the prevalence of anxiety among those who reported a quite impact of COVID-19 on their lives was 49.16%. The distribution of anxiety symptoms in the population is not random and there are differences. There were statistically significant differences in the prevalence of anxiety among university teachers of different ages, working years, self-perceived family economic status, and social support (all $p < 0.0001$). The prevalence of anxiety among teachers who reported a greater impact of COVID-19 on life was significantly higher ($p < 0.0001$). In addition, marriage and occupation were associated with the prevalence of anxiety ($p < 0.05$) (**Table 1**).

The Influential Factors Associated With Anxiety University Teachers 1 Year After the COVID-19 Outbreak

Screening positive for anxiety among university teachers was associated with being female, age >60 years, married, bad family economic status, 1–5 years of work, and a quite impact of COVID-19 on life. The multivariate logistic regression analysis showed that female teachers had a higher risk of anxiety symptoms (*OR* = 1.207; 95%*CI*: 1.106–1.318). Compared with teachers aged ≤30 years, those aged ≥60 years had a significantly higher risk of anxiety (*OR* = 2.004; 95%*CI*: 1.128–3.560). Additionally, there was a higher risk of anxiety in married teachers (*OR* = 1.319; 95%*CI*: 1.150–1.513) than in unmarried teachers. In addition, those who reported poor family economic status were associated with a higher risk of anxiety than those who reported good economic status (*OR* = 1.580; 95%*CI*: 1.321–1.891). However, teachers who had worked 11–20, 20–30 years, and longer than 30 years showed a lower risk of anxiety than teachers who had worked for 1–5 years. Those who reported a moderate, slight, or no impact of COVID-19 on their lives showed a reduced risk of anxiety compared to those who reported a quite impact (*OR* for moderate, 0.557; 95%*CI*, 0.508–0.611; *OR* for slight/no, 0.377; 95%*CI*, 0.323–0.439) (**Table 2**).

DISCUSSION

This multicenter study investigated anxiety symptoms among 10,320 teachers from 21 universities 1 year after the start of the COVID-19 pandemic. The results indicated that a significant proportion of the university faculty and staff had mental health problems, with 4,542 (40.0%) participants reporting anxiety symptoms. Previous studies confirmed that the prevalence of anxiety increased owing to COVID-19 (17, 18). The percentage of anxiety among university teachers in this study is close to 34.6% of that reported in a survey of university professors when the COVID-19 pandemic outbreak almost 1 year in Brazil (19). That is, anxiety symptoms seem to be very common among university teachers during the COVID-19. University teachers undertake the task of teaching and play the role of researchers (20). Owing to the COVID-19 pandemic, many university teachers could not continue their research projects. A study of teachers from kindergarten to university in China in the same period showed that 17.7% of teachers reported symptoms of anxiety, with a significantly higher percentage of university teachers reporting moderate and severe anxiety than teachers in other types of schools (21). Therefore, we suggest that the COVID-19 is a more significant psychological challenge for university teachers. Studies have shown that negative psychological emotions, such as stress and anxiety, have an impact on teachers' health (11, 22), leading to a decrease in their work enthusiasm and a decline in teaching quality (23). Simultaneously, anxiety is also an important cause of death among teachers (24). Therefore, a comprehensive investigation and intervention should be conducted on the mental health of university teachers in the current pandemic situation.

We also found that gender, age, marriage, economic status, years of work, and the degree of impact of COVID-19 on life were associated with anxiety. As in previous studies, women have been identified to be at a higher risk of mental health problems (11, 25). We believed that the possible mechanisms involved physical and psychological components. Influenced by gender chromosome genes and psychological characteristics, women are found to exhibit more self-blame in stressful events and show a tendency toward avoidance, depression, and other negative coping methods, which are closely related to the increase in anxiety symptoms in women (26). Additionally, we found that participants aged ≥60 years were more likely to have anxiety than those aged ≤30 years. First, older teachers had a higher risk of infection and poorer prognosis. Consequently, health stress and negative emotions were worse in older than in younger people, as confirmed in other studies (27, 28). Second, a recent study has confirmed that social networks could influence mental health in older adults who have struggled to reap the benefits of electronic social networks. COVID-19 has resulted in prolonged social isolation among older individuals, leading to aggravated anxiety symptoms (29). Interestingly, we found that the risk of anxiety among married university teachers was 1.319 times higher than that of unmarried teachers. Previous research also showed that married teachers appear to be under greater stress. They are required to take on more family responsibilities and worry more about parents and children influence the COVID-19 than unmarried teachers (22, 30). In addition, studies have shown that COVID-19 exacerbates teachers' job instability and increases the rate of layoffs, thus increasing the economic pressure on teachers (25, 31). This phenomenon was also reflected in our

TABLE 1 | The anxiety of university teachers 1 year after COVID-19 pandemic.

Variables	Total (*n*)	Anxiety (%)	*F*/*t* value	*P*-value
Gender				
Male	4,542	1,736 (38.22)	10.1610	0.0014
Female	5,760	2,380 (41.32)		
Age				
18–30	3,248	1,403 (43.20)	34.0309	<0.0001
31–40	3,653	1,473 (40.32)		
41–50	2,301	863 (37.51)		
51–60	1,030	350 (33.98)		
>60	70	27 (38.57)		
Ethnic group				
Ethnic Han	9,379	3,750 (39.98)	0.0381	0.8453
Others	923	366 (39.65)		
Years of work				
1–5	3,853	1,662 (43.14)	47.3024	<0.0001
6–10	1,923	785 (40.82)		
11–20	2,582	1,007 (39.00)		
21–30	1,278	452 (35.37)		
>30	666	210 (31.53)		
Marriage				
Not-married	3,173	1,311 (41.32)	11.0638	0.0114
Married	6,761	2,681 (39.65)		
Widowed	40	9 (22.50)		
Divorced	328	115 (35.06)		
Self-perceived family economic status				
Good	1,053	330 (31.34)	149.1549	<0.0001
Fair	7,544	2,894 (38.36)		
Bad	1,705	892 (52.32)		
Impact of COVID-19 on life				
Quite impacted	5,350	2,630 (49.16)	431.9809	<0.0001
Moderately impacted	3,752	1,218 (32.46)		
Slightly or not impacted	1,200	268 (22.33)		
Concern about COVID-19				
Quite concerned	9,615	3,844 (39.98)	0.0067	0.9347
Moderately concerned	663	261 (39.37)		
Slightly or not concerned	24	11 (45.83)		
Social support				
High	118	59 (50.00)	286.2510	<0.0001
Moderate	2,858	1,511 (52.87)		
Low	7,326	2,546 (34.75)		
Total	10,302	4,116 (39.95)		

study in that teachers with poor economic status had a higher detection rate of anxiety symptoms. Furthermore, the risk of anxiety was higher among teachers with <5 years of experience. The reasons for this may be attributed to the fact that new teachers who graduate from college and enter the workforce with low control over the content of their work (32). According to previous studies, teachers with more years of experience are more capable of solving problems independently in their daily work (33). Therefore, they have a higher ability to cope with the dual stress of the pandemic and the profession. Even though, there were differences in the risk of anxiety among university teachers in different occupation types, occupation type was not an influential factor in teacher anxiety. Thus, all teachers should be covered, whether they are in teaching positions, management positions, or others, when adopting psychological interventions for university teachers. The results of this study showed that the degree of impact of COVID-19 on life was an important influencing factor for university teachers. This is in line with a study conducted by Fu (4). Evidently, individuals whose lives are severely impacted by COVID-19, especially those who have lost family members, should be the focus of our subsequent intervention.

TABLE 2 | Multivariate logistic regression analysis of factors associated with university anxiety among university teachers.

Variables		*SE*	*Wald*	*P*	*OR*	*95%CI*
Gender						
Male	Reference					
Female		0.0447	17.6962	<0.0001	1.207	1.106–1.318
Age						
18–30	Reference					
31–40		0.0790	0.6344	0.4258	0.939	0.804–1.096
41–50		0.0982	0.1142	0.7354	1.034	0.853 1.253
51–60		0.1333	1.1396	0.2857	1.153	0.888–1.497
>60		0.2933	5.6145	0.0178	2.004	1.128–3.560
Years of work						
1–5	Reference					
6–10		0.0723	2.0983	0.1475	0.901	0.782–1.038
11–20		0.0764	3.8941	0.0485	0.860	0.740–0.999
21–30		0.1027	4.0097	0.0452	0.814	0.666–0.996
>30		0.1478	7.5007	0.0062	0.667	0.499–0.891
Marriage						
Not-married	Reference					
Married		0.0699	15.7075	<0.0001	1.319	1.150–1.513
Widowed		0.4025	3.0645	0.0800	0.494	0.225–1.088
Divorced		0.1412	0.0469	0.8286	1.031	0.782–1.360
Self-perceived family economic status						
Good	Reference					
Fair		0.0761	2.9402	0.0864	1.139	0.982–1.323
Bad		0.0915	25.0190	<0.0001	1.580	1.321–1.891
Impact of COVID-19 on life						
Quite impacted	Reference					
Moderately impacted		0.0473	153.0590	<0.0001	0.557	0.508–0.611
Slightly or not impacted		0.0787	154.0149	<0.0001	0.377	0.323–0.439
Social support						
High	Reference					
Moderate		0.1985	3.0424	0.0811	1.414	0.958–2.086
Low		0.1965	2.9217	0.0874	0.715	0.486–1.050

The relationship between social support and mental health was not conclusive for a long time (34, 35). Many scholars generally regarded social support as a protective factor for mental health; a lower level of social support is negatively correlated with anxiety symptoms (34). However, the findings of this study revealed a different viewpoint. This may be attributed to the following reasons: (1) the protective effect of perceived social support on university teachers was weak; and (2) the number of teachers with a high level of perceived social support was very small in this study, and more than half of the teachers had a low level of social support; therefore, the sample size should be increased to confirm the accuracy of the research conclusion. Nevertheless, further expansion of our study is needed to assess the stability and reliability of our results.

Strengths and Limitations

This study had several advantages. First, to the best of our knowledge, this is the first and largest multicenter survey of anxiety among university teachers conducted 1 year after the outbreak of the COVID-19 pandemic. Second, this study showed that nearly half of the university teachers had psychological problems. Considering the continued spread of the pandemic and the complexity of its psychological impact on teachers, this study could provide a valuable reference for the management of psychological problems among teachers in other regions and countries. However, our study had a limitation, in that it was a cross-sectional study and lacked longitudinal follow-up. Therefore, causality could not be established. Hence, further investigation is required on the long-term psychological effects of the pandemic on teachers. In addition, the universities included in this study were all public institutions, and the data collection did not collect information on teachers' anxiety at different levels, and there were some limitations in extrapolating the research results to different levels of teachers in more public and private universities.

CONCLUSION

About two-fifths of Chinese university teachers experienced anxiety symptoms 1 year after the start of the COVID-19 pandemic. Therefore, the government should focus on the mental health of teachers, particularly female and older teachers. In addition, we believed that dynamic and long-term psychological intervention measures should be taken to reduce the adverse psychological effects of the COVID-19 pandemic on teachers. These findings might be useful for providing a current anxiety profile of university teachers 1 year after the onset of the COVID-19 and pandemic for functioning as a reference point for further studies.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary materials, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Research Ethics Committee of Hainan Medical University in Haikou, China. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

WF, YL, and CL conceived and designed the study. LZ, SY, JW, XH, and WF participated in the acquisition of data. WF, XH, and SY analyzed the data. YL, XH, and CL gave advice on methodology. WF drafted the manuscript, XH, YL, and CL revised the manuscript. All authors read and approved the final manuscript.

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Neurological and Psychological Characteristics of Young Nitrous Oxide Abusers and Its Underlying Causes During the COVID-19 Lockdown

Gang Wu[1,2†], *Shanshan Wang*[2†], *Tingling Wang*[2], *Jiali Han*[2], *Anna Yu*[3], *Changqiang Feng*[1], *Yajing Wang*[2] *and Suzhi Liu*[2*]

[1] Department of Pharmacy, Taizhou Hospital of Zhejiang Province Affiliated to Wenzhou Medical University, Linhai, China,
[2] Department of Neurology, Taizhou Hospital of Zhejiang Province Affiliated to Wenzhou Medical University, Linhai, China,
[3] Department of Mental Health, Taizhou Hospital of Zhejiang Province Affiliated to Wenzhou Medical University, Linhai, China

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Edited by:
Xenia Gonda,
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***Correspondence:**
Suzhi Liu
liusz@enzemed.com

[†]These authors have contributed equally to this work and share first authorship

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Background: The COVID-19 pandemic has a serious impact on the mental health of the public due to its economic and social impact. And psychological effects have led to drug and alcohol abuse. After the city lifted the lockdown, we consecutively encountered several young nitrous oxide abusers admitted to hospital for neurological treatment.

Purpose: To inform physician decisions and social intervention, this observational study aimed at investigating the neurological and psychological characteristics of nitrous oxide abusers and its underlying causes during the COVID-19 lockdown.

Methods: The nitrous oxide abusers who sought neurological treatment at our hospital between May 2020 and June 2020 were enrolled. Clinical data including socio-demographic, physical examination, laboratory examination, electromyography and neuroimaging were collected. Their motivations for inhaling nitrous oxide, knowledge about the nitrous oxide abuse and the accompanying of family were investigated face to face. Psychological status was assessed by the Symptom Checklist 90 (SCL-90) psychological evaluation.

Results: Six nitrous oxide abusers were enrolled and the age was 22 ± 4.3. Clinical presentations included varying degrees of limb numbness and an ataxic gait. Laboratory examination revealed that all the patients did not have pernicious anemia, 4 patients had decreased vitamin B12 while 3 patients exhibited elevated homocysteine levels. MR of the spinal cord revealed that 4 patients had abnormal signals in the cervical spinal cord of high symmetry with splayed or inverted V sign after T2WI. Electromyogram (EMG) test showed 5 patients had peripheral nerve damage. The SCL-90 psychological evaluation results indicated that all patients had severe anxiety, depression and psychosis and they had severer psychological problems than ordinary citizens. Their motives for inhaling nitrous oxide are to relieve boredom, curiosity and buddy pressure. Their family spent <1 day per week to stay with them during city lockdown.

Conclusion: The enrolled patients caused by abuse of nitrous oxide presented with symptoms of subacute combined with spinal degeneration. They had more serious psychological problems related to the COVID-19 pandemic. These cases make us value the psychological problems of young people under the outbreak and take multi-layered measures from families, schools (companies), hospitals, and governments to address it.

Keywords: COVID-19, nitrous oxide, neurological, psychological, subacute combined degeneration of the spinal cord

INTRODUCTION

The COVID-19 pandemic and the ensuing lockdown have had a serious impact on the physical and mental health of the public (1, 2). And the psychological effects have led to drug and alcohol abuse (3). After the city lifted the lockdown, we consecutively encountered some young nitrous oxide abusers who were admitted to hospital for neurological treatment, which was a significant increase compared with the same period. It is important to characterize their neurological and psychological outcomes and explore the underlying causes in order to improve the clinical management during the COVID-19 pandemic period.

MATERIALS AND METHODS

Study Design and Participants

Patients attending Taizhou Hospital of Zhejiang Province for care due to nitrous oxide abuse were consecutively enrolled. Clinical data including sociodemographic characteristics, physical examination, laboratory examination, electromyography, neuroimaging, and psychological assessment were obtained. The duration and frequency of nitrous oxide use, the sources of laughter were inquired. Their motivations for inhaling nitrous oxide were investigated face to face. The family environment, siblings, interpersonal relationships, personality traits, financial conditions, and academic performance were investigated. The survey about the time their parents or family member spent to stay with them and knowledge about the nitrous oxide abuse was carried out. The history of physical illness and family history were recorded. After the city was unsealed, the first two nitrous oxide abuser came to the hospital for neurological treatment at the same time. We thought it might be a phenomenon and therefore started this observational study. The study was done between May 2020 and June 2020.

All data were anonymized to comply with the provisions of personal data protection. The participants have provided their consent to publish the observational study, and the consent procedure was approved by the Ethics Committee of Taizhou Hospital of Zhejiang Province. All procedures were performed according to the guidelines of the institutional ethics committee and the tenets of the Declaration of Helsinki were adhered to throughout.

Abbreviations: SCL-90, Symptom Checklist 90; EMG, Electromyogram; MRI, Magnetic Resonance Imaging; CMAP, Compound muscle action potential; SNAP, Sensory nerve action potential; SCD, Subacute combined degeneration of the spinal cord; COVID-19, Corona Virus Disease 2019; SARS-CoV-2, Severe Acute Respiratory Syndrome Coronavirus 2.

Magnetic Resonance Imaging (MRI)

An MRI scan of the cervical spine and brain was done to all patients. T1WI sequences included MRI sequences with and without gadolinium. Sagittal and axial images were obtained using T2-weighted MRI sequences. Data on the affected spinal cord segments (number of segments of the spine) and their positions on the sagittal image (cervical and thoracic vertebrae) were recorded.

Electromyogram (EMG)

Neurologic manifestations such as muscle weakness, sensory loss, and cognitive decline were recorded. Nerve conduction studies were performed on the median nerve, ulnar nerve, peroneal nerve, tibial nerve, and sural nerve depending on the clinical manifestations of patients. Compound muscle action potential (CMAP) amplitude, distal latency, sensory nerve action potential (SNAP) amplitude, and conduction velocity were detected using a full range functional EMG evoked potentiometer (Keypoint 9033A07, Denmark).

Psychological Assessment

Using Symptom Checklist 90 (SCL-90), the mental state of the patients and ordinary citizens was assessed by a professional psychiatrist. The severity of symptoms (normal, mild, moderate, partial severe, severe, degree from light to heavy) is determined by the number of standard deviations of the dimension score from the norm group mean.

Statistical Analyses

Data were analyzed by the Statistical Package for Social Sciences (IBM SPSS 16.0). Descriptive statistics and one-sample *t*-test were performed for data comparison between nitrous oxide abusers and ordinary citizens. Statistical significance was set at $P \leq 0.05$.

RESULTS

Sociodemographic and Laboratory Characteristics of the Patients

From May 2020 to June 2020, six patients with nerve damage caused by nitrous oxide inhalation were consecutively admitted to our hospital. As shown in **Table 1**, the mean age of the 6 patients was 22 ± 4.3, four were college students while two were high school graduates. The average duration of nitrous oxide

TABLE 1 | Sociodemographic and laboratory characteristics of the case series.

Case	Age	Sex	Education level	Duration of N2O Use (month)	Frequency of N2O Use		Vitamin B12 level (pg/ml)	Homocysteine (μmol/L)
					Before 3rd, Feb (/time, times/month)	After 3rd, Feb (/time, times/week)		
1	19	Male	College student	12	240–480, 4–5	240–480, 2–3	137.3	36.5
2	25	Female	High school	3	0	240–480, 1–2	262.7	7.9
3	28	Male	High school	3	0	240–480, 2–3	139.1	41.2
4	18	Female	College student	12	240–480, 4–6	480–720, 2–3	120.5	12*
5	22	Female	College student	3	0	480–720, 2–3	340.6*	10.5*
6	17	Female	College student	6	240–480, 3–4	240–480, 2–3	112.5	22

*N2O, nitrous oxide. *Values after 2 days medicine treatment.*

abuse was 6.5 ± 4.4 months. Three of them began inhalation of nitrous oxide after 3rd, Feb, the day the city began lockdown. They consumed 240–720 nitrous oxide per time and 1–3 times per week. Nitrous oxide is bought in recreation place or through friends. Most of the patients have decreased vitamin B12 and increased homocysteine.

Half of the patients were only children and half had one sibling. One had a poor interpersonal relationship with his family, and one was doting by his parents. All the patients did not live with their family and their parents or family members spent <2 h a day or 1 day per week to stay with or care for them during city lockdown. Their personality traits were either introverted, or withdrawn, or perverted. Five patients were in good economic condition and one was moderate. Five patients had moderate academic performance and one was lower. In addition, they didn't know that nitrous oxide abuse could lead abnormality of neurological function.

The patients stated that the reasons for nitrous oxide abuse were the lack of employment or study during the pandemic, a history of nitrous oxide abuse and relapse during the pandemic, boredom, curiosity and peer pressure.

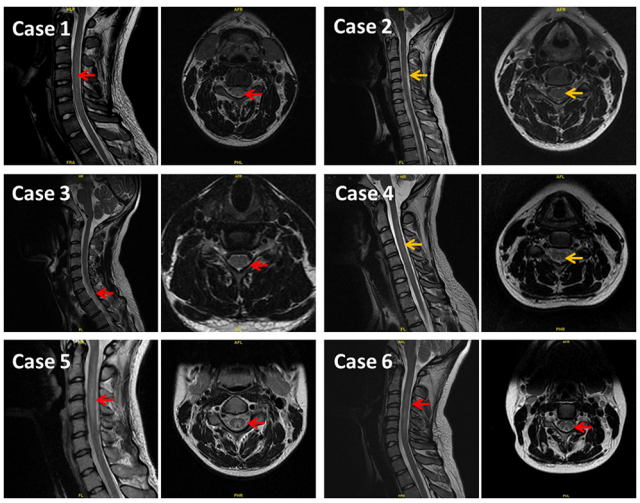

FIGURE 1 | Results of MR T2WI showing high symmetry signal in the cervical spinal posterior cord, presenting splayed or inverted V sign. On the left of each case is sagittal image and on the right is axial image. Red arrows indicate a clearly high signal. Yellow arrows indicate slightly higher or suspicious signals.

Neurological Characteristics of the Patients and Therapeutic Process

In the physical examine, all patients presented with limb numbness and varying degrees of walking instability. Varying degrees of sensory impairment and sensory ataxia were exhibited among the patients. There was no case of a positive pathological sign or obvious damage to the pyramidal tract. EMG examination showed peripheral nerve damage in patients except case 6. The abusers had multiple motor and sensory axonal damage and myelin sheath change, or motor nerve damage, or partial nerve damage. One case (case 4) had decreased muscle strength. Mild memory loss was documented in 2 patients (data not shown).

The imaging results showed that four patients had high symmetric signals with splayed or inverted V signs in the cervical spinal cord after MR T2WI. Case 4 exhibited a slightly high signal while case 1 did not exhibit any imaging abnormalities (see **Figure 1**). All the patients presented no symptoms caused by autoimmune encephalitis, intracranial infection, cerebrovascular disease, brain trauma, tumor, or other toxic/metabolic causes, etc. All were diagnosed with subacute combined degeneration of the spinal cord (SCD). The six patients had improved neurological outcomes after vitamin B12 and adenosine cobalamin therapies for 5–8 days and discharged. They were prescribed vitamin B12 on discharge and told to return do a follow-up check on time.

All the patients had no history of physical illness or family history.

Psychological Characteristics of the Nitrous Oxide Abusers

The SCL90 psychological evaluation results showed that the total score was 303.7 ± 43.1, each case was more than 250 points, and all cases had various psychological problems. The major severe psychological manifestations were anxiety, depression, hostility and psychosis (see **Table 2**).

To analyze the differences in the psychological status of nitrous oxide abusers and normal people, the SCL-90 score

TABLE 2 | The results of psychological assessment by Symptom Checklist 90 evaluation.

Case	Somatization		Obsessive-compulsive		Interpersonal sensitivity	
	Average score	Degree	Average score	Degree	Average score	Degree
1	2.92	Partial severe	3.4	Partial severe	3.78	Partial severe
2	2.5	Moderate	2.4	Mild	4	Partial severe
3	4.33	Severe	3.7	Partial severe	4.11	Severe
4	3.5	Severe	2.2	Mild	2.67	Mild
5	3	Partial severe	3.3	Partial severe	4	Partial severe
6	2.25	Moderate	2.7	Moderate	3.33	Moderate
Case	**Depression**		**Anxiety**		**Hostility**	
	Average score	Degree	Average score	Degree	Average score	Degree
1	4.15	Severe	3.8	Severe	4	Severe
2	3.31	Partial severe	4	Severe	3.5	Partial severe
3	4.62	Severe	4.2	Severe	4	Severe
4	3.62	partial severe	3.4	severe	4	severe
5	4.08	Severe	3.7	Severe	3.5	Partial severe
6	3.08	Partial severe	2.9	Severe	3.83	Severe
Case	**Phobic anxiety**		**Paranoid ideation**		**Psychoticism**	
	Average score	Degree	Average score	Degree	Average score	Degree
1	3.57	Severe	3.33	Partial severe	3.43	Severe
2	2.71	Partial severe	3	Moderate	3.2	Severe
3	4.14	Severe	3.67	Severe	4.2	Severe
4	1.57	Normal	2.5	mild	3.2	severe
5	3.86	Severe	3	Moderate	3	Partial severe
6	2.71	Partial severe	4	Severe	2.3	Moderate

of both groups was compared. The SCL-90 score of ordinary citizens under the level I emergency response was reported in a study which consisted sample size of 1,060 participants (1). It was noted that the SCL-90 scores of nitrous oxide abusers in anxiety, hostility, depression, interpersonal relationships, paranoia, psychosis and somatization were significantly higher than those of health controls, $P < 0.01$(**Table 3**), indicating that these young nitrous oxide abusers presented severer psychological problems than ordinary citizens of the same age. In view of this situation, all the patients were asked to go to the psychological department for check-up after discharge from hospital.

TABLE 3 | Psychological status of the case series according to SCL-90, compared to ordinary citizens during COVID-19.

Dimension	Case series ($n = 6$)	Ordinary citizens ($n = 1,060$)	*t*	*P*
Somatization	3.08 ± 0.75	1.81 ± 0.69	4.171	0.009
Obsessive-compulsive	2.95 ± 0.6	2.24 ± 0.75	2.887	0.034
Interpersonal sensitivity	3.65 ± 0.55	2.06 ± 0.73	7.019	0.001
Depression	3.81 ± 0.58	1.96 ± 0.70	7.856	0.001
Anxiety	3.67 ± 0.46	1.91 ± 0.71	9.287	0.000
Hostility	3.81 ± 0.25	1.86 ± 0.68	19.426	0.000
Phobic anxiety	3.09 ± 0.95	2.03 ± 0.74	2.738	0.041
Paranoid ideation	3.25 ± 0.54	1.93 ± 0.71	6.04	0.002
Psychoticism	3.22 ± 0.62	1.88 ± 0.69	5.331	0.003

DISCUSSION

Due to the COVID-19 pandemic and the lockdown that followed, public psychological problems cannot be ignored. In addition to the heightened mental stresses among patients and healthcare workers during the COVID-19 pandemic, the mental health of healthy people was also affected. There was a drastic increase in public fear, a decline in social and economic activities that triggered psychosocial sequelae. Quarantined individuals exhibited depression, fear, guilt and anger (4). Psychosocial stress due to social changes in response to COVID-19 infections enhanced mental problems (1, 2, 5). In their study, Cuiyan Wang et al. reported that a total of 53.4% of the respondents exhibited either moderate or severe psychological problems under impact of the pandemic, 16.5% exhibited moderate to severe depressive symptoms, 28.8% had moderate to severe anxiety symptoms while 8.1% had moderate to severe stress (6). The psychological

effects lead to drug and alcohol abuse (3, 7). And it is notable that these problems are more likely to happen among children and adolescents (8–10).

After the city lifted the lockdown, we consecutively encountered 6 nitrous oxide abusers who were hospitalized for neurological therapy within 1 month and they were all youth. It is notable that there were only 6 patients of nitrous oxide abuse were treated between October 2017 and December 2019 in our hospital and it cued the effect of the COVID-19 pandemic and the lockdown on public health especially the young. For physician decisions and social intervention, it was urgent to investigate the neurological characteristics and psychological state of them and the underlying causes of nitrous oxide abuse during the COVID-19 lockdown.

For more than 170 years, nitrous oxide has been used as an anesthetic in clinical practice. Its inhalation causes feelings of euphoria, involuntary laughter, distorted voices and mild hallucinations and it gradually becomes a popular way to relieve the pressures among the youth (11, 12). A global drug survey (GDS2014) conducted in 17 countries involving 74,864 patients confirmed that the prevalence of nitrous oxide use as a recreational drug in the UK and US was 38 and 29.4%, respectively (12). Incidences of nitrous oxide abuse in China are gradually increasing, with the majority of the abusers being the youth (11).

The adverse effects of exposure to nitrous oxide include slowed reaction rate, dizziness, nausea and vomiting. Inhalation of large quantities of nitrous oxide at a high pressure may lead to suffocation. Long-term adverse effects include nerve damage due to vitamin B12 deficiency, cobalamin reactive psychosis, and homocysteine accumulation (13). Vitamin B12 is an important cofactor of cellular methionine synthase. Extremely low levels of vitamin B12 leads to methionine consumption and homocysteine accumulation. Methionine consumption leads to a decrease in downstream S-adenosine, which is required for myelin production and maintenance. Deficiency in vitamin B12 leads to demyelination and gliosis of the central nervous system (especially the dorsal spinal cord), as well as demyelination of peripheral nerves. Homocysteine accumulation increases the risk of stroke and peripheral neuropathy (14).

Pernicious anemia and neurological damage caused by nitrous oxide are very common. Clinical manifestations of these conditions include paresthesia in limbs, gait instability or difficult walking, weakness, falls or balance disorders, Lhermitte's Sign and ataxia (15). Occasionally there is cognitive impairment and optic atrophy (14, 16). In this study, all the 6 nitrous oxide abusers presented with limb numbness and varying degrees of walking instability. Two patients presented with mild memory loss, 4 presented with increased T2 signal in cervical spinal cord, 3 presented with extensive peripheral nerve damage, while 1 exhibited mild anemia. In terms of treatment, the neurological symptoms could be ameliorated by in time vitamin B12 supplementary (13, 17). All the patients had improved neurological outcomes after vitamin B12 therapies and discharged.

Considering the impact of the COVID-19 epidemic on people's mental health (18), the psychological assessment was carried out. The results indicated varying degrees of anxiety, depression, hostility and psychosis and one case presented obvious suicidal tendency. The SCL-90 score of the 6 patients was significantly higher compared to that of healthy individuals. During COVID-19 pandemic and city lockdown, stressors such as university closures, social distancing, pessimism on the economic prospects are susceptible to lead development of mental health symptoms (18). Compared with the past, the increase in the number of hospitalizations caused by nitrous oxide abuse, and the increase of nitrous oxide dose or relapse reflected to a certain extent the impact of the COVID-19 pandemic on people's psychological status.

To explore the potential causes of nitrous oxide abuse during the COVID-19 lockdown, motivations for inhaling nitrous oxide, sociodemographic characteristics, family environment, siblings, interpersonal relationships, personality traits, financial conditions, and academic performance were investigated. The results showed that risk factors for nitrous oxide abuse included the lack of employment or study during the pandemic, a history of nitrous oxide abuse and relapse during the pandemic, boredom, curiosity and peer pressure, parental or family inconcern or doting, and possible good economic situation.

Although there were still many debates about the lockdown policy (19), it did inhibit the spread of the SARS-CoV-2 and reduce the absolute number of deaths (20). We should focus more on solving the problems caused by the city lockdown such as the psychological problems and take effective measures for the above potential causes. It should enhance the combination of meaning-based coping and spirituality processes to mitigate the adverse effects of coronavirus stress on wellbeing (21). Multi-layered interventional measures from families, schools, hospitals, and governments should be implemented as early as possible. It is worth emphasizing that the patients' family rarely communicated with them during the lockdown. Loneliness is strongly associated with mental health problems (22). Therefore, the company of the family appears to be extremely important (23). Indoor games, read and physical sports with the family are recommended. Despite of social distancing and school closures, on-line courses and virtual workshops where clinician-led mental health and psychosocial services such as stress control, drug abuse education are conducted should be encouraged. For those with obvious suicidal tendency, severe depression or other serious psychological problems, drug therapy intervention by psychiatrist needs to be involved (24). Lastly, government's measures should be taken to control the nitrous oxide flooding from the source such as recreation places (11).

Disadvantage of this study: nitrous oxide abuse not only leads to peripheral neuropathy, SCD and other physiological diseases (25–27) but also causes a series of abnormal mental symptoms, including personality changes, mood disorientations (such as anxiety, depression, mania), impulsive and aggressive behaviors, hallucinations, delusions and other psychotic symptoms (28). We failed to obtain the psychological assessment data of the patients before the pandemic and before they started abusing nitrous oxide. The causal relationships between the pandemic and psychological changes, and between nitrous oxide abuse and psychological changes could not be explained. The second

disadvantage is that the psychological status of the general population in the city was not obtained at the time of psychological assessment of the patients.

CONCLUSION

The nitrous oxide abusers during the COVID-19 pandemic and lockdown presented SCD neurological symptoms and more serious psychological problems than healthy controls. In addition to the neurological therapy, more attention should be payed to the mental health of them. These young cases make us value the psychological problems of young people under the outbreak and it is imperative to take multi-layered, three-dimensional measures from families, schools (companies), hospitals, and governments to address it.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of Taizhou Hospital of Zhejiang Province. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

GW, SW, and SL were involved in conception and design, case diagnosis, data analysis, data interpretation, critical review, and manuscript drafting for this article. TW, CF, AY, YW, and JH were involved in data collection. GW and JH contributed to manuscript revision. All authors reviewed and confirmed for this article. All authors contributed to the article and approved the submitted version.

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Determinants of Anxiety in the General Latvian Population During the COVID-19 State of Emergency

Jelena Vrublevska[1,2], Viktorija Perepjolkina[3], Kristine Martinsone[4], Jelena Kolesnikova[4], Ilona Krone[4], Daria Smirnova[5,6], Konstantinos N. Fountoulakis[7] and Elmars Rancans[1]*

[1] Department of Psychiatry and Narcology, Riga Stradins University, Riga, Latvia, [2] Institute of Public Health, Riga Stradins University, Riga, Latvia, [3] Faculty of Communication, Riga Stradins University, Riga, Latvia, [4] Department of Health Psychology and Pedagogy, Riga Stradins University, Riga, Latvia, [5] International Centre for Education and Research in Neuropsychiatry (ICERN), Samara State Medical University, Samara, Russia, [6] Department of Psychiatry, Narcology, Psychotherapy and Clinical Psychology, Samara State Medical University, Samara, Russia, [7] 3rd Department of Psychiatry, School of Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece

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Michele Fornaro, University of Naples Federico II, Italy

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Vivian Isaac, Flinders University, Australia

***Correspondence:**
Jelena Vrublevska
vrublevskaja@inbox.lv

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Background: The COVID-19 pandemic and its restrictive public health measures have seriously affected mental health of society. Social, psychological, and health-related factors have been linked to anxiety in the general population.

Aim: We investigate the association of various sociopsychological and health-related determinants of anxiety and identify the predicting factors for anxiety in the general population during the COVID-19 state of emergency from in Latvia.

Methods: We conducted an online survey using a randomized stratified sample of the general adult population in July 2020 for 3 weeks. Anxiety symptoms were measured using the State-Trait Anxiety Inventory (STAI-S). Sociodemographic, health-related, sociopsychological characteristics and suicidality were identified using the structured questionnaire. The statistical analysis included Pearson's chi-square test, *post hoc* analysis, and binomial logistic regression.

Results: The weighted study sample included 2,608 participants. The mean STAY-S score of the total sample was 22.88 ± 12.25. In the total sample, 15.2% (n = 398) of participants were classified as having anxiety. The odds ratio (OR) of having anxiety was higher in females (OR = 2.44; 95% CI 1.75–3.33) and people who had experienced mental health problems in the past (OR = 1.45; 95% CI 1.03–2.04), had suicide attempt in the past (OR = 1.68; 95% CI 1.08–2.59), were worried about their health status due to COVID-19 (OR = 1.64; 95% CI 1.36–1.16), were worried about stigmatization from others if infected with COVID-19 (OR = 1.18; 95% CI 1.03–1.35), were worried about information regarding COVID-19 from the Internet (OR = 1.24; 95% CI 1.08–1.43), persons who were lonely (OR = 1.90; 95% CI 1.54–2.34), and persons with negative problem orientation (OR = 1.26; 95% CI 1.06–1.51). Protective factors were identified as having good self-rated general health (OR = 0.68, 95 % CI 0.58–0.81), maintaining a daily routine (OR = 0.74, 95 % CI 0.61–0.90), having financial stability (OR = 0.66, 95 % CI 0.55–0.79), and having good psychological resilience (OR = 0.90, 95 % CI 0.87–0.94).

Conclusions: This is the first study to report a prevalence of anxiety in the general population of Latvia. Certain factors that predict anxiety, as well as protective factors were identified.

Keywords: anxiety, COVID-19, pandemic, general population, mental health, predictors

INTRODUCTION

Even before the COVID-19 pandemic, anxiety disorders were the leading causes of burden globally, despite the existence of intervention strategies aimed at reducing their effects (1). The COVID-19 pandemic has had a significant impact on public health, including mental and physical health (2). Moreover, anxiety has been reported as a common experience among COVID-19 patients, while the public's pandemic-related health concerns and fears of contracting COVID-19 serve as contributing factors to anxiety (2, 3).

A large-scale meta-analysis of 71 published papers revealed there was a 32.6% total prevalence of anxiety during the COVID-19 pandemic (4), while the prevalence estimates of anxiety differ remarkably across countries and populations (5). Meanwhile, people with mental health disorders may be considerably more affected by emotional reactions in the form of anxiety generated by the COVID-19 pandemic (6).

Many studies have suggested that anxiety during the COVID-19 pandemic is associated with certain sociodemographic characteristics, health-related factors (e.g., mental health problems and suicidality in the past), and sociopsychological factors (e.g., loneliness, poor relationship quality, changes in daily routine and behavior, low psychological resilience, and negative problem orientation) (7–14). Available research indicates that females and those of a younger age who lived in rural areas and had lower socioeconomic status had a higher risk of anxiety (7). Moreover, other social and economic factors, such as economical struggles, unemployment, being unmarried, having chronic diseases, sedentary behavior, and poor sleep quality, were associated with anxiety during the COVID-19 pandemic (6, 15, 16). The literature has also suggested that the COVID-19 pandemic has triggered feelings of fear as a response to the sense of extreme threat for both the community and individuals (8, 17, 18). Moreover, metacognitions, intolerance of uncertainty, and emotional dysregulation have all been linked to the fear of COVID-19 and anxiety (10).

Changes in daily life, loneliness, social isolation have had a huge impact worldwide, with serious psychological implications (18, 19). Loneliness can occur not only in the context of social isolation, but can even be felt when others are physically present, and has been linked to anxiety, implying that lonely persons are more vulnerable (11, 19). Meanwhile, the prolonged "stay-at-home" and confinement conditions have led individuals to be more engaged with technology use (20). The Internet, as a valuable source of health information, has become more widely used by the general population during the ongoing COVID-19 pandemic (12). However, repeated media exposure to pandemic-related material and extensive online searches for health-related information can intensify anxiety and develop a cycle of psychological discomfort that is hard to break (12). In addition, problem-solving is a broad coping technique that promotes and sustains general competence and adaptability. It can have positive and/or negative orientations, while the deficits of positively-orientated problem-solving show significant correlations with anxiety (21, 22). Finally, resilience is a dynamic process that involves adaptation in the face of adversity and refers to the tendency to retain stable, healthy functioning following a potentially stressful life experience (23). Recent data suggest that during the COVID-19 pandemic, highly resilient, risk-tolerant individuals reported having lower anxiety (13).

There are concerns that COVID-19 pandemic could lead to increased suicide rates. However, the data concerning suicidality during the COVID-19 pandemic are not conclusive. The risk of suicide may have increased due to the stigmatization of COVID-19-infected patients and their families. Moreover, people with psychiatric illnesses may experience worsening symptoms or develop altered mental states (e.g., anxiety), which is related to increased suicide risk. High levels of suicidality have been reported previously (24), while the data on suicides from 21 countries have shown no evidence of a significant increase in suicide risk since the pandemic began (25). Conversely, other studies (14) have suggested that that the COVID-19 pandemic may trigger suicidality and behavior. For example, Fountoulakis et al. (17) assume that stress and anxiety develop first, followed by depression and suicidality.

Following the World Health Organization's (WHO) declaration of a global pandemic, the Latvian authorities declared the first state of emergency in March 2020 with a number of epidemiological security measures and restrictions, primarily the restriction of meetings, travel, most public places and educational institutions, which lasted until June 2020. Noteworthy, at that time restrictions due to the pandemic in Latvia were much milder than in other Baltic and European countries. According to the Latvian National Health Service data, as of 1 July 2020, there were 1118 confirmed COVID-19 cases in Latvia with 32 deaths and 198,508 tests having been performed. A strict lockdown due to large increase in COVID-19 cases was first introduced in October 2021 (26, 27).

Given that the COVID-19 pandemic is a global problem that has affected countries to varying degrees, there is a need for a transnational understanding of the potential sociodemographic and sociopsychological predictors of anxiety. This need is reinforced by the fact that Latvia before the pandemic had one of the highest suicide rates in Europe (28). Moreover, anxiety in the general Latvian population has not yet been estimated. In addition to determine the anxiety status of the general population during the COVID-19 pandemic, key risk and protective factors

need to be identified to determine an at-risk group and measures that can be taken to protect those who are at risk from anxiety symptoms and improve their mental health.

This study aims to investigate the association between sociodemographic, health-related, and sociopsychological determinants and anxiety and identify the predicting factors for anxiety in the general population of Latvia during the state of emergency from March to June 2020.

METHODS

The Survey

We conducted a quantitative cross-sectional online survey that included a randomized stratified sample of the Latvian general population aged 18–74 years. The survey was within the framework of the National Research Program, and a sample of the Latvian general population was a part of the COVID-19 Mental Health International for the General Population project (COMET-G) (17). COMET-G is large international study with sample of 55,589 participants from 40 countries who filled the structured questionnaire (17). The survey was translated from English into Latvian and Russian. Both translations were then studied by a Latvian- and Russian-speaking focus group for verification. The COMET-G study protocol was supplemented with sections of the questions on the socio-psychological impact of the COVID-19 pandemic and the attitude on the measures implemented by the government. The full survey consisted of 27 thematic sections, including questions on sociodemographic information, overall mental functioning, general health status, fear of COVID-19, thoughts on the preventative measures taken against COVID-19, family relationships, lifestyle changes, spiritual inquiries, Internet use, psychological resilience, emotion regulation, positive and negative orientation toward social problems, and loneliness. The detailed protocol of the COMET-G (which included questions on general data, family relationships, health status, thoughts on COVID-19 and its preventative measures, anxiety, suicidality, and lifestyle changes) is available in the web appendix at Fountoulakis et al. (17).

Data Collection

The data collection was conducted from July 6 to 27, 2020 (29, 30). The fieldwork team that was provided by the research company KANTAR followed the ESOMAR International Code on Market and Social Research (31). The data collection was stratified by gender, age, region, urbanization, and nationality, and was based on statistics published by the Office of Citizenship and Migration Affairs of Latvia (32). A precisely selected and segmented database was used to correspond to the general population of Latvia thus ensuring the representativeness of the sample of respondents (33). An SSL (Secure Sockets Layer) data transmission protocol was used to ensure the security of the online data transmission (34). Respondents received individual invitations by e-mail, with a password and a link to an online questionnaire, which could be completed by respondents at their preferred time until the specified survey closing time July 27. A reminder about completing the questionnaire was sent to participants by email. During the fieldwork, the database was regularly cleaned. Inactive participants were deleted, and the database was continuously updated with new participants. When the respondent filled out the questionnaire, it was saved on KANTAR's server and was not available for later editing.

Each survey item was assigned an ID code, and the data were collected anonymously online. The study was approved by the Ethics Committee of Riga Stradins University, Riga, Latvia. The first page of the online questionnaire included the declaration of voluntarily consent for participation.

Measures

Anxiety

Anxiety symptoms were measured using the State-Trait Anxiety Inventory (STAI-S) (35), which was part of the online questionnaire. The internal consistency of the STAI in our study was good (Cronbach's $\alpha = 0.94$). The cut-off point for the STAI-S scores used in our study was based on the normative data information (mean and standard deviation scores of the non-clinical and clinical groups) (36). The cut-off score was computed as follows:

$$c = \frac{s_0 M_1 + s_1 M_0}{s_0 + s_1}, \quad (1)$$

where M1 = mean of the clinical group, S1 = standard deviation of the clinical group, M0 = mean of the non-clinical group, and S0 = standard deviation of the non-clinical group (37). According to the equation, a cut-off score of 36 was determined.

The participants' changes in anxiety were assessed using self-rated responses to the question: "How much has your emotional state changed in relation to the appearance of anxiety and insecurity compared to before the COVID-19 pandemic?" The responses were scored on a five-point scale.

Sociodemographic Determinants

To verify the association between anxiety and the sociodemographic characteristics, the participants' gender, age, ethnicity, urbanization, family status, education, and employment were recorded. Being a close relative or caretaker of a person who is at high risk of becoming infected with COVID-19 was assessed by "yes" or "no" responses.

Health-Related Determinants

The participants' general health was assessed by the question: "In general, how do you rate your health over the last month?" The responses were answered on a five-point scale. There was also an additional question: "Do you suffer from any chronic medical somatic conditions (e.g., diabetes, mellitus, hypertension, asthma, etc.)?" Self-reported mental disorders in the past were acquired by the question: "In the past, have you had any mental health problem that were serious enough to make you seek professional help, psychotherapy, or medication treatment?" The responses were in the form of "yes" or "no".

Suicidality and Behaviors

We used the Risk Assessment of Suicidality Scale (RASS) to assess participants' suicidality and behaviors. The RASS was previously validated in a study using a general Greek population sample and was found to be a reliable tool (38). The internal consistency of

the RASS in our general Latvian population sample was found to be good (Cronbach's $\alpha = 0.93$) (29).

Sociopsychological Determinants

We assessed fear of COVID-19, relationship quality, religious/spiritual inquiries, Internet use, and daily routine using the questions that are available on the COMET-G's web appendix (17).

Psychological Determinants

We evaluated loneliness using the statement: "I felt lonely more often during the state of emergency situation than in the situation before." The responses were scored on a four-point scale. We used the Emotion Regulation Skills Questionnaire (ERSQ-27), which was previously adapted for use in Latvia (39–41), to evaluate participants' emotional regulation ability. The ERSQ consists of 27 statements divided into 9 scales, with responses scored on a five-point scale. However, this study only used the total score (Cronbach's $\alpha = 0.96$). We used the Psychological Resilience Scale, which is a seven-item measure (Cronbach's $\alpha = 0.87$), to assess participants' psychological resilience. The responses were scored on a five-point scale (42).

Finally, we used the Social Problem-Solving Inventory-Revised Version (SPSI-R) (43), which was previously adapted for use in Latvia (44, 45), and is a multidimensional measure containing 52 statements. This study used two short-form scales: the Negative Problem Orientation (NPO) (Cronbach's $\alpha = 0.87$) and the Positive Problem Orientation (PPO) (Cronbach's $\alpha = 0.85$). The responses were scored on a five-point scale.

Statistical Analysis

Descriptive statistics were computed for all variables used in the analyses. A cut-off point of the STAI-S score ($\geq$ 36) was used to determine anxiety. We conducted between-group comparisons of frequencies using Pearson's chi-square test for categorical variables, and the *post hoc* analysis involved pairwise comparisons using the multiple z-test of two proportions with a Bonferroni correction. An independent samples *t*-test was used to analyze the mean differences for the continuous variables between anxiety and non-anxiety group. Variables that achieved a screening level of significance ($p < 0.05$) were simultaneously entered into a binomial logistic regression. Data were analyzed with SPSS version 27.0.

RESULTS

Sociodemographic Determinants and Their Association With Anxiety

Of the 3,110 questionnaires received, after data cleaning and weighing 2,608 questionnaires were obtained. The mean STAI-S score of the total sample is 22.88 ± 12.25. In the total sample, 15.2% ($n = 398$) are classified as having anxiety. **Table 1** presents the sample's sociodemographic characteristics and a chi-square test results. All expected cell frequencies were greater than five. The prevalence of anxiety among females is much higher than among males (77.1 vs. 22.9%, respectively). The comparison by age group reveals that the proportion of 18–29-year-olds is significantly higher in the anxiety group compared to the non-anxiety group (21.9 vs. 12.6%, respectively) and lower in the age group containing 40–49-year-olds (17.8 vs. 22.6%, respectively). The anxiety group has a difference in the proportion of Latvians and Russians (60.8 vs. 32.2%, respectively) when compared to the non-anxiety group (67.1 vs. 26.7%, respectively). The proportion of people living in the rural area is lower in the anxiety group compared to the non-anxiety group (22.1 vs. 27.6%, respectively). Meanwhile, those who are caretakers or close relatives of a person in a vulnerable group are more likely to meet the criteria of having anxiety compared to participants who are not (46.7 vs. 34.4%, respectively). The results are statistically significant (*p*-values are displayed in **Table 1**). There was not a statistically significant association between anxiety and such sociodemographic variables as family status [$\chi^2(3) = 2.84$, $p = 0.416$], education [$\chi^2(2) = 2.89$, $p = 0.235$], and employment [$\chi^2(3) = 3.68$, $p = 0.298$].

Health-Related Determinants of Anxiety

All health-related variables analyzed in this study were statistically significantly associated with anxiety (**Table 2**). Results of chi-square test show that of those who had anxiety, 61.3% show that their emotional state has worsened a little compared to 23.0% of those without anxiety, and 17.3% show that "It got a lot worse" compared to 0.9% of the group without anxiety. A total of 13.1% of respondents with anxiety state that their anxiety is "Neither better nor worse" compared to 71.4% of participants without symptoms of anxiety. A total of 35.9% of respondents with anxiety report a moderate or bad general health status compared to 11.2% of respondents without any health conditions. A total of 34.7% of those with anxiety suffer from chronic somatic conditions compared to 27.1% of respondents without anxiety. The participants with anxiety also have had significantly more mental health disorders in the past.

Table 3 shows that 20.9% of the participants who have anxiety confirm that they have a fear of dying, 2.6% have frequent thoughts of harming themselves, and 3.6% have suicide ideation. Participants with anxiety show an increased tendency to think about suicide compared to those without anxiety (15.3 vs. 4.1%, respectively). A total of 11% of participants with anxiety indicated at least one attempted suicide in the past compared to 4.8% of participants without anxiety.

Sociopsychological Determinants of Anxiety

Table 4 shows that moderate and severe fears of contracting COVID-19 are statistically significantly more prevalent in participants with anxiety than those without anxiety (63.8 vs. 27.3%, respectively) as well as the fear that a family member could contract COVID-19 and die (50.6 vs. 15.4%, respectively). Meanwhile, fear of possible stigmatization (i.e., in the case of contracting COVID-19, people would distance themselves from the infected person and behave differently to them) are statistically significantly associated with those with anxiety than those without anxiety (64.3 vs. 36.6%, respectively). The belief that the COVID-19 precautions are effective is not associated with symptoms of anxiety.

TABLE 1 | Sociodemographic determinants and their association with anxiety ($n = 2,608$).

Characteristics	All respondents ($N = 2,608$)	Anxiety below cut-off point ($n = 2,210$)	Anxiety above cut-off point ($n = 398$)
Gender		$\chi^2 = 55.95$, $p < 0.0001$	
Male	1,036 (39.7%)	945 (42.8%)$_a$	91 (22.9%)$_b$
Female	1,570 (60.2%)	1,263 (57.2%)$_a$	307 (77.1%)$_b$
Other/ did not want to define	2 (0.1%)	–	–
Age		$\chi^2 = 31.75$, $p < 0.0001$	
18–29	365 (14.0%)	278 (12.6%)$_a$	87 (21.9%)$_b$
30–39	538 (20.6%)	446 (20.2%)$_a$	92 (23.1%)$_a$
40–49	570 (21.9%)	499 (22.6%)$_a$	71 (17.8%)$_b$
50–59	598 (22.9%)	513 (23,2%)$_a$	85 (21.4%)$_a$
60–69	433 (16.6%)	380 (17.2%)$_a$	53 (13.3%)$_a$
70 and older	104 (4.0%)	94 (4.3%)$_a$	10 (2.5%)$_a$
Ethnicity		$\chi^2 = 5.96$, $p = 0.051$	
Latvian	1,724 (66.1%)	1,482 (67.1%)$_a$	242 (60.8%)$_b$
Russian	719 (27.6 %)	591 (26.7%)$_a$	128 (32.2%)$_b$
Other	165 (6.3%)	137 (6.2%)$_a$	28 (7.0%)$_a$
Urbanization		$\chi^2 = 5.53$, $p = 0.063$	
Capital city	1,013 (38.8%)	844 (38.2%)$_a$	169 (42.5%)$_a$
Other city or town	897 (34.4%)	756 (34.2%)$_a$	141 (35.4%)$_a$
Rural area	698 (26.8%)	610 (27.6%)$_a$	88 (22.1%)$_b$
Family status		$\chi^2 = 2.84$, $p = 0.416$	
Single	469 (18.0%)	386 (17.5%)$_a$	83 (20.9%)$_a$
Married or in relationship	1,733 (66.4%)	1,480 (67.0%)$_a$	253 (63.6%)$_a$
Divorced/widowed	371 (14.2%)	315 (14.3%)$_a$	56 (14.1%)$_a$
Other	35 (1.3%)	29 (1.3%)$_a$	6 (1.5%)$_a$
Education		$\chi^2 = 2.89$, $p = 0.235$	
Less than high school degree	62 (2.4%)	57 (2.6%)$_a$	5 (1.3%)$_a$
High school degree	964 (37.0%)	810 (36.7%)$_a$	154 (38.7%)$_a$
More than high school degree	1,544 (59.2%)	1,311 (59.4%)$_a$	233 (58.5%)$_a$
Missing data/ unknown	38 (1.5%)	32 (1.4%)$_a$	6 (1.5%)$_a$
Employment		$\chi^2 = 3.68$, $p = 0.298$	
Employed	1,873 (71.8%)	1,598 (72.3%)$_a$	275 (69.1%)$_a$
Unemployed	197 (7.6%)	158 (7.2%)$_a$	39 (9.8%)$_a$
Economically inactive (retired, student, housewife, etc.)	498 (19.1%)	420 (19.0%)$_a$	78 (19.6%)$_a$
Other	40 (1.5%)	34 (1.5%)$_a$	6 (1.5%)$_a$
B4 Caretaker or close relative of a person that belongs to a vulnerable group		$\chi^2 = 22.06$, $p < 0.0001$	
Yes	947 (36.3%)	761 (34.4%)$_a$	186 (46.7%)$_b$
No	1,661 (63.7%)	1,449 (65.6%)$_a$	212 (53.3%)$_b$

Each subscript letter denotes a subset of Anxiety score (below/above cut-off point) categories whose column proportions do not differ significantly from each other at the 0.05 level.

Table 5 shows that moderate to severe worries about COVID-19 information on the Internet are statistically significantly more prevalent in respondents with anxiety than those without anxiety (50.0 vs. 27.4%, respectively). Participants with anxiety are more prone to using the Internet moderately to more than usual than the participants without anxiety (59.3 vs. 34.1%, respectively). Increased use of social media is also associated with the tendency to meet the criteria of anxiety (46.5 vs. 21.4%, respectively). The results show statistical significance.

Table 6 shows that increased conflicts with family members (17.6% of those with anxiety vs. 4.2% of those without anxiety), worsening of the overall quality of relationships with the family members (16.3% of those with anxiety vs. 3.6% of those without anxiety), difficulties in maintaining a basic daily routine (49.7% of those with anxiety vs. 20.8% of those without anxiety), financial difficulties due to the pandemic (50% of those with anxiety vs. 28.9% of those without anxiety), and feelings of loneliness (64% of those with anxiety vs. 24.8% of those without anxiety) show statistically significant association with anxiety.

Psychological Determinants of Anxiety

Table 7 shows that psychological factors such as resilience, emotional regulation skills, and social problem-solving skills (such as positive and negative problem orientation) show a

TABLE 2 | Health-Related determinants of anxiety ($n = 2,608$).

Characteristics	All respondents ($N = 2,608$)	Anxiety below cut-off point ($n = 2,210$)	Anxiety above cut-off point ($n = 398$)
F21. How much has your emotional state changed in relation to the appearance of anxiety and insecurity compared to before the COVID-19 epidemic? ($M = 2.71$, $SD = 0.66$)		$\chi^2 = 636.42$, $p < 0.0001$	
It got a lot worse	88 (3.4%)	19 (0.9%)$_a$	69 (17.3%)$_b$
It got a little worse	751 (28.8%)	507 (23.0%)$_a$	244 (61.3%)$_b$
Neither better nor worse	1,631 (62.5%)	1,577 (71.4%)$_a$	52 (13.1%)$_b$
It's a little improved	106 (4.1%)	79 (3.6%)$_a$	27 (6.8%)$_b$
It has improved a lot	32 (1.2%)	26 (1.2%)$_a$	6 (1.5%)$_a$
B1. In general, your health over the last month can be described as ($M = 2.59$, $SD = 0.98$)		$\chi^2 = 179.28$, $p < 0.0001$	
Excellent	425 (16.3%)	399 (18.1%)$_a$	26 (6.5%)$_b$
Very good	665 (25.5%)	596 (27.0%)$_a$	69 (17.3%)$_b$
Good	1,127 (43.2%)	967 (43.8%)$_a$	160 (40.2%)$_a$
Moderate	333 (12.8%)	214 (9.7%)$_a$	119 (29.9%)$_b$
Bad	58 (2.2%)	34 (1.5%)$_a$	24 (6.0%)$_b$
B2. Do you suffer from any chronic medical somatic condition (for example: diabetes, mellitus, hypertension, asthma, etc.)?		$\chi^2 = 9.65$, $p < 0.002$	
Yes	736 (28.2%)	598 (27.1%)$_a$	138 (34.7%)$_b$
No	1,872 (71.8%)	1,612 (72.9%)$_a$	260 (65.3%)$_b$
B5. In the past, have you had any mental health problem serious enough to make you seek professional health, psychotherapy or medication treatment?		$\chi^2 = 123.98$, $p < 0.0001$	
Yes	410 (15.7%)	273 (12.4%)$_a$	137 (34.4%)$_b$
No	2,198 (84.3%)	1,935 (87.6%)$_a$	261 (65.6%)$_b$
Anxiety in the past		$\chi^2 = 108.71$, $p < 0.0001$	
Yes	217 (8.3%)	131 (5.9%)$_a$	86 (21.6%)$_b$
No	2,391 (91.7%)	2,077 (94.1%)$_a$	312 (78.4%)$_b$
Depression in the past		$\chi^2 = 82.74$, $p < 0.0001$	
Yes	220 (8.4%)	140 (6.3%)$_a$	80 (20.1%)$_b$
No	2,388 (91.6%)	2,068 (93.7%)$_a$	318 (79.9%)$_b$
Psychosis in the past		$\chi^2 = 13.79$, $p < 0.0001$	
Yes	27 (1.0%)	16 (0.7%)$_a$	11 (2.8%)$_b$
No	2,581 (99.0%)	2,192 (99.3%)$_a$	387 (97.2%)$_b$
Bipolar Disorder		$\chi^2 = 11.25$, $p < 0.001$	
Yes	12 (0.5%)	6 (0.3%)$_a$	6 (1.5%)$_b$
No	1,596 (99.5%)	2,204 (99.7%)$_a$	392 (98.5%)$_b$
Other		$\chi^2 = 13.84$, $p < 0.0001$	
Yes	50 (1.9%)	33 (1.5%)$_a$	17 (4.3%)$_b$
No	2,558 (98.1%)	2,177 (98.7%)$_a$	381 (95.7%)$_b$

Each subscript letter denotes a subset of Anxiety score (below/above cut-off point) categories whose column proportions do not differ significantly from each other at the 0.05 level.

weak to moderate association with the STAI-S score. Participants with anxiety show significantly lower results for psychological resilience (large effect size), emotional regulation skills, and positive problem orientation (small effect size for both variables), but higher mean scores for negative problem orientation (large effect size).

Factors That Predict Anxiety

A binomial logistic regression was performed to ascertain the effects of socio-demographic, health-related, life-style and psychological variables on the likelihood that participants have anxiety. Twenty-eight factors which were found to be associated with anxiety at a p-value of < 0.05 were further analyzed using the multiple logistic regression model to determine the predictors of anxiety. Linearity of the continuous variables (gender, B1, O1, O5, O6, O11, O12, O13, C1, C3, C4, P1, E3, E4, E5, E7, K1, K3, K4, Loneliness, Emotion Regulation, Psychological Resilience, NPO and PPO) with respect to the logit of the dependent variable was assessed *via* the Box-Tidwell procedure (46). A Bonferroni correction was applied using all 50 terms in the model resulting in statistical significance being accepted when $p < 0.001$ (47). Based on this assessment, all continuous independent variables were found to be linearly related to the logit of the dependent variable. There was 66 standardized residuals with a value of 10.82 to −7.11 (M = 3.66, SD = 2.89) standard deviations, which all were kept in the analysis, because they form only 2.53% of

TABLE 3 | The association of anxiety and suicidality and self-harm history in the general population of Latvia during the COVID-19 state of emergency (n = 2,608).

Characteristics	All respondents (N = 2,608)	Anxiety below cut-off point (n = 2,210)	Anxiety above cut-off point (n = 398)
O1. Are you afraid that you are going to die? (M = 1.37, SD = 0.62)		$\chi^2 = 360.70$, $p < 0.0001$	
Not at all	1,804 (69.2%)	1,662 (75.2%)$_a$	142 (35.7%)$_b$
A little bit	666 (25.5%)	493 (22.3%)$_a$	173 (43.5%)$_b$
Much	106 (4.1%)	48 (2.2%)$_a$	58 (14.6%)$_b$
Very much	32 (1.2%)	7 (0.3%)$_a$	25 (6.3%)$_b$
O5. Do you think of harming yourself psychically? (M = 1.07, SD = 0.32)		$\chi^2 = 45.40$, $p < 0.0001$	
Not at all	2,472 (94.8%)	2,118 (95.8%)$_a$	354 (88.9%)$_b$
A little bit	105 (4.0%)	71 (3.2%)$_a$	34 (8.5%)$_b$
Much	20 (0.8%)	17 (0.8%)$_a$	3 (0.8%)$_a$
Very much	11 (0.4%)	4 (0.2%)$_a$	7 (1.8%)$_b$
O6. Do you often think of committing suicide if you have the chance? (M = 1.07, SD = 0.32)		$\chi^2 = 43.17$, $p < 0.0001$	
Not at all	2,479 (95.1%)	2,123 (96.1%)$_a$	356 (89.4%)$_b$
A little bit	96 (3.7%)	68 (3.1%)$_a$	28 (7.0%)$_b$
Much	23 (0.9%)	16 (0.7%)$_a$	7 (1.8%)$_b$
Very much	10 (0.4%)	3 (0.1%)$_a$	7 (1.8%)$_b$
O11. How much has your tendency to thing about death and/or suicide changed, compared to before outbreak of COVID-19? (M = 3.07, SD = 0.59)		$\chi^2 = 80.51$, $p < 0.0001$	
Very much increased	32 (1.2%)	20 (0.9%)$_a$	12 (3.0%)$_b$
Increased a bit	119 (4.6%)	70 (3.2%)$_a$	49 (12.3%)$_b$
Neither increased, nor decreased	2,260 (86.7%)	1,956 (88.5%)$_a$	304 (76.4%)$_b$
Decreased a bit	40 (1.5%)	32 (1.4%)$_a$	8 (2.0%)$_a$
Very much decreased	157 (6.0%)	132 (6.0%)$_a$	25 (6.3%)$_a$
O12. Have you ever hurt yourself in any way deliberately, during your whole life so far? (M = 1.14, SD = 0.51)		$\chi^2 = 13.81$, $p < 0.003$	
Never	2,375 (91.1%)	2,030 (91.9%)$_a$	345 (86.7%)$_b$
Once	129 (4.9%)	103 (4.7%)$_a$	26 (6.5%)$_a$
2–3 times	69 (2.6%)	53 (2.4%)$_a$	16 (4.0%)$_a$
Many times	35 (1.3%)	24 (1.1%)$_a$	11 (2.8%)$_b$
O13. Have you ever attempted suicide, during your whole life so far? (M = 1.08, SD = 0.33)		$\chi^2 = 28.74$, $p < 0.0001$	
Never	2,457 (94.2%)	2,103 (95.2%)$_a$	354 (88.9%)$_b$
Once	111 (4.3%)	79 (3.6%)$_a$	32 (8.0%)$_b$
2–3 times	33 (1.3%)	25 (1.1%)$_a$	8 (2.0%)$_a$
Many times	7 (0.3%)	3 (0.1%)$_a$	4 (1.0%)$_b$

Each subscript letter denotes a subset of Anxiety score (below/above cut-off point) categories whose column proportions do not differ significantly from each other at the 0.05 level.

the total sample, and 61 of them (92.42%) are participants of the anxiety group, which is of our interest and represent real cases. The logistic regression model was statistically significant [χ^2 (28) = 882.87, $p < 0.001$], explained 50.0% (R^2) of the variance in clinically-significant anxiety, and correctly classified 89.8% of cases. Of the 28 predictor variables for anxiety, the following 15 were statistically significant and are presented in **Table 8**: gender (female: OR = 2.44, 95 % CI 1.75–3.33, $p < 0.001$), having mental health problems in the past (OR = 1.45, 95 % CI 1.03–2.04, $p = 0.035$), fear of dying during the state of emergency (OR = 1.67, 95 % CI 1.33–2.10, $p < 0.001$), suicidality in the past (OR = 1.68, 95 % CI 1.08–2.59, $p = 0.020$), fear about one's health status due to COVID-19 (OR = 1.64, 95 % CI 1.36–1.97, $p < 0.001$), fear about a family member's health due to COVID-19 (OR = 1.36, 95 % CI 1.16–1.58, $p < 0.001$), fear of stigmatization if infected with COVID-19 (OR = 1.18, 95 % CI 1.03–1.35, $p = 0.016$), worried about information regarding COVID-19 from the Internet (OR = 1.24, 95 % CI: 1.08–1.43, $p = 0.003$), loneliness (OR = 1.90, 95 % CI: 1.54–2.34, $p < 0.001$), and negative problem orientation (OR = 1.26, 95 % CI 1.06–1.51, $p = 0.011$).

Protective factors found to be improvements in general health status (OR = 0.68, 95 % CI 0.58–0.81, $p < 0.001$), maintaining one's daily routine (OR = 0.74, 95 % CI 0.61–0.90, $p = 0.003$), having a stable economic situation (OR = 0.66, 95 % CI 0.55–0.79, $p < 0.001$), and having good psychological resilience (OR = 0.90, 95 % CI 0.87–0.94, $p < 0.001$).

TABLE 4 | The association of anxiety and fears, thoughts about COVID-19, and religious/spiritual inquiries in the general population of Latvia during the COVID-19 state of emergency ($n = 2,608$).

Characteristics	All respondents ($N = 2,608$)	Anxiety below cut-off point ($n = 2,210$)	Anxiety above cut-off point ($n = 398$)
C1. Are you afraid that you will contract the coronavirus? ($M = 2.19$, $SD = 0.96$)		$\chi^2 = 455.57$, $p < 0.0001$	
Never	649 (24.9%)	621 (28.1%)$_a$	28 (7.0%)$_b$
A little	1,102 (42.3%)	986 (44.6%)$_a$	116 (29.1%)$_b$
Moderately	624 (23.9%)	508 (23.0%)$_a$	116 (29.1%)$_b$
Much	176 (6.7%)	83 (3.8%)$_a$	93 (23.4%)$_b$
Very much	57 (2.2%)	12 (0.5%)$_a$	45 (11.3%)$_b$
C2. Do you believe that the precautions work effectively or that if you are about to contract the disease, you will contract it anyway? ($M = 1.18$, $SD = 0.39$)		$\chi^2 = 1.34$, $p = 0.248$	
Precautions work effectively	2,131 (81.7%)	1,814 (82.1%)$_a$	317 (79.6%)$_a$
Precautions cannot protect you	477 (18.3%)	396 (17.9%)$_a$	81 (20.4%)$_a$
C3. Does the possibility that a member of your family could contract the coronavirus and die because of it makes you frightened? ($M = 2.52$, $SD = 1.15$)		$\chi^2 = 312.00$, $p < 0.0001$	
Never	512 (19.6%)	494 (22.4%)$_a$	18 (4.5%) $_b$
A little	930 (35.7%)	836 (37.8%)$_a$	94 (23.6%)$_b$
Moderately	626 (24.0%)	541 (24.5%)$_a$	85 (21.4%)$_a$
Much	371 (14.2%)	256 (11.6%)$_a$	115 (28.9%)$_b$
Very much	169 (6.5%)	83 (3.8%)$_a$	86 (21.6%)$_b$
C4. Are you afraid that in case you contract the coronavirus, some people will step away from your life and behave to you in a different way later? ($M = 1.70$, $SD = 1.00$)		$\chi^2 = 224.54$, $p < 0.0001$	
Never	1,544 (59.2%)	1,402 (63.4%)$_a$	142 (35.7%)$_b$
A little	550 (21.1%)	457 (20.7%)$_a$	93 (23.4%)$_a$
Moderately	333 (12.8%)	259 (11.7%)$_a$	74 (18.6%)$_b$
Much	127 (4.9%)	70 (3.2%)$_a$	57 (14.3%)$_b$
Very much	54 (2.1%)	22 (1.0%)$_a$	32 (8.0%)$_b$
P1. Over the last 2–3 weeks, my religious/ spiritual inquiries have been increased ($M = 1.27$, $SD = 0.56$)		$\chi^2 = 44.36$, $p < 0.0001$	
Not at all	2,023 (77.6%)	1,761 (79.7%)$_a$	262 (65.8%)$_b$
A little bit	475 (18.2%)	373 (16.9%)$_a$	102 (25.6%)$_b$
Much	89 (3.4%)	60 (2.7%)a	29 (7.3%)$_b$
Very much	21 (0.8%)	16 (0.7%)a	5 (1.3%)$_a$

Each subscript letter denotes a subset of Anxiety score (below/above cut-off point) categories whose column proportions do not differ significantly from each other at the 0.05 level.

DISCUSSION

This study investigates the association between anxiety and sociodemographic and health-related characteristics (e.g., such as suicidality, fear of COVID-19, relationship quality, daily routine, and Internet use) as well as psychological determinants to predict the factors for anxiety, using a representative sample of general Latvian population during the COVID-19 state of emergency. The study sample included 2,608 participants. It is noteworthy, that the prevalence of anxiety in the general Latvian population has not yet been estimated, although there is currently an ongoing population study on the prevalence of mental disorders and suicidality in Latvia (29). The current study found that the prevalence of anxiety was estimated at 15.2%, which is in line with the average prevalence of anxiety disorders in Europe (48). Many studies have suggested that COVID-19 has triggered higher levels of anxiety and distress (8, 9, 18) than the estimated anxiety prevalence rate found in our study. However, it is important to mention that different methodologies and tools have been used across these studies, and high level of anxiety might also depend on the temporal situation and specific events (49, 50). Another important aspect is that individuals who have been isolated and quarantined due to COVID-19 have experienced significant levels of anxiety, anger, confusion, and fear (51). Moreover, at the time of our study, restrictions related to the pandemic in Latvia were much milder than in other Baltic and European countries.

The data analysis revealed that anxiety was 2.44 times more prevalent in females than males. This finding is in accordance with most of the data received from different countries, and indicates that females are at a higher risk of anxiety disorders (7, 52). Although anxiety was more prevalent in the youngest age group, age was not significant in the logistic regression model.

Unsurprisingly, the data indicate that people with pre-existing mental health disorders show higher levels of COVID-19-related anxiety than those with no history of mental health disorders (17, 18). Our study confirmed this finding, as those who had mental health issues in the past were 1.45 times more likely to have anxiety. While some studies have also indicated that individuals

TABLE 5 | The association of anxiety and Internet use characteristics in the general population of Latvia during the COVID-19 state of emergency ($n = 2,608$).

Characteristics	All respondents ($N = 2,608$)	Anxiety below cut-off point ($n = 2,210$)	Anxiety above cut-off point ($n = 398$)
K1. The information and use of the internet worry me about the issue regarding the COVID-19 ($M = 1.94$, $SD = 0.99$)		$\chi^2 = 130.98$, $p < 0.0001$	
Not at all	1,059 (44.4%)	1,063 (48.1%)$_a$	96 (24.1%)$_b$
A little	640 (24.5%)	537 (24.3%)$_a$	103 (25.9%)$_a$
Moderately	657 (25.2%)	518 (23.4%)$_a$	139 (34.9%)$_b$
Much	122 (4.7%)	75 (3.4%)$_a$	47 (11.8%)$_b$
Very much	30 (1.2%)	17 (0.6%)$_a$	13 (3.3%)$_a$
K2. Generally, most of the internet sources regarding information about COVID-19 are misinforming/ misleading ($M = 2.68$, $SD = 1.09$)		$\chi^2 = 5.22$, $p = 0.266$	
Not at all	378 (14.5%)	320 (14.5%)$_a$	58 (14.6%)$_a$
A little	822 (31.5%)	703 (31.8%)$_a$	119 (29.9%)$_a$
Moderately	828 (31.7%)	705 (31.9%)$_a$	123 (30.9%)$_a$
Much	425 (16.3%)	346 (15.7%)$_a$	79 (19.8%)$_b$
Very much	155 (5.9%)	136 (6.2%)$_a$	19 (4.8%)$_a$
K3. Due to the conditions, the internet takes up more of my time than usual ($M = 2.21$, $SD = 1.26$)		$\chi^2 = 142.72$, $p < 0.0001$	
Not at all	1,084 (41.6%)	992 (44.9%)$_a$	92 (23.1%)$_b$
A little	536 (20.6%)	466 (21.1%)$_a$	70 (17.6%)$_a$
Moderately	468 (17.9%)	384 (17.4%)$_a$	84 (21.1%)$_a$
Much	391 (15.0%)	293 (13.3%)$_a$	98 (24.6%)$_b$
Very much	129 (4.9%)	75 (3.4%)$_a$	54 (13.6%)$_b$
K4. How much do you use the social media while in insolation at home? ($M = 1.80$, $SD = 0.51$)		$\chi^2 = 112.83$, $p < 0.0001$	
More than before	658 (25.2%)	473 (21.4%)$_a$	185 (46.5%)$_b$
The same as before	1,817 (69.7%)	1,621 (73.3%)$_a$	196 (49.2%)$_b$
Less than before	133 (5.1%)	116 (5.2%)$_a$	17 (4.3%)$_a$

Each subscript letter denotes a subset of Anxiety score (below/above cut-off point) categories whose column proportions do not differ significantly from each other at the 0.05 level.

with chronic medical conditions are more likely to have anxiety (53), our study found that the presence of a chronic somatic disorder was not a significant predictor. It is noteworthy that we found that the presence of chronic somatic disorders in the general Latvian population was not a risk factor for depression during the state of emergency from March to June 2020 (29). Moreover, in the study on the 12-month prevalence of major depression in Latvia was found that presence of three or more self-reported somatic conditions is related to increased odds of major depression, while presence of one or two somatic disorders is not (54). Moreover, in our study, self-rated better general health was related to decreased odds of having anxiety and served as a protective factor.

The previous literature has addressed that before the pandemic, acute stress was related to suicide ideation in older adults who had severe medical conditions. Moreover, the high risk of suicide during the pandemic has been associated with high levels of perceived stress, depression, and insomnia (24). Our study found that during the state of emergency, the fear of dying, thoughts of harming one's self, and suicide ideation were more prevalent in those who had anxiety. The logistic regression analysis revealed that fear of dying during the state of emergency and suicidality in the past increased the odds of having anxiety and, therefore, were significant predictors of anxiety, but self-harm behavior in the past was not a significant predictor. Fountoulakis et al. (17) developed a model to explain the effect of the pandemic on mental health that is based on the assumption that anxiety develops first and then progresses into depression and then suicidality.

Fears about the COVID-19 pandemic, one's health status, family members, and stigmatization were significantly more prevalent in those who had anxiety and served as predictors to anxiety. The data from previous studies have suggested that the COVID-19 pandemic has contributed to existential fears of infection and death (18). Moreover, the existing research has highlighted the important role of the complex relationship between fear, stress, and anxiety in the development of depression (55).

In our study, a decline in the overall quality of family relationships and increased family conflicts were more prevalent in the participants who had higher anxiety scores. Anxiety was also more prevalent among those who had difficulty in maintaining a basic daily routine. Maintaining a healthy lifestyle to help foster self-efficacy can, therefore, be presented as a protective factor for anxiety (56). The logistic regression model revealed two important factors that played a protective role

TABLE 6 | The association of anxiety and quality of relationships, daily routine and financial difficulties during COVID-19 epidemic ($n = 2,608$).

Characteristics	All respondents ($N = 2,608$)	Anxiety below cut-off point ($n = 2,210$)	Anxiety above cut-off point ($n = 398$)
E3. Are there any conflicts with the rest of your family members during this period? ($M = 2.71$, $SD = 0.77$)		$\chi^2 = 109.36$, $p < 0.0001$	
Much less	299 (11.5%)	252 (11.4%)$_a$	47 (11.8%)$_a$
Less	351 (13.5%)	304 (13.8%)$_a$	47 (11.8%)$_a$
Same	1,796 (68.9%)	1,562 (70.7%)$_a$	234 (58.8%)$_b$
More	143 (5.5%)	84 (3.8%)$_a$	59 (14.8%)$_b$
Much more	19 (0.7%)	8 (0.4%)$_a$	11 (2.8%)$_b$
E4. Has the overall quality of relationships with the other members of your family changed compared to the one before the quarantine, due to COVID-19? ($M = 3.07$, $SD = 0.48$)		$\chi^2 = 110.63$, $p < 0.0001$	
Much worse	11 (0.4%)	7 (0.3%)$_a$	4 (1.0%)$_a$
Worse	133 (5.1%)	72 (3.3%)$_a$	61 (15.3%)$_b$
It has not changed	2,165 (83.0%)	1,885 (85.3%)$_a$	280 (70.4%)$_b$
A little bit better	257 (9.9%)	211 (9.5%)$_a$	46 (11.6%)$_a$
Much better	42 (1.6%)	35 (1.6%)$_a$	7 (1.8%)$_a$
E5. Do you manage to maintain a basic daily routine (waking up in the morning, regular meals and sleeping hours, activities) both yourself (if you live alone) or as a family? ($M = 2.76$, $SD = 0.72$)		$\chi^2 = 153.31$, $p < 0.0001$	
Not at all	203 (7.8%)	136 (6.2%)$_a$	67 (16.8%)$_b$
Somehow, but not always	453 (17.4%)	322 (14.6%)$_a$	131 (32.9%)$_b$
Generally, yes	1,708 (65.5%)	1,537 (69.5%)$_a$	171 (43.0%)$_b$
Clearly follow (or adhere to) a routine	244 (9.4%)	215 (9.7%)$_a$	29 (7.3%)$_a$
E7. How are your finances as a result of the outbreak? ($M = 2.67$, $SD = 0.76$)		$\chi^2 = 99.44$, $p < 0.0001$	
Much more difficult than before	229 (8.8%)	149 (6.7%)$_a$	80 (20.1%)$_b$
Somehow more difficult	610 (23.4%)	491 (22.2%)$_a$	119 (29.9%)$_b$
Same as always	1,584 (60.7%)	1,404 (63.5%)$_a$	180 (45.2%)$_b$
Somehow easier	163 (6.3%)	147 (6.7%)$_a$	16 (4.0%)$_b$
Much easier than before	22 (0.8%)	19 (0.9%)$_a$	3 (0.8%)$_a$
Loneliness ($M = 1.40$, $SD = 0.68$)		$\chi^2 = 358.18$, $p < 0.0001$	
Not at all	1,804 (69.2%)	1,661 (75.2%)$_a$	143 (35.9%)$_b$
Somewhat	614 (23.5%)	459 (20.8%)$_a$	155 (38.9%)$_b$
Moderately so	139 (5.3%)	78 (3.5%)$_a$	61 (15.3%)$_b$
Very much so	51 (2.0%)	12 (0.5%)$_a$	39 (9.8%)$_b$

Each subscript letter denotes a subset of Anxiety score (below/above cut-off point) categories whose column proportions do not differ significantly from each other at the 0.05 level.

TABLE 7 | Descriptive statistics of psychological characteristics and *t*-test results in the general population of Latvia during the COVID-19 state of emergency ($n = 2,608$).

Variable	All respondents ($N = 2,608$)		Anxiety below cut-off point ($n = 2,210$)		Anxiety above cut-off point ($n = 398$)		*t*	*Cohen's d*
	M	*SD*	*M*	*SD*	*M*	*SD*		
Psychological Resilience	25.56	4.91	26.18	4.55	22.11	5.40	14.19***	0.81
Successful emotion regulation	2.48	0.73	2.50	0.74	2.38	0.67	3.23**	0.17
Negative problem orientation	1.30	0.86	1.20	0.81	1.85	0.91	−13.29***	0.75
Positive problem orientation	2.19	2.18	2.21	0.86	2.07	0.81	2.93**	0.17

***$p < 0.01$. ***$p < 0.001$. The results of t-test (assuming unequal variances) comparing the parameter estimates between the two groups (no-clinically significant anxiety, Anxiety below cut-off point; and clinically significant anxiety, Anxiety above cut-off point).*

against anxiety: maintaining a daily routine and having financial stability. These findings are in line with the existing research (57).

The previous studies have indicated a rise in problematic Internet use and overuse by the general population during the pandemic (58). Disordered Internet use generates marked distress, worry, and significant impairment in personal, family, social, educational, and occupational functioning (59). Moreover, Internet browsing about COVID-19, distress related to this

TABLE 8 | Logistic regression predicting likelihood of anxiety based on sociodemographic, health-related, relationship quality, daily routine, internet use and psychological characteristics in the general population of Latvia during the COVID-19 state of emergency.

	B	S.E.	Wald	*df*	*p*	Odds Ratio	95% CI for Odds Ratio	
							Lower	Upper
Age	−0.01	0.01	1.75	1	0.185	0.99	0.98	1.00
Gender (female *vs.* male)	0.89	0.17	27.73	1	0.000	2.44	1.75	3.33
B1. General health status	−0.38	0.08	20.27	1	0.000	0.68	0.58	0.81
B2. Chronic medical somatic condition (yes *vs.* no)	0.01	0.17	0.001	1	0.977	1.01	0.72	1.40
B4. Caretaker of person from vulnerable group (yes *vs.* no)	0.25	0.15	2.93	1	0.087	1.29	0.96	1.72
B5. Mental health problems in the past (yes *vs.* no)	0.37	0.18	4.46	1	0.035	1.45	1.03	2.04
O1. Fear to die during the emergency state	0.51	0.12	19.74	1	0.000	1.67	1.33	2.10
O5. Thoughts of harming oneself during the emergency state	−0.55	0.28	3.98	1	0.050	0.58	0.34	0.99
O6. Thoughts about death/suicide during the emergency state	0.16	0.29	0.31	1	0.576	1.18	0.67	2.08
O11. Changes in the frequency of thoughts about death/suicide during the emergency state	0.08	0.12	0.41	1	0.524	0.93	0.74	1.17
O12. Self-harm in the past	−0.30	0.16	3.62	1	0.057	0.74	0.547	1.01
O13. Suicide attempt in the past	0.52	0.22	5.39	1	0.020	1.68	1.08	2.59
C1. Fear about one's health due to coronavirus	0.49	0.10	27.05	1	0.000	1.64	1.36	1.97
C3. Fear about family member's health due to coronavirus	0.30	0.08	15.22	1	0.000	1.36	1.16	1.58
C4. Fear about stigmatization after illness (coronavirus)	0.16	0.07	5.79	1	0.016	1.18	1.03	1,35
P1. Religious / spiritual inquiries	−0.08	0.12	0.49	1	0.485	0.92	0.729	1.16
E3. Conflicts with family members	0.16	0.10	2.73	1	0.099	1.18	0.97	1.42
E4. Changes in the quality of relationships with family members	−0.19	0.14	1.66	1	0.197	0.83	0.63	1.10
E5. Managing to maintain a basic daily routine	−0.30	0.10	9.10	1	0.003	0.74	0.61	0.90
E7. Financial strain	−0.42	0.09	21.06	1	0.000	0.66	0.553	0.79
K1. The information and use of the internet worry me about the issue regarding the COVID-19	0.22	0.07	8.83	1	0.003	1.24	1.08	1.43
K3. Increase in internet usage time	0.05	0.07	0.51	1	0.477	1.05	0.92	1.19
K4. Changes in the use of social media	0.21	0.15	1.98	1	0.160	0.81	0.60	1.09
Loneliness	0.64	0.11	36.59	1	0.000	1.90	1.54	2.34
Emotion Regulation	0.23	0.14	2.87	1	0.090	1.26	0.96	1.64
Psychological Resilience	−0.10	0.02	28.03	1	0.000	0.903	0.87	0.94
Negative Problem Orientation	0.23	0.09	6.52	1	0.011	1.26	1.06	1.51
Positive Problem Orientation	0.14	0.11	1.78	1	0.182	1.15	0.94	1.42
Constant	−2.60	1.12	5.42	1	0.020	0.07		

Gender is for, females compared to males; B2. Chronic medical somatic condition is for "yes" response compared to "no"; B4. Caretaker of person from vulnerable group is for "yes" response compared to "no"; B5. Mental health problems in the past are for "yes" response compared to "no". Odds Ratio = Exp(B).

information, excessive time spent on the Internet, and increased use of social media have been associated with increased anxiety in the general population during the pandemic (60). Although we found that excessive time spent online and more frequent social media use during the state of emergency was more prevalent among those who had anxiety, the logistic regression analysis revealed that these factors were not significant predictors of anxiety. In our study, excessive worrying about COVID-19 was a significant risk factor for having anxiety (OR = 1.24), yet a change in social media use was not a risk factor, which is in line with a study on interactions between anxiety levels and life habits changes in the general population of Russia (3). We also found that an increase in Internet usage was not a significant predictor.

Loneliness has been identified as a major adverse consequence of the COVID-19 pandemic. The previous studies have reported that when people are isolated or lonely, they become significantly more vulnerable to anxiety (61, 62). In our study, those who had experienced loneliness were 1.90 times more likely to risk having anxiety. This result indicates that anxiety can be predicted when people have low psychological resilience. Our results support the recent studies during the COVID-19 pandemic that show that having a lower psychological resilience score indicates a higher level of anxiety (13). Our data also show that anxiety can be predicted by having a negative orientation in problem-solving during the pandemic.

A major strength of our study is that it includes a large representative sample of the general Latvian population, which allows for both estimations and determinants of anxiety at the national level. Our results also highlight the importance of supporting those who are at risk to alleviate suffering in the

instance of future possible lockdowns, and emphasize that groups that already had poor mental health before the pandemic are at risk both during and after the pandemic. These findings show the importance of providing the community with the necessary psychological support to reduce anxiety. In addition to focusing on the negative effects, it is very important to develop prevention and intervention measures that aim at thriving, so as to reduce harm and achieve positive results (18).

This study has several practical implications. Our findings can help develop future strategies for managing psychological support for segments of the population who are at risk. Our results indicate that the following measures could be implemented: (1) improve the recognition of anxiety and other mental disorders at the primary-care level and provide general practitioners with advice and consultations from mental health specialists; (2) use a variety of communication channels (e.g., infographics, social media, school websites, etc.) to inform the target group about simple, realistic, effective, and evidence-based self-help strategies for mental health prevention, and promote and strengthen psychological resilience techniques; and (3) enable collaboration between psychiatrists, psychologists, and policymakers to develop effective interventions and implementation strategies to strengthen the psychological resilience of the Latvian population.

CONCLUSION

This study examines the association between various factors and anxiety, and identifies the predicting factors for anxiety using a representative sample of the general Latvian population during the COVID-19 pandemic. We identified the following predictors for anxiety: being female, having mental health problems in the past, suicidality, having fears about one's health status due to COVID-19, fear of stigmatization if infected with COVID-19, worrying about information on the Internet, loneliness, and having negative problem orientation. Protective factors were also identified (improvements in general health status, maintaining one's daily routine, having a stable economic situation, and having good psychological resilience). These findings confirm previous recommendations by other authors on the need for proactive intervention to protect the mental health of the population, but especially of vulnerable groups (17).

Limitations

The results of current paper must be considered in the context of some limitations. Our cross-sectional study did not allow us to make any causal interferences. Therefore, further longitudinal studies could provide more information on causal relationships. An important limitation is that invitations were sent to potential respondents *via* e-mail. For that reason certain groups of the Latvian populations probably were less likely to fill in the questionnaire. Another important limitation that may have influenced the results is the use of self-report measures and scales. For example, anxiety symptoms were measured using a self-reported questionnaire which may have brought bias to an overestimation or underestimation of the prevalence of observed pathology. Moreover, there is no clinical verification of anxiety disorders. Finally, recall bias may have influenced some measures, such as report of existing chronic somatic disorders. It should be noted that Latvian population speak Latvian or Russian and the preparation phase of the study was limited in time, therefore it was not possible to validate the measures used in the COMET-G study. Voluntary recruitment can also lead to so-called non-response bias, where non-respondents may have different characteristics than survey respondents. In the present study it was impossible to identify whether the non-participants were significantly different from the sample of the survey respondents, and this is one major limitation of our study. It is noteworthy to mention that as a part of the study was international, the use of a single protocol was critical. It is also important to state that the data were collected in July 2020, in the period, when number of COVID-19 cases in Latvia was low. Moreover, during the state of emergency from March to June 2020, the COVID-19 restrictions were noticeably milder than in other Baltic and European countries. Finally, use of highly related variables in logistic models may affect significance. It would be worthwhile to conduct a similar study in the future to investigate the long-term outcome and the long-term impact of the pandemics on mental-health of the Latvian population because of more strict COVID-19 restrictions, and significantly increased rates of the cases of infected people and the death rate. Finally, the lack of baseline data concerning anxiety and related factors before the pandemic did not allow us to make any comparisons.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of Research in Riga Stradins University. The first page of the online questionnaire included the declaration of voluntarily consent for participation. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JV contributed with development of the conception and design of the study and he is a national coordinator of COMET-G project, participated in the translation of the protocol to Latvian and Russian languages, and wrote the first draft of the manuscript. VP contributed with the development of the conception and design of the study, development of the questions for the questionnaire, was responsible for the translation of the developed questionnaire into Russian, was responsible for the statistical data analysis and the result part of the manuscript, interpreted the data, and participated in writing the manuscript. KM contributed with development of the conception and design of the study, development of the questions for the questionnaire, and participated in writing the manuscript. JK contributed with development of the conception and design of the study, was

responsible for the translation of the developed questionnaire into Russian, and participated in writing the manuscript. IK participated in writing the manuscript. DS coordinator of the COMET-G project. KF principal investigator of the COMET-G project and development of the study protocol. ER contributed with development of the conception and design of the study, is a national coordinator of the COMET-G project, and participated in writing the manuscript. All authors participated in interpreting the data and developing further stages and the final version of the paper.

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Concerns and Challenges Related to Sputnik V Vaccination Against the Novel COVID-19 Infection in the Russian Federation: The Role of Mental Health, and Personal and Social Issues as Targets for Future Psychosocial Interventions

Anna V. Vasileva[1,2], Tatiana A. Karavaeva[1,3,4,5], Dmitriy S. Radionov[1], Alexander V. Yakovlev[6,7], Igor N. Mitin[8], Emanuele Caroppo[9], Sergey I. Barshak[8] and Kirill S. Nazarov[8]*

[1] Federal State Budgetary Institution «V. M. Bekhterev National Research Medical Center for Psychiatry and Neurology» of the Russian Federation Ministry of Health, Saint-Petersburg, Russia, [2] I. I. Mechnikov North-Western Medical State University, Saint Petersburg, Russia, [3] Federal State Budgetary Institution of Higher Education «Saint-Petersburg State University», Saint-Petersburg, Russia, [4] Federal State Budgetary Institution of Higher Education «Saint-Petersburg State Pediatric Medical University» of the Ministry Healthcare of Russian Federation, Saint-Petersburg, Russia, [5] Federal State Budget Institution «National Medical Research Center of Oncology Named After N. N. Petrov» of the Russian Federation Ministry of Health, Saint-Petersburg, Russia, [6] Federal State Budgetary Military Educational Institution of Higher Education «Military Medical Academy Named After S. M. Kirov» of the Ministry of Defense of the Russian Federation, Saint Petersburg, Russia, [7] Saint-Petersburg State University of Aerospace Instrumentation, Saint Petersburg, Russia, [8] Federal State Budgetary Institution "Federal Research and Clinical Center of Sport Medicine and Rehabilitation of Federal Medical Biological Agency", Moscow, Russia, [9] Local Health Unit ASL Roma 2, Rome, Italy

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Edited by:
Daria Smirnova, Samara State Medical University, Russia

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Jelena Vrublevska, Riga Stradiņš University, Latvia
Felicia Iftene, Queens University, Canada

***Correspondence:**
Anna V. Vasileva
annavdoc@yahoo.com

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Background: Vaccine hesitancy causes serious difficulties in vaccination campaigns in many countries. The study of the population's attitude toward vaccination and detection of the predictive important individual psychological and social factors defining the vaccination necessity perception will allow elaborating promoting vaccination adherence measures.

Objectives: The aim of this research was to study COVID-19 threat appraisal, fear of COVID-19, trust in COVID-19 information sources, COVID-19 conspiracy beliefs, and the relationship of sociodemographic variables to COVID-19 preventive behavior.

Methods: We carried out a cohort cross-sectional study of the population's attitude toward vaccination against the novel COVID-19 coronavirus infection, using a specially designed questionnaire for an online survey. Totally, there were 4,977 respondents, ranging in age from 18 to 81 years. Statistical assessment was carried out using the SPSS-11 program.

Results: There were different attitudes toward vaccination. Among respondents, 34.2% considered vaccination to be useful, 31.1% doubted its effectiveness, and 9.9% considered vaccination unnecessary. The survey indicated that 7.4% of respondents were indifferent to the vaccine, while 12.2% deemed it to be dangerous. Nearly one-third

(32.3%) of respondents indicated that they did not plan to be vaccinated, while another third (34.0%) would postpone their decision until more comprehensive data on the results and effectiveness of vaccination were available. Only 11.6% of the respondents were vaccinated at the time of the study. Young people were less focused on vaccination compared to middle-aged and elderly people. Receiving information concerning COVID-19 vaccination from healthcare workers and scientific experts was associated with greater vaccination acceptance.

Conclusion: The study results showed that vaccination attitudes interacted with individuals' mental health and various sociodemographic factors. Insofar as reports of physicians and experts are essential for shaping attitudes to vaccination, the study results inform the selection of target groups in need of particular psychosocial interventions to overcome their vaccine hesitancy.

Keywords: attitudes toward vaccination, COVID-19, coronavirus infection, pandemic, psychosocial interventions targets

INTRODUCTION

The COVID-19 pandemic outbreak, which began in early 2020, has become the hitherto most critical event of the century, with a toll of millions of lives. Furthermore, the pandemic has had a serious impact on the mental health and wellbeing of populations around the world (1, 2). State-of-the-art technologies, including mathematical model-based analysis, big-data techniques, and algorithms based on artificial intelligence (AI) have been implemented to cope with this health, economic, and social emergency. In particular, the recent use of AI has significantly accelerated the development of vaccines and treatments. In some circles, this technology has been a source of fear, mistrust, and conspirological beliefs (3). The mathematical model-based analysis enables a better understanding of the factors promoting COVID-19 transmission, supporting a more reliable prediction of the pandemic development: even at its earlier phase, such methods showed that even a moderately effective vaccine would significantly reduce the rate of COVID-19 transmission. The model-based analysis predicted that even a vaccine, such as VES, with greater than 70% efficacy against infection could stop the spread of COVID-19. Conversely, the achievement of herd immunity in the worldwide population would likely have resulted in up to 30 million deaths, while exhausting healthcare resources worldwide (4).

Given the present circumstances of restrictions and risks, rational actors would reasonably be expected to be vaccinated based on their informed appraisal of risk and benefit (5). Nevertheless, we have observed massive disapproval and hostility to vaccination and restriction measures aimed to stop the spread of COVID-19 transmission, culminating in protests in many countries against obligatory vaccination. One of the main expressed concerns is about the safety and possible side effects of the new speedily developed COVID-19 vaccines. Psychological defense mechanisms along with partial reality distortion make mental health issues a serious obstacle in the campaign against the pandemic (6, 7). The spread of COVID-19 infection is accompanied by a massive infodemic, with misinformation spreading much faster than the virus itself and having a great effect on public acceptance of vaccination another other public health measures (8–10).

In particular, the involvement of the new technologies aimed to stop the pandemic is dramatically augmenting public mistrust, conspirological theories, and vaccine hesitancy as detected by digital media portals (9, 11–14). Vaccine hesitancy is a matter of great concern to the World Health Organization (WHO). Even in 2015, the WHO, 2015 Strategic Advisory Group of Experts on Immunization identified vaccine hesitancy as a delay in acceptance or refusal of vaccination, despite the availability of vaccination services. Vaccine hesitancy can differ in intensity and involves various conspirological beliefs, such as the contention that it serves as a tool of mass chipping and pervasive social control. The spread of misinformation only increases vaccine hesitancy, and WHO announced this in 2019 (thus, prior to the pandemic) to be one of ten main global health threats and a massive obstacle to achieving population immunity against disease (15, 16). In the Russian Federation, the Moscow-based Gamaleya Research Institute of Epidemiology and Microbiology applied its experience in platform research for Ebola and Middle East respiratory syndrome vaccines toward the development of Gam-COVID-Vac (Sputnik V), a heterologous rAd26 and rAd5 vector-based COVID-19 vaccine. This initially demonstrated a good safety profile and induced strong humoral and cellular immune responses in participants in phase 1/2 clinical trials. The interim analysis of the phase 3 trial of Gam-COVID-Vac showed 91.6% efficacy against COVID-19 and good tolerance (17, 18). Experience has shown that because of vaccine hesitancy and mythological thinking, vaccine availability does not ensure mass population vaccination.

The WHO recommends that each country study its climate of vaccine hesitancy and develop targeted strategies, including brief psychosocial interventions or campaigns, to increase vaccination acceptance (19). Our first study, conducted during the early months of Sputnik V vaccination, preceding the public

Abbreviations: COVID-19, coronavirus disease 2019; WHO, World Health Organization.

educational campaigns, showed that only 12.2% of respondents had been vaccinated and more than 60% had some degree of hesitancy. Recent studies have shown the importance of receiving information about COVID-19 vaccination from healthcare workers for vaccination acceptance as well as the perceived severity of COVID-19 (20). The other research emphasized the impact of COVID-19 threat appraisal on the COVID-19 preventive behavior adherence (5). As mentioned above, the COVID-19 experience is an important factor in the study of attitudes toward vaccination. Understanding the factors that determine vaccine hesitancy is essential for the planning of brief, targeted psychosocial interventions (21). Understanding the sources of unwillingness to be vaccinated is crucial for elaboration of appropriate measures to improve vaccination adherence.

Objectives

The objectives of this study are identification of the predictive significant individual psychological and social combination of variables, determination of vaccination attitude at the beginning of the vaccination campaign in the Russian Federation, and elaboration of the model that can predict vaccination attitude.

Hypothesis

Different vaccination attitudes are connected with specific respondents' characteristics such as sociodemographic factors, gender, social and educational status, personal COVID-19 experience, presence of anxiety and worries, wellbeing status, personal beliefs about vaccination usefulness or harm, and attitude to one's health. The identification of these variables' patterns allows the prediction of vaccination attitudes in different population groups for the further development of the targeted public health programs aimed to increase vaccination acceptance.

MATERIALS AND METHODS

A cohort cross-sectional study of the population's attitude toward vaccination against the COVID-19 coronavirus was carried out using a specially designed questionnaire for a mass online survey. The sample was collected through study promotion *via* the most popular social media (VK, WhatsApp, Viber, Facebook, and Telegram). Considering the importance of opinions of healthcare professionals, we targeted our recruitment toward medical professional portals and mailing lists. In addition, to obtain a group of respondents with preexisting mental health conditions, we promoted the study through mailing list databases and *via* a partnership with the Russian Society of Psychiatrists and patient organizations. The total sample of 4,172 respondents included 42.2% with higher medical education and 20.5% with a previous history of mental disorders, attested by their presence on mailing lists. The study was attended by respondents from 64 of the 85 districts of the Russian Federation. Most cities with a population of 1 million or more were represented, namely, St. Petersburg, Moscow, Novosibirsk, Chelyabinsk, Kazan, Ufa, Rostov-on-Don, Voronezh, and Krasnodar (refer to **Table 1**). Approximately 40% of respondents lived in smaller settlements (less than 500,000 people) but were nonetheless able to participate given the broad Internet penetration. The survey was extended from 5 March to 5 June 2021.

The questionnaire allowed us to obtain sociodemographic, anamnesis, clinical data, and psychological characteristics of respondents while assuring anonymity. The complete questionnaire was divided into the following sections:

Section 1 included sociodemographic parameters such as age, sex, education, social status, the population of the place of residence, type of activity, family, and a financial statement.

Section 2 included attitude toward vaccination against the novel coronavirus infection, the incidence of previous novel coronavirus infection among respondents and their immediate family/social circle, the general attitude toward vaccination and specifical vaccination against the novel coronavirus infection, if the respondent was vaccinated, and whether he/she plans to be vaccinated, willingness to recommend that relatives and friends be vaccinated (which greatly affects the broader formation of attitudes to vaccination), the presence of anxiety associated with the risk of getting sick and with the risk of possible complications from vaccination, and the presence of somatic and mental disorders that might affect the attitude to vaccination.

Section 3 was comprised as follows:

1. A questionnaire containing beliefs about vaccines and vaccination. The Vaccination Attitudes Examination (VAX) Scale, the double translation of the questionnaire, has been made before its implementation in the study (22).
2. The General Health Questionnaire, GHQ12, evaluating an individual's psychological wellbeing and distress D. P. Goldberg (1972). The adaptation of the Russian version was made by Burlachuk L. F. in 2005 (23, 24).
3. Health Attitude Questionnaire (R. A. Berezovskaya, 2005).

Participation in the study was anonymous and voluntary. The Independent Ethical Committee at the V. M. Bekhterev National Medical Research Center approved the study for Psychiatry and Neurology (EK-I-31/21 from 25 February 2021). Before filling out the questionnaire, the respondent had the opportunity to get acquainted with the goals and conditions of the study and to give informed consent to participate by marking in the appropriate paragraph. After filling out the questionnaire, the respondent could send the completed data, or withdraw from the survey without the inclusion of their responses in the survey. Only surveys with 100% completion were analyzed. Analysis and assessment of the survey's results were carried out within 2 months after the launch of Russia's mass vaccination campaign.

TABLE 1 | Sociodemographic characteristics of the study group.

Settlement	Sample (n)	Percentage (%)
In the countryside	324	7.8
In a city with a population of less than 100,000 people	478	11.5
In a city with a population of 100,000 – 500,000 people	931	22.3
In a city with a population of 500,000 -1,000,000 people	844	20.2
In a city with a population of more than 1,000,000 people	1,595	38.2
Total sample	4,172	100

The inclusion criteria were as follows:

1. Over the age of 18
2. Informed consent to participate in the study
3. Ability to read Russian and fill out an online questionnaire

The ex/non-inclusion criteria were as follows:

1. Age less than 18 years
2. Inability to understand the text and content of the questionnaire

The exclusion criteria were as follows:

1. Participants declining at any stage to participate in the survey

Statistical assessment was carried out using the SPSS-11 program. Descriptive data analysis and two-dimensional (cross-tabulation) statistical analysis were used. Statistical confidence was judged according to the F-test (Fisher's criterion; φ). The procedure for data collection excluded the possibility of duplication. The significance level was defined as l φ = 0.05. Results from 4,977 people aged 18–81 years were included, with a mean (SD) age of 37.58 (13.56) years. Of the population, 1,393 (28.0%) were men and 3,584 (72.0%) were women. The study included all age groups of the adult population, according to the WHO classification: young aged (18–44 years)—3,445 (69.2%); middle-aged (45–59 years)—1,178 (23.7%); elderly aged (60–74 years)—343 (6.9%); and extremely old aged—11 (0.2%). The elderly and extremely elderly groups were combined to yield 354 respondents (7.1%). The educational attainment of respondents was 23 (0.5%) with secondary education, 987 (19.8%) with further education, 387 (7.8%) with incomplete higher education, 2,603 (52.3%) with higher education, and 977 (19.6%) with two higher educations or academic degrees.

Social Status of Respondents

Among the 4,977 respondents, 921 (18.5%) were students, 3,426 (68.8%) were working, 249 (5.0%) were business owners, and 153 (3.1%) were homemakers. There were 160 (3.2%) pensioners, 57 (1.1%) unemployed, and 11 (0.2%) living on benefits. Since the presence of technical knowledge is important for the formation of attitudes toward vaccination, medical education and medical specialty were separately considered. The total sample included 2,153 (X%) health workers, among which 908 people (42.2%) were physicians, 291 (13.5%) nurses, 59 (2.7%) paramedics, 28 (1.3%) medical attendants, 498 (23.1%) medical students, 122 (5.7%) administrative staff, and 247 (11.5%) other health workers. Among the respondents, 859 (20.5%) suffered from anxiety disorders, of which 411 (9.9%) had suffered from depression and 126 (3.0%) mainly had psychotic mental disorders.

RESULTS

COVID-19 Personal Experience

About half (n = 2,909; 58.4%) of the respondents did not suffer from a novel coronavirus infection since COVID-19 outbreak, asymptomatic infection (n = 390; 7.8%), mild illness (n = 910; 18.3%), moderate illness (n = 670; 13.5%), and severe illness (n = 98; 2.0%). Restrictive measures introduced for the older population and the very old proved to be effective; among these age groups, a significantly higher proportion of patients did not experience infection with the virus (67.8%), compared to rates in the young (58.7%) and middle-aged (54.8%) subgroups. Reliable differences are observed both between the young and the elderly ($p < 0.01$; φ = 2.798) and between the middle aged and the elderly ($p < 0.01$; φ = 3.572).

It was also assessed whether close contacts of individuals had suffered from a novel coronavirus infection as well as the severity and course of the disease. Respondents were allowed to answer the question in a multiple-choice format. One-third of respondents' relatives (n = 1,654; 33.2%) suffered asymptomatic infection; 3,584 (72.0%) experienced mild illness. Almost half of respondents' relatives (n = 2,123; 42.7%) suffered from severe illness (hospitalization was required) and a large number of relatives (n = 1,015; 20.4%) died as a result of coronavirus infection. Only 647 (13.0%) of relatives did not have this infection.

COVID-19 Vaccination Attitude

Among the population, there were different views and ideas about the benefits and need for vaccinations in general and vaccination against various infections. Responses were distributed approximately evenly across four types of vaccination attitudes. No significant differences by age group were found for this variable.

Among respondents, 1,309 (26.3%) people tried to avoid any vaccination, 1,370 (27.5%) were vaccinated sometimes, 855 (17.2%) were always observed, and 1,443 (29.0%) were vaccinated at the recommendation of specialists. The main objective was to assess the attitude of the population to vaccination against the novel coronavirus infection. A third of those respondents (n = 1,703; 34.2%) considered vaccination useful, while a third (n = 1,550; 31.1%) doubted its effectiveness, 9.9% (n = 492) of respondents considered vaccination unnecessary, and 12.2% (n = 609) considered it to be dangerous. Indifferent attitude toward vaccination was formed in 7.4% (n = 367) of respondents. Some other opinions were held by 5.1% (n = 256). There is a relationship between the attitude to vaccination and the age of the respondents (refer to **Table 2**). Old and very old respondents considered vaccination to be unnecessary, dangerous, or doubtful in its effectiveness less often than young or middle-aged respondents ($p < 0.01$).

There are also sex differences in vaccination attitude; more men than women consider vaccination to be useful ($p < 0.01$; φ = 6.461), and there are fewer respondents among men who doubt the effectiveness ($p < 0.01$; φ = 5.923). Among women, there is a greater percentage of those who consider vaccination to be dangerous ($p < 0.01$; φ = 3.389). Most of the respondents do not have fears related to possible vaccine shortages (n = 3,579; 85.8%). Such concern was noted by 500 people (12.0%), with 93 (2.2%) respondents having very significant concerns about vaccine shortages. When the questionnaire asked regarding specific actions of respondents

TABLE 2 | COVID-19 vaccination attitudes among different age groups.

The attitude of the population to vaccination against COVID-19	Age groups (WHO)			Total sample n (%)
	Age group I (ages from 18 to 44)	Age group II (ages from 46 to 54)	Age group III (ages from 60 to 89)	
Vaccination is unnecessary	411	71	10	492 (9.9%)
	11.9%	6.0%	2.8%	
	I and II. $p < 0.01$. $\varphi = 6.192$ I and III $p < 0.01$. $\varphi = 6.593$			
Vaccination is useful	957	542	204	1703(34.2%)
	27.8%	46.0%	7.6%	
	I and II. $p < 0.01$. $\varphi = 11.259$ I and III. $p < 0.01$. $\varphi = 10.965$ II and III. $p < 0.01$. $\varphi = 3.828$			
Vaccination is dangerous	474	116	19	609 (12.2%)
	13.8%	9.8%	5.4%	
	I and II. $p < 0.01$. $\varphi = 3.674$ I and III. $p < 0.01$. $\varphi = 5.232$II and III. $p < 0.01$. $\varphi = 2.772$			
Doubts about the effectiveness	1113	343	94	1550 (31.1%)
	32.3%	29.1%	26.6%	
	I and II. $p < 0.05$. $\varphi = 2.044$			
	I and III. $p < 0.05$. $\varphi = 2.224$			
Indifferent attitude	325	32	10	367 (7.4%)
	9.4%	2.7%	2.8%	
	I and II. $p < 0.01$. $\varphi = 8.681$ I and III. $p < 0.01$. $\varphi = 5.142$			
Others	165	74	17	256 (5.1%)
	4.8%	6.3%	4.8%	
Total sample n (%)	3445	1178	354	4977 (100%)
	100.0%	100.0%	100.0%	

in attitude to their own vaccination, 577 (11.6%) respondents noted they have already been vaccinated, 661 (13.3%) planned to vaccinate shortly, 1,693 (34.0%) are going to make decisions based on data on long-term outcomes and vaccination results, 1,610 (32.3%) indicated they do not plan to vaccinate, and 436 (8.8%) have medical contraindications (refer to **Figure 1**).

There are significant differences in the age group. Among young people, there are more respondents who do not plan to be vaccinated than among middle-aged people ($p < 0.01$; $\varphi = 11.288$) and the elderly ($p < 0.01$; $\varphi = 10.499$), less who plan to be vaccinated in the near future ($p < 0.01$; $\varphi = 4.978$; $\varphi = 5.679$), and less already vaccinated ($p < 0.01$; $\varphi = 7.526$; $\varphi = 4.264$). The proportion of respondents who would recommend vaccinations to friends and relatives and their relation to attitude to this preventive measure is important for assessing respondents' attitudes to vaccination against the novel coronavirus infection. Less than a third of respondents (1,340; 26.9%) noted that they would recommend a vaccine; 1,986 (39.9%) respondents are not ready to recommend it, and 293 (5.9%) intend to actively dissuade others, and 1,358 (27.3%) have not yet decided. Respondents who are ready to recommend vaccinations to friends and relatives consider it useful for the most part (88.1%). Respondents who replied that they will try to dissuade relatives or did not plan to recommend it consider it dangerous (54.3% and 19.4%, respectively), unnecessary (25.3% and 16.1%), or ineffective (16.0% and 43.2%) (refer to **Supplementary Table 1**).

The impact of sociopsychological factors on the attitude toward vaccination.

The attitude toward vaccination is manifested and largely formed depending on the results shown by vaccination in different countries, i.e., on data provided by the media, official state, and medical sources. It was noted assessing the respondents number who were interested in the course of vaccination, monitor the results and effectiveness of vaccinations, 723 (14.5%) people closely follow, they report that they monitor to some extent, a third of respondents ($n = 1,478$; 29.7%); 1,255 (25.2%) are somewhat less interested. A third of respondents ($n = 1,521$; 30.6%) do not monitor the results of vaccination. Those respondents who consider vaccination unnecessary (63.0%) and are indifferent (56.4%) are more interested in vaccination results. A significant number of respondents who consider the vaccine dangerous or doubt its effectiveness continue to be interested in the results (58.5% and 67.0%, respectively).

The likely cautious population's attitude toward vaccination may be due to fear of perceived complications. Only 946 (19.0%) people are not afraid of possible complications, 1,342 (27.0%) are slightly feared, 1,163 (23.4%) are moderately feared, 801 (16.1%) are greatly feared, and 725 (14.6%) are very much feared. In the group of respondents who are very afraid of complications from vaccination, the greater proportion of those generally consider it dangerous (40.6%) or doubt its effectiveness (30.3%) (refer to **Supplementary Table 2**). Notably, doctors are reliably less afraid of complications from vaccination than all other categories of medical workers and respondents who do not work in the medical field ($p < 0.01$).

Of the total sample, 1,485 (29.8%) people suffer from any chronic disease (e.g., hypertension, diabetes mellitus, bronchial

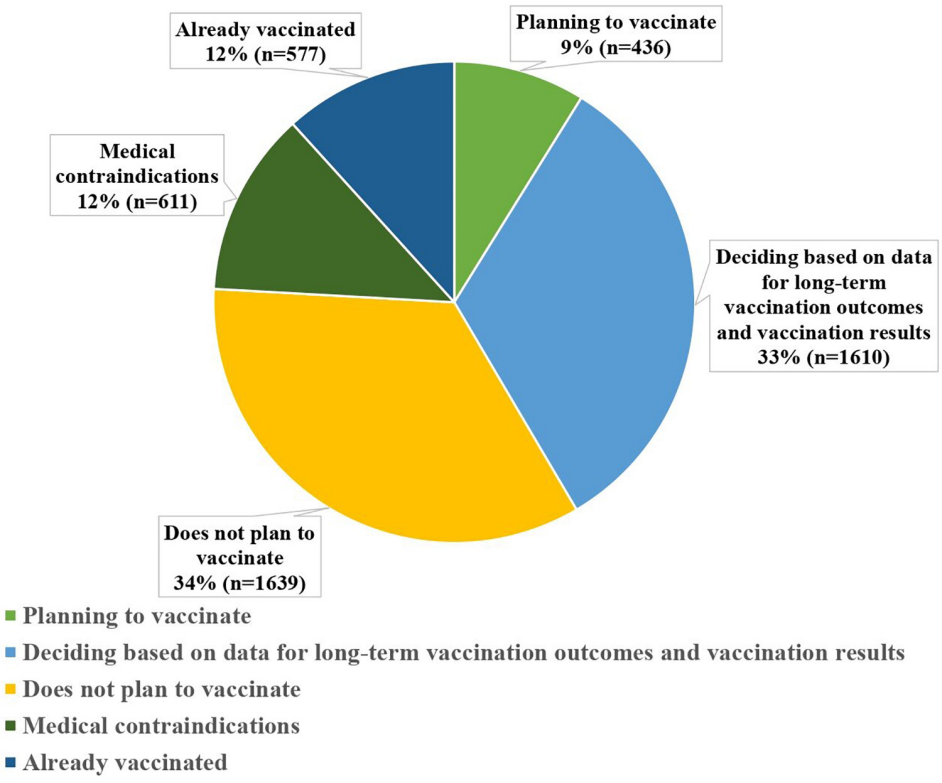

FIGURE 1 | Vaccination behavior types as presented in the study group.

asthma, obesity, or being overweight). Among them, some people are very afraid of complications ($p < 0.01$; $\varphi = 25.621$). In addition, significantly less than those who consider vaccination unnecessary-87 – 5.9%) ($p < 0.01$; F = 6.585) than necessary.

The study demonstrated that vaccination attitude is influenced by individuals' mental health. By filling out the questionnaire, respondents were able to indicate the presence of a known mental health disorder based on a previously given diagnosis. Individuals with anxiety ($p < 0,01$; $\varphi = 6.584$) and depressive disorders ($p < 0.01$; $\varphi = 4.671$) had significantly more concerns about possible vaccination complications than healthy respondents. In contrast, people with anxiety disorders more than others evaluated immunization as a useful measure against COVID-19 ($p < 0.01$; $\varphi = 6.352$); among the depressive patients, more respondents had doubts about vaccination efficacy than in the other groups ($p < 0.01$; $\varphi = 5.149$). Patients with other mostly psychotic mental disorders to some degree were more indifferent to vaccination ($p < 0.01$; $\varphi = 7.437$). In addition, there are significantly fewer people who consider vaccination unnecessary – 87 (5.9%) ($p < 0.01$; $\varphi = 6.585$). In all groups of people who fear for the health of relatives, the proportion of those who consider vaccination useful is significantly higher compared to those who do not have such fears ($p < 0.01$; $\varphi = 7.263$; $\varphi = 11.451$; $\varphi = 10.76$; $\varphi = 8.56$). There is a relationship between the vaccination attitudes and the fear of the severity of contracting coronavirus infection (refer to **Supplementary Table 3**).

Among those who are not afraid of contracting coronavirus, the percentage of those who consider vaccination unnecessary is **higher** compared to those who are afraid of getting sick ($p < 0.01$ compared to all groups). Almost half of those who fear getting sick moderately (45.0%; $p < 0.01$; $\varphi = 12.328$), strongly (52.6%; $p < 0.01$; $\varphi = 6.15$), and very strongly (47.7%; $p < 0.01$; $\varphi = 5.338$) are confident in the utility of vaccination, reliably more than those who are not afraid to get sick. These groups of respondents have less doubt about the effectiveness of the vaccine. A slightly more than a third of respondents ($n = 2,000$; 40.2%) noted that they do not experience anxiety at all due to the current situation with coronavirus, rarely experience anxiety ($n = 1,247$; 25.1%), sometimes ($n = 1,326$; 26.6%), often ($n = 302$; 6.1%), and very often ($n = 102$; 2.0%). Among those who often and very often experience anxiety due to the situation with coronavirus, a large number of those who consider the vaccine useful (44.7% and 52.9%; respectively) are significantly more than those who do not experience anxiety (25.4%) ($p < 0.01$; $\varphi = 6.625$; $\varphi = 5.645$). Individuals who very often experience anxiety are less doubtful of vaccine efficacy, at only 22.5%, which is lower than in other groups where anxiety was less common ($p < 0.05$; $\varphi = 2.476$). The fear of dying due to coronavirus is not experienced by 2,552 (51.3%) respondents, is experienced less by 1,871 (37.6%) respondents, is experienced strongly by 345 (6.9%) respondents, and is experienced very strongly by 209 (4.2%) respondents. The preferred information sources defining the vaccination

attitudes and behavior in the population were studied (refer to **Table 3**). The respondents were provided with a list of the main information sources with multiple-choice options. The majority of the respondents preferred reports from scientists, physicians, and other experts (81.2%). Opinions of family members and friends (22.9%), the media (20.9%), and social networks (16.3%) have a significantly lower influence. Statements and opinions of public figures have the lowest level of public confidence (10.6%), significantly lower compared to scientists and physicians ($p < 0.01$; $\varphi = 78.918$).

There is a relationship between the education of respondents and the proportion of people who noted the significant influence of a particular information sources. Among people with higher education, a significantly larger number noted the significant influence of scientists, doctors, and experts on their relationship to vaccination compared to those who had further education (85.0% and 64.7%, respectively, $p < 0.01$, $\varphi = 12.76$). Among those with further education, respondents noted the influence of the media (31.4%) and social networks (24.0%) are more than among those with higher education (18.4%: $p < 0.01$; $\varphi = 8.106$ and 14.2%: $p < 0.01$; $\varphi = 6.715$, respectively).

Vaccination Beliefs

A questionnaire on attitudes to vaccination was included as a separate block of the questionnaire, with 12 questions and four scales, namely, "Distrust of the benefits of the vaccine," "Distrust of unforeseen consequences in the future related to the vaccine," "Concerns about commercial speculation," and "Preference for natural immunity." Respondents noted their attitude to the statements in the questionnaire on a six-point scale ranging from 1 (absolutely disagree) to 6 (absolutely agree). The average value was calculated. Indicators ranging from 1 to 3 indicate disagreement with the statements, indicators ranging from 3 to 4 indicate neutrality, and indicators ranging from 4 to 6 indicate consent with the statements. Responses from respondents in different age groups were also studied. Those surveyed by all age groups believe the vaccine has not been sufficiently studied and can negatively affect health. Among respondents, there is no support for the idea of commercial speculation on vaccination that vaccines are more beneficial to pharmaceutical companies than the population, and the vaccination program itself is profane (2.96). Young people do not believe that vaccination gives them a sense of safety (2.95), unlike middle-aged and elderly people who agree that vaccines can stop serious infectious diseases (4.03 and 4.29).

TABLE 3 | Information sources influencing the formation of attitudes toward vaccination.

	Opinion about coronavirus infection and vaccination is determined by:	Sample (n)	Sample (%)
1	Reports by scientists, physicians and other experts	4,042	81.2
2	Opinion of famous people and public figures	527	10.6
	1 and 2 $p < 0.01$; $\varphi = 78.918$		
3	Media	1,041	20.9
4	Opinions of my family members and friends	1,140	22.9
5	Information in social networks	809	16.3

Discriminant Analysis Results

To build a model, the respondents' answer about their attitude toward vaccination (variable Q2_015) has been chosen as a group variable. According to the values of this variable, the observations were divided into 6 groups of respondents (refer to **Table 4**).

The analysis of the questionnaire results, based on the descriptive statistic methods and contingency tables revealed that the respondents' attitudes toward vaccination, can be influenced by a number of variables. These variables, conditionally combined into 6 semantic groups, are shown in **Supplementary Table 4**.

Notably, a number of variables presented in **Supplementary Table 4** were calculated based on the respondents' answers. These are the variables Q1_009a from the first group of variables and Q2_014a from the second group of variables. The variables included in the 4th to 6th groups of variables are the values of the scales of the previously mentioned questionnaires VAX, GHQ-12, and attitude to one's health questionnaire (R. A. Berezovskaya) and also were calculated based on the respondents' answers.

The task was to develop a mathematical-statistical model that could classify the respondent into one of the 6 groups presented in **Table 4** based on the values of the variables presented in **Table 4**.

To build the model, the initial data set of 4,977 observations was analyzed, and 83 observations containing incomplete data were excluded. The remaining 4,894 observations were divided into two parts, namely, the training sample ($N = 2447$) and control sample ($N = 2447$).

To develop the model, the observations from the training sample were used. To check the quality of the developed model, observations from the control sample were used.

Discriminant analysis was used to build this model. The first five canonical discriminant functions were used in the calculated model. Thus, the first discriminant function provides 88.7% of the prognosis and the second for 7.5%. The sum of the first two discriminant functions provides a 96.2% prognosis (refer to **Table 5**).

Supplementary Table 5 shows the unstandardized coefficients of the canonical discriminant functions for each of the variables used in the model. Group means of non-standardized canonical discriminant functions (group centroids) for the groups of respondents described in **Table 4** are presented in **Supplementary Table 6**.

TABLE 4 | Respondents' groups as divided by the factor of their attitudes toward vaccination.

Q2_015 = 1	Respondents who consider vaccination unnecessary (group 1)
Q2_015 = 2	Respondents who consider vaccination useful (group 2)
Q2_015 = 3	Respondents who consider vaccination dangerous (group 3)
Q2_015 = 4	Respondents who doubt vaccination effectiveness (group 4)
Q2_015 = 5	Respondents who are indifferent toward vaccination (group 5)
Q2_015 = 6	Respondents who have others attitude toward vaccination (group 6)

TABLE 5 | Classification model confusion matrix (% of true and false classification results in the control sample data).

Discriminant function	Eigen value	% of variance	Cumulative%	Canonical correlation
1	1,010a	88,7	88,7	,709
2	,086a	7,5	96,2	,281
3	,024a	2,1	98,3	,154
4	,014a	1,2	99,5	,117
5	,005a	,5	100,0	,072

Supplementary Table 5 allows you to calculate the values of discriminant functions 1–5 based on the variables presented in **Supplementary Table 4**. The obtained values of discriminant functions 1–5 are compared with group centroids (in **Supplementary Table 6**). Thus, the respondents are classified, i.e., assigning it to one of the six groups under consideration.

Figures 2, **3** present the groups and groups' centroid location on the discriminant functions axis. Consequently, group 1 (respondents consider vaccination to be unnecessary), group 5 (respondents who are indifferent toward COVID-19 vaccination), and group 2 (respondents who think vaccination to be useful) were located on the first discriminant function axis. At the same time, group 1 follows group 3 (respondents who consider vaccination to be dangerous) on the second discriminant function axis.

Thus, a set of discriminant functions was developed that allows the recognition (classification) of the respondent's attitude toward vaccination based on the analysis of his/her answers to a number of questions from the proposed questionnaire.

To evaluate the effectiveness of the developed model, the data in the control sample were classified using the developed discriminant functions. **Supplementary Table 7** presents the results of the quality assessment of the developed classification model. These results are presented in the form of a matrix containing the percentage of correct and incorrect classifications of control sample data. Computations showed that 45.7% of the primary groups were classified correctly.

It is worth mentioning that the model has a high percentage of correct classification (69.9%) for group 2 (respondents who thought vaccination to be useful), and a relatively high percentage of the correct classification (50.5%) for group 3 (those who consider vaccination dangerous). At the same time, the model hardly differentiates groups 1 and 3. However, if we classify this group as a vaccination non-compliant population, the percentage of correct allocation can be acceptable.

DISCUSSION

During the start-up phase of prevention programs against the novel coronavirus infection, participants were surveyed about their views on vaccination. A third of respondents consider vaccination useful, while the same portion doubts its effectiveness. About a quarter of respondents perceive it as unnecessary, dangerous, or indifferent. These perceptions influence behavior and decision-making regarding one's own vaccination. A third of the entire sample notes that they do not plan to vaccinate, another third doubts the decision and focuses on the more distant results of the vaccination program conducted in the country, 11.6% are already vaccinated, and 13.3% plan to vaccinate shortly. The percentage of Russian citizens who were unwilling to get a COVID-19 vaccine was similar to the results from a European survey published in 2020 of adults across seven European countries (19). Our results suggest more positive vaccination attitudes among older adults (65 years and older) and middle-aged adults compared to young people. The COVID-19 vaccine-related attitudes research in Canada has shown similar results of some degree of vaccine hesitancy in 60% of the respondents, with a significant association with younger age (18–39 years). In a similar United Kingdom study, the uncertain group made up nearly a quarter, with a large proportion of younger age respondents constituting the 14% who were unwilling to get vaccinated (6.21). The study results showed that men considered the vaccine useful more often and had a lower proportion of those with vaccine hesitancy compared to women. Women had negative attitudes toward COVID-19 vaccination in a large number of studies conducted worldwide, which can most likely be attributed to beliefs that the vaccine can have a negative impact on reproductive function (23–27). Lack of trust in the vaccine's benefits and efficacy as well as concerns about the novelty, safety, and unknown side effects comprise the key obstacles to vaccine willingness.

Overall, respondents' concerns are mostly related to fear of possible negative complications from the vaccine, which are currently unobvious or unknown (4.17). This echoes results obtained in numerous other studies; newness, safety, and potential side effects can be considered universal concerns, making an impact on achieving COVID-19 public immunity (14, 28, 29). The absence of COVID-19 contamination concerns, poor compliance with epidemiological guidelines, and low knowledge about COVID-19 and possible complications is associated with lower vaccination adherence. The same tendencies were found in a number of other studies (30, 31). The attitude toward vaccination determines the population's activity and intention to recommend vaccination to their loved ones and friends. Only less than a third of those interviewed are willing to do the latter. Most respondents will experience, to varying degrees, fear of getting a coronavirus infection, concern for the health of their relatives, and anxiety due to the current situation with coronavirus in general. The presence of these experiences contributes to a more positive attitude toward vaccination. Considering the higher mortality rate and the difficulties in compliance with protective behavior due to cognitive defects, there is an urgent need to develop personalized psychosocial interventions to improve vaccination adherence in mentally ill patients (32–34). Among the factors influencing vaccination attitudes, the reports of scientists, physicians, and experts in the field are of greater importance, which generally reflects the public's confidence in the information obtained from these sources. In general, among the population, the level of confidence in the vaccine can currently be estimated as average. Among young people, the idea of the benefits of the vaccine is viewed with more

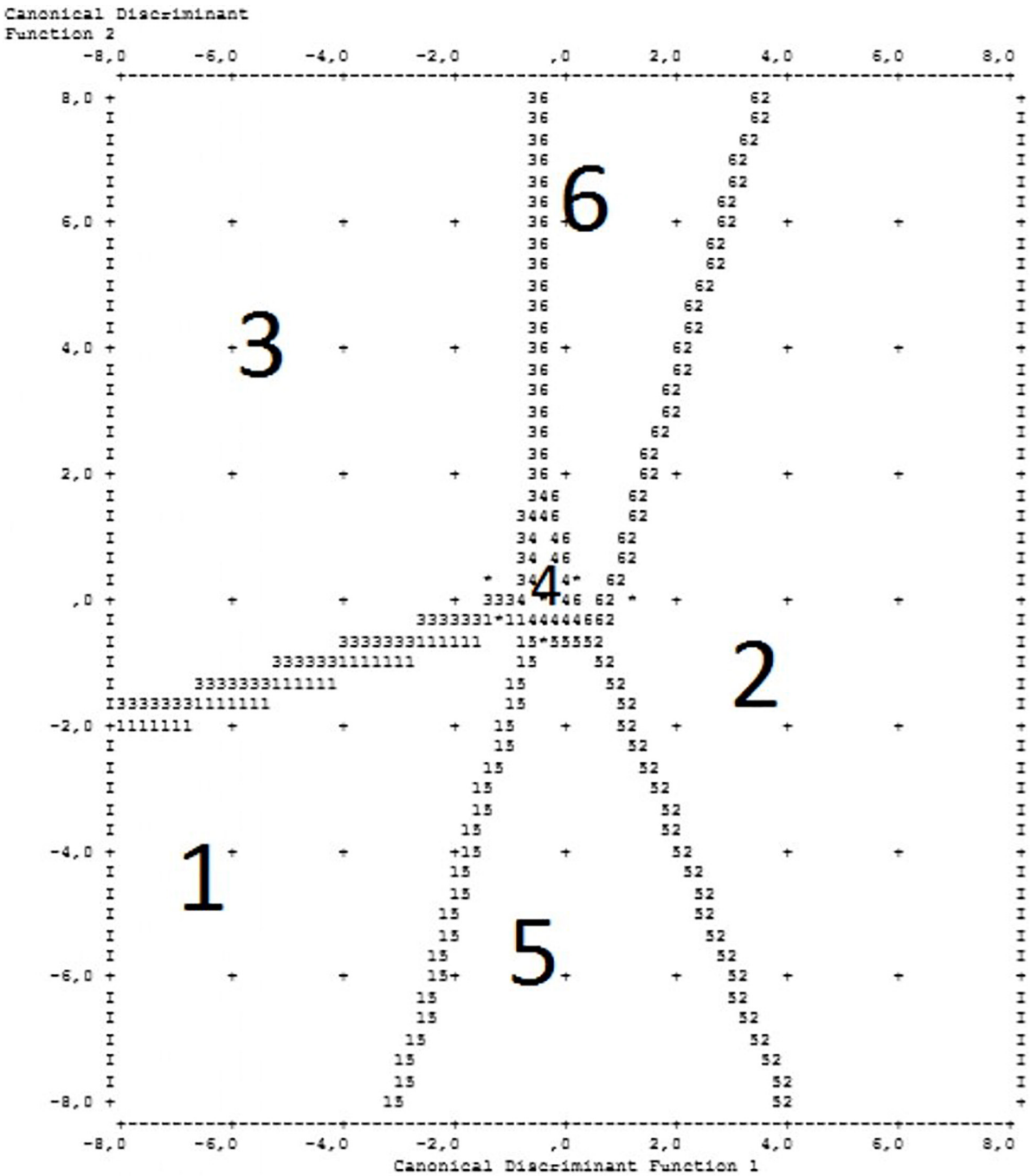

FIGURE 2 | Groups and groups' centroid location on the discriminant functions axis.

skepticism than among middle-aged and elderly people. Most of the concerns relate to possible negative unforeseen consequences of vaccination that may result in the future. The analysis showed an association of certain sociodemographic characteristics and individual experiences of the COVID-19 pandemic with attitudes toward vaccination.

The implementation of discriminant analysis in the large sample analysis allowed us to make a mathematical model. It can be used to predict an individual's attitude toward vaccination against the novel coronavirus infection based on the connected variables group. The use of predictive models can determine specific population groups and implement public health programs aimed to increase vaccination adherence at the early stages of vaccination campaigns. Considering the factors that separate the groups provides the opportunity to elaborate on targeted public health strategies and correct their content. As an

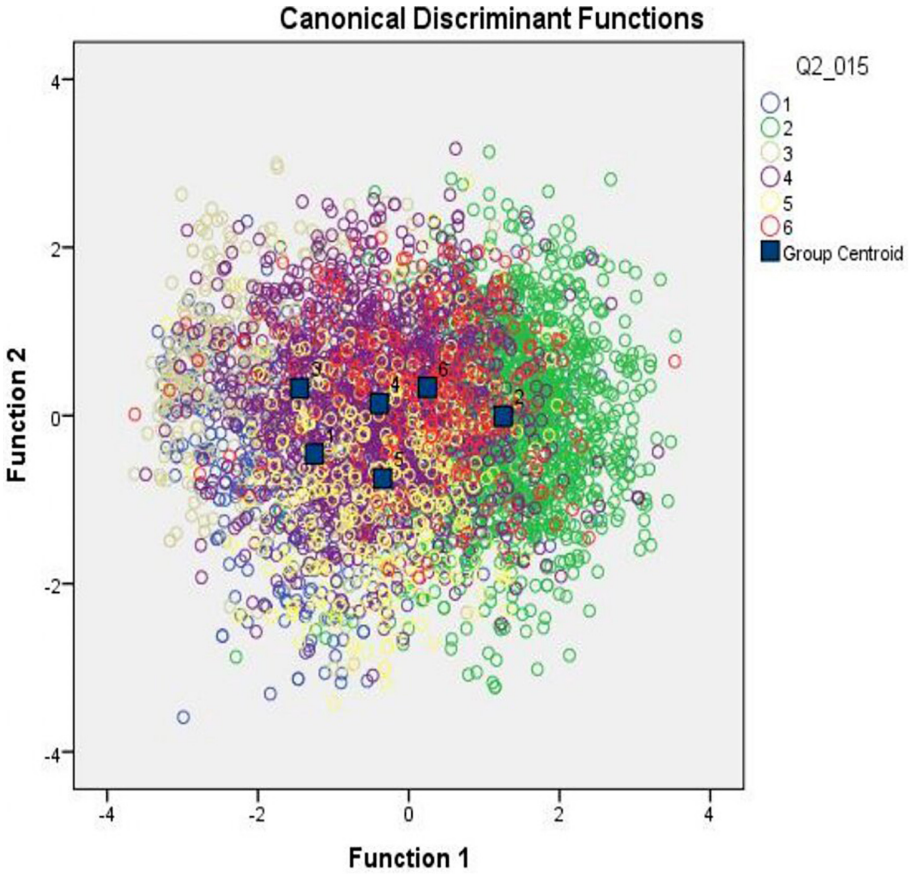

FIGURE 3 | Groups and groups' centroid location on the discriminant functions axis.

example, people having concerns about possible vaccination side effects should be provided with information about vaccination consequences, and people with indifferent vaccination attitudes should be addressed with motivation enhancing interventions.

CONCLUSION

The study results show the population's vaccination attitude in the first 2 months after its start. The data analysis revealed the impact of specific social demographic characteristics, personal COVID-19 pandemic experience, and mental health status on the vaccination attitude rate.

1) At the beginning of the vaccination campaign, 32.4% of the respondents considered it useful; 31.1% doubted its effectiveness; 9.9% considered vaccination unnecessary; 12.2% deemed it dangerous; and 7.4% are indifferent toward vaccination.

2) Higher vaccination adherence is associated with elderly and senile age, negative COVID-19 personal experience (respondents themselves or their close ones had severe COVID-19 cases, or died), somatic diseases, anxiety disorders, and healthcare worker professions.

3) Vaccine hesitancy is mainly determined by fear of possible adverse side effects and distrust of the benefits of vaccination.

4) The mathematical model can statistically accurately classify patients in one of the defined groups, using analysis of the following variables: gender and social characteristics, COVID-19-associated personal experience, presence of somatic diseases and mental health problems, COVID-19-associated anxiety, presence/absence of the specific general vaccination beliefs, psychological wellbeing and distress level, and attitude to one's health.

Given the importance of creating accurate perceptions among the population concerning the fight against the new coronavirus infection, psychosocial interventions aimed at increasing adherence to vaccination should address targets that are associated with a wary attitude of the population toward preventive measures. Considering the relatively large proportion of uncertain individuals in the sample, future research should investigate the factors defining the uncertainty about vaccination to build the most promising target for psychosocial interventions aimed to improve immunization. Concerns about vaccine safety and novelty, identified in the study as important factors in vaccine hesitancy, should be included as the main targets in the tailored public health vaccination campaign. Simple, clear explanations of how the new technologies can speed up vaccine creation and a balanced discussion of immunization risks and benefits should be emphasized. Given that healthcare professionals and scientists

are more trusted sources, these key opinion leaders should be more involved in the vaccination campaign. The additional refreshment professional training for healthcare workers focused on infectious diseases and immunology can significantly improve their own vaccine hesitancy and make them knowledgeable and encouraging in their dialog for vaccine uncertain and unwilling populations. For specific social groups that are associated with vaccine hesitancy, including younger people and women, the public health messaging should be tailored accordingly to provide transparent and clear-cut information about vaccination safety and address the female fears about possible infertility and vaccination teratogenic effects. For the young population, relevant celebrities should be involved in the vaccine campaign, and the negative social consequences of the prolonged pandemic should be emphasized to empower the youth that their decisions and behavior matter in the fight against the COVID-19 pandemic.

Taking into account the higher mortality rate and difficulties in compliance with protective behavior due to cognitive deficits, there is an urgent need to develop motivating psychosocial interventions to improve vaccination adherence in mentally ill patients (12). It could be recommended to organize the COVID-19 vaccination centers in the framework of mental health services to provide timely immunization to patients suffering from psychotic disorders. When researching vaccination attitudes, it is vital to involve population groups with more nuanced decision-making processes and vaccination unwillingness and uncertainty understanding in order to design psychosocial interventions accordingly.

Study Limitations

The major limitation of this cross-sectional study is that it represents one snapshot in time. The responses were collected at the beginning of the mass vaccination campaign and before any announcements about the success and safety of mass COVID-19 vaccination could be made.

The survey recruited participants from social media platforms and through mailing lists. There could be a component of selection bias as participants volunteered to participate in the research surveys through an electronic platform, which may lead to an increased selection of individuals with higher involvement in the COVID-19 pandemic, resulting in an underestimation of vaccine hesitancy. The availability of "Sputnik V" in all regions of the Russian Federation should inspire the government to encourage the population to get vaccinated, which can differ from other countries.

Our research also has some limitations regarding instruments. Since data collection took place over the Internet, the population study design does not permit the usage of psychometric instruments to evaluate anxiety symptoms' intensity and their interrelationship with attitudes toward vaccination. Further research in smaller groups that include patients with anxiety and other mental disorders should be designed with the use of appropriate psychometric scales to obtain more specific information about psychopathological disturbances. The "attitude to one's health" questionnaire used in this study is an original Russian instrument that cannot be compared to the results of similar international studies. It can be useful to include international instruments in further study designs.

Despite the diversity of the sample and the rich geographic representations and demographic measures, we cannot exclude that more extreme views on vaccines were not adequately captured or that certain specific subgroups, including rural areas, within the population, were not fully represented. We can infer that certain population groups were more likely to participate in the study than others, such as active Internet users.

Future research tracking changing attitudes toward vaccination will be important as the COVID-19 pandemic and its vaccination campaign continue.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The participants provided their written informed consent to participate in this study. The Independent Ethical Committee at the V. M. Bekhterev National Medical Research Center approves the study for Psychiatry and Neurology (EK-I-31/21 from 25.02.2021).

AUTHOR CONTRIBUTIONS

AV and TK designed the study and wrote the first draft of the manuscript. AV, TK, DR, IM, SB, KN, and EC performed the study. AY undertook the imaging data analysis. EC, AV, and DR revised the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.835323/full#supplementary-material

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Validity and Reliability of the Persian Version of COVID-19 Anxiety Syndrome Scale Among the Iranian General Population

Esmaeil Hoseinzadeh[1], *Abbas Ebadi*[2,3], *Hamid Sharif Nia*[4,5], *Erika Sivarajan Froelicher*[6,7] *and Pardis Rahmatpour*[8]*

[1] Department of Nursing, School of Nursing and Midwifery, Tehran Islamic Azad University of Medical Sciences, Tehran, Iran, [2] Behavioral Sciences Research Center, Life Style Institute, Baqiyatallah University of Medical Sciences, Tehran, Iran, [3] Nursing Faculty, Baqiyatallah University of Medical Sciences, Tehran, Iran, [4] Department of Nursing, School of Nursing and Midwifery, Mazandaran University of Medical Sciences, Sari, Iran, [5] Department of Nursing, School of Nursing and Midwifery Amol, Mazandaran University of Medical Sciences, Sari, Iran, [6] Department of Physiological Nursing, School of Nursing, University of California, San Francisco, San Francisco, CA, United States, [7] Department of Epidemiology & Biostatistics, School of Medicine, University of California, San Francisco, San Francisco, CA, United States, [8] Department of Nursing, Alborz University of Medical Sciences, Karaj, Iran

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***Correspondence:**
Pardis Rahmatpour
par.rahmatpour@gmail.com

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The crisis of the COVID-19 prevalence in Iran, as well as the world, caused mental disorders and anxiety syndrome. The COVID-19 anxiety syndrome scale (C-19ASS) assesses conceptually and psychometrically the nature of the COVID-19 threat experience instead of a response to the threat, fear, and COVID-19 anxiety. Therefore, the aim of this study is to evaluate the psychometric properties of the Persian version of the anxiety syndrome scale of COVID-19 in the population of Iran. The Persian version of C-19ASS was sent to Iranian adults *via* online social networking applications and finally, 932 adults responded to the questionnaire. The results of exploratory factor analysis revealed two-factor structures for C-19ASS, which explained 48.70% of the total variance. Given the confirmatory factor analysis findings, all goodness of fit indices confirmed the model fit. All coefficients of internal consistency were estimated as acceptable reliability. The results showed that the C-19ASS has good psychometric properties, and can be used by researchers, psychologists, and healthcare providers to assess the anxiety syndrome of the Iranian population during the COVID-19 pandemic.

Keywords: COVID-19, anxiety syndrome, Iran, validity, reliability

INTRODUCTION

In Iran, from 3 January 2020 to 15 March 2022, there have been 7,126,906 confirmed cases of COVID-19 with 139,063 deaths, according to WHO (1). It is well known that stressful life events can cause psychological symptoms (2). The public physical health, anxieties, and human safety are affected by this infectious disease that has caused numerous psychological health problems and psychological symptoms (3, 4). The COVID-19 outbreak is exacerbating the anxiety that many people feel. Anxiety is defined as distress or fear caused by the prediction of an event or a real or understandable threatening situation (3, 5). Anxiety syndrome may appear in a combination of avoidance, worrying, and monitoring of threat, such a set of incompatible contrasting forms may have an essential role in the stability of psychological depression (6).

The COVID-19 pandemic has exerted high pressures on health systems of countries where the virus is most prevalent (7). It has destructive and variable effects on all aspects of human life (8). It led to lockdowns that lasted over multiple months affecting educational and non-essential business activities in many countries. These lockdowns were implemented for the rapid reduction of COVID-19 transmission (9). All affected countries have a complete or partial cessation of social activities and a wide range of interventions. Examples include social isolation, individual isolation, social distancing, and quarantine to prevent the gathering of large numbers of people, beyond the immediate members of the household.

Many people who have been quarantined may feel lonely, bored, inactive, and insecure about food and economic issues as well as feel fear and anxiety about the infection caused by the disease (10). National polls show a severe increase of fear and anxiety about the virus (11). For example, a study of 44,000 participants in Belgium, conducted at the beginning of April 2020, reported that 20% of people had anxiety and 16% of them had a depressive disorder (11). Based on the model provided in Iranian study anxiety syndrome and fear of COVID-19 with mediation effects of perceived stress explained 70% of the total variance of psychological behavioral responses (4). According to the clinical manifestations of this disease such as respiratory failure, sepsis, shock, and various organ failures, it is understandable that medical professionals and public health specialists focus on caring for the sick people. While it is recognized that corona virus spreads to the general population, there is less attention given to the mental health consequences of the COVID-19 crisis (12). About 54%of the Chinese general population (n = 1,210) reported moderate or severe psychological effects of the disease outbreak, 16.5% reported moderate or severe depressive symptoms, and 28.8% reported moderate or severe anxiety symptoms (13). In the systematic review study of Salari et al. (14) the prevalence of stress, anxiety, and depression among the general population during the COVID-19 pandemic were 29.6% (sample size of 9,074), 31.9% (sample size of 63,439), and 33.7% (sample size of 44,531), respectively. Previous research has shown that people who suffer from pandemic anxiety tend to also show an increase in stress, anxiety, and suicide (15).

There are different scales such as the scale of the fear of COVID-19 (16), Coronavirus anxiety scale (17), scale of threat of Coronavirus (18), and COVID stress scale (19). These scales are intended to identify people who have been affected by anxiety, fear, and uncertainty over this growing epidemic crisis. However, the COVID-19 anxiety syndrome scale (C-19ASS) assesses conceptually and psychometrically the nature of the COVID-19 threat experience instead of a response to threat, fear, and COVID-19 anxiety. This scale has been developed and psychometrically tested by Nikcevic and Spada in the U.K. This scale identifies features of anxiety syndrome related to COVID-19 and assessed its validity and reliability (6).

Considering the prevalence of COVID-19 anxiety syndrome in Iran, and the lack of an accurate scale to measure it among the Iranian population, the aim of this study is to evaluate the psychometric properties of the Persian version of the anxiety syndrome scale of COVID-19 in the population of Iran.

METHODS

This methodological study design was used to achieve the research objective. Data collection took place between October and November 2021.

Measurement

The measurements consist of two parts: demographic information, and the Persian version of C-19ASS. The original version of C-19ASS consists of nine items and two factors including perseveration (six items) and avoidance (three items). The C-19ASS is a short easily administered scale that can be used with both healthy and frail individuals exposed to any specific traumatic event. The response options for the C-19ASS are scored on a 5-point Likert-type scale from 0 (not at all) to 4 (Nearly every day) (6).

Translation

At first, the written permission was obtained from the authors of the scale, Professor Marcantonio M. Spada *via* email. Then, two English-Persian translators translated the C-19ASS independently. The research team, as well as two professional translators, evaluated the two translations and created a Persian translation of C-19ASS. In the next step, two Persian to English translators who had no knowledge of the English version of the C-19ASS were asked to back-translate the Persian version of the C-19ASS scale into English. Then the panel of experts compiled and compared the results of the back-translation with the original instrument to detect any differences and similarities between the original instrument and the back-translated version.

All items translate into Persian and back-translated into English without any required modifications and Dr. Marcantonio M. Spada (The main developer scale) confirmed The Backward Scale. It is noteworthy that all the steps of this process were performed based on the World Health Organization protocol of forward-backward translation technique (20).

Participants

The Persian version of C-19ASS was sent to Iranian adults *via* an online data gathering and 932 adults responded to the questionnaire. The online scale was created *via* Google Forms and its URL link was sent by email or social networking applications such as a Telegram channel or WhatsApp to a group of adults. To prevent duplicate data, the Google Form was restricted to get the data from each individual once. The inclusion criteria for participants were adults (age $>$ 18) who were willing to participate in this study. The sample size should be at least 200 cases for factor analysis (21). Of these, 466 subjects were used for the exploratory factor analysis (EFA) and a second group with 466 subjects serves as the confirmatory factor analysis (CFA).

Data Analysis

The construct validity of the Persian version of C-19ASS was evaluated by exploratory and confirmatory factor analysis. Maximum likelihood EFA with Promax rotation was conducted. The Kaiser–Meyer–Olkin test (KMO > 0.7: acceptable) and Bartlett's test of sphericity were calculated. The number of factors was determined based on parallel analysis, scree plot. Items with absolute loading values of 0.3 or greater and communalities more than 0.2 were considered appropriate (21). For assessment of the extracted factors, CFA was conducted using the maximum-likelihood method and the most common goodness of fit indices.

According to Fornell and Larcker's criteria (22), the Average Variance Extracted (AVE), Maximum Shared Squared Variance (MSV), and Composite Reliability (CR) were estimated to assess the convergent and discriminant validity. In addition, discriminant validity was evaluated by heterotrait-monotrait ratio of correlations (HTMT) approach. All values in the HTMT matrix table should be <0.85 (23). The reliability of the scale was evaluated using internal consistency and construct reliability (CR). The average inter-item correlation (AIC) was in the range of 0.2 to 0.4, Cronbach's alpha and McDonald's omega was >0.7 and are considered acceptable internal consistency (24). The CR was calculated using the structural equation model analysis as an alternative to Cronbach's alpha coefficient – it was acceptable if it was >0.7 (25). The relationship between demographic information and level of C-19ASS were evaluated by independent *t*-test, one-way ANOVA, and Pearson correlation coefficient.

TABLE 1 | Demographic characteristics of participants ($n = 932$).

Variables	EFA (466): *n* (%)	CFA (466): *n* (%)
Gender	388 (83.26)	404(87.12)
Female	380 (81.54)	414 (88.84)
Male	78 (16.73)	60 (12.87)
Marital status		
Single	164 (35.19)	134 (28.75)
Married	302 (64.80)	332 (71.24)
Education level		
Under diploma	3 (0.64)	10 (2.14)
Diploma	19 (4.07)	34 (7.29)
Upper Diploma	26 (5.57)	59 (12.66)
Bachelor	233 (50)	207 (44.42)
Master	155 (33.26)	125 (26.82)
PhD	30 (6.43)	31 (6.65)

Multivariate Normality and Outliers

Both univariate and multivariate normality of the data was evaluated in this study. The univariate distributions were tested for outliers, skewness, and kurtosis. The normality of the multivariate distribution was assessed using Mardia's coefficient of multivariate kurtosis, and the Mardia's coefficient. Mardia's coefficient > 7.98 can be considered as indicative of departure from multivariate normality. Moreover, the outliers of the multivariate distribution were detected using Mahalanobis distance ($P < 0.001$) (21).

The $SPSS_{26}$, SPSS-R $menu_2$, $AMOS_{26}$, and $JASP_{0.15.0.0}$ software were used to perform all of the statistical calculations.

Ethical Consideration

The Tehran Islamic Azad University of Medical Sciences Research Ethics Committee approved the protocol of this study (IR.IAU.TMU.REC.1400.315). While sending the online scale through social networking programs, the objectives of the study

TABLE 2 | Exploratory factors extracted of COVID-19 anxiety syndrome scale (C-19ASS; $n = 466$).

Factors	Q_n. Item	Factor loading	h^2	λ	%Variance
COVID-19 Anxiety	**7.** I have checked my family members and loved one for the signs of coronavirus (COVID-19).	0.932	0.772	2.748	30.535
	8. I have been paying close attention to others displaying possible symptoms of coronavirus (COVID-19).	0.817	0.640		
	2. I have checked myself for symptoms of coronavirus (COVID-19).	0.706	0.519		
	9. I have imagined what could happen to my family members if they contracted coronavirus (COVID-19).	0.650	0.461		
	6. I have read about news relating to coronavirus (COVID-19) at the cost of engaging in work (such as writing emails, working on word documents or spreadsheets).	0.494	0.320		
Self-care behaviors	**3.** I have avoided going out to public places (shops, parks) because of the fear of contracting coronavirus (COVID-19).	0.707	0.498	1.636	18.173
	1. I have avoided using public transport because of the fear of contracting coronavirus (COVID-19).	0.641	0.341		
	5. I have avoided touching things in public spaces because of the fear of contracting coronavirus (COVID-19).	0.571	0.389		
	4. I have been concerned about not having adhered strictly to social distancing guidelines for coronavirus (COVID-19).	0.530	0.444		

λ, *Eigenvalue;* h^2, *Communalities.*

were fully explained to the participants. Subjects were informed that participation was voluntary and that their decision would not affect their care. Participants were reassured about the confidentiality of the data.

RESULTS

The mean and standard deviation for the age of 932 adults was 31.14 (SD = 7.81) years. Other demographic characteristics of participants are shown in **Table 1**. Also, the level of C-19ASS was estimated 31.68 (SD = 8.23, CI 95%: 31.14–32.21).

In maximum likelihood EFA, the KMO test value was 0.852, and Bartlett's test value was 30,036.137 ($P < 0.001$). The EFA results revealed two factors with 48.70% explained variance for the C-19ASS (see **Table 2**, **Figure 1**).

The acceptable fit indices showed that the model was confirmed (see **Table 3** and **Figure 2**). The convergent and discriminant validity for both factors were acceptable for the current study. The value in the HTMT matrix was <0.66, indicating discriminant validity was established in this study. All coefficients of internal consistency were estimated as acceptable reliability (see **Table 4**). There was no significant relationship between demographic variables and C-19ASS.

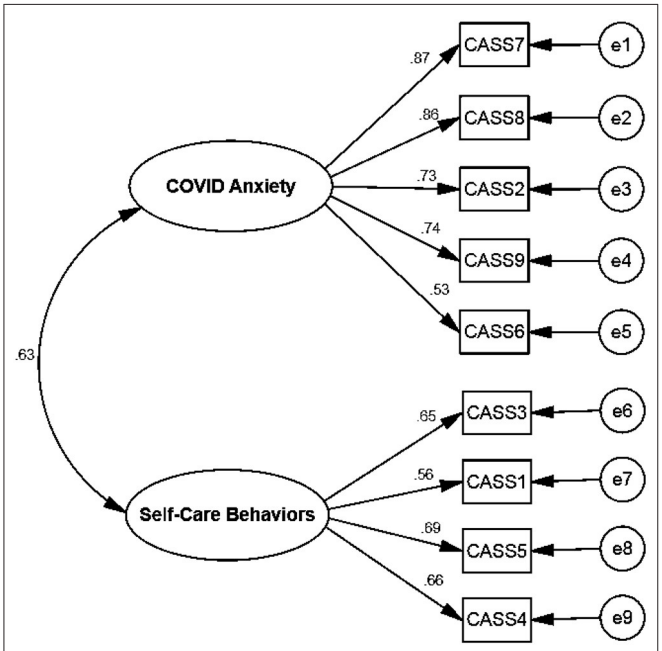

FIGURE 1 | The CFA model of the C-19ASS.

DISCUSSION

The results of this study demonstrated that the Persian version of C-19ASS has nine items in two subscales namely *COVID-19 Anxiety* and *self-care behaviors*, these two factors explained about the half of total variance of anxiety syndrome among the Iranian general population. Although one of the advantages of convenience sampling is that participants are readily available but at a disadvantage, a particular sample may be given more attention or, conversely, a group of the target population may not be included in the sample. Due to the fact that in this study, samples were collected through Google Form and social networks, people who were not members of social networks could not access the data collection form.

In the present study, the high level of Cronbach's alpha (>0.72), McDonald's omega (>0.72), and the average correlation between the items demonstrated that two factors of the scale had acceptable internal consistency. The results of internal consistency were almost similar to the original scale. The calculation of McDonald's omega is the advantage of this study because it does not depend on sample size and numbers of items. Also, based on the results of CR (>0.85) and Max-R, the Persian version of C-19ASS had good reliability. The CR is estimated by factor loading in CFA (26).

Based on the EFA results, two factors were identified, the first of which is *COVID-19 anxiety* which consists of five items. Anxiety is a mental disorder defined by excessive anxiety that leads to panic and is often accompanied by physical symptoms (27). People usually need more information about critical events to reduce anxiety caused by uncertainty in a critical event (27). For this reason, in examining COVID-19 anxiety syndrome in this study, people more than anything, are searching for the signs and symptoms of COVID-19 disease and news related to COVID-19.

The second factor is *self-care behaviors*. Behaviors that are performed with the aim of preventing disease and maintaining individual well-being is commonly defined as self-care behaviors. Self-care is a decision-making process with the aim of preventing COVID-19 and maintaining well-being in the COVID-19 pandemic (28).

The numbers of factors and items of the Persian version of C-19ASS were similar to the original. The only difference between the original version and the Persian version was an item "4) I have been concerned about not having adhered strictly to social

TABLE 3 | Fit indices of the first order confirmatory factor analysis of the C-19ASS ($n = 466$).

CFA index	CFI	IFI	PCFI	PNFI	RMSEA	CMIN/DF	*P*-Value	df	χ^2
	0.957	0.957	0.691	0.672	0.033	2.107	<0.001	26	54.798

DF, Degree of freedom; PCFI, Parsimonious Comparative Fit Index; PNFI, Parsimonious Normed Fit Index; CMIN/DF, Minimum Discrepancy Function divided by Degrees of Freedom; RMSEA, Root Mean Square Error of Approximation; TLI, Tuker-Lewis Index; and CFI, Comparative Fit Index, IFI, Incremental Fit Index, Fitness indexes, PNFI, PCFI (>0.5); TLI, IFI, CFI (>0.9), RMSEA (<0.08), CMIN/DF (<3 good, <5 acceptable).

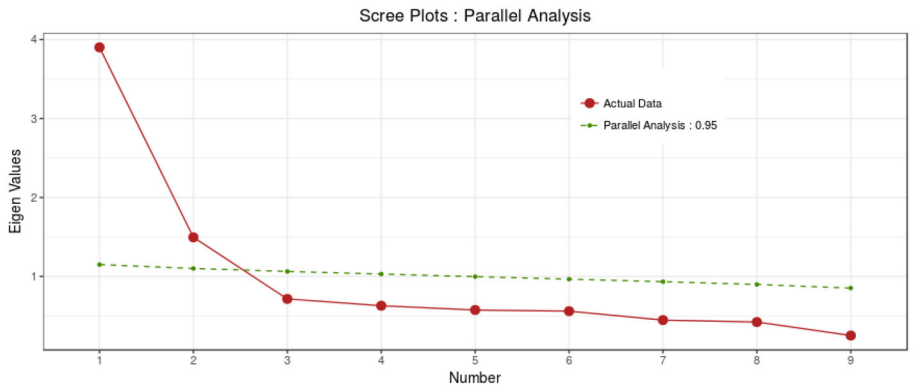

FIGURE 2 | The scree plot of the C-19ASS.

TABLE 4 | The indices of the convergent, discriminant validity, and internal consistency C-19ASS for the CFA ($n = 466$).

Index / Factors	CR	AVE	MSV	MaxR (*H*)	Alpha (CI95%)	Omega	AIC
COVID-19 anxiety	0.867	0.573	0.399	0.897	0.844(0.828 to 0.859)	0.849	0.521
Self-care behaviors	0.738	0.417	0.399	0.743	0.721(0.691to 0.749)	0.726	0.396

distancing guidelines for COVID-19". This item in the original version loaded into the first factor. But in the present study replaced in the second factor.

The findings of this study indicate that the Iranian version of the C-19ASS scale for evaluating COVID-19 anxiety syndrome is effective and useful in the general population to determine the prevalence of COVID-19. This scale helps the health-care providers, psychologists, and psychiatrists to identify and screen high-risk individuals and to offer preventive interventions to minimize the development of irreversible complications of anxiety syndrome.

The crisis of COVID-19 prevalence in the world, as well as Iran, caused mental disorders and COVID-19 anxiety syndrome, physical, psychological, and financial impacts on people and the government (29). The psychometric analysis of C-19ASS in the Iranian population in this situation showed that the concept of anxiety caused by COVID-19 was explained nearly 50% by the C-19ASS, which contained acceptable psychometric properties.

One of the limitations of this study was related to convenience sampling which is limited in its ability to reach all groups of the population (for example, the elderly population and individuals with no internet or without access to social media such as WhatsApp, Telegram, or email). Since the elderly are more affected by the COVID-19 pandemic due to their vulnerability and it was difficult to access them through social networks, it is recommended that this group be considered in evaluating the scale.

CONCLUSION

The Persian version of the C-19ASS scale had an acceptable construct validity and reliability. It has two factors with nine items that explained 48.70% of the total variance of the C-19ASS in the Iranian population during the COVID-19 pandemic. This scale could be beneficial for researchers, psychologists, and healthcare providers to assess anxiety syndrome during the COVID-19 pandemic.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The Tehran Islamic Azad University of Medical Sciences Research Ethics Committee approved the protocol of this study (IR.IAU.TMU.REC.1400.315).

CONSENT TO PARTICIPATE

Informed consent was obtained from all individual participants included in the study.

AUTHOR CONTRIBUTIONS

AE, HS, ES, and EH contributed to the study conception and design. Material preparation and data collection were performed by EH and HS performed data analysis. The first draft of the manuscript was written by EH, PR, HS, and AE. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Second Wave of COVID-19 Pandemic in Argentinian Population: Vaccination Is Associated With a Decrease in Depressive Symptoms

Pedro Benedetti[1†], *Alejo Barbuzza*[1†], *Franco Moscato*[1], *Victoria Reppucci*[1], *Celina Goyeneche*[1,2], *Cynthia Katche*[1,2], *Jorge H. Medina*[1,2], *Haydee Viola*[1,2,3], *Fabricio Ballarini*[1,2‡] *and Diego Moncada*[1,2,4*‡]

[1] Instituto Tecnológico de Buenos Aires, Buenos Aires, Argentina, [2] Facultad de Medicina, Instituto de Biología Celular y Neurociencia "Prof. E. De Robertis" (IBCN), UBA-CONICET, Buenos Aires, Argentina, [3] Departamento de Fisiología, Facultad de Ciencias Exactas y Naturales, Biología Molecular y Celular "Dr. Héctor Maldonado" (FBMC), University of Buenos Aires (UBA), Buenos Aires, Argentina, [4] Centro Integrativo de Biología y Química Aplicada, Universidad Bernardo O'Higgins, Santiago, Chile

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***Correspondence:**
Diego Moncada
dmoncada@fmed.uba.ar

[†]These authors have contributed equally to this work and share first authorship
[‡]These authors have contributed equally to this work and share last authorship

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Background: Since the irruption of the coronavirus disease 2019 (COVID-19) the planet has submerged in a time of concern and uncertainty, with a direct impact on people's mental health. Moreover, the recurrent outbreaks that periodically harry different regions of the world constantly refocus people's concerns to the pandemic. Yet, each new wave heats the diverse countries in different situations, including the advances in their vaccination campaigns. In this research, we studied the levels of the general anxiety disorder (GAD) and depression in the Argentine population across the first and second waves of infections that occurred in our country.

Methods: We conducted an on-line survey, within each peak of the pandemic. People were asked to self-report GAD and depression symptoms using the GAD-7 and PHQ-9 questioners, inform their vaccination status, the frequency they performed physical activity as well as working condition and modality. Here, we identified the more vulnerable groups and evaluated factors that could mitigate the rise of these mental disorders, focusing on vaccination.

Results: Our data shows that reported GAD and depression levels were higher during the second wave than during the first one. More importantly, vaccinated people were less depressed than non-vaccinated people, while GAD levels remained equivalent in both groups. Other factors directly associated with lower GAD and depression levels were performing frequent physical activity and being employed, regardless of the employment modality. These observations were replicated in different age ranges and genders.

Conclusion: This work evidences GAD and depression in different pandemic waves in Argentina, as well the factors that may contribute to reducing the magnitude of these disorders, including vaccination.

Keywords: COVID-19, GAD-7, PHQ-9, vaccination, physical activity

INTRODUCTION

COVID-19 is a disease caused by the coronavirus SARS-CoV-2 that has stroked mankind for more than 18 months. So far, up to the end of August 2021 it has caused 4.4 million deaths on the planet and 110.000 originated in Argentina, which unfortunately ranks 15th in the world (1). In addition to the many physical illnesses associated with the COVID-19, it also causes psychological disorders such as depression and anxiety. Several examples of this have been reported around the world (2–11). In this work, we studied the self-perceived levels of GAD and depression in adults between 18 and 50 years old, along the pandemic period, throughout two cross-sectional surveys performed in the first (November 2020) and at the second waves (May 2021) of the SARS-CoV-2, in the Buenos Aires Metropolitan Area of Argentina. Furthermore, our objective was to analyze the impact of vaccination, physical activity and work modality, under the hypothesis that they may act as possible protective factors of the population's mental health after such a prolonged period of the pandemic.

It is reported that key changes in life domains, including home confinement, reduction in face-to-face social interaction and disrupted occupation/ education roles, are associated with the impairments observed in common mental disorders such as anxiety and depression (12). The clearer tool available to end such disrupted daily routines is massive vaccination at the national and worldwide level. Fortunately, different COVID-19 vaccines were developed and proved efficient to reduce the number of hospitalizations with severe symptoms and the number of casualties. Unfortunately, there is a continuum from complete acceptance to total refusal of all vaccines, with vaccine hesitancy lying between the two poles (13). One of the reasons to refuse vaccination is the fear of vaccines side effects (14). Therefore, adequate information on this subject is critical to make people aware about the importance of weighing their decision to accept and foster the vaccination process.

The interaction between mental disorders and the effect of vaccination is intricate. It was reported that GAD and depression can increase associated with vaccine hesitancy (15, 16), but also people with higher levels of anxiety are those who agree to be vaccinated (15, 17). On the other hand, these psychological factors negatively influence vaccine efficacy (18). In Argentina the first wave of COVID-19 occurred in the absence of vaccines (November 2020), but the second wave (May 2021) surprised the country in the middle of the massive vaccination campaign which to that moment vaccinated more than a million people per week (19). Thus, we registered the self-reported levels of GAD and depression in the adult population during these two waves of COVID-19 and analyzed the impact of vaccination on their mental health.

Besides vaccination, other public policies were applied during the pandemic for the prevention of infections, which included social isolation. Elevated self-reported levels of anxiety and depression were associated with self-reported COVID-19 pandemic-related self-isolation and self-quarantine activity (20–22). One of the consequences of social isolation was the obligation or necessity of many people to carry out their work at home. In this study we have analyzed the levels of GAD and depression in adults in relation to their working status (workers or non-workers) and modality (face-to-face, work from home or hybrid). Finally, a behavioral factor that contributes to reduce the risk of suffering from these ailments is the practice of physical activity. Various studies have been carried out relating the frequency and intensity of physical activity with respect to its effectiveness in terms of mental health (23–26). Here, we determined the distribution of the adult population that exercises with low or high weekly frequency and analyzed its relation with people's self-perception of GAD and depression.

In summary, we conducted the research under the hypothesis that vaccination, physical activity and work modality, may act as possible protective factors on GAD and depression during the pandemic waves. Our results show variations of GAD and depression reported at the population level in two consecutive COVID-19 outbreaks. They describe the impact in different age groups and genders, and shed light on the positive effects of vaccination, physical activity and working status on the mental health during the pandemic.

MATERIALS AND METHODS

Study Settings and Participants

A cross-sectional design was performed to survey adult population, residents of the Metropolitan Area of Buenos Aires (AMBA), Argentina, in two different moments during the COVID-19 pandemic. The participants were recruited via social media of local scientific communicators, and responded to the survey through the platform Google Forms. In both surveys, the participants completed the GAD-7 and the PHQ-9 tests and reported their COVID-19 vaccination status, the weekly frequency they performed physical activity, their employment status, and the work modality (**Supplementary Materials**). After accessing the webpage, the participants were allowed to complete the survey without time limits. In general, this operation lasts approximately 15 min. Only full answered surveys were considered for the analysis.

Data were collected first in October/November 2020 (from 22nd October 2020 to 7th November 2020, $n = 1{,}531$, 79,29% women) and second in May 2021 (from 5th May 2021 to 10th May 2021, $n = 4{,}576$, 83,10 % women). We divided this population into two groups of study: people between 18 and 30 years old and people between 31 and 50 years. This division was performed using as guidance the one established by the national institute for statistics and census (INDEC) to differentiate between young (15–29 years) and adults (17, 26, 30–58) within the economically active population (27–30). In our case we excluded the population under 18 years old due to the impossibility of obtaining reliable on-line informed consents signed by the parents of the minors. These groups can share certain lifestyles, and characteristics: young are studying or having a low-responsibility jobs, in our country a large percentage of them live with their parents (64%) and do not have children (90%) (29). On the other hand, the majority of people between 30 and 60 years of age must have greater family care responsibilities and are the economic support of the family (28–30).

In total 2,830 people responded the first survey. We excluded from the analysis 1,285 respondents that did not belong to the AMBA region and 14 for being older than 50 years old. In the first case exclusions were performed for not being representative samples of their geographical regions. In the second for not being representative of the age range (>50) of the target region. In the second survey responded 7,735 participants. In this case, and to match samples, 3,002 were excluded for geographical reasons and 157 for being older than 50 years old. People younger than 18 years were blocked by the system. Considering the AMBA population and the proportion of people between 18 and 50 years old, at least of 379 persons are required to have a confidence level of 95% with a 5% of margin error. Since we surveyed people using an online convenience method, we decided to maximize the sample size to all the participants that responded within the data collection period.

The AMBA is the biggest urban conglomerate in Argentina. It is a geographical region composed of the Autonomous City of Buenos Aires and multiple political units of the Buenos Aires province with a population of approximately 15 million people.

Dynamic of COVID-19 Pandemic and Vaccination in Argentina

In Argentina, the first case of COVID-19 was detected on the 3rd March 2020. On the 18th March 2020 the government decreed a nationwide lockdown (31) that lasted until the 7th November. During this period, only the essential activities were permitted. Restrictions were revised and updated every 2 weeks by a phase system that moved depending on the epidemiological indicators.

The surveys were conducted within the first and the second waves of contagions, in the context of particular epidemiological situations. The first one, performed in October/November 2020, matched with the end of the first wave of SARS-CoV-2 when the total confirmed cases in Argentina were 1.236.851, with 33.348 confirmed deaths, a 59,6% of occupied Intensive Therapy Unit (ITU) beds in the AMBA (32), and without vaccines available. At the end of the second data recollection (10th May 2021) Argentina counted 3.165.121 total confirmed cases, 67.821 confirmed deaths, and an ITU occupancy of 77% in the AMBA. However, at this moment 7,718,272 people were vaccinated with one dose (17.2%) and 1,404,487 with two doses (3.1%), in the middle of a nationwide vaccination campaign (33). The first vaccinated group was the risk population (Sanitary personnel, people aged over 60 years, and those with certain preexistent medical problems).

Survey Structure Measures

Socio-Demographics

in both surveys, all participants (October/November 2020 and May 2021) informed their gender ("men," "women," and "other"), age ("18" up to "50"), area of residence ("AMBA" or "Not AMBA"), employment status ("worker" or "non-worker"), work modality ("Face to face," "Work from home" or "Hybrid"), and number of days they performed physical activity per week ("0" up to "7"). In the second survey, we also asked about the vaccination status (vaccinated, not vaccinates or I'd rather not answer); 3 participants decided not to answer and were excluded from this part of the analysis. Only people of the AMBA region were considered for this study.

Mental Health Measures

Generalized Anxiety

Generalized anxiety was measured through the 7-item Generalized Anxiety Disorder Scale (GAD-7, 34) which is validated and widely used in various populations (35, 36). This mental health instrument gathers information about generalized anxiety symptoms of the 2 weeks previous to the questionnaire. Respondents report their symptoms using a 4-point Likert rating scale ranging from 0 (not at all) to 3 (almost every day) along 7 questions, therefore the total score ranges from 0 to 21. Scores of 0–4 are thought to represent minimal anxiety, 5–9 mild anxiety, 10–14 moderate anxiety, and 15–21 severe anxiety (34). We assessed the reliability in both periods of data collection by calculating the Cronbach indexes, which were contained within the 95% of confidence interval (CI). They were $\alpha = 0.88$ (CI 0.87–0.89) for the first wave and $\alpha = 0.89$ (CI 0.885–0.895) for the second one, reflecting a high reliability.

Depression

Depression was measured using the Patient Health Questionnaire (PHQ-9; 37). The PHQ-9 resulted in a reliable and widely validated measure of depressive symptoms (37–39). Each respondent must answer nine questions that describe depression symptoms, considering the last 2 weeks. Each question can be answered with a 4-point Likert rating scale ranging from 0 (not at all) to 3 (almost every day) along nine questions, thus the total score ranges from 0 to 27. Scores of 0–4 suggest minimal depression, 5–9 mild depression, 10–14 moderate depression, 15–19 moderately severe depression, and 20–27 severe depression (37). The Cronbach indexes were $\alpha = 0.86$ (CI 0.849–0.87) for the first wave and $\alpha = 0.86$ (CI 0.854–0.866) for the second one, reflecting high reliability on the data collected in both periods.

Ethical Considerations

This study was approved by ethics council of the Life Sciences Department of the Instituto Tecnológico de Buenos Aires. Before answering the survey, each participant was provided with an informed consent that had to be approved to participate in the study. Data was analyzed to maintain anonymity of the participants. All the procedures conducted in this study followed the ethical standards of the institutional and/or national research committee as well as with the Helsinki Declaration of 1975, as revised in 2008.

Statistical Analysis

Depending on the type of variable we calculated descriptive statistics for the sample. For each continuous variable (GAD-score from GAD-7, Depression score from PHQ-9 and mean day of weekly days of physical activity) descriptive statistics were expressed as means with standard error of the mean (SEM) and for non-continuous variables as counts and percentages (%). The specific statistical tests used in each case are informed in the corresponding figure legends. Descriptive statistic for

each figure is supplied as **Supplementary Tables 1–6**. Normality and homocedacy were analyzed using the Kolmogorov-Smirnov, Bartlett's and F tests (**Supplementary Tables 7–12**). Non-parametrical tests were used to analyze samples that did not follow a normal distribution or the homocedacy requirements of parametric tests. Outliers were searched using the ROUT method with a Q value of 1%. All the non-parametric statistics were re-analyzed using the equivalent parametric test by assuming a normal distribution of the means due to the large sample size. No differences between tests were found. The differences were considered significant when $p < 0.05$ ($\alpha = 0.05$). We report exact *p*-values, no adjustments were adopted. The statistical analysis was performed using GraphPad Prism® 8.0.1 software. Effect sizes are reported for all the significant differences, in the correspondent figure legends. For this purpose, Cohen's d was calculated for *t*-tests; Cohen's f^2 and η^2 for one-way ANOVAs and Cohen's f^2 and partial η^2 (η_p^2) for two-way ANOVAs. Cohen's d and f^2 were calculated using the WebPower On-line software; η^2 and η_p^2 were calculated manually. In both cases, we assumed a normal distribution of the sample mean, due to its large size, to perform the calculations. Effect sizes for X^2 independency tests are expressed as phi (φ) coefficient. The relation between GAD and depression scores were calculated using the Spearman's rank correlation coefficient (r_s).

RESULTS

We started by analyzing the GAD in people from 18 to 30 years old (from now young adults) and observed increased scores during the second wave compared to the first wave (**Figure 1A**). In fact, mean GAD scores during this second wave went over 10, usually considered the cut-off between mild and moderate GAD conditions (34). Hence, we analyzed whether the increased anxiety was reflected by change in the percentage of people expressing moderate to severe GAD (score>10) and we observed that, during the second wave of the pandemic, the population with these conditions increased by almost 10% (**Figure 1B**). A posterior gender analysis revealed a differential effect of the wave on young men and women. The latter group reported higher GAD scores during the second outbreak, and in addition women presented higher GAD than men in both waves (**Figure 1C**). Actually, while the man population with moderate to severe GAD increased less than 2% during the second wave, that of the woman population raised almost 11% (**Figure 1D**).

Then, we evaluated the same variables for people between 31 and 50 years old (from now adults). In this case, we also observed a higher mean GAD scores in the second wave of contagion than in the first one, which overpassed the value of 10 (**Figure 1E**). This increase also reflected a rise of more than 15 % of the population that reported moderate to severe GAD scores during this period (**Figure 1F**). The posterior gender analysis revealed that women were more anxious than men since the first wave; in addition, this gender difference remained during the rise of anxiety observed in both genders at the second wave (**Figure 1G**). In particular, population with moderate to severe GAD increased around 15% in adult men and women, showing that both genders contributed evenly to the rise of GAD observed in adult people during the second wave (**Figure 1H**). It is worth noting that during the second wave, for both age ranges, circa 60% of women reported moderate to severe GAD while only 40 % of men were in these conditions.

In young adults, the depression scores reported during the second wave were significantly higher than in the first one (**Figure 2A**). This was also reflected in a higher percentage of people reporting moderate to severe depression symptoms during the second wave with respect to the first one, representing approximately 5% more of the surveyed population (**Figure 2B**). The posterior gender analysis revealed that young women reported higher depression levels than men in both outbreaks (**Figure 2C**). Analyzing the percentage population that reported moderate to severe symptoms, we observed a significative increase of almost 5% in women during the second outbreak (**Figure 2D**). A similar profile was observed in adults, with higher depression levels reported during the second wave (**Figure 2E**); reflecting an increase of 6 % in the population with moderate to severe depression (**Figure 2F**). As with the young adults, women reported higher depression scores than men in both waves. Women, also reported higher depression scores during the second outbreak (**Figure 2G**), a moment when the percentage of female population with moderate to severe symptoms increased by 9% (**Figure 2H**). On the contrary, the adult male population reported similar levels of depression during these pandemic waves, which was reflected in similar percentages of the adult male population with depression scores over 10 in both waves (**Figures 2C,D,G,H**).

Given the well-known comorbidity between GAD and depression, we evaluated their relation in both outbreaks and observed that their scores correlated positively for both age ranges and almost indistinguishable in both waves (Young adults $r_s = 0.73$ (95% CI: 0.6895–0.7623) and $r_s = 0.69$ (95% CI: 0.6665–0.7156) for 1st and 2nd wave, respectively. Adults: $r_s = 0.68$ (95% CI: 0.6410–0.7158) and $r_s = 0.72$ (95% CI: 0.6998–0.7371) for 1st and 2nd wave, respectively). Neither the slope of the linear regressions adjusting to the correlations nor the basal values changed between outbreaks ($p > 0.05$), pointing to an equivalent relation between GAD and depression of the populations surveyed in the first and the second outbreak.

It is worth notice that, while vaccines were unavailable in Argentina during the first wave, the second wave started during the vaccination campaign. Thus, we also studied whether the vaccination status was related to GAD and depression scores. We observed that regardless of the vaccination status, GAD scores during the second wave were higher than during the first wave, both, for young adult (**Figure 3A**) and adult (**Figure 3D**) populations, with the exception of young adult men (**Figures 3B,C,E,F**). In the same direction, the unvaccinated people from the second wave reported higher depression scores than the group of the first wave (**Figure 4**, except for young men **Figure 4C**). However, those persons of the adult population that received at least one dose of any COVID-19 vaccine reported fewer depression symptoms than those unvaccinated in the second wave (**Figures 4D,E,F**). This same effect repeated in the group of young adult women (**Figure 4B**). Thus, excepting the

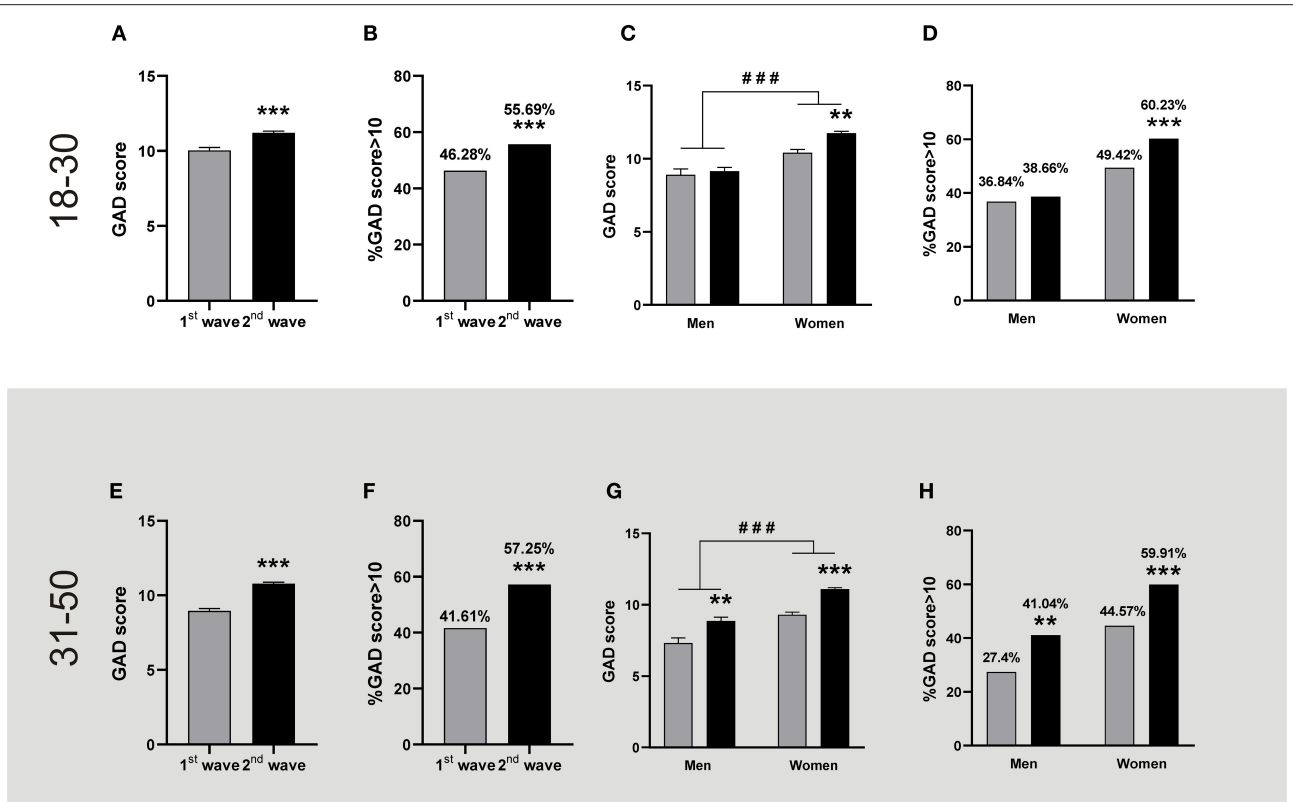

FIGURE 1 | GAD levels registered during the first and the second wave of COVID-19. The figures show the mean + SEM GAD scores or the percentage of people with GAD scores >10 during the first (grey bars) and the second (black bars) wave. The descriptive statistics are reported in **Supplementary Table 1**. **Top panel:** People aged between 18 and 30. **(A)** People reported higher GAD scores in the 2nd wave ($n = 1{,}844$) than in the 1st wave ($n = 685$). Mann-Whitney *U*-test, $^{***}p < 0.001$; Cohen's $d = 0.23$. **(B)** The percentage of people with a GAD score >10 was higher during the second wave; $^{***}p < 0.001$, X^2, $\varphi = 0.096$. **(C)** Women but not men reported higher GAD scores in the 2nd wave. $^{###}p < 0.001$ women vs. men, and $^{**}p < 0.01$ vs. 1st wave after two-way ANOVA; Cohen's $f^2 = 0.23$; $\eta_p^2 = 0.023$ for the gender factor and $\eta_p^2 = 0.003$ for wave factor (women: 1st wave $n = 514$, 2nd wave $n = 1{,}456$. Men: 1st wave $n = 171$, 2nd wave $n = 388$). **(D)** A higher percentage of women reported a GAD score >10 during the 2nd wave; $^{***}p < 0.001$ vs. 1st wave, X^2, $\varphi = 0.10$. **Bottom panel:** People aged between 31 and 50. **(E)** People reported higher GAD scores in the 2nd wave ($n = 2{,}732$) than in the 1st wave ($n = 846$). Mann-Whitney *U*-test, $^{***}p < 0.001$, Cohen's $d = 0.37$. **(F)** The percentage of people with a GAD score >10 was higher during the second wave; $^{***}p < 0.001$, X^2, $\varphi = 0.13$. **(G)** Both genders reported higher GAD scores in the 2nd wave. $^{###}p < 0.001$ women vs. men, and $^{**}p < 0.01$ and $^{***}p < 0.001$ vs. 1st wave after two-way ANOVA; Cohen's $f^2 = 0.49$ and 0.31 for men and women respectively; $\eta_p^2 = 0.016$ for the gender factor and $\eta_p^2 = 0.010$ for wave factor (Women: 1st wave $n = 700$, 2nd wave $n = 2{,}347$. Men: 1st wave $n = 146$, 2nd wave $n = 385$). **(H)** A higher percentage of women and men reported GAD scores >10 during the 2nd wave; $^{**}p < 0.01$ and $^{***}p < 0.001$ vs. 1st wave, X^2., $\varphi = 0.13$ for both men and women.

young adult men group, vaccination was associated with lower depression symptoms.

Since performing physical activity has been associated with lower levels of GAD and depression (26) the survey also inquired the participants about the frequency they performed exercise. Then we clustered them into two groups, those who exercised up to 2 days per week (low frequency) and those who did it 3 days or more (high frequency). We observed that, despite the registered levels of GAD and depression increased both in young adults and in adults regardless of the frequency of physical activity, in all cases the high frequency of physical activity was associated with a lower anxiety (**Figures 5A,B**) and depression (**Figures 5C,D**). In fact, the percentage of participants exercising with low frequency almost doubled to those who did it with high frequency, regardless of the age range and the analyzed wave (**Figure 5**). Thus, while the changes in GAD and depression levels reported in the two waves were unrelated to the percentage of people performing more or less exercise, the group of persons performing frequent exercise were also the one with less anxiety and depression symptoms.

Finally, considering that different working modalities were adopted since the beginning of the pandemic, we evaluated the effect of this variable on the anxiety and depression levels during the second wave, a moment when the change in the working modality was consolidated for most people in Argentina. In particular, we focused on the working status, that is, people who work or who do not work (non-working), and the work modality, that is, from home, face to face, or hybrid. As shown in **Figure 6A** the GAD of the young adult population was equivalent among non-workers and workers of the different modalities. On the contrary, adult working people were less anxious that non-working adult people, irrespective of their

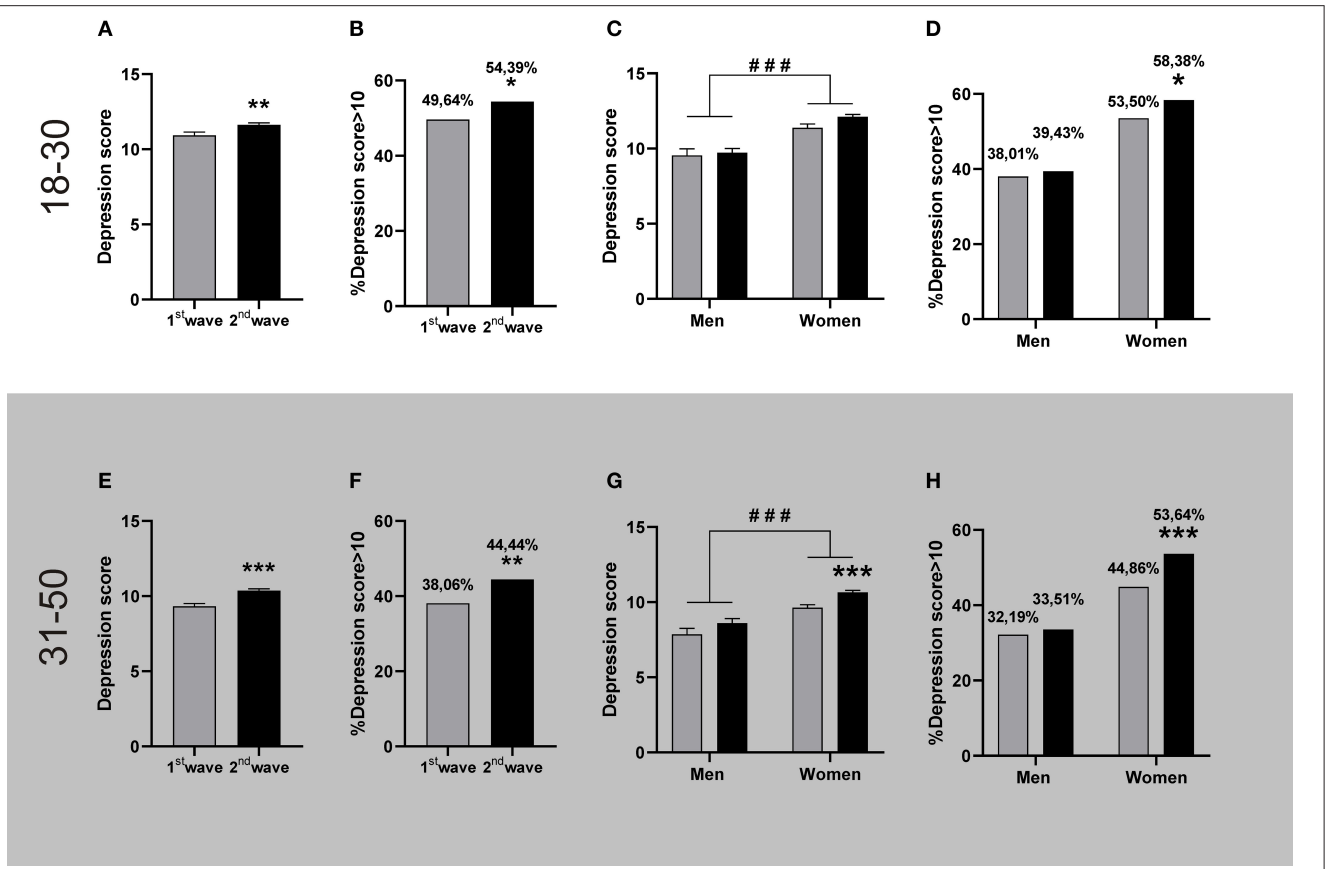

FIGURE 2 | Depression levels registered during the first and the second wave of COVID-19. The figures show the mean + SEM depression score or the percentage of people with depression scores >10 during the first (grey bars) and the second (black bars) wave. The descriptive statistics are reported in **Supplementary Table 2**. **Top panel:** People aged between 18 and 30. **(A)** People reported higher depression scores during the 2nd wave ($n = 1{,}844$) than in the 1st wave ($n = 685$). Mann-Whitney U-test, $^{**}p < 0.01$; Cohen's $d = 0.11$. **(B)** More people presented depression scores >10 during the 2nd wave; $^{*}p < 0.05$, X^2, $\varphi = 0.042$. **(C)** Both genders reported equivalent GAD levels in both waves, and women reported higher GAD than men within each wave, $^{\#\#\#}p < 0.001$ women vs. men, after two-way ANOVA; $\eta^2_p = 0.018$ for the gender (Women: 1st wave $n = 514$, 2nd wave $n = 1{,}456$. Men: 1st wave $n = 171$, 2nd wave $n = 388$). **(D)** A higher percentage of women reported depression scores >10 during the 2nd wave; $^{*}p < 0.05$ 1st wave, X^2, $\varphi = 0.043$ for women. **Bottom panel:** People aged between 31 and 50. **(E)** People reported higher depression scores during the 2nd wave ($n = 2{,}732$) than in the 1st wave ($n = 846$). Mann-Whitney U-test, $^{***}p < 0.001$; Cohen's $d = 0.19$. **(F)** More people presented depression scores >10 during the 2nd wave; $^{**}p < 0.01$, X^2, $\varphi = 0.054$. **(G)** Women reported more depression in the second wave. $^{\#\#\#}p < 0.001$ women vs. men, and $^{***}p < 0.001$ vs. 1st wave, after two-way ANOVA; Cohen's $f^2 = 0.17$ for women; $\eta^2_p = 0.016$ for the gender factor and $\eta^2_p = 0.010$ for wave factor. (Women: 1st wave $n = 700$, 2nd wave $n = 2{,}347$. Men: 1st wave $n = 146$, 2nd wave $n = 385$). **(H)** A higher percentage of women presented depression scores >10 during the 2nd wave; $^{***}p < 0.001$ vs. 1st wave, X^2, $\varphi = 0.073$ for women.

working modality (**Figure 6C**). This effect was more pronounced on the depression scores, where working adults, independently of the work modality, were less depressed than non-working ones (**Figure 6D**). A similar pattern, but less conspicuous and without evident effect of face-to-face work ($p = 0.842$), was observed in young adults (**Figure 6B**).

DISCUSSION

The most relevant results of this work indicate that subjects between 18 and 50 years old reported higher GAD and depression scores during the second wave of COVID-19 than those who did it after the first wave. In accordance with these results, the percentage of the population with a GAD and depression scores higher than moderate (equal to or higher than 10) increased during the second wave compared to the first one. Moreover, our results show a series of factors that help to mitigate the effect of GAD and depression in mental health. The most notorious factor was the effect of vaccination. Being vaccinated against COVID-19, was associated with lower levels of depression within the second wave. In contrast, being vaccinated did not alter GAD levels. Also, practicing physical activity more than twice a week was associated with reduced anxiety and depression in both the first and the second wave. Finally, lower GAD and depression levels were specifically identified during the second wave in adults of 31–50 years old who worked, either face-to-face or online, in contrast to those who did not work.

We start analyzing these results concerning others obtained in Argentina by different research groups. Reports from March 2020, at the start of the lockdown, informed in young people

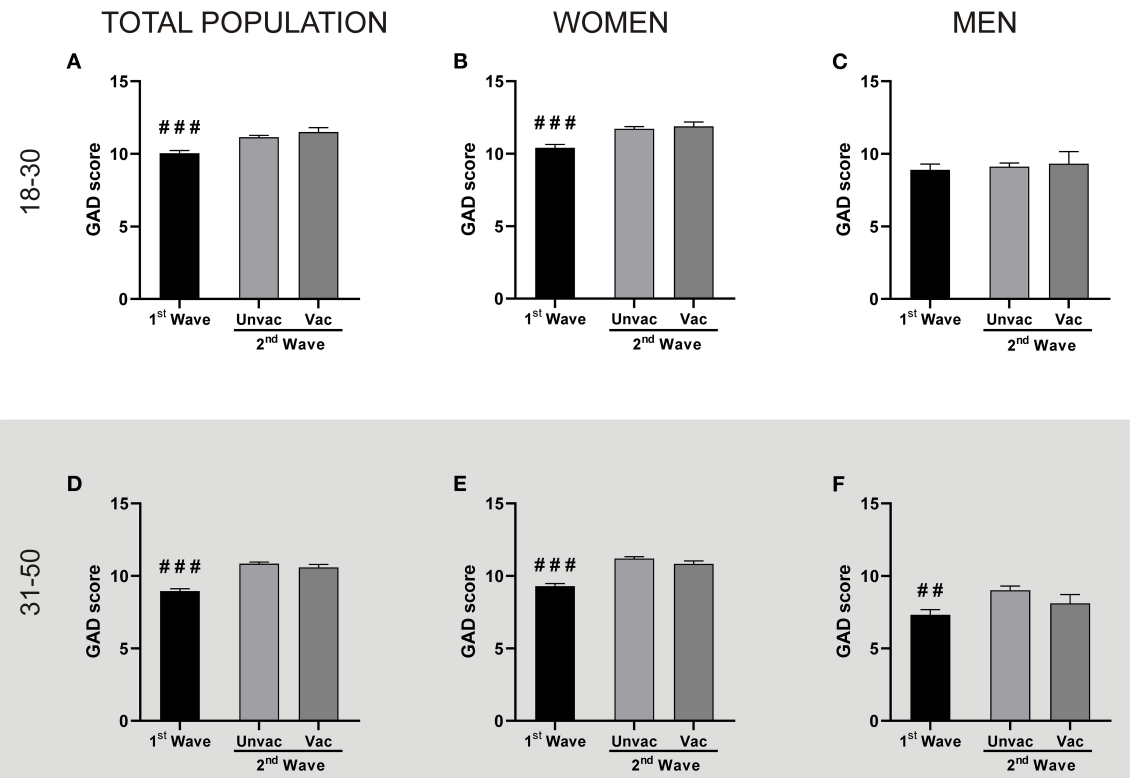

FIGURE 3 | The vaccination status did not correlate with GAD levels changes. Each panel compares the GAD scores reported by the unvaccinated people during the 1st and the 2nd wave, and the GAD scores between unvaccinated (Unvac) and vaccinated (Vac) people within the 2nd wave, by two independent Mann-Whitney *U*-test. Data shown as mean + SEM. The descriptive statistics are reported in **Supplementary Table 3**. **Top panel:** People aged between 18 and 30. **(A)** Total population: $^{###}p < 0.001$ vs. unvaccinated; Cohen's $d = 0.21$; (Unvac 1st wave $n = 685$; unvaccinated $n = 1{,}538$; vaccinated $n = 303$). **(B)** Women: $^{###}p < 0.001$ vs. unvaccinated; Cohen's $d = 0.26$ (1st wave $n = 514$; unvaccinated $n = 1{,}195$; vaccinated $n = 259$). **(C)** Men: (1st wave $n = 171$; unvaccinated $n = 343$; vaccinated $n = 44$). **Bottom panel:** People aged between 31 and 50. **(D)** Total population: $^{###}p < 0.001$ vs. unvaccinated; Cohen's $d = 0.38$ (Unvac 1st wave $n = 846$; unvaccinated $n = 2{,}035$; vaccinated $n = 692$). **(E)** Women: $^{###}p < 0.001$ vs. unvaccinated; Cohen's $d = 0.39$ (1st wave $n = 700$; unvaccinated $n = 1{,}709$; vaccinated $n = 633$). **(F)** Men: $^{##}p < 0.01$ vs. unvaccinated; Cohen's $d = 0.40$ (1st wave $n = 146$; unvaccinated $n = 326$; vaccinated $n = 59$).

from 18 to 25 years old a prevalence of moderate to severe GAD of 35% (40). In April of the same year, reports from the general population evidenced a 31.8% incidence (4). Our data collected in November 2020 showed a prevalence of 46%, and in May 2021, at the second wave of infections, it was 56%. When analyzing the group aged between 25 and 44 years, the prevalence was 25% in March 2020 (40); in our group of adults (30–50 years old) in November of 2020, it was 42%, and in May of 2021, it was 57%. This information suggests that the percentage of adults between 18 and 50 years old who reported moderate to severe GAD symptoms increased steadily in the 15 months since the beginning of the lockdown in Argentina. The reports of moderate to severe depression of Argentinean young people show that its prevalence ranged between 40 and 60% from the beginning of the lockdown until May 2021 (40, 41). In March of the 2020th, its incidence in the population aged between 25 and 44 was around 30% (40). This value was similar to that obtained in the general population for April 2020 (4). Then, our results in the adult population for November 2020 showed 38% of incidence, and in May 2021, 44%. Together, the information of this age group evidences a slight but sustained increment of moderate to severe depression symptoms during the curse of the pandemic.

In the regional context, other countries that suffer from limited economies and resources for their health services also experienced the first COVID-19 outbreak at a comparable time course. A study compared GAD and depression symptoms carried out in seven of those Latin American countries (Argentina, Ecuador, Mexico, Paraguay, Uruguay, Colombia, and El Salvador) between June and September 2020, when they experienced their first wave of contagions. That research informed a prevalence of moderate to severe GAD and depression symptoms of 25–30%. The exception was Uruguay, with an incidence close to 10%. In the particular case of Argentina, at that time, these parameters were at 30% (42). On the other hand, Brazil, the most affected country by the pandemic of the region, reported between May and July 2020 an 81.90% prevalence of anxiety and 68% of depression, with moderate to severe symptoms (43). In Argentina, when the cases of contagion showed a sustained increase toward November 2020, we found a 40–50% prevalence for both parameters, and in May 2021, these values were between 45 and 57%. In Peru, another country in the

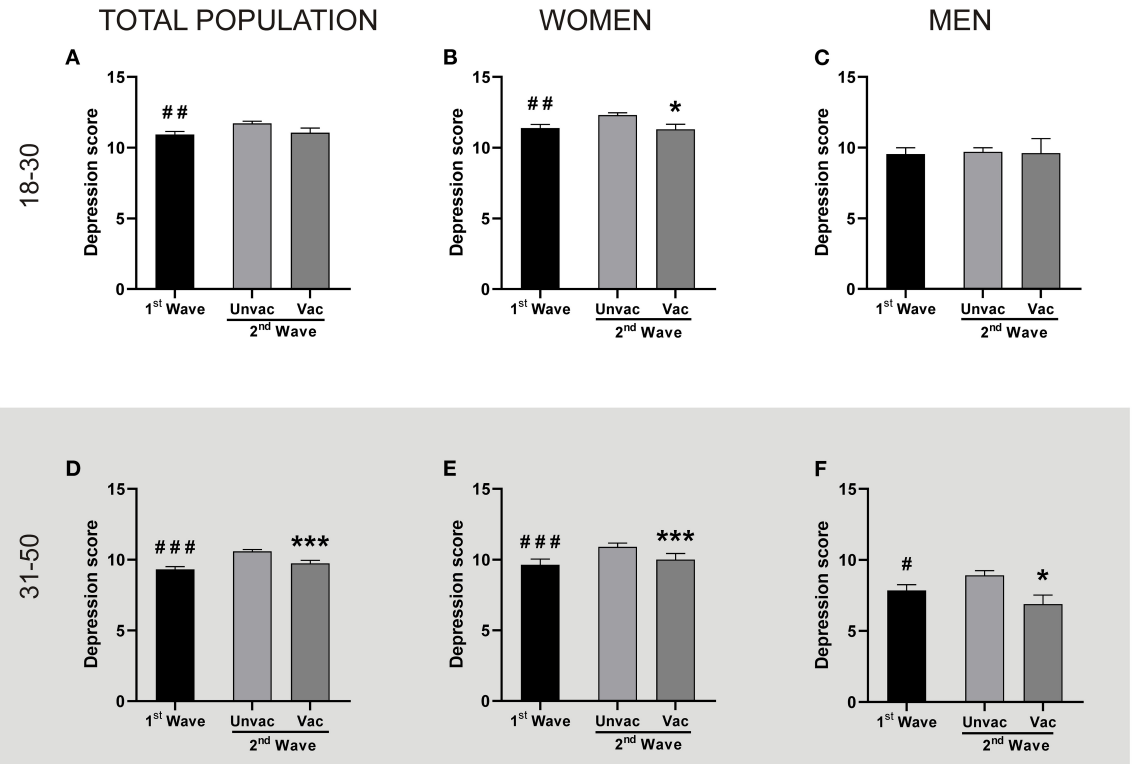

FIGURE 4 | Vaccination was associated with lower depression levels in adult people and young adult women. Each panel compares the Depression levels reported by the unvaccinated people during the 1st and the 2nd wave, and also the same parameter between unvaccinated and vaccinated people within the 2nd wave, by two independent Mann-Whitney *U*-test. The descriptive statistics are reported in **Supplementary Table 4**. **Top panel:** People aged between 18 and 30. **(A)** Total population: $^{\#\#}p < 0.01$ 1st Wave ($n = 685$) vs. Unvaccinated ($n = 1{,}538$); Cohen's $d = 0.13$. Vaccinated ($n = 303$). **(B)** Women: $^{\#\#}p < 0.01$ and $^{*}p < 0.05$ vs. Unvaccinated; Cohen's $d = 0.16$ and 0.17 respectively (1st wave $n = 514$; unvaccinated $n = 1{,}195$; vaccinated $n = 259$). **(C)** Men: ($n = 171$; 343; 44, for 1st wave, unvaccinated and vaccinated, respectively). **Bottom panel:** People aged between 31 and 50. **(D)** Total population: $^{\#\#\#}p < 0.001$ and $^{***}p < 0{,}001$ vs. unvaccinated; Cohen's $d = 0.22$ and 0.15 respectively (1st wave $n = 846$; unvaccinated $n = 2{,}035$; vaccinated $n = 692$). **(E)** Women: $^{\#\#\#}p < 0.001$ and $^{***}p < 0.001$ vs. unvaccinated; Cohen's $d = 0.23$ and 0.16 respectively (1st wave n=700; unvaccinated $n = 1{,}709$; vaccinated $n = 633$). **(F)** Men: $^{\#}p < 0.05$ and $^{*}p < 0.05$ vs. unvaccinated; Cohen's $d = 0.20$ and 0.38 respectively (1st wave $n = 146$; unvaccinated $n = 326$; vaccinated $n = 59$).

region, the prevalence of depression was 44% in young adults, although in adults was 26% by May 2021 (44). Thus, according to these works, within the Latin American region, GAD and depression of the Argentine population increased through the pandemic, showing prevalence levels similar to some of its sister countries, except for Uruguay and Brazil, which respectively had lower and higher levels than our country.

As we mentioned before, the level of GAD was higher in the second wave of infections by COVID-19 in 2021 compared to the first one. It is known that GAD values correlate positively to depression values (45, 46). A study conducted in Australia in 2012 reports that 39% of individuals with GAD also meet criteria for depression and the authors found that comorbid depression and anxiety disorders occur in up to 25% of general practice patients (47). We obtained positive correlations between GAD and depression, regardless of the age range, in both outbreaks registered in the Metropolitan area of Buenos Aires. The correlation slopes during the second wave were equivalent to those of the first one. This indicates that the populations surveyed in both waves had equivalent relations and suggest that those factors associated with the higher GAD of the second wave are most likely those associated with the higher depression scores.

Our data reflects that being vaccinated is a key factor associated with a lower self-perception of depression. This may be due to a feeling of sanitary well-being, since people who accept to receive the vaccine for COVID-19 seek to protect their health, reduce the duration and severity of the disease and look for the outbreak to end (48). On the other hand, the most common reasons for vaccination refusal are related to fear of the vaccines' side effects, the lack of knowledge about their effectiveness, and distrust to vaccines developed abroad (48). Moreover, our data showed that people were more anxious in May 2021 (during Argentina second wave of contagious), when the vaccination campaign was accelerating, than 6 months before when vaccines were not yet available. This fact could be a predictor of higher tendency to receive COVID-19 vaccines, since greater anxiety, confidence in vaccines, and collective responsibility were associated with the request of vaccination (17). In particular, COVID-19-related anxiety, and fears of infection correlated positively with vaccine acceptance (15). Alternatively, the high

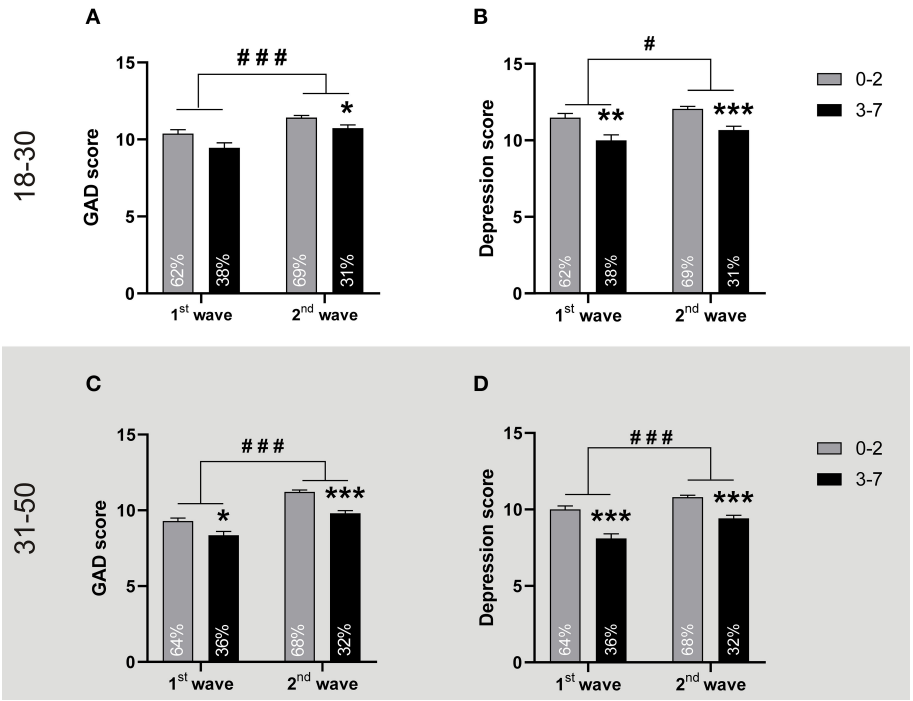

FIGURE 5 | Practicing physical activity more than 2 days per week is associated with lower GAD and depression. **Top panel:** People aged between 18 and 30. The figures show the mean + SEM of **(A)** GAD scores and **(B)** Depression scores of young adults who practiced physical up to 2 days per week (0–2), or more (3–7), in the 1st wave and in the 2nd wave ($n = 428$; 257; 1,266 and 578, respectively). $^{*}p < 0.05$, $^{**}p < 0.01$, and $^{***}p < 0.001$ vs. 0–2 group and $^{\#}p < 0.05$, $^{\#\#\#}p < 0.001$ vs. 1st wave, after two-way ANOVA. Each bar also informs the percentage of the population studied in the wave that exercised with low or high frequency. For GAD scores: Cohen's $f^2 = 0.12$ vs. 0–2 group in the 2nd wave, $\eta_p^2 = 0.004$ for the physical activity frequency factor and $\eta_p^2 = 0.009$ for the wave factor. For depression scores Cohen's $f^2 = 0.15$ and 0.23 vs. 0–2 group for the 1st and 2nd wave respectively; $\eta_p^2 = 0.010$ for the physical activity frequency factor and $\eta_p^2 = 0.002$ for the wave factor. The descriptive statistics are reported in **Supplementary Table 5**. **Bottom panel:** People aged between 31 and 50. The figures show the mean+SEM of **(C)** GAD scores and **(D)** Depression scores of adults who practiced physical activity up to 2 days per week (0–2), or more (3–7), in the 1st wave and in the 2nd wave ($n = 542$; 304; 1,870; and 862, respectively). $^{*}p < 0.05$, $^{***}p < 0.001$ vs. 0–2 group and $^{\#\#\#}p < 0.001$ vs. 1st wave, after two-way ANOVA. Each bar also informs the percentage of the population studied in the wave that exercised with low or high frequency. For GAD scores: Cohen's $f^2 = 0.09$ and 0.26 vs. 0–2 group in the 1st and 2nd wave respectively, $\eta_p^2 = 0.008$ for the frequency of physical activity factor and $\eta_p^2 = 0.017$ for the wave factor. For depression scores Cohen's $f^2 = 0.19$ and 0.24 in the 1st and 2nd wave respectively; $\eta_p^2 = 0.0134$ for the frequency of physical activity factor and $\eta_p^2 = 0.0056$ for the wave factor. The descriptive statistics are reported in **Supplementary Table 5**.

degree of GAD reported in 2021 could also be due to vaccination hesitance. In this sense, it has been reported that having ambivalent attitudes toward vaccination are related to mental health morbidity such as depression, peritraumatic stress, but fundamentally triples the risk for anxiety (16). Thus, the rise in anxiety levels observed in May 2021 could be associated either to the acceptance or the hesitance to vaccination. It worth noticing the role of mass and social media toward vaccination hesitance by the distribution of sensationalistic and/or conspiracy theories (49, 50). Thus, beyond the negative effect of this infodemic on the public health by its effect on the vaccination campaigns, it may be also responsible of direct harm to people's mental health.

A study carried out at the end of February 2021 showed that in Latin American countries 8 out of 10 adults have vaccination intention and fear of its side effects. In Argentina, the people showed a 70–75% intention of vaccination with a lower frequency of fear of side effects than in other countries of the region (84.5%) (51). The constant recommendations from peers and healthcare providers, explaining the possible side effects against the benefits of being inoculated, and its frequency, may bring peace of mind to the population and increase the willingness to get vaccinated. In this way, more population shall accept the vaccines, bringing multiple benefits for the personal and public health. From one side, the direct personal and public benefit of protection toward physical by the use of vaccine, which demonstrated positive effects against the COVID-19 (52–56). And from the other side, contributing to the concomitant decrease in the levels of depression, as shown in this study. In fact, these psychological factors shape the antibody responses to vaccines. In this sense, fear of COVID-19 itself, stress, depression, loneliness, and social isolation can impair the vaccine's ability to confer immunity against the virus (18). In any case, as it has been observed that vaccinated people can contract and spread SARS-CoV-2, it is important to keep social distancing measures for preventing the progression of the viral infection during the mass vaccination campaign (57); even when social isolation can reduce direct and indirect effects of the vaccination on mental health of the people (21, 22).

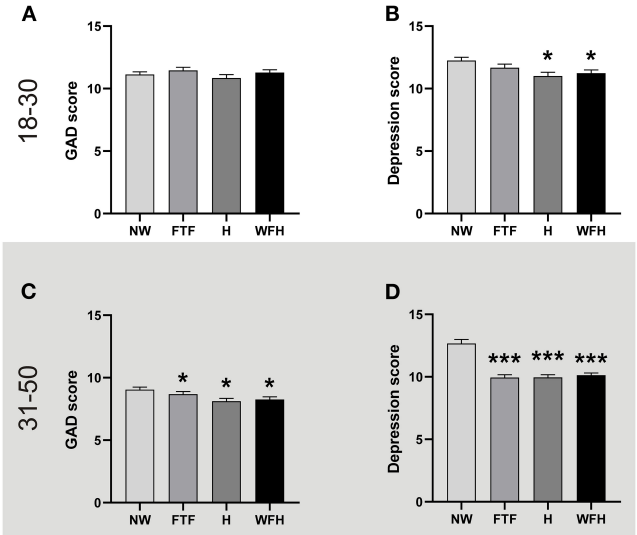

FIGURE 6 | Working was associated with less depression during the second wave. The figures show the mean + SEM of GAD or Depression scores of non-working people (NW), and those who work face to face workers, hybrid modality (H), or from home (WFH). The descriptive statistics are reported in **Supplementary Table 6**. **Top panel:** People aged between 18 and 30. **(A)** GAD scores were equivalent regardless of the working status or modality. One-way ANOVA, $p > 0.05$. **(B)** Working was associated with lower depression levels except for FTF modality. $^{*}p < 0.05$, vs. NW, Kruskal-Wallis analysis after a one-way ANOVA (non-parametric); Cohen's $f^2 = 0.17$ and 0.16, and vs. NW for H and WFH respectively; $\eta^2 = 0.0065$. NW ($n = 568$), FTF ($n = 451$), H ($n = 311$), and WFH ($n = 514$). **Bottom panel:** People aged between 31 and 50. **(C)** Working was associated with lower GAD scores regardless of the modality. $^{*}p < 0.05$ vs. NW, Kruskal-Wallis analysis after ANOVA (non-parametric); Cohen's $f^2 = 0.06$; 0.15 and 0.14 vs. NW for FTF, H and WFH respectively; $\eta^2 = 0.0064$. **(D)** Working was associated with lower depression levels regardless of the modality. $^{***}p < 0.001$ vs. NW, Kruskal-Wallis analysis after ANOVA (non-parametric); Cohen's $f^2 = 0.32$, 0.33 and 0.33 vs. NW for FTF, H and WFH respectively; $\eta^2 = 0.023$. NW ($n = 346$), FTF ($n = 630$), H ($n = 643$), and WFH ($n = 1,112$).

Another parameter registered in the surveys was the frequency of physical activity performed by the population. We observed that those who exercised more than twice a week reported lower levels of GAD and depression than those who exercised less frequently. Our study revealed that GAD and depression levels of the studied population were higher in the second wave, regardless of the frequency that people exercised. However, within each wave, both surveys (November 2020 and May 2021) showed that the group that performed frequent physical activity also reported less anxiety and depression. Thus, while general changes between waves were independent of how much people exercised, our results show, in a consistent way and on a high number of participants, that frequent exercise benefits mental health, independently of its basal state in the population. So, recommendations to increase public awareness about the impact on mental health of interrupted daily routines should include regularizing existing positive routines, in particular, the practice of physical exercises that has been diminished in this pandemic (58, 59). In our study, the percentage of people who reported exercising more than twice a week decreased from 37 to 31% from the first wave of contagious to the second one. A research performed in Australia reported that half of responders declared a reduction in physical activity since the onset of the COVID-19 pandemic, which was likely a consequence of social distancing, the closure of usual exercise venues, or unwillingness to change previous exercise habits (25). As the result, during the lockdown the group of more sedentary people presented more anxiety and depression symptoms (60). This work did not delve into the neurobiological mechanisms by which physical activity affects the levels of anxiety and depression. However, it is worth noticing that they include the regulation of the hypothalamic-pituitary-adrenal axis, effects on the endogenous opioid system, and the increase of the brain-derived neurotrophic factor level, which also affect the reactivity to stress and mood (61, 62).

Finally, the consolidation of multiple working modalities during the pandemic let us wonder of their relation with the anxiety and the depression levels during the second wave. We observed that the group of adult working people had lower GAD and depression than people who did not work. Nevertheless, this was a work effect rather than a modality effect, as GAD and depression levels were equivalently low with independence of the working-modality (at home, face-to-face or hybrid). In the case of the young adults' group, a similar but less conspicuous association was observed only in the depression levels. Our data is in agreement with previous one, showing that active workers showed fewer depression symptoms than unemployed people did (63). The COVID-19 pandemic and lockdown seems particularly stressful for individuals without work who reported more mental health disorders (8).

In sum, our results show that the second wave of contagion in the Metropolitan area of Argentina surprised with higher GAD and depression levels than the first outbreak that occurred 6 months earlier. Being vaccinated was selectively associated with decreased levels of depression in adults between 18 and 50 years old. In addition, the regular practice of physical activity as well as working coupled to a reduced self-perception of anxiety and depression symptoms. Determining the factors that contribute to reduce the risk of GAD and depression is important at scientific, clinical and even political level. Particularly, in pandemic times when they over pass the normal population values this knowledge could be used to develop strategies, such as fostering physical activity practices, guarding the employment and accelerating the vaccination campaigns, in order to prevent further injuries to people's mental health.

STRENGTHS AND LIMITATIONS

To our knowledge, this is the first study to analyze general anxiety and depressive symptoms in two consecutive COVID-19 outbreaks and relate them to the presence and administration of COVID19 vaccines in Argentina's largest urban conglomerate. Among other strengths, it is worth noticing the large sample size and its relative representability, for recruiting the participants of the general population. Another valuable aspect is the timing of the sampling during the two waves, in moments when none of

them were vaccinated (first wave) and when only some of them were (second wave), which allowed to analyze non-vaccinated people between waves and vaccinated against non-vaccinated people within the same wave. Yet, this study has some limitations that require acknowledging. The online sampling, which allowed data recollection in lockdown periods, might be the major one. Most respondents were young to middle age people, highly educated, and actively involved in accessing to COVID19 and other scientific information. Therefore, self-selection bias could exist and affect the representativeness of the sample. Also, we decided to exclude social structure characteristics from our analysis, opening the possibility to a sociodemographic mismatch between the 1st and 2nd outbreak population of respondents. Yet, it is worth noticing that the same recruiting method (same social media from the same scientific communicators) was used in both outbreaks, thus reducing the possibility of this mismatch. Therefore, we tried to reach as many people as possible and be cautious in our conclusion. Regarding the sample size, more people responded to the second survey than the first one, probably indicating the rise of people's interest in this kind of studies during the development of the pandemics. Second, the number of women that responded to the survey was 3–4 times higher than the number proportion of men. Thus, the possibility exists that the mean in GAD and depression symptoms of the total population over represent the symptomology of women. As a positive aspect, it worth noticing than the behavior of GAD and depression symptomology, as well as their levels associated with vaccination, physical activity and working status were equivalent for women and men, with the notorious exception of young men population. Therefore, the behavior of the symptomology of the total population may well represent that of men and women. Third, we assessed the psychological impact on general anxiety disorder and depression through self-reported answers of the participants rather than clinical diagnosis by a physician. To minimize this limitation, we surveyed using the GAD-7 and PHQ-9 questionnaires. These are well-established tools for valid and efficient screening and assessing the severity of GAD and depression in clinical practice and research (2, 3, 5–10, 12, 17, 20, 21, 34–39). In addition, we think that increased or decreased symptomology in large samples may well represent the direct impact in general anxiety and depression disorders of the population. Fourth, the cross-sectional design adopted in this study implies that the association between GAD and depression symptomology with the different waves and vaccine inoculations is not necessarily causal. Also, other confounding factors associated with the vaccinated group of people may explain the decrease in depressive symptoms. Finally, this is a correlational study at group level. Therefore, the conclusions do not necessarily apply to a particular individual but reflect the possible risks and benefits for different groups in the population. Future longitudinal studies, at the individual level in other countries or regions, may help support our findings and rule out the possibility of ecological fallacy.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Council of the Life Sciences Department of the Instituto Tecnológico de Buenos Aires. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

DM, FB, HV, and JM contributed to the conception and the design of the study. FB, PB, and AB obtained the data. PB, AB, FM, VR, and CG organized the database, performed the statistical analyses, and sketched the figures. DM, HV, CK, FB, and JM oversight the statistical analyses and figures. DM and HV wrote the first draft of the manuscript. PB and AB wrote the first draft of the methods section. DM, HV, FB, CK, JM, PB, and AB contributed to the manuscript revision. All authors read and approved the final version of this manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.832352/full#supplementary-material

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COVID-19 Pandemic: The Impact of COVID-19 on Mental Health and Life Habits in the Canadian Population

Felicia Iftene[1], Roumen Milev[1], Adriana Farcas[2], Scott Squires[2], Daria Smirnova[3] and Konstantinos N. Fountoulakis[4]*

[1] Providence Care Hospital, Department of Psychiatry, Queen's University, Kingston, ON, Canada, [2] Center for Neuroscience Studies, Queen's University, Kingston, ON, Canada, [3] International Centre for Education and Research in Neuropsychiatry (ICERN), Samara State Medical University, Samara, Russia, [4] 3rd Department of Psychiatry, School of Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece

Objectives: The study aims to investigate the rate of clinical depression in the adult population during the COVID-19 pandemic, as well as the changes in anxiety, distress, suicidal ideation, and their relations with several personal and interpersonal/social variables.

Methods: This is an epidemiological, non-interventional study. It is part of an international multi-center study, with the main site at the Aristotle University of Thessaloniki, in Greece (COMET-G Study). We are presenting aspects of the research involving the Canadian site, based on 508 Canadian responders to the online survey (QAIRE).

Results: Of the 508 responders, 72.2% were females aged 42.57 ± 14.00 years; 27.2% were males aged 42.24 ± 15.49 years; and 0.6% were others aged 46.33 ± 17.79 years. Increased anxiety during the lockdown was reported by 69.3% of those surveyed. The rate of suicidal thoughts increased in 19.5% of participants during the lockdown. Depression was reported by 22% of responders, while distress was present in 18.4%. We found a greater prevalence of depression, but not distress, in individuals with a history of any mental disorder. Based on the multiple regression analysis, we found four CORE factors equally influencing the changes in mental health during the lockdown (gender, quality of sleep, family conflicts, and changes in daily routine). In the Canadian population, two major changes acted as protective factors, significantly expressed when compared with the worldwide tendencies: fewer financial difficulties; and an increase in religious beliefs.

Conclusion: The rate of major depression, distress, and suicidal ideation was higher in Canadians than in the worldwide population (per COMET-G), but the relative risk to develop depression in the presence of a history of mental disorders was lower. Almost 90% of Canadians believed in the real story of COVID source of provenience.

Keywords: depression, suicidality, mental health, conspiracy theories, COVID-19, Canada, lockdown

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National and Kapodistrian University of Athens, Greece

****Correspondence:***
Felicia Iftene
iftenef@yahoo.com

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INTRODUCTION

It has been more than 2 years since March 11, 2020, when the COVID-19 pandemic was declared. We started our journey through a very difficult time of uncertainty, facing an extreme threat. We have been dealing with major changes in our daily routines and expectations, facing isolation, unemployment, economic crisis, and increased human losses. We tried to better understand "the enemy," to get organized, develop, and follow rules and protocols. According to Statistics Canada, 90% of Canadians adopted public health precautions in less than 1 month.

In December 2020, during the second lockdown in Ontario and Alberta, the COVID vaccination started. In January 2022, during the Omicron wave, 84.3% of the Canadian population aged 5 years or older had received their first dose of vaccine (83.48% of Ontarians), while 78.0% were fully vaccinated. In Ontario, where we had one of the most successful vaccination campaigns in the world, 91.2% of vaccine doses have been administered (1).

Regarding the coping aspect of this pandemic, in June 2021, only 55% of Canadians reported "excellent" or "very good" mental health, compared with 68% in 2019. As expected, different nuances of anxiety and depression were experienced, going from extremis to panic and desperation.

There is a large body of literature analyzing different aspects of mental health changes during the COVID-19 pandemic, in general, as well as during lockdowns, in particular (2–5). A recent study, which included 1,006 subjects from Italy, evaluated the psychological repercussions of isolation during the first lockdown in the spring of 2020, concluding that the longer the isolation and the less adequate the physical space where people were isolated, the worse the mental health was (e.g., depression); during this critical time, online contact was found to be crucial in protecting mental health (6). A longitudinal observational study from Germany (7) focusing on anxiety disorders suggests that those with a personal history of mental disorders, particularly anxiety disorders and generalized anxiety disorder, are vulnerable to experience psychological strain in the context of the pandemic; they might likely overestimate the potential threat and should be targeted by preventive and therapeutic interventions. Using qualitative methods (8), it was identified that a history of anxiety or depression affects multiple levels of the social-ecological model during the pandemic, defining the most important mental health stressors. At the individual level, we see isolation/loneliness, fear of contracting COVID-19, and uncertainty about the future; at the interpersonal level, we have fears of family members contracting COVID-19, separation from family members, and domestic relationships; while at the community and societal level, these stressors are represented by employment, community and societal systems, and media. At the beginning of the pandemic, an Italian study (9), aimed at identifying psychological changes during the lockdown period as well as factors associated with these changes, was conducted (original sample = 2,766, with an online follow-up survey for 439 participants). The authors found an increase in stress and depression over the lockdown, but not anxiety. Higher levels of depression at the start of the lockdown, as well as fewer coping strategies and childlessness, were associated with increased depression at follow-up, whereas higher levels of stress at the start of the lockdown and younger age were associated with higher stress at follow-up. In China [Le (10)], a large sample, cross-sectional, population-based, online survey study was conducted to investigate the prevalence of and risk factors associated with mental health symptoms in the general population (56,679 participants), during the COVID-19 pandemic. The results of this survey indicate that mental health symptoms may have been common during the COVID-19 outbreak, especially among infected individuals, people with suspected infection, and people who might have contact with patients with COVID-19. Some measures, such as quarantine and delays in returning to work, were also associated with a decline in mental health among the public.

The COVID-19 pandemic stormed our lives and changed our perspectives. Unfortunately, studies on COVID-19 have significant data heterogeneity, largely due to differing cultural/economic specifics between countries, as well as differences in timing (data collected in different phases of the pandemic), sample size, and instruments. There was a need for a holistic, longitudinal, and comparable, real-time assessment of emotional, behavioral, and societal impacts of the COVID-19 pandemic across nations (11, 12). Konstantinos Fountoulakis and his international research team worked on the COMET-G study, which gives a larger picture of the phenomena by using both a standard time frame and identical instruments in 40 counties across the world. Our current paper is a part of Fountoulakis' international study, specifically looking at the mental health changes and their possible determinants in Canadians.

As researchers and mental health providers within the scope of precision and personalized psychiatry, we consider it important to identify the exact contribution of specific variables to observed pathology. This research aims to assess how the COVID-19 pandemic, either in itself or as a result of the measures adopted to control the outbreaks, has affected various aspects of the mental functioning, needs, and behaviors of the general population.

We are referring here only to the Canadian part of the research, based on 508 Canadian responders to the online survey. This portion of the international study aims to investigate the rate of clinical depression in the adult population over the age of 18 years in Canada during the COVID-19 pandemic. Secondary aims are to investigate the changes in anxiety, distress, suicidal ideation, and their relations with several personal and interpersonal/social variables.

We hypothesized that there will be an increase in depression and distress across the general Canadian population, with a higher rate in those with a history of any mental condition.

MATERIALS AND METHODS

This is an epidemiological, non-interventional study – part of an international multi-center study, with the main site at the Aristotle University of Thessaloniki, Greece, Europe.

The questionnaire used for this project was developed as part of an initiative by the Mental Health Sector of the Scientific Researches Institute of the Pan-Hellenic Medical Association.

This study was started in Europe, and the initial approval for this research project was given by the Ethics Committee of the Faculty of Medicine, Aristotle University of Thessaloniki, Greece. For our part of this research, we received approval from the Health Science Research Ethics Board at Queen's University, Kingston, Canada. Participation in this study was voluntary and the respondents had to be at least 18 years old to participate. The first QAIRE page included a declaration of consent, which all participants accepted before filling out the survey. Due to the format of the questionnaire, respondents were required to have access to technology and be able to read and answer questions in English or French.

We used two types of Google Documents links: one with the questionnaire for the respondents and one for monitoring purposes for the research team.

For data collection, the Google Documents (one in English and another in French) disseminated the QAIRE anonymous questionnaire across the general population of Canada. QAIRE was designed as an anonymous research tool (each respondent provided only their year of birth, with no other personal data being required or registered). Using a separate link, the research team was able to use Google Documents to check the number of responses and to facilitate the data collection, when necessary. This link was only for use in Canada, as the questionnaire related to Canada's lockdown conditions (and not any other country). All responses were automatically saved and summarized in the associated Excel file on Google Disc. Only Prof. Konstantinos Fountoulakis, two general coordinators, and our research team had access to this dataset online.

The expected sample was 8,000 to 10,000 responders across Canada – Canada's population is 38.01 million (2020). Inclusion criteria: any person of age 18 years and older, with access to technology, and who were able to read/answer the questions in English or French. The enrolment period lasted from August 2020 through March 2021.

The study population was self-selected. Initially, for the first 4 months, we (research team members, neighbors, colleagues, and people from different volunteering associations) distributed the questionnaire to people from Eastern Ontario, using emails to personal connections within the region (aiming to first obtain a description of the phenomena in this part of the country). We obtained 405 answers, from the South East Ontario Region's population of 1.76 million (which includes the cities of Ottawa, Brockville, Cornwall, Kingston and Pembroke, and towns of Gananoque, Prescott and Smith Falls, and counties of Prescott and Russell, Stormont, Dundas and Glengarry, Lanark, Leeds and Grenville, Frontenac and Lennox, and Addington). Subsequently, for the last four distribution months, we circulated the questionnaire using the most common media tools (Facebook, LinkedIn, Research Gate, and Twitter). Unfortunately, the rate of response fell below expectations. This was likely due in part to the important burden imposed by the pandemic, with people using media channels to comfort themselves rather than further focusing on worries and uncertainty. The increased availability of people contacted directly could be explained by a sense of responsibility and reciprocity, compared to the wide media approach which allows for anonymity and the freedom to postpone the engagement. Some responders provided us with feedback; from this, we learned that the 107 answers from the Canada-wide distribution came mainly from Nova Scotia, British Columbia, Québec, and Alberta.

Of the 512 total responders, we excluded 4 (who were under the age of 18 years), making the working sample of 508 persons. Distress and clinical depression were identified with the use of a cut-off and a previously developed algorithm, respectively. According to a previously developed method by the Greek site (13, 14), both a cut-off score of 23/24 for the CES-D as well as a derived algorithm were used, with cases of major depression being those identified by both methods. Those identified by only one of these tools are considered cases of distress (false positive cases in terms of depression). The two bibliographical studies show that 10% of the population are falsely diagnosed with depression by CES-D; these respondents were not depressed but had high-stress levels. A combined approach with the algorithm plus the cut-off method was able to clarify if the person is depressed or stressed.

Measures

The online questionnaire (QAIRE) registered demographic, health data, previous psychiatric history, current symptoms of anxiety [STAI-Y1 state, (15)], depression (CES-D), and suicidality (RASS), as well as changes in sleep, sexual activity, family relationships, finance, eating, exercising, and religion/spirituality. Each question of the QAIRE questionnaire protocol was given an ID code, reflecting the part of the protocol it belongs to, with a capital letter (defining 12 sections, coded from A to P) and a number (total 121 questions, with Likert scale response options) to denote its position within that protocol part. Throughout the results, these ID codes are used for increased accuracy (**Supplementary Appendix 4**).

Statistical Analysis

A method of simplified post-stratification was used to create a standardized study sample with characteristics as close as possible to those of the general population. Considering the small sample size, we measured the Cronbach's alpha for the scales we used: alpha CES-D - 0.92; alpha STAI-Y1-0.93; alpha RASS-0.42.

Descriptive statistics were calculated and descriptive tables were created for the variables under investigation. Chi-square tests were used for the comparison of frequencies when categorical variables were present, and for the *post hoc* analysis of the results, a Bonferroni-corrected method of pair-wise comparisons was used. We performed multiple forward stepwise linear regressions. Multifactorial Analysis of Variance (MANOVA) was used to test for the main effect as well as the interaction among categorical variables, with Tukey's *post hoc* test being employed to investigate which variables could contribute to the development of others.

RESULTS

Study Sample

Of the 508 responders, 72.2% were females aged 42.57 ± 14.00 years; 27.2% were males aged 42.24 ± 15.49 years; and 0.6% were others aged 46.33 ± 17.79 years (**Table 1**: Descriptive Data).

Living Situation, Family Status, and Relationships

Only 18.3% of the study sample was living in the country's capital (Ottawa), 15.2% in a city of more than one million inhabitants, and 42.9% in a city with 100,000 to 1 million inhabitants. More than half (65%) of responders were married or common-law partners (marital status); only 14.6% were living alone (with nobody else under the same roof); and 45.9% had three or more people living in the house during the lockdown. In our sample, 243 responders (47.8%) had no children at all, while 28.1% have two children. For families with children, 22.7% stated that it was more difficult to manage their daily life and behavior than before. The responders stated that they were a close relative or caretaker of a person that belongs to a vulnerable group in 45.5% of cases. During the lockdown, the family relationships became more conflictual in 23.8% of cases, less conflictual in 20.3% of cases, and 55.9% of responders reported no changes. The overall quality of relationships with other family members was reported to have improved for 27.9% of responders, worsened for 18.8% of responders, and remained unchanged for 58.5%. The basic daily routine (waking up in the morning, regular meals and sleeping hours, and activities) was affected in 91.3% of cases, with 64.4% of responders noting this to be the case either "most of the time" or "always."

Education, Work, and Finances

A 88.8% of responders had a bachelor's degree or higher. In terms of employment, 45.3% were civil servants, approximately 17% were working in the private sector, 11% were college or university students, and 10.7% were retired or were not working for a variety of reasons. From our sample, 29.9% were working in the healthcare sector (6.5% were doctors, 5.1% were nurses, 3.1% were administrative staff in hospitals, and 15.2% other healthcare professions/hospital staff). The percentage of people that did not work during the lockdown was 15.2%. Changes in finances due to the outbreak were reported as worse in 28.4% of cases, better in 21.6%, and unchanged in 50%.

TABLE 1 | Descriptive statistics of the original (raw) and the standardized study samples in comparison to the general population.

	General population aged 18–87 years old		Raw study sample		Standardized study sample
	N[1]	%	*N*	%	%
Sex					
Males	9.98 mil	48.49	138	27.2	48.5
Females	10.6 mil	48.94	367	72.2	51.5
Other	0.75 mil	0.34	3	0.6	0.3
Age					
Males mean age	40.1		43.01		43.01
Females mean age	42.2		42.57		42.57
Other mean age			46.33		
Work status					
Total population	20.58 mil		508	100	100
Unemployed	1.89 mil		17	3.4	4.3
Students	1.78 mil		56	11	12.3
Self-employed	2.9 mil		134	26.3	27.7
Civil servant	3.6 mil		230	45.3	42
Disability pension	6.2 mil		4	0.8	1.2
Other			28	5.5	5.0
Family and household					
Married	14,547,623		305	60	59.5
Lives alone	3,969,790		75	14.8	14.7
2-people household	4,834,605		202	39.8	37.2
3-people household	2,140,640		85	16.7	17.6
4-people household	1,946,275		106	20.9	22.0
>5 people household	1,180,770		40	7.9	8.5
Mental health history					
History of deliberate harm			81	15.9	
History of suicide attempt			30	5.9	

[1] *Source: www.statista.com.*

General Somatic Health and Lifestyle Changes

A history of chronic somatic diseases, such as asthma, diabetes mellitus, and hypertension was reported by 28.5% of responders. A worsening sleep pattern was reported by 47% of responders; 55.1% tended to stay up late at night and slept for many hours during the day; 37.4% reported experiencing dreams in which they felt trapped; 8% were taking sleeping pills for insomnia.

And 84.4% of responders acquired an internet-related habit they didn't have before (e.g., a new FB account, engaging in cybersex, or gambling); a majority of respondents (80.7%) observed that the internet took up more of their time than usual.

Changes in their sexual life were reported by 37.8% of responders, with a decrease in desire for sexual intercourse reported in 20.9% of cases, and 20.7% of responders characterizing the frequency of their sexual intercourse as clearly inadequate. However, 30.5% believed that sex helps in dealing with stress and anxiety either "much" or "very much," while 25% did not believe it does so at all.

Physical activity was not affected by lookdown for 20.9% of responders, while it decreased by 44.3% and increased by 34.9%. A great number of subjects (90%) stated that exercise helps with anxiety prevention, with 49.5% saying it does so either "much" or "very much."

Eating habits were unchanged for 39.0% of responders, 41.7% were eating larger amounts of food or more meals per day than usual, and 30.5% reported eating healthier than usual. An increase in body weight was reported by 43% of responders.

During the lockdown, there were reported positive changes (using less) in smoking (11.6%), drinking patterns (15.2%), and illegal substance use (11.2%). A worsening use pattern was reported by 9.3% of responders for smoking, 29.3% for drinking (more than one drink or its equivalent every day), and 4.1% for illegal drugs.

Changes in religious/spiritual beliefs were present in 34% of those surveyed.

Conspiracy Theories

Supplementary Appendix 3 summarizes the responses to all conspiracy theories, by current clinical depression and history of any mental disorder. We did not find a significant correlation between any theory and current depression and/or history of mental illness.

Mental Health Data

Emotional Status

Increased anxiety during the lockdown was reported by 69.3% of those surveyed, and more than 18% reported that it increased "much" (24.8% reported unchanged and 5.7% reported decreased anxiety during the lookdown). The rate of suicidal thoughts increased for 19.5% of responders during the lockdown.

Depression at the time of completing the survey was reported by 22% (112 individuals), while distress was present in 18.4% of responders.

The subjective (by answers to specific questions) and objective (CES-D) emotional state is represented in **Table 2**.

The rate of clinical major depression and distress was higher in females (**Table 3**).

The health care workers, working on the front line during the pandemic, were the category of people most exposed to contracting the virus. The rate of distress versus major depression among health care professionals was not as high as expected (**Table 4**).

TABLE 2 | Emotional state by answers to specific questions (subjective) and clinical depression considering both CES-D methods (objective).

Question	Scoring	%
F21. How much has your emotional state changed in relation to the appearance of anxiety and insecurity compared to before the COVID-19 epidemic?	It got a lot worse	18.3
	It got a little worse	51.0
	Neither better nor worse	24.8
	It's a little improved	4.1
	It has improved a lot	1.8
G21. How much has your emotional state related to the experience of joy or melancholy changed in comparison to before the COVID-19 epidemic?	It got a lot worse	13
	It got a little worse	46.3
	Neither better nor worse	35.0
	It's a little improved	4.3
	It has improved a lot	1.4
O11. How much has your tendency to think about death and/or suicide changed, compared to before the outbreak of COVID-19 epidemic?	Very much increased	3.5
	Increased a bit	15.9
	Neither increased nor decreased	75.8
	Decreased a bit	3.7
	Very much decreased	1.0
Clinical depression according to both CES-D methods	No depression	59.6
	Depression according only to CES-D cut off[1]	40.2
	Depression according only to CES-D algorithm[1]	22.2
	Depression according to both methods[2]	22.0

[1]*Distress.* [2]*Clinical depression.*

TABLE 3 | Rate of distress and depression by gender.

	No symptoms (*n* = 303)	Distressed (*n* = 93)	Depressed (*n* = 112)
Sex (% of group)			
Males	100 (33.0)	16 (17.2)	22 (19.6)
Females	201 (66.3)	77 (82.8)	89 (79.5)
Other	2 (0.7)	0	1 (0.9)
Mean Age (SD)	44.4 (14.3)	38.5 (14.6)	41.6 (13.2)

TABLE 4 | Rate of distress and depression by employment in health care sector.

Employment in health sector (% of group)	No symptoms (*n* = 303)	Distressed	Depressed (*n* = 112)
Doctor	20 (6.6)	9 (9.7)	4 (3.6)
Nurse	18 (5.9)	2 (2.2)	6 (5.4)
Other clinicians	41 (13.5)	11 (11.8)	18 (16.1)
Administrative staff	9 (3.0)	5 (5.4)	2 (1.8)
Other hospital staff	5 (1.7)	1 (1.1)	1 (0.9)
Does not work in health sector	210 (69.3)	65 (69.9)	81 (72.3)

TABLE 5 | The relationship between depression and previous history of psychiatric and/or chronic somatic disorders (Chi-square tests).

History	Control	Distressed	Depressed	% Depressed	Chi-square (*df* = 2)
Any mental disorder	**107a (143.1)**	52a (43.9)	**81a (52.9)**	33.8%	48.37, $p < 0.001$
No mental disorder	**196b (159.9)**	41a (49.1)	**31b (59.1)**	11.6%	
Anxiety disorder	48a (48.9)	18a (15.0)	16a (18.1)	19.5%	1.02, $p = 0.602$
No anxiety disorder	255a (254.1)	75a (78.0)	96a (93.9)	22.5%	
Depressive disorder	**49a (80.5)**	29a (24.7)	**57a (29.8)**	42.2%	51.76, $p < 0.001$
No depressive disorder	**254b (222.5)**	64a (68.3)	**55b (82.2)**	14.7%	
Other disorder	10a (13.7)	5a (4.2)	8a (5.1)	34.8%	2.98, $p = 0.225$
No other disorder	293a (289.3)	88a (88.8)	104a (106.9)	21.4%	
Self-harm	**31a (48.3)**	16a (14.8)	**34a (17.9)**	42.0%	24.85, $p < 0.001$
No self-harm	**272b (254.7)**	77a (78.2)	**78b (94.1)**	18.3%	
Suicide attempt	**12a (17.9)**	5a (5.5)	**13a (6.6)**	43.3%	8.66, $p = 0.013$
No suicide attempt	**291b (285.1)**	88a (87.5)	**99b (105.4)**	20.7%	
Chronic somatic condition	83a (86.5)	24a (26.5)	38a (33.9)	26.2%	2.13, $p = 0.345$
No chronic somatic condition	220a (216.5)	69a (66.5)	74a (80.0)	20.4%	

The bold values are statistically significant.

Relationship Between Depression and Previous History of Psychiatric and/or Chronic Somatic Disorders (Chi-Square Tests)

More than half of the responders (52.1%) reported having no history of mental disorders. A history of anxiety was present in 16% of responders, bipolar disorders in 1.2%, and psychosis in 0.4%, while a history of depression was present in 26.4%.

The relationship between depression and previous history of psychiatric and/or chronic somatic disorders (Chi-square tests) is represented in **Table 5**.

The highest Relative Risk (RR) to develop depression concerned the coexistence of history of depression and self-harm/attempts (RR = 4.71) (**Table 6**).

Prediction of Changes in the Mental State During the Pandemic (Forward Stepwise Multiple Linear Regression)

Dependent variables: Change in anxiety, change in depressive affect, presence of distress or depression, change in suicidal thoughts; 54 Independent variables (**Supplementary Appendix 1**). In **Supplementary Appendix 2**, we illustrated the protective factors (in green) and the risk factors (in red) for each of the four dependent variables (change in anxiety, change in depressive affect, presence of distress or depression, and change in suicidal thoughts). In our analysis, we included an entity named CORE factors, that were consistent across all four of the psychopathology variables; two of them acted as protective factors (keeping a basic routine during the lockdown and the improved sleep) and two as risk factors (gender-female and conflicts with family). The other factors included specifics in the equation of each of the four changes in mental status discussed (**Supplementary Appendix 3**).

DISCUSSION

This study aimed to investigate the rate of clinical depression in the adult population during the COVID-19 pandemic, as well as changes in anxiety, distress, suicidal ideation, and their relations with several personal and interpersonal/social variables. We found that the rate of suicidal thoughts increased for 19.5% of responders during the lockdown. Depression was reported in 22% of participants, while distress was present in 18.4%.

Our Sample

Comprised 508 subjects, with a better representation for individuals living in Eastern Ontario, than Canada wide. However, the standardized study sample, from **Table 1**, provided close values. We used these values (**Table 1**) only to ensure that the demographic composition of our sample is comparable to the general population (16) – in our case, the Canadian population. Our results reflect the raw data and not the standardized sample. Through our analysis, we followed the same steps and strategies used in the parent study COMET –G. Through our analysis, we

TABLE 6 | The relative risk to develop depression in people with history of various mental disorders versus participants with no mental health history.

	Without history of self-harm or suicide attempt		With history of self-harm or suicide attempt	
History	**%**	**RR**	**%**	**RR**
No history of mental disorder	10.2	1.00	41.7	4.09
Any mental disorder	30.5	2.99	41.1	4.03
Anxiety disorder	17.9	1.75	26.7	2.62
Depressive disorder	38.8	3.80	48.0	4.71
Other disorders (e.g., psychosis, bipolar)	40.0	3.92	25.0	2.45

followed the same steps and strategies used in the parent study COMET –G. Gender/age distribution showed 72.2% females aged 42.57 ± 14.00 years; 27.2% males aged 42.24 ± 15.49 years; and 0.6% others aged 46.33 ± 17.79 years.

Living Situation, Family Status, and Relationships

A significant percentage of responders reported deterioration in family dynamics during the lockdown (conflicts, change for worse in the quality of relationships). As expected, changes in basic routine affected 91.3% of subjects, with routine being changed "most of the time" or "always" for 64.4% of responders. Fountoulakis found that a higher number of individuals in Greece were able to maintain their daily routine (18.13%) during the lockdown.

The families with children (52.8% in our sample) indicated struggling to manage their behaviors more than before the pandemic in 22.7% of responses, similar to Greek families (27.43%). In Italy (17), research conducted on 1226 parents found that 17% of their sample experienced significant parenting-related exhaustion, with mothers more severely affected. Greater parenting-related exhaustion was predicted by psychological distress, lower parental resilience, motherhood, fewer perceived social connections, and being single, as well as having a child with special needs, having a large number of children, and having younger children.

The rate of people being either relatives or caretakers of vulnerable persons was slightly higher in our sample (45.5%) than the one communicated by the COMET-G Study (44.41%).

Under 15% of responders from our sample were living alone (still higher than the responses communicated by the COMET-G Study, of around 10% worldwide), becoming even more isolated during the pandemic. In addition, fewer than 20% of our subjects reported a decrease in communication with the extended family.

Education, Work, and Finances

Our sample was comprised of a high number of highly educated people with more than bachelor's degree as their educational status (88.8%), higher than the general Canadian population where only 64% have higher education. This is probably due to the self-selection of responders. The worldwide percentage of people with higher education is 75%, according to the COMET-G Study [COMET-G, (18)]. In terms of employment, 11% were college or university students, 10.7% were retired or were not working for a variety of reasons, and almost 30% were working in the health sector. A higher number of people were working during the pandemic in our sample than worldwide (78.4% compared with 66.14%). It would be interesting to know the percentage of people working remotely, from home (QAIRE had no question targeting this aspect). There are differences in changes in mental health during the lockdown, modulated by the type of work [see section "Relationship Between Depression and Previous History of Psychiatric and/or Chronic Somatic Disorders (Chi-Square Tests)"]. Despite the increased number of people not working during the lockdown, 21.6% of responders from our sample stated that their finances have improved, while 50% stated that their financial status was unchanged. This is one of the protective factors for anxiety and depression and could be explained by the generous compensatory financial support through Canada's COVID-19 Economic Response Plan; for example, CERB (Canada Emergency Response Benefit), provided as financial support to employed and self-employed Canadians who were directly affected by COVID-19, as well as Canada Emergency Student Benefit (CESB), and Support for vulnerable people (homeless, indigenous communities, senior). Another explanation for this preservation in financial status is the abrupt changes in lifestyle which may have reduced spending (beauty services, restaurants, and shopping malls closed; inability to travel or pursue other hobbies such as golfing, skiing; theatres and arenas closed, etc.). And finally, we suspect that the financial status was preserved by a lower percentage of people without work (21.6%) compared with the global general population of 33.86% [COMET-G, (18)]; in Greece, this percentage was 47.37% (19).

An interesting survey conducted in Korea in December 2020 found that among the 322 participants, the prevalence of probable depression and GAD were 19.3 and 14.9%, respectively, with high rates of probable depression (23.3%) and GAD (19.4%) among persons currently having job-related and financial issues. Decreased access to nature/greenspaces during the lockdown were significantly associated with depression; an alternative explanation was that those experiencing poor mental health may be less likely to visit green spaces during the pandemic (20).

General Somatic Health and Lifestyle Changes

Are extremely important in anxiety determinism (worsening of sleeping pattern, eating more, drinking more, increase in body

weight, increased time spent on the internet). A worsening sleep pattern was reported by almost half of our sample, with more than half (55.1%) tending to stay up late at night, which could be partially explained by the increased interest in internet use. An important percentage of people (84.4%) acquired a new internet-related habit during the pandemic (e.g., a new FB account, engaging in cybersex, or gambling), while the majority (80.7%) observed that the internet took up more of their time than usual. A study of the interactions between anxiety levels and life habit changes in the Russian general population during the pandemic lockdown (21) concluded that factors of decreased physical activity and sleep disturbances related to the lockdown, as well as excessive internet browsing for information about COVID-19, emerged as risk factors for increased anxiety, more notably in women than in men. The decreased physical activity in our sample was reported by 44.3% of responders and close to the 45.05% reported worldwide [COMET-G, (18)]. The decrease in smoking and use of illegal drugs was seen equally in Canadians as in the COMET-G Study, and both studies found comparable changes related to sexual life, eating, and sleep patterns. However, 34% of interviewed people in Canada increased their religious beliefs, compared to the 19.18% communicated in the COMET-G Study. This could be considered a protective factor for suicidal attempts, if not also for distress.

Conspiracy Theories

In the COMET-G Study, Fountoulakis (19) observed that some conspiracy theories are exerting a protecting effect at certain phases. We did not find a significant correlation between any theory and current depression and/or history of mental illness.

For Canadians, out of the seven theories inquired about, only the belief that "COVID-19 appeared accidentally from human contact with animals" was embraced by almost 90%, with 53.5% believing "much" and "very much" in this.

Changes in Mental Health

Emotional Status During the Pandemic

Increased anxiety during the lockdown was reported by 69.3% in our sample. Major depression was detected in 22%, while distress was present in 18.4%. When compared with the worldwide rate of 17.80% with major depression and 16.71% with distress, calculated under the same circumstances and time [COMET-G, (18)], there was a higher rate of both in Canada. A low rate of increased anxiety during the pandemic was reported in Pakistan, and the authors concluded that it "demonstrates either the resilience of Pakistanis or the lack of understanding of the seriousness of the situation" (22). Higher distress levels were reported by Yael (23), who imagined the profile of individuals with elevated distress as: "being younger, female, not in a relationship, having a below-average income, being diagnosed with the disease, living alone during the outbreak, having a close other in a high-risk group, and negatively self-rating one's health status." Chang et al. (24) found that fear of COVID-19 among people with mental illness was associated with psychological distress (including depression, anxiety, and stress), while the present study found that mental disorder is associated with depression only.

The rate of suicidal thoughts increased for 19.5% of responders during the lockdown, while the COMET-G study found an increase of only 17.16%. There is a large heterogeneity among countries in the description of suicidal behavior during the pandemic, again, possibly due to the different times of rating and different instruments used (18, 25, 26).

The History of Any Mental Disorder

A history of self-harm and suicidality represented a risk factor for developing depression. People with a history of any mental disorder had higher rates of developing depression than people with no such history; these rates are higher for Canadians when compared with the global population as reported in Fountoulakis' paper (32% vs. 13.07%). In Fountoulakis' paper, the highest risk was associated with a history of self-harm/suicidality/bipolar disorder (RR 5.88), while in the Canadian population, the higher risk was represented by a history of self-harm/suicidality/depression (RR 4.80). People with no history of mental illness had a lower risk of developing depression (RR 1.00), the same risk for Canadians as Fountoulakis' general population. The presence of a chronic somatic condition was not a significant risk factor for the development of depression in Canadians, compared with Fountoulakis 'general population where the RR was 1.22.

A history of self-harm or suicidality emerged as a risk factor even for persons without a reported mental health history, of which 41.67% develop depression in the presence of this risk factor. The combination of both self-harm and a history of suicidal attempts with specific mental health history revealed that subjects without any such history had the lowest rate of current depression (10.00%), while the presence of previous self-harm/attempts increased the risk in subjects with past anxiety (26.67%), depression (48.00%), and other mental disorder (25.00%).

Prediction of Changes in the Mental State During the Pandemic (Forward Stepwise Multiple Linear Regression)

Of the protective and risk factors modulating the change in anxiety, the change in depressive affect, the presence of distress or depression, and the change in suicidal thoughts, we found four factors (CORE) that were consistent across all four of the psychopathology variables. Two of them acted as protective factors (keeping a basic routine during the lockdown and the improved sleep) and two as risk factors (gender-female and conflicts with family). A systematic review conducted on PubMed, Embase, Medline, Web of Science, and Scopus in 2020 [Jiaqi (27)] showed relatively high rates of symptoms of anxiety (6.33 to 50.9%), depression (14.6 to 48.3%), and psychological distress (34.43 to 38%) in the general population during the COVID-19 pandemic in China, Spain, Italy, Iran, the United States, Turkey, Nepal, and Denmark. Risk factors associated with distress measures included female gender, younger age group ($\leq$40 years), presence of chronic/psychiatric illnesses, unemployment, student status, and frequent exposure to social media/news concerning COVID-19.

CONCLUSION

In our sample, we found a greater prevalence of depression but not distress in individuals with a history of any mental disorder. Based on the multiple regression analysis, we found four CORE factors equally influencing all considered changes in mental health during the lockdown: gender, quality of sleep, daily routine, and conflicts with family.

In the Canadian population, two major changes acted as protective factors, significantly expressed when compared with the worldwide tendencies: the lesser financial difficulties (support offered by the Government, higher number of subjects working, even if from home) and an increase in religious beliefs. The impact was not on the general rate of major depression, distress, and suicidal ideation (these were higher in Canadians than worldwide), but on the lower relative risk to develop depression in the presence of a history of mental disorders.

Almost 90% of Canadians believed in the most probable real story of COVID source of provenience.

Our research findings will help better understand the factors involved in the determinism of depression, suicidality, and distress in the Canadian population during critical situations. These could be taken into consideration when organizing future mental health programs and interventions, aiming to protect at-risk populations.

Strengths and Limitations

The strength of the current paper derives from the large bulk of information obtained, which allowed us to have an idea of how the pandemic affected Canadians' life.

The limitations derive from the small sample size and the method in which data were collected (anonymously online through responder self-selection). The changes during the lockdown discussed here are only perceived changes as we do not have a pre-lockdown measure. The low internal consistency of the RASS (0.42) in the present study is another limitation.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Health Science Research Ethics Board at Queen's University, Kingston, ON, Canada. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements. Written informed consent was obtained from the individual(s), and minor(s)' legal guardian/next of kin, for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.871119/full#supplementary-material

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Determinants of Stress Levels and Behavioral Reactions in Individuals With Affective or Anxiety Disorders During the COVID-19 Pandemic in Russia

Mikhail Yu Sorokin[1], Evgeny D. Kasyanov[2], Grigory V. Rukavishnikov[2], Maria A. Khobeysh[1], Olga V. Makarevich[1], Nikolay G. Neznanov[3,4], Tatyana G. Maximova[5], Dmitry N. Verzilin[6,7], Natalia B. Lutova[1] and Galina E. Mazo[2]*

[1] Department of Integrative Pharmaco-Psychotherapy of Patients With Mental Disorders, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia, [2] Department of Translational Psychiatry, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia, [3] Department of Geriatric Psychiatry, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia, [4] Department of Psychiatry and Addictions, I.P. Pavlov First Saint Petersburg State Medical University, Saint Petersburg, Russia, [5] Faculty of Infocommunication Technologies, ITMO University, Saint Petersburg, Russia, [6] St. Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences, St. Petersburg Federal Research Center of the Russian Academy of Sciences, Saint Petersburg, Russia, [7] Department of Management and Economy of Sports, Lesgaft National State University of Physical Education, Sport and Health, Saint Petersburg, Russia

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Pedro Morgado, University of Minho, Portugal

Reviewed by:
Arghya Pal, All India Institute of Medical Sciences, India
Dian-Jeng Li, Kaohsiung Municipal Kai-Syuan Psychiatric Hospital, Taiwan

***Correspondence:**
Mikhail Yu Sorokin
m.sorokin@list.ru

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Introduction: Individuals with affective and anxiety disorders are among those most vulnerable to the negative effects of the COVID-19 pandemic.

Aim: This study aims to analyze the determinants of stress levels and protective behavioral strategies associated with the COVID-19 pandemic in Russian-speaking people with affective or anxiety disorders (AADs).

Materials and Methods: In this cross-sectional online survey, the psychological distress and behavioral patterns of respondents with self-reported AAD (n = 1,375) and without disorders (n = 4,278) were evaluated during three periods of restrictive measures in Russia (March–May 2020). Distress levels were verified using the Psychological Stress Measure (PSM-25).

Results: Stress levels among respondents with AAD were higher at all study periods than for those with no mental disorder (Cohen's d 0.8–1.6). The stress level increased (Cohen's d = 0.4) in adolescents (16–18 years) with AAD and remained the same in those without disorders; in youths (19–24 years) with and without disorders, an increase (Cohen's d = 0.3) and a decrease (Cohen's d = 0.3) in the stress were observed, correspondingly; the stress in adults (25–44 years) with disorders did not change and decreased in those without disorders (Cohen's d = 0.4). Individuals with bipolar disorders demonstrated lower stress than individuals with depressive (Cohen's d = 0.15) and anxiety disorders (Cohen's d = 0.27). Respondents with depressive and bipolar disorders employed fewer protective measures simultaneously and were less likely to search for information about COVID-19.

Conclusion: The presence of affective or anxiety disorders is associated with a more acute response to the COVID-19 pandemic. Apparently, the type of mental disorder influenced stress levels and protective behavior patterns.

Keywords: SARS-CoV-2, anxiety disorders, depressive disorder, bipolar disorder, psychological distress, health risk behavior

INTRODUCTION

Stress associated with the COVID-19 pandemic has a complex multifactorial nature and an ambiguous profile of the behavioral reactions of the population (Fountoulakis et al., 2022). The danger of coronavirus infection has caused a wide range of psychological problems among the population of countries with high viral infection rates (Qiu et al., 2020). The greatest negative impact on mental health has been caused by such factors as: an unprecedented, potentially life-threatening situation of uncertain duration and economic consequences; increased family conflicts during large-scale quarantine measures in all major cities; an inconsistent information background with an oversupply of contradictory data (Sorokin et al., 2021; Vrublevska et al., 2021). The mental health consequences of such a crisis, including an increase in suicide rates, are predicted to continue for a long period of time and to peak after the actual pandemic (Pirkis et al., 2021).

Initial results confirmed that individuals with affective disorders are exposed to higher levels of stress, which in turn are associated with maladaptive situational and lifestyle changes occurring in response to the COVID-19 pandemic (Van Rheenen et al., 2020). In such individuals, the maladaptation and levels of preexisting anxiety and depressive symptoms are likely to increase with each subsequent wave of COVID-19 infection because they are more vulnerable to biological, social, and economic disruptions (Dabrowska et al., 2021). Moreover, individuals with affective or anxiety disorders are in high need of many variable factors associated with proper mental health care. Regular access to mental health-care services, medications, stable daily routines, and social interactions are necessary for those with mood illnesses. The psycho-social stress and limited access to the abovementioned elements could significantly affect the anxiety and mood symptoms in individuals with mental disorders (Asmundson et al., 2022). Subsequently, it was found that individuals with affective disorders have an increased risk of COVID-19 infection, as well as an increased risk of hospitalization and death (Diez-Quevedo et al., 2021). Thus, the impact of the COVID-19 pandemic on mental health is not equal for all groups of the population, especially for persons with major psychiatric disorders. Therefore, these imbalances in response to stress associated with the COVID-19 pandemic require more detailed study, taking behavioral reactions and socio-demographic indicators into account.

The study hypothesis is that the presence of affective or anxiety disorders is associated with a more acute response to the COVID-19 pandemic and epidemiological restrictions.

The study aims to analyze the determinants of stress levels and protective behavioral strategies associated with the COVID-19 pandemic in Russian-speaking people with affective and anxiety disorders.

METHODS

The study data were obtained through an extensive online survey conducted among Russian-speaking respondents during the restrictive period introduced as a measure to prevent the spreading of coronavirus infection. The most significant parts of the sample were obtained for 3 periods:

- 30 March to 8 April 2020 (1st period)–introduction of the first restrictive measures in Russia due to the worsening of the epidemiological situation;
- 29 April to 8 May 2020 (2nd period)–final stage of restrictive measures;
- 9 May to 18 May 2020 (3rd period)–cancellation of federal restrictive measures, early days of the post-restriction period.

Participants in the research were invited to complete an anonymous questionnaire *via* Google Forms, which took about 15 min. The questionnaire was distributed *via* social networks and on the websites of public organizations and thematic communities (refer to Acknowledgments).

The inclusion criteria were the ability to read Russian and consent to the processing of personal data. The non-inclusion criteria were the absence of values for individual points of the survey when filling in the questionnaire.

The questionnaire was based on self-reports on the socio-demographic characteristics of respondents and their place of residence, as well as on self-reports of their health status. The questionnaire, which was distributed in communities of patients with mental disorders, included a question on the presence/absence of a diagnosed affective or anxiety disorder with the option of choosing one of the proposed diagnoses in the questionnaire: depressive disorder, bipolar affective disorder, generalized anxiety disorder, cyclothymia, or dysthymia.

All participants in the study were invited to select any of the proposed concerns about the COVID-19 pandemic and any of the preventative measures they had implemented. Original questionnaire items which were already used earlier (Sorokin et al., 2020) described 10 types of concerns associated with COVID-19 (contagiousness of the virus; risk of isolation; the absence of specific treatment for COVID-19; fear for self-life; risk to the lives and health of relatives; possible financial difficulties; severe social consequences; lack of safety equipment for sale; possible lack of medication for daily intake; and impossibility of

traditional way of life) and six behavioral patterns of infection prevention (wearing a mask or respirator; use of antiseptics; hand washing; social distance; and self-isolation). The reliability of these two subsets of dichotomous questions was calculated with the Kuder–Richardson-20 test: for concerns—0.41, for preventative measures—0.6. The results reflected the diversity of emotional and behavioral reactions of respondents, so these levels were considered satisfactory. Individual respondents could also indicate how often they requested information about the pandemic during the last week ranked by eight degrees, ranging from "never" to "hourly".

Psychological stress scale (PSM-25) is 8-point Likert scale ("not at all" to "greatly") used Lemyre in 1990 to assess current stress levels. Translated and adapted version for the Russian-speaking population was used (Vodop'yanova, 2009). The integral indicator of psychological stress in it is the total score, varying between 25 and 200. It reflects the expression of emotional, cognitive, and somatic reactions through the indicators of three subscales identifying three levels of stress. A total of 6 of the 25 questions (nos. 2, 7, 9, 15, 16, and 22) on the psychological stress scale describing somatic stress reactions were evaluated separately. A high score–a sum higher than 155 points–indicates a state of maladaptation and the need for correction; a score of 154–100 points indicates an average level of stress; low–under 100 points–indicates a state of psychological adaptation to workloads. In this study, PSM-25 demonstrated excellent internal consistency with Cronbach's alpha 0.949.

The study design was controlled by the independent ethical committee (IRB registration number: Э К-И-132/20). It was in conformity with the Declaration of Helsinki. It included a collection of anamnestic, socio-demographic data, and clinical parameters after the respondents signed a voluntary informed consent.

Data Cleansing

We analyzed the values of the PSM-25 items to identify irrelevant answers and outliers. We used the scales of the PSM-25 items to calculate for all observations the Mahalanobis distances from the pattern consisting of average values. Then, we filtered out 11 outliers from the original 5,728 records. All outliers produced high Mahalanobis distances and revealed contradictory answers to interrelated questions. We also filtered out seven records with identical values in all PSM-25 items.

As there was no registration for the respondents, we checked the answers to the question: "Are you filling up this form for the first time?" For the repeated applications, we tried to find pairs with similar personal data as age, gender, educational level, marital status, occupation, and city. We identified 48 pairs (96 records) of repeat interviews of the same respondents. Among 48 pairs, we identified 26 where there was not $<$20 days between interviews. Those 26 pairs were analyzed separately as dependent samples. All 48 records of second interviews were removed from the main sample.

A total of three main grouping factors, including age, length of interview, and type of disorder (with no affective/anxiety disorder as a zero type), were used for extracting groups of records to be compared. We divided respondents into eight age groups and six periods. When comparing groups of records, we mostly used 1–5 age groups and 1–5 periods containing the majority of records.

Exploratory Analysis

We used the ANOVA test, IBM SPSS Statistics (RRID:SCR_019096), to compare the amount and dynamic of distress in groups of respondents with/without affective or anxiety disorders. All groups corresponding to different time periods were separated. We obtained higher levels of distress for respondents with a disorder and different dynamics of distress levels for groups of respondents with/without a disorder (increase/reduction in the distress level).

We used regression analysis to examine whether the total distress level depended on age. For all groups of records, we observed negative dependency between these two variables. As the age of respondents was distributed rather differently in the groups under observation, we had to use more detailed analysis to distinguish the effects of disorder type and age on the distress level.

Hypothesis Testing

When the gender composition of respondents was similar in all groups of observations (16% males and 84% females), the age distribution was essentially different. For example, the average age of respondents with a disorder was about 24, compared with 34 for those without a disorder.

For matching different groups of observations, we excluded random records, so that relative frequencies of ages became equal–not attempting to fit samples to an ideal, but filtering all the samples, so that the total number of records removed was minimal. We solved two optimization tasks: in the first task, we removed as few records as possible; in the second task, we used weights equal to inverse values of the sample sizes. The second task was used when the sample sizes were essentially different.

To compare different groups, we used factorial or one-way ANOVA and estimated standard errors and 95% confidential intervals for average values of dependent variables. We also performed *post hoc* analysis. When the variable did not match Gaussian distribution, we always used nonparametric tests, specifically repeated Mann–Whitney tests for two independent samples. However, we confirmed the fact that ANOVA tests are robust to the violation of normality for large sample sizes, as in our comparisons, ANOVA and nonparametric tests gave similar results. When testing hypothesis for all the PSM-25 items, we took into account multiple comparisons. However, there was no need to lower the level of significance, as p-values were usually low and there were many positive results among the PSM-25 items.

Sampling Characteristics

Based on the self-report data on the presence of mental disorders, the final sample of 5,662 records was divided into two groups. The research group included 1,375 records (24.1%) containing information on the presence of affective pathology: 590 (10.3%) depressive disorders (including dysthymia), 530 (9.3%) bipolar disorders (including cyclothymia), and 255 (4.5%) anxiety disorders (general anxiety disorder, and panic disorder).

The control group included 4,278 respondents (75.9%) who reported no affective or anxiety disorders.

To assess the age differences, the following subgroups of respondents within the research and control groups were included in the analysis: adolescents from 16 to 18 (1.6 and 1.8%, respectively), young adults from 19 to 24 (2.5 and 4.1%, respectively), and adults from 25 to 44 (19.9 and 42.7%, respectively). In all the subgroups analyzed (age, history of diseases, and specificity of reactions to the pandemic), the male to female ratio in the sample remained stable: 16 and 84%, respectively.

The survey covered respondents living in all federal districts of Russia. Residents of major cities made up 19.2 and 35% of the sample (Moscow and St. Petersburg, with populations of over 10 million and 5 million, respectively). Residents of other cities with populations of over one million accounted for 16.2%. Respondents from cities with a population of less than one million people constituted 29.6% of the sample.

RESULTS

Stress in Comparison Groups

In the exploratory analysis, data were obtained on significantly higher rates of psychological stress (Cohen's d 0.8–1.6) in respondents with affective or anxiety disorders than for those with no mental disorder (**Figure 1**). At this point, we examined full groups of respondents with no adjustments to the age structures. In factorial ANOVA, we obtained significant differences with $p < 2e\text{-}8$ between groups for the factor of disorder (yes/no) and for the join factor disorder*period. We obtained p=0,051 for the factor of period. *Post hoc* analysis (least significant difference (LSD) test) confirmed the differences with $p < 0{,}03$ for all $2*3 = 6$ groups except the pair period=2 and period=3 in the control group. For the factor of period, the tests of homogeneity of variances (Hartley F-max, Cohran C, Bartlett'sh chi-square) passed. The test failed for the factor of disorder. However, we can assume that the difference between the groups of respondents with/without affective disorder is too high ($p < 1e\text{-}15$) to be overturned with homogeneity tests.

In all age subgroups and time periods, respondents self-reporting affective or anxiety disorders (research groups) continued to show significantly higher rates of psychological stress than those with no affective/anxiety disorders (control group). It is noteworthy that the differences in stress levels between the control and research groups in the overall sample increased from the introduction of epidemiological restrictions to the period after their cancellation. However, these dynamics were not uniform in individual age groups.

Dynamics of Stress Levels Between Periods of Epidemiological Restrictions

Among the three age subgroups, an increase in stress levels in the research group and a reduction in the control group between the 1st and 3rd periods were observed only among

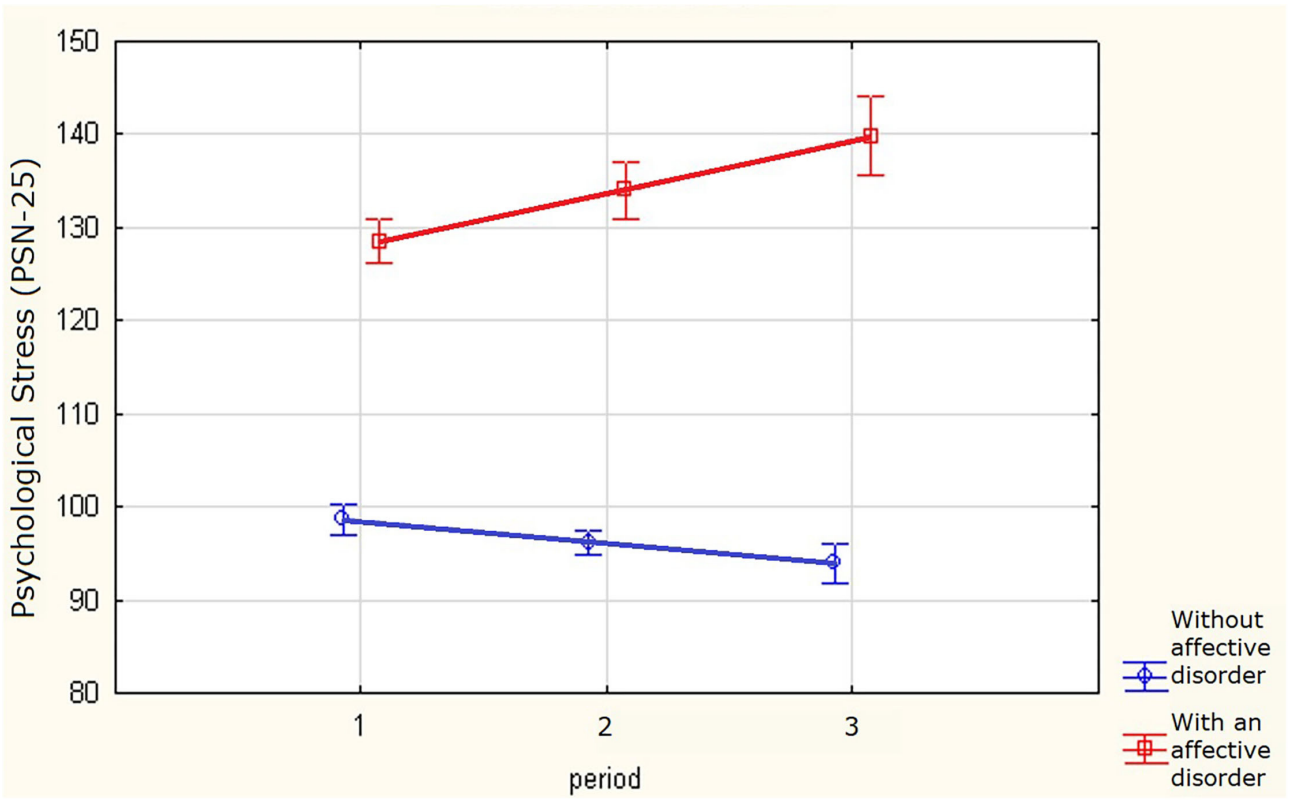

FIGURE 1 | Levels and dynamics of stress for respondents with/without affective or anxiety disorders.

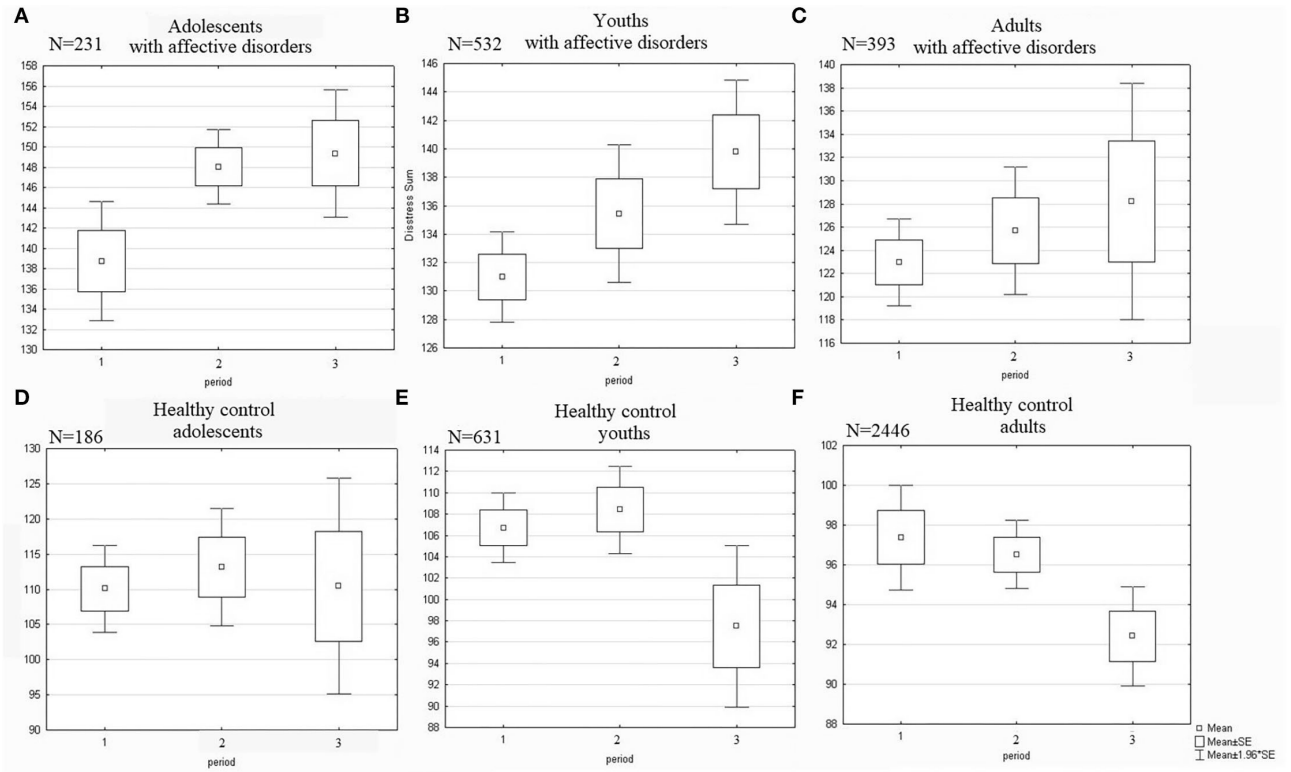

FIGURE 2 | Dynamics of stress levels in adolescents and youths in contrast to adults. Significant differences **(A)** between "1" and "2" with $p = 0.036$. **(B)** between "1" and "3" with $p = 0.02$. **(E)** between "1" and "3" with $p = 0.039$ and between "2" and "3" with $p = 0.012$. **(F)** between "1" and "3" with $p = 0.008$ and between "2" and "3" with $p = 0.017$. No significant differences between periods in adults with affective disorders **(C)** and in healthy control adolescents **(D)**.

young adults aged 19–24 (Cohen's d=0.32 and Cohen's d=0.30; **Figures 2B,E**). In all the remaining figures, we performed the Mann–Whiney U test to confirm inter-group differences as all samples were rather far from normal distribution. Adolescents aged 16–18 from the research group showed higher rates of psychological stress in the 3rd period than those interviewed during the introduction of restrictive measures in the 1st period (Cohen's d =0.39, **Figure 2A**), but no reliable control dynamics were revealed (**Figure 2D**). Among adults in the control group, a reduction in stress levels between the 1st and 3rd periods was observed (Cohen's $d = 0.40$, **Figure 2F**), but there were no reliable dynamics in the research group (**Figure 2C**).

High levels of stress among young adults in the research group were associated with higher somatic rates on the PSM-25 scale in the 3rd period compared with the 1st period (Cohen's d=0.26, **Figure 3A**). In contrast, individuals aged from 19 to 24 in the control group who were examined after the removal of the anti-epidemic restrictions showed a lower level of somatization than those examined at the beginning of quarantine in the 1st period (Cohen's d=0.40, **Figure 3B**).

Nosological Characteristics of Stress and Behavior Associated With the Pandemic

The level of stress on the PSM-25 scale was specifically associated with affective/anxiety disorders. Among subgroups of respondents with depressive, bipolar, and anxiety disorders, individuals with bipolar disorders demonstrated significantly lower levels of stress compared with individuals with depressive (Cohen's d=0.15) and anxiety disorders (Cohen's d=0.27) (**Figure 4A**).

It is also important to note that stress response characteristics were combined with the modification of protective behavior (**Figure 4B**) and the search for information about the pandemic (**Figure 4C**) both in the nosological subgroups of the research group and in the control group.

Respondents self-reporting depression and bipolar disorder used fewer protective measures simultaneously compared with the control group. However, there was a significant reduction in the concurrently practiced means of preventing infection only among those who reported depressive disorders (Cohen's $d = 0.15$), whereas among respondents with bipolar disorders the narrowing of protective measures were negligible (Cohen's $d = 0.1$). No reliable differences were found between the control group and the subgroup with anxiety disorders.

In the subgroup with depressive or bipolar disorders, respondents were less likely to search for news about the pandemic than those in the subgroup of anxiety disorders (Cohen's $d = 0.28$ and 0.28, respectively), and in comparison with the control group (Cohen's d=0.17 and 0.16, respectively). Participants self-reporting an anxiety disorder were the most

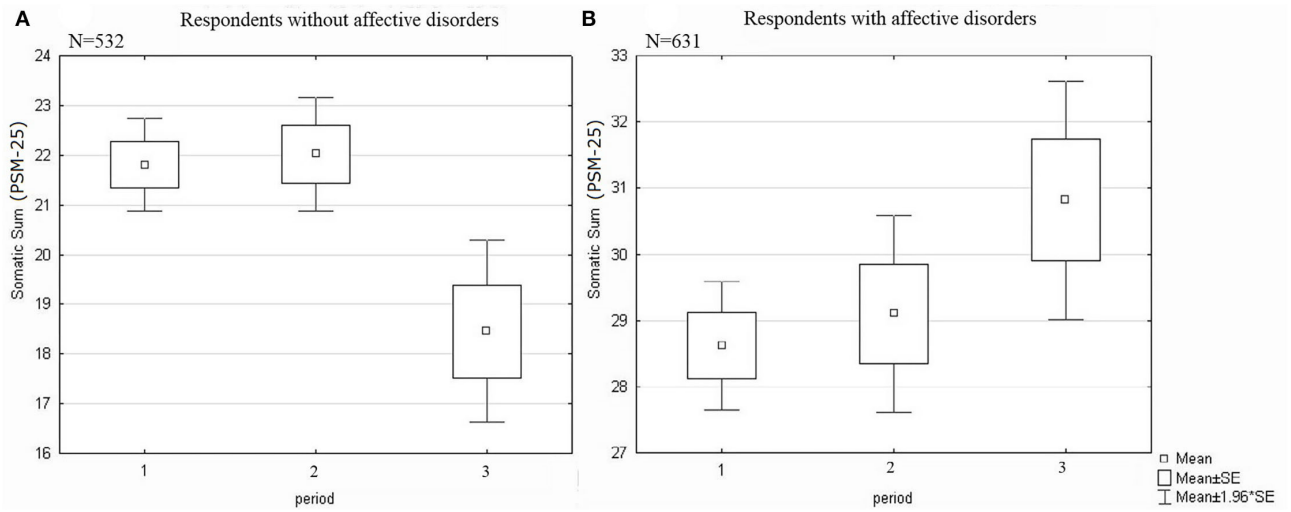

FIGURE 3 | Dynamics of somatization in presence of an affective/anxiety disorder among young adults. Significant differences **(A)** between "1" and "3" with $p = 0.01$ and between "2" and "3" with $p = 0.005$. **(B)** between "1" and "3" with $p = 0.046$.

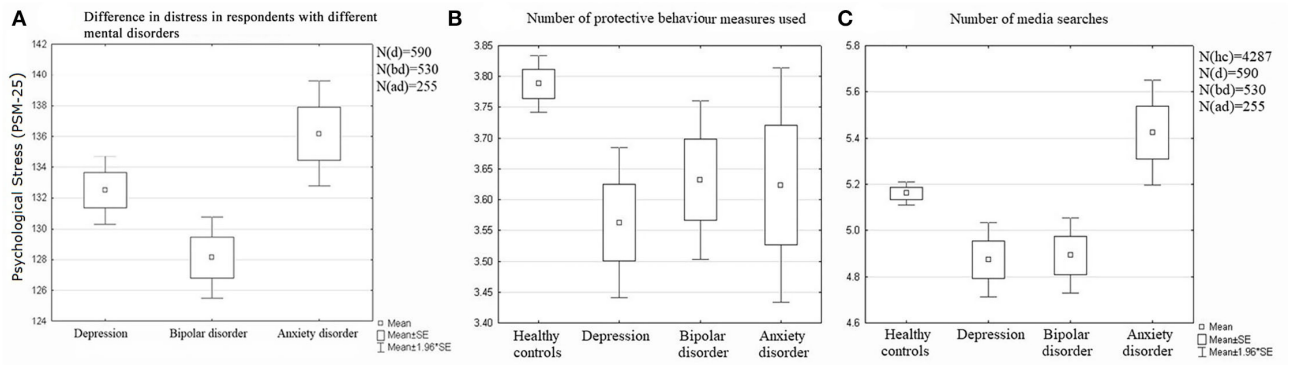

FIGURE 4 | Stress levels, anxiety, and behavioral reactions in respondents depending on the presence of an effective anxiety disorder. Significant differences **(A)** between "bd" and "ad" with $p = 0.002$. **(B)** between "hc" and "d" with $p = 0.0001$ and between "hc" and "bd" with $p = 0.043$. **(C)** between "hc" and "d" with $p = 0.017$, between "hc" and "bd" with $p = 0.012$, between "hc" and "ad" with $p = 0.001$, between "d" and "ad" with $p = 0.0002$, and between "bd" and "ad" with $p = 0.0001$.

likely to turn to the news (compared with depressive or bipolar disorders, Cohen's $d = 0.28$ and 0.28, respectively; with Cohen's $d = 0.16$). Respondents in the control group demonstrated an average frequency of searching for information about the pandemic.

DISCUSSION

Our research has demonstrated that the presence of affective or anxiety disorders is associated with a more severe response to the COVID-19 pandemic in different periods. Based on the socio-demographic characteristics, data on the behavioral reactions of the population and place of residence, as well as on the results of psychometric research on stress levels, we made four main observations.

First, stress levels among respondents self-reporting an affective or anxiety disorder were higher at all periods of the study than among those with no mental disorders. Second, the dynamics of stress levels in the research and control groups were heterogeneous and varied across the age subgroups. Third, the type of affective disorder influenced protective behavioral patterns and intensity of searching for information about the pandemic. Fourth, individuals with bipolar disorders had significantly lower stress levels than respondents with depressive or anxiety disorders.

As far as we can ascertain from available literature, this is the first study to provide evidence that multidirectional dynamics of stress during the COVID-19 pandemic are determined not only by the affective status of respondents but also by their age groups. In a sample of adolescents (16–18) and young adults (19–24) reporting a history of affective/anxiety disorders, average stress levels at the time of the cancellation of restrictive measures (period 3) were higher than at the time of the introduction of epidemiological restrictions (period 1). Among young and adult

respondents who denied having mental disorders, stress levels at the final stage of the restrictive measures (period 2) were lower than those initially identified.

The differences in stress levels and their dynamics in respondents who confirmed or denied the presence of affective/anxiety disorders (taking nosology into account) were linked to their behavioral patterns. An increase in time spent searching for information about the pandemic is known to be directly associated with increased anxiety (Nekliudov et al., 2020). At the same time, the usage of hand hygiene can be associated with the reduction of anxiety and stress associated with COVID-19 (Wang et al., 2020). In our sample, the history of anxiety disorders was associated with frequent searching for news about the pandemic. At the same time, the history of bipolar or depressive disorders was associated with less searching for news about COVID-19 in the media. Most notable is that respondents who reported a history of depressive disorders practiced the fewest protective behavioral strategies. Thus, the relatively favorable course of stress reactions in respondents with a history of bipolar disorders, on the contrary, was linked to a slight reduction in their protective behavioral patterns in relation to coronavirus.

The differences identified in behavior associated with the search for information about COVID-19 and protective measures in respondents from different nosological groups may be seen as a predisposition for a more effective response to stress among respondents self-reporting a bipolar disorder and respondents without mental disorders and less effective response among respondents self-reporting depressive or anxiety disorders. The wider spread of pandemic anxiety known from bipolar disorder literature is unlikely to be associated with the development of severe distress in our sample (Van Rheenen et al., 2020). It is possible that a stressful response to the COVID-19 pandemic may be related not to the intensity of anxiety stress but to a disturbance of an individual's adaptive-compensatory reactions (Sorokin et al., 2021). The different results regarding bipolar disorders in our study and the COLLATE project can also be explained by the use of different psychometric tools (Van Rheenen et al., 2020).

According to our data, this is one of the largest studies of the determinants of stress levels in the Russian population, which took into account the presence of mental disorders. The results of this study formed the basis for the development of algorithms for the diagnosis and therapy of mental disorders registered during the COVID-19 pandemic in Russia (Neznanov et al., 2021). The findings are important for public health to take preventive screening measures among the population to reduce the burden of the COVID-19 pandemic.

Limitations

The study had several limitations. First, it had a cross-sectional rather than longitudinal design, so the information on stress dynamics should be interpreted as a population change in response to the pandemic rather than as an increase or reduction in stress among the respondents over time. Second, data on the psychiatric condition of the subjects were based on their self-reports. According to the literature, this is strongly related to the results of medical history collection but does not enable us to speak about the verified diseases of respondents. Third, the need to comply with quarantine restrictions determined that the only possible format for conducting a study in the initial stages of the pandemic was in the form of an online questionnaire, which also had a number of features: the predominant participation of women in such studies and selection errors for persons who are not active users of the Internet. Fourth, the internal consistency of two subsets of questions about COVID-19 concerns and protective behavior was low. Meanwhile, according to Lee J. Cronbach, the reliability measure could reflect not only the consistency among items in a test but also the agreement among scorers of a performance test and the stability of performance of scores on multiple trials of the same procedure (Cronbach and Shavelson, 2004). In this sense, our results were taken into account as satisfactory and reflecting inter-subjects' diversity of COVID-19 reactions, as well as the differences revealed within periods of the pandemic and served an addition to main psychometric instrument (PSM-25) which demonstrated excellent reliability. Fifth, a number of data obtained in the course of the study, in particular about the specifics of somatic diseases of respondents, their education, family status, and the current level of the epidemic process in the region of their residence, were not taken into account in the analysis in this article, as they require further dynamic study taking into account the protracted nature of the pandemic.

CONCLUSION

Assessment of the population's psychological reactions to the COVID-19 pandemic is a complex task that requires not only consideration of socio-geographical (age, residence) and clinical characteristics (history of affective or anxiety disorders), but also an analysis of the time periods. Individuals self-reporting affective or anxiety disorders tend to respond more emotionally to the pandemic by forming a wide range of anxiety concerns and make less effective use of protective behavioral strategies. As a result, this may determine different trends in stress response: an increase in distress during a pandemic among those who report affective/anxiety disorders and a reduction among those who report no mental disorders. Given the dynamics observed, psychiatric services should be prepared for a greater burden of affective and anxiety disorders after the actual end of the pandemic, especially among young people. Future studies should pay more attention to the secondary mental health effects of the COVID-19 pandemic on the most vulnerable groups.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Independent Ethics Committee in V. M. Bekhterev

National Medical Research Center for Psychiatry and Neurology. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

Conceptualization of the study, goals, and aims: GM, NL, and EK. Investigation: EK, MS, OM, GR, and MK. Methodology and project administration: GM, NL, EK, and MS. Resources, writing, reviewing, and editing: NN, GM, and NL. Statistics: TM, DV, and MS. Writing (original draft): MS, EK, TM, and DV. All authors read and approved the final version of the manuscript.

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Relatives Experience More Psychological Distress Due to COVID-19 Pandemic-Related Visitation Restrictions Than In-Patients

Sabine Felser[1], Corinna Sewtz[1], Ursula Kriesen[1], Brigitte Kragl[1], Till Hamann[2], Felix Bock[3], Daniel Fabian Strüder[4], Clemens Schafmayer[5], Désirée-Louise Dräger[6] and Christian Junghanss[1]*

[1] Hematology, Oncology, Palliative Medicine, Department of Internal Medicine, Clinic III, University Hospital Rostock, Rostock, Germany, [2] Department of Neurology, University Hospital Rostock, Rostock, Germany, [3] Department of Radiation Oncology, University Hospital Rostock, Rostock, Germany, [4] Head and Neck Surgery "Otto Koerner", Department of Otorhinolaryngology, University Hospital Rostock, Rostock, Germany, [5] Department of General Surgery, University Hospital Rostock, Rostock, Germany, [6] Department of Urology, University Hospital Rostock, Rostock, Germany

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***Correspondence:**
Sabine Felser
sabine.felser@med.uni-rostock.de

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Background: The COVID-19 pandemic led to visiting restrictions (VRs) of patients in hospitals. Social contacts between patients' relatives play an important role in convalescence. Isolation may cause new psychological comorbidity. The present study investigated the psychological distress of VR in in-patients and their relatives.

Methods: From April 1, 2020 to May 20, 2020, 313 in-patients (≥14 years) of the University Medical Center Rostock were interviewed by questionnaires and 51 relatives by phone. Subjective psychological distress was assessed by a distress thermometer [0 (not at all)−100 (extreme)]. The study also investigated stressors due to VR, psychological distress in dependence on demographic or disease-related data, currently used communication channels and desired alternatives and support.

Results: Relatives were more psychologically distressed by VR than in-patients (59 ± 34 vs. 38 ± 30, $p = 0.002$). Loss of direct physical contact and facial expressions/gestures resulted in the most distress. Psychological distress due to VR was independent of demographics and indicates small positive correlations with the severity of physical restriction and the general psychological distress of in-patients. The most frequent ways of communication were *via* phone and social media. Frequently requested alternatives for patients were other interlocutors and free phone/tablet use, for relatives visiting rooms with partitions.

Conclusion: VRs are a stressor for patients and their relatives. The establishment of visiting rooms with partitions and the free use of phones/tablets could reduce the additional distress.

Keywords: communication, COVID-19, psychological distress, stress, visit restriction

INTRODUCTION

As social beings, humans depend on interactions with others in group bonds and relationships. Especially during states of exception as hospitalization social contacts and clear targeted communication are of great relevance; however, depending on the situation often limited.

Information exchange regarding disease and therapy between physician, patient, and relatives has been shown to influence patient satisfaction, treatment outcome, the healing process, and compliance (1–4). Contact with family members and close friends has positive effects on the health, everyday experience, and wellbeing of hospital in-patients (5). Relatives are not only supporters, but also affected persons and caregiver, which leads to a multiple burden (6). As a result of the knowledge of the importance and positive effects of the patient-relative relationship, hospitals have established visiting hours. Visitation restrictions (VR) have existed since the first hospitals were founded in the early 1800's. These were to reduce the spread of diseases and protect patients and their families from stress (7). In 2020, severe restrictions on visiting hours and bans on visiting occurred as a result of the COVID-19 pandemic. WHO and the European Center for Disease Prevention and Control published strict public health measures and guidelines to reduce the spread of the Coronavirus (8). The German Bundestag declared an "epidemic situation of national significance" in March 2020 (9) and enacted legal Corona protection measures based on the WHO guidelines. In the middle of March 2020, severe VRs in hospitals were determined (10). Based on the evidence that isolation/quarantine for the prevention of infectious diseases can cause mental health problems, such as depression, anxiety, and insomnia, there has been intense debate about VR (11, 12). The psychological impact of VR resulting from the COVID-19 pandemic on hospitalized patients and their families is largely unknown. Preliminary study results on investigations in vulnerable groups (nursing home residents, patients in palliative and intensive care units including neonatology), relatives of hospitalized children, and those who tested positive for COVID-19 and their relatives showed increased lonesomeness, depressive symptoms, agitation, aggression, decreased cognitive abilities, and general dissatisfaction for patients. For relatives, concerns, fears, and insecurities occurred (13–19). The present study aimed to investigate prospectively: (I) Whether hospitalized patients and their relatives experience different levels of psychological distress as a result of COVID-19-related VR? (II) Which items are particularly distressing? (III) Whether demographic and disease-related data provide information about psychological distress? and (IV) Which communication channels alternative to personal contact are currently used and which additions in terms of communication channels are desirable?

MATERIALS AND METHODS

Study Design

The prospective study was designed as a two-arm cross-sectional study. A survey of in-patients and their relatives (relative was defined as the most important contact person) was conducted by questionnaire in person (patients) or by telephone interview (relatives).

Patient-Sample, Inclusion Criteria

From April 1st until May 20th, 2020, a self-designed questionnaire survey of in-patients (age $\geq$14 years) was conducted at 17 somatic clinics of the University Medical Center Rostock (UMR) with various areas of care. Questionnaires were only handed out to patients once during their stay with a length of stay $\geq$ 2 days. Further inclusion criteria were: ability to consent, German-speaking, and physical and cognitive ability to complete a questionnaire. For underage patients (14–17 years), these criteria applied with regard to the legal guardians. The patient questionnaire was administered during the informed consent interview to minimize the number of contacts. Questionnaires were distributed and collected by medical staff, nursing staff, and study center staff.

Survey of Relatives

Patients were asked to provide a relative with contact details. If a relative was named, the study center staff contacted that person by telephone. After consent was given, the interview was conducted according to a standardized interview template. The interviews had an approximate duration of 10 min.

Participation in the survey was voluntary, and all patient/relative data were analyzed in a pseudonymous manner. The study was reviewed and approved by the ethics committee of the University of Rostock (A2020-68).

Visiting Restrictions/Exceptions

From March 13th, 2020, strict visiting restrictions to the in-patient areas of the Rostock University Medical Center applied. In individual cases, it was possible to deviate from this procedure. This resulted in inconsistent procedures for different areas. In wards with primarily cure-oriented intentions, patients with palliative diseases were under certain circumstances allowed to receive visitors. On the palliative ward, a maximum of two visitors per day were allowed to visit dying patients, only. Minor children were allowed to be accompanied by a healthy caregiver. The procedure in each individual case was determined by the facility manager of the respective department. The senior physicians in charge of the wards ensured implementation in consultation with the nursing teams. From May 20th, 2020, the strict visitation restrictions were abolished. Patients were then allowed to receive visits from caregivers again under strict conditions. This marked the end of this survey.

Questionnaire/Interview

Demographics

Assessed were age, gender, living situation, and the patient-relative relationship (e.g., spouses).

Disease-Related Data

The following questions were asked of the patient: reason (diagnosis) for hospitalization, duration of illness to date, whether first hospitalization/in-patient stay, number of days spent as an in-patient, and expected length of stay.

Patients and relatives were asked to indicate on a distress thermometer (0 not at all and 100 extremely) how much they are currently physically restricted and under psychological pressure.

Importance of Communication

All participants were asked by means of 5-level Likert scales how important communication is in everyday life and direct communication with relatives, friends, etc. to them.

Attitude Toward Visitation Restrictions and Their Effects

Patients and relatives recorded: preferred frequency of visits, missed communication elements (e.g., facial expressions/gestures), understanding of the visitation restrictions, the general and personal perception of the VR on 5-point Likert scales, and the severity of the communication restriction. The strength of subjective psychological distress as a result of the VR was recorded using a distress thermometer (0 not at all−100 extremely). To be able to assess which proportion of the patients/relatives were distressed and to what extent, the following grouping was performed: Value "0" on the visual analog scale (VAS) = "not stressed," VAS $> 0 \leq 30$ = "slightly stressed," VAS $> 30 \leq 70$ = "moderately stressed," VAS $> 70 \leq 90$ = "highly stressed," and VAS > 90 = "very highly stressed."

Current and Desired Communication Channels

Patients and relatives were asked to provide information about the technologies used and ways of communication under the given conditions. In addition to given answer options, the respondents had the opportunity to add further technologies. Furthermore, wishes and possibilities for improvement in communication were surveyed. In addition to the predefined answer options, there was also the possibility of free-text options.

Statistics

In addition to descriptive analysis, interval-scaled data were tested for normal distribution using the Shapiro–Wilk test. Depending on the scale level, correlations and mean differences were tested using the Pearson chi-square test, Spearman correlation, and Mann–Whitney U test, respectively. The level of significance was set at $p \leq 0.05$. Cramer's V (CV), effect size (ES), and correlation coefficient r, respectively, were used to interpret the strength of the relationships depending on the scale level. SPSS 22.0 (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis of the data.

RESULTS

A total of 313 patients participated in the survey. These provided eligible 85 relatives, 51 of whom agreed to the interviews.

Demographic Data

The questionnaires were completed by 120 (38%) women and 191 (61%) men (no sex $n = 2$). The mean age of the total cohort was 60 ± 16 years. Two hundred and seventeen (69%) of the patients lived with partner(s) and/or child(ren) at the time of hospitalization (**Table 2**).

Interviews were conducted with 51 relatives (40 (78%) women and 11 (22%) men) with an average age of 60 ± 13 years. Seventy-eight percent of the relatives were married to the patients (**Table 1**). The relatives-patients groups differed in gender distribution ($p < 0.001$, ES = 0.508).

Diseases-Related Data

Information on disease-related data can be found in **Table 2**. One-quarter of the patients each were assigned to neurological, surgical, or internal medicine institutions. Patients in the palliative care unit and patients hospitalized for COVID-19 infection were grouped under "palli/infect" (8%). "Other" facilities (18%) included radiation therapy, psychosomatics, dermatology, and pediatric and adolescent clinics. Approximately one-third of the patients surveyed were in-patients due to oncological disease.

Of all patients, physical impairment with a mean of 44 ± 29 was reported, and the current psychological distress with 38 ± 29.

The 51 family members reported a mean of 16 ± 23 for physical limitation and 54 ± 30 for current psychological distress. There were significant mean differences between patients and relatives for both factors ($p < 0.001$, ES = 0.466 and $p = 0.043$, ES = 0.200, respectively; **Table 1**).

Importance of Communication

Daily communication was considered important to very important by 80% of the patients and 100% of the relatives ($p < 0.001$, ES = 0.360). Direct communication with relatives, friends, etc. was considered (very) important by 76% of patients and 92% of relatives ($p < 0.001$, ES = 0.442; **Table 1**).

Attitude Toward Visitation Restrictions and Their Effects

Desired visit frequencies and missed communication elements are shown in **Table 1**. While 33% of the patients wanted daily visits, 65% of the relatives did ($p < 0.001$, ES = 0.345). Most frequently, both, patients and relatives, missed direct physical contact and nonverbal communication by means of facial expressions and gestures.

Comprehension of the VRs was 96% for each of the patients and relatives, respectively.

Figure 1 gives a graphical overview of the psychological distress and the perception of VR in patients compared to relatives. On average, patients reported psychological distress due to VR as 40 ± 32, whereas relatives reported it as 59 ± 34. The proportion of severely and very severely distressed was higher among relatives ($p = 0.002$). The sex-stratified analysis shows a higher psychological distress of the relatives in both genders compared to the patients (male: patients vs. relatives 40 ± 32 vs. 66 ±29, $p = 0.012$, ES = 0.179; female: patients vs. relatives 41 ± 33 vs. 56 ± 35, $p = 0.014$, ES = 0.196).

As shown in **Table 2**, there are no associations between the severity of psychological distress due to VR and demographic characteristics. In relation to the disease-related data, there were small or medium associations between psychological distress due

TABLE 1 | Patient- and relatives-characteristics, study results.

	Variable	*n* = x (%) or mean ± SD (range)		*p*
		Patients	Relatives	
Patient- and relatives-characteristics	Total cohort	51	51	
	Sex			**<0.001***
	Female	14 (28)	40 (78)	
	Male	37 (72)	11 (22)	
	Age [years]	61±17 (15–89)	60 ±13 (33–82)	0.377
	Patient and relative living together			
	Yes	45 (88)		
	Patient and relative relationship			
	Married, cohabiting partner	40 (78)		
	Parent, child, other, N/A	11 (22)		
	First hospitalization			
	Yes	8 (16)		
	Days in hospital when interviewed			
	≤ 5	26 (51)		
	>5	23 (45)		
	N/A	2 (4)		
	Physical restriction (0 = none to 100 = extreme)	43 ± 29 (0–100)	16 ± 23 (0–80)	**<0.001***
	General psychological distress (0 = none to 100 = extreme)	41 ± 28 (0–100)	54 ±30 (0–100)	**0.043***
Study results	Psychological distress due to visitation restrictions (0 – none, 100 – extreme)	38 ±30 (0–100)	59 ± 34 (0–100)	**0.002***
	Importance of communication in everyday life			**<0.001***
	Very unimportant	0 (0)	0 (0)	
	Unimportant	2 (4)	0 (0)	
	Rather unimportant	8 (16)	0 (0)	
	Important	21 (41)	15 (29)	
	Very important	20 (39)	36 (71)	
	Importance of direct communication in everyday life			**<0.001***
	Very unimportant	1 (2)	1 (2)	
	Unimportant	3 (6)	0 (0)	
	Rather unimportant	7 (14)	3 (6)	
	Important	21 (41)	5 (10)	
	Very important	18 (35)	42 (82)	
	Desired visit frequency			**<0.001***
	<1 times per week	6 (12)	2 (4)	
	1–2 times per week	10 (20)	2 (4)	
	Every 2–3 days	16 (31)	10 (20)	
	Daily	16 (31)	33 (65)	
	Several times a day	1 (2)	0 (0)	
	Missing elements of communication			
	Direct physical contact	29 (57)	37 (73)	**0.049***
	Facial expression and gestures	23 (45)	37 (73)	**0.002***
	Voice	22 (43)	16 (31)	**0.280**
	Nothing	12 (24)	4 (8)	**0.036***
	Current contact via			
	Visit (special regulation)	8 (16)		
	Phone	45 (88)		
	Text-only messages	9 (18)		
	Video calls	11 (22)		
	Social media	32 (63)		

(Continued)

TABLE 1 | Continued

Variable	*n* = x (%) or mean ± SD (range)		*p*
	Patients	**Relatives**	
Desired support			
On mobile phone use	6 (12)	1 (2)	
For video calls	3 (6)	3 (6)	
Rooms/times for telephone calls	9 (18)	8 (16)	
Rooms/times for video calls	6 (12)	6 (12)	
Free bed phone	12 (24)	2 (4)	
Free use of tablet/pc	8 (16)	6 (12)	
Other interlocutors	19 (37)	N/A	
Others	3 (6)	20 (40)[1]	

SD, standard deviation; p, significance value; N/A, not available.
Bold/ statistically significant values ($p \leq 0.05$).*
[1]*Visit in a visiting room (with partitions) was indicated 16 times, 1 time each help with the use of the tablet, use of a ward tablet, conversation with the physician, and the possibility to meet/see outside or from the balcony.*

to VR and the degree of physical impairment ($p < 0.001$) or general psychological distress ($p < 0.001$). These associations did not become apparent to relatives. The variance resolution between the parameters "general psychological distress" and "psychological distress due to VR" was 21% (patients) and 8% (relatives).

Current and Desired Communication Channels

Of the 51 relatives, eight (16 %) had special visitation rights during the study period. The most frequently used means of communication were telephony and social media, which were used by 45 (88 %) and 32 (63 %) patient/relative pairs, respectively. Videotelephony was used to communicate by 11 (22%) patients/relatives pairs (**Table 1**).

Of all in-patients, 19 (37%) wished for other interlocutors (e.g., other in-patients and caregivers) as alternative visitors. Twelve (24%) wanted free bed phones and eight (16%) free use of tablet/PC. Relatives primarily used free text when indicating desired alternatives. Analysis of responses revealed that 16 (32%) desired patient visitations and suggested visitation rooms with partitions (e.g., glass partitions) as an option.

DISCUSSION

The study revealed that VR in hospitals to control the COVID-19 pandemic is an additional stressor for patients and their relatives. In the investigated cohort of in-patients and their relatives regardless of gender, relatives were more psychologically stressed by VR than patients. Direct physical contact and facial expressions/gestures were missed most by patients and relatives. Visitor rooms with partitions are a potential alternative to reduce psychological distress due to VR, especially for relatives. In the following, the causes and possible consequences of psychological distress due to VR and recommendations for action are discussed.

Attitude Toward Visitation Restrictions and Their Effects

Almost all patients and relatives had an understanding of the VR and generally considered them to be (very) good. This is consequently considering the aim and reason for the VR was to protect these groups of people from infection, among other things. Nevertheless, the consequences of the VR had an impact on the mental conditions of patients and relatives. The collected data show that patients and relatives felt the psychological distress due to VR comparable to the general psychological distress they were exposed to in the actual situation. Both parameters, "general psychological distress" and "psychological distress due to VR" correlate only slightly with each other. The low variance resolution indicates that the VR is an additional stressor that is largely independent of other parameters. Consequently, VR places additional stress on the mental status of patients and relatives, as described by Meesters, among others, in mothers of infants (14).

Since the study presented here is cross-sectional, no concrete statements can be made about the medium- and long-term consequences among the respondents. In addition, the psychological distress due to VR was not assessed qualitatively. But based on the fact that elective procedures were severely restricted during the study period as part of the provision of ICU capacity in the context of the COVID-19 pandemic, it can be assumed that patients were confronted with more serious medical conditions (more than one-third were hospitalized due to cancer). The impact of VR during the COVID-19 pandemic on the wellbeing of hospitalized patients and their visitors, particularly in vulnerable populations, was examined by Inees et al. (20). Overall, the VRs were associated with negative emotions and detrimental effects on most in-patients and their families, especially in the context of end-of-life care (21). In end-of-life care, limiting visits or prohibiting visits resulted in inadequate emotional and spiritual care/support for patients and anxiety and despair among family members (22, 23). Patients were afraid of dying alone (24). In patients in the postoperative period, VR affected

TABLE 2 | Patient characteristics and association with psychological distress as a result of visit restriction[a].

Variable	*n* = x (%) or mean ± SD (range)	*p*	CV or r
Total cohort	313		
Sex		0.193	CV = 0.141
Female	120 (38)		
Male	191 (61)		
Diverse, N/A	2 (1)		
Age [years]	60 ± 16 (15 – 89)	0.173	r = −0.078
Living situation		0.451	CV = 0.114
Alone	74 (24)		
With partner or child(ren)	217 (69)		
Nursing or retirement home, N/A	22 (7)		
Assignment of facilities		0.351	CV = 0.120
Neurology	71 (23)		
Surgery[1]	78 (25)		
Internal medicine[2]	81 (26)		
Palliative care / Infectology	25 (8)		
Others[3]	58 (18)		
Oncological disease		0.757	CV = 0.084
Yes	110 (35)		
No	162 (52)		
N/A	41 (13)		
Duration of illness [month]		0.637	CV = 0.102
<3	143 (46)		
3–12	78 (25)		
>12	76 (24)		
N/A	16 (5)		
First hospitalization			
Yes	71 (23)		
No	239 (76)	0.991	CV =0.031
N/A	3 (1)		
Days in hospital when interviewed		0.307	CV = 0.127
≤ 5	153 (49)		
> 5	150 (48)		
N/A	10 (3)		
Expected additional days in hospital (pts perspective)		0.363	CV = 0.119
≤7	165 (53)		
>7 or unknown	142 (45)		
Physical restriction (0 = none to 100 = extreme)	44 ± 29 (0–100)	**<0.001***	r = 0.233
General psychological distress (0 = none to 100 = extreme)	38 ± 29 (0–100)	**<0.001***	r = 0.458

[a]*On a scale from 0 (none) to 100 (extreme), the psychological distress resulting from the visit restriction is on average 40 ± 32.*

SD, standard deviation; p, significance value; CV, Cramer's V; r, correlation coefficient; N/A, not available.

[1]*General-, Visceral-, Vascular- and Transplant-Surgery, Otorhinolaryngology, Head and Neck Surgery, Urology, Neurosurgery, Trauma-, Hand- and Reconstructive-Surgery.*

[2]*Hematology, Oncology, Pneumology, Gastroenterology, Cardiology, Nephrology, Endocrinology.*

[3]*Radiation therapy, Psychosomatics, Dermatology, Children's Hospital.*

*Bold/*statistically significant values (p ≤ 0.05).*

satisfaction with the hospital experience, and patients without visitors reported social isolation due to a lack of psychosocial support (25).

We suspect that the greater psychological distress on relatives results in part from the fact that they could not form their own impression of the patient's condition. It is known that inadequate information is a stressor for negative psychological effects such as posttraumatic stress symptoms, confusion, and anger (26). Furthermore, relatives feel helpless and guilty, because they cannot support their beloved ones (24). In addition, due to the extensive Corona protection measures, the relatives were exposed to additional restrictions (e.g., quarantine, contact blocks, and distance regulations) in everyday life, which have direct negative psychological consequences (11, 12, 26, 27). Furthermore, the

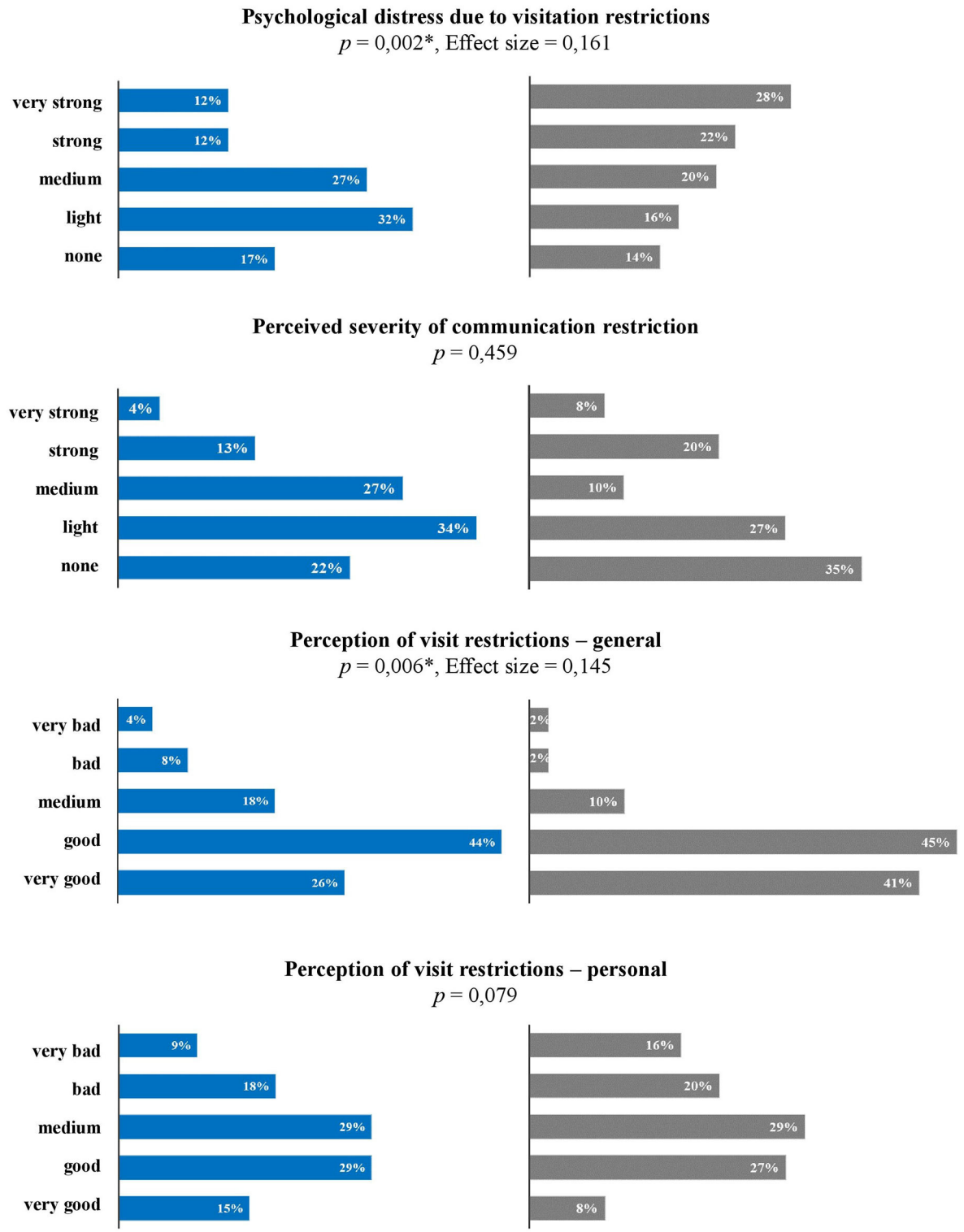

FIGURE 1 | Psychological distress and perception of visit restrictions by patients and relatives. *Statistically significant mean differences are indicated with $*p < 0.05$.

data suggest that patients, although more physically limited than their relatives, felt cared for well in the hospital. Different data show that an in-patient environment with appropriate medical presence and participatory decision-making processes can contribute to anxiety reduction and higher satisfaction (2, 3, 28).

Even if VR contribute to a reduction of surgical site infections in postoperative patients (29), this does not outweigh the sum of the mentioned serious consequences for patients and their relative. Urgent action is needed to reduce or prevent the negative psychological effects and psychiatric symptoms resulting from VR.

Impact of Demographic and Disease-Related Data

No predictors of the severity of psychological distress were identified within the demographic parameters analyzed. Also, length of hospitalization, single or repeated hospitalization, or cause of hospitalization (e.g., neurologic, surgical, and palliative) did not provide information on the severity of psychological distress due to VR. Only the severity of physical limitations and/or the general psychological distress the patients were under, showed a small positive correlation with psychological distress due to VR. For this reason, all patients should be given the necessary attention and offered help in dealing with VR.

Used Communication Channels, Missed Items, and Desired Support

Relatives, independent of the gender, claimed to have more distress than in-patient due to VR. This can partly be explained by the higher importance of communication and interpersonal relationships among the relatives. Thus, the desire to visit the in-patients was more pronounced among the relatives than the desire to get visited among the patients. During the study period, patients and relatives communicated most frequently *via* phone and social media. Consequently, direct physical contact and facial expressions/gestures were missed the most. While patients mentioned other interlocutors (e.g., other patients and caregivers) as a possible alternative, the establishment of visiting rooms with protective measures (e.g., partition walls/glasses) was most frequently desired by relatives. Video calls were used by only a few and were also mentioned as an alternative by only a few. We suspect that lack of experience, technical difficulty, and lack of access to a device are barriers. However, unsuitability for patients, e.g., due to sedation, could also be a reason (30). According to the answers, especially patients could benefit from free phone, tablet, and/or PC use. In addition, the patients' and relatives' requests for rooms/times for phone and video calls indicate a desire for more privacy.

To protect mental health, the establishment of visiting rooms with partitions and free phone/chat rooms as alternative communication channels for patients and relatives in clinics should be examined and implemented. These measures could reduce psychological distress, especially for the relatives of in-patients, due to visual contact, an improved flow of information, and more privacy. Special attention should be paid to bed-ridden patients with limited communication skills (e.g., sedation, mechanical ventilation, and tracheostomy) and their relatives (31).

Since the Corona case numbers in the federal state, where the investigation was performed (Mecklenburg-Vorpommern) during the study period were rather low compared to other federal states (from mid-March to the end of May 2020, 15 Corona patients were treated at UMR, three of them intensively; all patients were discharged), it can be assumed that the psychological distress of patients and their relatives was even higher in risk areas. Further research is needed to take targeted measures to benefit the mental health of patients and relatives during pandemic periods.

Limitations and Strengths

The survey was successfully conducted prospectively on a large cohort, despite the difficult baseline conditions, even for the study investigators. The service volumes and elective procedures were reduced at some hospitals during the survey period. The high number of oncological patients may be explained first by the fact that the study was led by the Department of Hematology, Oncology and Palliative Medicine (bias). Second, the treatments of these patients cannot be electively discharged. At the same time, this represents a strength, since specifically oncological patients were affected by VR.

Due to the involvement of a large number of clinics in the survey and the applicable contact restrictions, it was not possible to record exactly how many patients refused to participate, despite the coding of the questionnaires. A statement on the response rate is therefore not possible. As a result, a bias of the answers in the direction of socially desirable answers cannot be ruled out.

To keep the questionnaire and the interview duration short despite the complexity of the survey (aim: to increase the number of participants), only a visual analog scale and no standard psychological questionnaires were used to record psychological stress. As a consequence, no statements can be made about qualitative psychological stress. Whether and to what extent the visit restrictions had serious health consequences and which coping strategies were used should be investigated in further studies. Whether and to what extent the patients/relatives used psychotherapeutic services was not recorded and represents a further limitation of this study.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the University of Rostock. The patients consented to participate in the study by filling out the questionnaire. The relatives verbally agreed to be interviewed before the interview.

AUTHOR CONTRIBUTIONS

SF and CJ: conception of the work, data analysis and interpretation, and drafting the article. UK: conception of the work, data collection, and drafting the article. CSe: conception of the work and data collection. BK: data collection and head of study office. TH, FB, DS, CSc, and D-LD: data collection and critical revision of the article. All authors contributed to the article and approved the submitted version.

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BRIEF RESEARCH REPORT
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Sleep Quality Impairment Is Associated With Pandemic Attitudes During the Coronavirus Disease 2019 (COVID-19) Circuit Breaker Lockdown in England: A Cross-Sectional Study

Jonathan Kantor[1,2,3,4]*, *Bella Nichole Kantor*[5], *Rebecca G. Fortgang*[5] and *Edward F. Pace-Schott*[6]

[1] Center for Global Health, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, United States, [2] Center for Clinical Epidemiology and Biostatistics, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, United States, [3] Department of Dermatology, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, United States, [4] Florida Center for Dermatology, St Augustine, FL, United States, [5] Department of Psychology, Harvard University, Cambridge, MA, United States, [6] Department of Psychiatry, Harvard Medical School, Massachusetts General Hospital, Boston, MA, United States

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Pedro Morgado,
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Haitham Jahrami,
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***Correspondence:**
Jonathan Kantor
jonkantor@gmail.com

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Objectives: The COVID-19 pandemic has been associated with sleep quality impairment and psychological distress, and the general public has responded to the pandemic and quarantine requirements in a variety of ways. We aimed to investigate whether sleep quality is low during a short-term (circuit break) quarantine restriction, and whether sleep quality is associated with respondents' overall attitudes to the pandemic using a validated scale.

Design and Setting: Online cross-sectional study in England in November 2020.

Participants: The study included 502 respondents over the age of 18.

Measurements: Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), and pandemic attitudes were assessed using the Oxford Pandemic Attitudes Scale–COVID-19 (OPAS-C), a validated 20-item, 7-domain scale that assesses pandemic-related stress, fear, loneliness, sense of community, sense of exaggerated concern, non-pharmaceutical interventions, and vaccine hesitancy. Unadjusted and multivariable logistic regression odds ratios of association were assessed between the dependent variable of poor sleep quality (PSQI>5) and risk factors, including OPAS-C score, age, sex, educational status, and income.

Results: The mean (SD) PSQI score was 7.62 (3.49). Overall, 68.9% of respondents met criteria for poor sleep quality using the PSQI cutoff of >5. The mean (SD) OPAS-C score was 60.3 (9.1). There was a significantly increased odds of poor sleep quality in the highest vs. lowest OPAS-C quartiles (OR 4.94, 95% CI [2.67, 9.13], $p < 0.0001$). Age, sex, income, political leaning, employment status, and education attainment were not associated with poor sleep quality.

Conclusions: More than two-thirds of respondents met criteria for poor sleep quality. The odds of poor sleep quality increased in a dose-response relationship with pandemic attitudes (such as higher levels of pandemic-related stress, fear, or loneliness). The association between poor sleep quality and pandemic attitudes suggests opportunities for public health and sleep medicine interventions, and highlights the need for further research.

Keywords: COVID-19, sleep, OPAS-C, pandemic (COVID-19), mental health

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has been associated with significant effects on sleep quality, and numerous studies have evaluated the intersection between the pandemic, quarantine, physical activity reduction, and mental health outcomes (1–8). Several mechanisms have been proposed for the observed impaired sleep quality associated with the COVID-19 pandemic, including increased stressors and anxiety, decreased entrainment, and decreased physical activity, and several studies have now reviewed these associations (9–12).

The psychological toll of the COVID-19 pandemic is significant, and the effect of the pandemic – modulated both through its direct effects on stress and indirect effects on schedule – has been explored for both healthcare workers and the general population (6, 13, 14). Indeed, for those with baseline psychiatric comorbidities, such problems may be even more pronounced (6). Studies have explored the sleep quality of the general public, healthcare workers, those with baseline sleep disorders, and those with baseline psychiatric comorbidities during the various phases of the COVID-19 pandemic (15–25). Several studies have also reported longitudinal data, suggested a worsening of sleep quality during the pandemic (26, 27), while others have used historical controls to assess pandemic-related sleep quality changes (28).

In November 2020, in response to an increased COVID-19 caseload and concerns regarding hospital capacity, Prime Minister Boris Johnson announced a "circuit break" quarantine would go into effect across England (29). The finite nature of this circuit break, coupled with the public's recent lived experience of 8 months of preceding restrictions, presented an opportunity to investigate the effect of limited-duration lockdowns on sleep quality. Given that sleep quality impairment has been tied to loneliness and other *chronic* stressors, whether a short-term lockdown, where the emotional stressors and overall experience is anticipated to be temporary, affects sleep quality is unknown. Since individuals may be less bothered both practically and emotionally by a temporary and finite lockdown than by restrictions that have no predetermined endpoint, and because these short-term restrictions may become a more common approach as the pandemic continues to evolve, this is an area where further research is needed.

We therefore sought to explore both whether sleep quality is low during a circuit break quarantine of finite duration and whether sleep quality is associated with respondents' overall attitudes to the pandemic using validated scales. A better understanding of these questions may have implications for both public policy and public health interventions.

METHODS

Participants and Procedure

Participants consisted of an internet-based sample of adults residing in the UK. Inclusion criteria were age 18 years or older and current residence in the UK at the time of the study. This study was approved by the Ascension Health Institutional Review Board.

This was a cross-sectional, internet-based study conducted in November 2020. An online survey was developed using the Qualtrics platform (Qualtrics Corp, Provo, Utah) that included validated scales for sleep quality and COVID-19 attitudes, as well as other demographic questions. The survey was distributed using Prolific Academic (Oxford, United Kingdom), an established platform for academic survey research, to a database of survey respondents in the UK, and distributed using a survey panel approach (30). Respondents were rewarded with a small payment (<£1). Participants provided consent and were permitted to terminate the survey at any time. All surveys were anonymous and confidential, with linkages between data performed using a 24-character alphanumeric code. The investigators had no access to identifying information at any time.

Sleep Quality

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a validated 9-question scale that has been used extensively to assess sleep quality in the context of the COVID-19 pandemic (4, 22, 31–34). Scores range from 0 (no sleep quality impairment) to 21 (extreme sleep quality impairment), and a cutoff of >5 has been used since the scale's original development to define impaired sleep quality (31). Previous studies have suggested that the PSQI has a sensitivity of 89.6% and specificity of 86.5% using this cutoff for identifying impaired sleep quality (35).

COVID-19 Attitudes

Attitudes to the COVID-19 pandemic were assessed using the Oxford Pandemic Attitudes Scale – COVID-19 (OPAS-C), a validated 20-item, 7-domain scale that assesses a range of attitudes to COVID-19 (**Table 1**) (36). Domains include stress, fear, loneliness, sense of community, sense of exaggerated concern, non-pharmaceutical interventions, and

TABLE 1 | The OPAS-C.

Number	Item	Domain
1	I am having trouble relaxing because of the virus	Stress
2	I cannot control worrying about the virus.	Stress
3	I think about the virus more than I would like.	Stress
4	Thoughts of the virus pop into my head even when I do not want them to.	Stress
5	I have trouble concentrating because I think about the virus so much.	Stress
6	I check the news or online sources for updates on the virus more than I would like.	Stress
7	I am having trouble sleeping because I am thinking about the virus.	Stress
8	I am afraid of getting the virus myself.	Fear
9	I am afraid of a family member getting the virus.	Fear
10	I feel isolated from other people in the pandemic.	Loneliness
11	With the pandemic, I feel like I cannot connect to other people.	Loneliness
12	I feel close to other people.	Community
13	I feel part of a larger community of people.	Community
14	I think the pandemic is a hoax.	Exaggerated
15	I think people are getting too excited about the pandemic.	Exaggerated
16	I am wearing a face covering or mask when I am around people.	NPIs
17	I am social distancing.	NPIs
18	I am washing my hands frequently.	NPIs
19	I would take the coronavirus vaccine when it becomes available.	Vaccine
20	I would have my children or parents take the vaccine when it comes out.	Vaccine

All answer choices are rated using a 5-point Likert scale (strongly disagree though strongly agree). For questions 1–13, strongly agree is scored as 5, while for questions 14–20 strongly agree is scored as a 1 (reverse scoring). Higher values reflect a greater burden, and the total score therefore ranges from 20 to 100.

vaccine hesitancy. Scores range from 20 to 100, with higher values representing a greater burden and less adjustment to the pandemic.

Demographic Information

Age, sex, employment status, household income, and political affiliation were included based on self-report. Binary choices were provided for sex selection. Employment status was divided into full-time, part-time, or no employment. Income was included as a continuous variable based on total yearly household income. Political leaning was established through a Likert-style question regarding self-identification as conservative or liberal.

Statistics

Sample size calculations were conducted for the primary endpoint of detecting a 5% difference in the OPAS-C by sleep quality status, dichotomizing between those with and without poor sleep quality using a PSQI cutoff of 5. 442 subjects (221 per group) would be adequate to detect a 5% change in OPAS-C with 80% power and with an alpha of 0.05, assuming a baseline OPAS-C mean of 56.1 with a standard deviation of 10.5 and assuming equal group sizes (37).

Demographic data are presented as mean values with 95% confidence intervals (CI). *T*-tests and chi-squared tests were used as appropriate for continuous and categorical variables, respectively. Unadjusted and multivariable logistic regression odds ratios of association were assessed between the dependent variable of poor sleep quality (defined as PSQI>5) and putative risk factors, including OPAS-C score, age, sex, educational status, and income. Respondents were also divided into quartiles based on OPAS-C score, and both mean PSQI values and the proportion meeting poor sleep quality criteria were presented by quartiles; the significance of interquartile differences was assessed using analysis of variance.

All statistical analyses were performed using Stata 13 for Mac (Stata Corporation, College Station, Texas).

RESULTS

Characteristics

Of the 513 subjects who were recruited, 502 completed the survey, yielding a completion rate of 97.9%. All completed surveys were received during the lockdown. The mean (SD) age of respondents was 34.2 (12.8), and 341 (69.5%) of the respondents were female; respondent characteristics are outlined in **Table 2**. Demographic data did not differ significantly between those that did and did not meet criteria for poor sleep quality.

Sleep Quality

The mean (SD) PSQI score was 7.62 (3.49) with a range of 1-20. Overall, 68.9% ($n = 346$) of respondents met criteria for poor sleep quality using the established PSQI cutoff of >5.

Pandemic Attitudes

The mean (SD) OPAS-C score was 60.3 (9.1), with a range of 38 to 80; for reference, the mean (SD) OPAS-C score in the UK assessed in July 2020 during the original OPAS-C validation study was 56.1 (10.5) (36). The mean (SD) OPAS-C subscale scores were as follows: stress 19.9 (6.9); fear 7.8 (1.9); loneliness 10.5 (3.2); sense of community 5.3 (2.0); concern that the pandemic is exaggerated 8.3 (1.8); attitude to non-pharmaceutical interventions (NPIs) 4.4 (1.9); and attitude to vaccination 4.2 (2.5). The OPAS-C subscales have not been separately validated, and no cutoffs have been established for a negative or dysfunctional attitude to the COVID-19 pandemic.

Association Between Sleep Quality and Pandemic Attitudes

Stratifying overall PSQI scores and the proportion meeting poor sleep quality criteria by OPAS-C quartiles demonstrated a progressive worsening of sleep quality as pandemic attitudes worsened, as seen in **Table 3** ($p < 0.0001$). Unadjusted logistic regression analysis demonstrated that OPAS-C scores were significantly associated with poor sleep quality (OR 1.07, 95% CI [1.05, 1.10], $p < 0.0001$ for each unit increase in OPAS-C score).

TABLE 2 | Demographic and characteristics of respondents, overall and by sleep quality status.

Characteristic	No. (%)		
		Poor Sleep Quality*	
	Total	Yes	No
Overall	502 (100)	346 (68.9)	156 (31.1)
Sex			
Men	150 (30.6)	97 (46.1)	53 (54.3)
Women	341 (69.5)	241 (53.9)	100 (45.7)
Age, y			
18–30	244 (48.6)	171 (70.1)	73 (29.9)
31–40	121 (24.1)	80 (66.1)	41 (33.9)
41–50	69 (13.8)	52 (75.4)	17 (24.6)
51–60	44 (8.8)	28 (63.6)	16 (36.40
>60	24 (4.8)	15 (62.5)	9 (37.5)
Education level			
< High school	1 (0.2)	0 (0)	1 (100)
High school	131 (26.2)	96 (73.3)	35 (26.7)
Some college	101 (20.2)	71 (70.3)	30 (29.7)
Bachelor's	184 (36.7)	119 (64.7)	65 (35.3)
Graduate	84 (16.8)	59 (70.2)	25 (29.8)
Employment status			
Full time	201 (46.6)	141 (70.2)	60 (29.9)
Part time	102 (23.7)	70 (68.6)	32 (31.4)
Not employed	128 (29.7)	87 (68.0)	41 (32.0)
Income			
<£10,000	57 (11.4)	41 (71.9)	16 (28.1)
£10,000–£30,000	171 (34.1)	119 (69.6)	52 (30.4)
£30,001–£50,000	147 (29.3)	105 (71.4)	42 (28.6)
£50,001–£80,000	80 (15.9)	50 (62.5)	30 (37.5)
£80,001–£100,000	20 (4.0)	12 (60.0)	8 (40.0)
£>100,000	27 (5.4)	19 (70.4)	8 (29.6)
Political leaning			
Conservative	81 (16.1)	55 (67.9)	26 (32.1)
Liberal	261 (52.0)	183 (70.1)	78 (29.9)
Ambivalent	160 (31.9)	108 (67.5)	52 (32.5)

*Defined as PSQI>5.

TABLE 3 | Sleep quality stratified by OPAS-C quartile.

OPAS-C Quartile	Mean (95% confidence intervals)	
	PSQI raw score	Proportion of respondents meeting cutoff criteria for poor sleep quality*
Quartile 1	6.45 (5.93, 6.96)	0.54 (0.46, 0.63)
Quartile 2	7.08 (6.43, 7.73)	0.59 (0.50, 0.68)
Quartile 3	7.80 (7.28, 8.33)	0.78 (0.71, 0.86)
Quartile 4	9.35 (8.66, 10.04)	0.85 (0.79, 0.92)

*Defined as PSQI>5.

TABLE 4 | Association of individual OPAS-C subscale scores with the likelihood of being a poor sleeper (defined as PSQI>5).

OPAS-C Subscale	Odds of being a poor sleeper (per 1-point increase in each subscale)	*P*-value
Stress	1.11 (1.07, 1.14)	<0.0001
Fear	1.16 (1.05, 1.28)	0.003
Loneliness	1.16 (1.09, 1.23)	<0.0001
Community	0.82 (0.75, 0.91)	<0.0001
Exaggerated	1.01 (0.91, 1.13)	0.787
NPIs	0.86 (0.78, 0.95)	0.002
Vaccine	1.02 (0.95, 1.11)	0.560

There was a significantly increased odds of poor sleep quality in the highest versus lowest OPAS-C quartiles (OR 4.94, 95% CI [2.67, 9.13], $p < 0.0001$), suggesting that poor sleep quality is associated with less positive or healthy pandemic attitudes. These associations persisted in fully adjusted models (OR 1.07, 95% CI [1.05, 1.10], $p < 0.0001$ for each unit increase in OPAS-C score and OR 4.88, 95% CI [2.51, 9.48], $p < 0.0001$ for the highest versus lowest OPAS-C quartiles). In a secondary analysis, association of poor sleep quality with the individual OPAS-C subscales varied by subscale (**Table 4**).

Age (OR 0.99, 95% CI [0.98, 1.01], $p = 0.421$), sex (OR 0.76, 95% CI [0.51, 1.14], $p = 0.186$ for male sex), income (OR 0.93, 95% CI [0.80, 1.08], $p = 0.352$), political leaning (OR 0.98, 95% CI [0.55, 1.74], $p = 0.950$), employment status (OR 0.90, 95% CI [0.56, 1.46], $p = 0.676$ for unemployed vs. full time), and educational attainment (OR 1.08, 95% CI [0.65, 1.80], $p = 0.765$ for those with a graduate degree vs. all others) were not significantly associated with sleep quality on logistic regression analyses with categorical variables. A fully adjusted logistic regression model similarly did not demonstrate any significant associations.

DISCUSSION

We found that the November 2020 circuit break was associated with impaired sleep quality in the UK, and that the degree of sleep quality impairment was associated with pandemic attitudes as assessed with the OPAS-C. Every 1-point increase in the OPAS-C score – with higher scores representing worsening attitudes to the pandemic –was associated with a 7.4% increase in odds of being a poor sleeper. Thus for each 1-SD increase in OPAS-C score, the odds of being a poor sleeper increased by 66.7%. An important strength of this study was our use of validated scales for assessing both sleep quality and pandemic attitudes.

Both the raw PSQI scores and the proportion of respondents meeting criteria for poor sleepers appeared high when compared with historical controls, though without a longitudinal design it is impossible to determine this definitively. The mean PSQI score in an Italian general population prior to the COVID-19 pandemic was 4.0 and approximately 35% of the population met criteria for poor sleep, though one study of young adults in Spain suggested

a pre-pandemic mean PSQI of 5.8 with 47% meeting criteria for poor sleep pre-pandemic (38–40).

We did not detect an association between poor sleep quality and several demographic variables, such as age, sex, employment status, political leaning, and income. While the study may have been underpowered to detect these associations, this also bolsters the effect size of our finding that pandemic attitudes are associated with poor sleep quality. A prior study evaluated the relationship between sleep quality and pandemic attitudes, and also found an association between impaired sleep quality and dysfunctional pandemic attitudes, though it did not use a validated scale for pandemic attitudes and focused exclusively on worry, stress, and adverse life impact related to COVID-19 (41).

Several studies have demonstrated that with a shift to lockdown, where the majority of the population is restricted from working and leaving their homes on a regular basis, the absence of an early morning awakening drive may lead to both a reduction in social jetlag, as weekdays and weekends functionally merge, and a more delayed chronotype (42). Thus, the decreased entrainment seen as part of the loss of zeitgebers may be responsible for some of the sleep onset delay seen in the pandemic context (43, 44). In addition to delayed onset, a modest increase in sleep quantity has been observed in several studies (45).

Several other mechanisms may be responsible for the effect of the COVID-19 pandemic on sleep, and these were not directly evaluated in this study; some have suggested that decreased physical activity brought on by quarantine leads to sleep impairment and ensuing poor mental health outcomes, and decreased physical activity itself may be associated directly with the poor mental health outcomes as well (46, 47). Sleep impairment may also be associated with an increase in electronic device usage and other sedentary behavior, further exacerbating this feedback loop (39). Moreover, decreased daylight exposure due to activity restrictions may lead to a further reduction in entrainment induced by the primary zeitgeber (48, 49). Finally, dietary changes are another possible contributor to pandemic-related sleep impairment, as this may also affect both sleep itself as well as the likelihood of engaging further in physical activity (5).

Given the association between sleep disorders and mental health outcomes, and the potential effects of both pandemic-related stress and reduced entrainment on sleep, the COVID-19 pandemic may represent a perfect storm, as unhealthy behaviors such as decreased activity couple with decreased daylight exposure, reduced work-related zeitgebers, and general stress induced by both schedule change and pandemic-related fears to produce a sleep-unfriendly environment. Thus the combination of stress and reduced entrainment may be partly responsible for a decrease in sleep quality during the pandemic (50). Given the social responsibility for sleep researchers to educate the general public and healthcare providers regarding sleep in the pandemic context, further highlighting the importance of research investigating the intersection between COVID-19 and sleep quality is of significant value (48).

Loneliness and perceived social support may represent important considerations when attempting to understand the intersection between sleep and the COVID-19 pandemic. Loneliness may be responsible for part of the sleep quality impairment seen in older adults, and this may combine with an increased baseline prevalence of sleep quality disturbance to result in an elevated risk of poor pandemic-context sleep in older adults (51). Moreover, one study demonstrated a dose-response relationship between social support and sleep quality, and a similar modulating effect between social support and mental health outcomes such as depression and anxiety (52). Furthermore, self-esteem may modulate the effects of stress on both anxiety and sleep (9), and false beliefs may also affect sleep quality (53), while habituation may lead to a gradual improvement in sleep quality (54), further complicating the psychological constructs underlying sleep impairment. Finally, impaired sleep may interact further with underlying psychological processes and result in impaired immune function, with potentially serious effects in a pandemic context (55, 56).

As seen in **Table 4**, there was a variable association of individual OPAS-C subscale scores with poor sleep quality, with the stress, fear, and loneliness subscales associated with worse sleep quality and community and NPI subscales associated with improved sleep quality. While stress, fear, and loneliness are known to be associated with impaired sleep quality, the sense of community and NPI subscales of the OPAS-C increase for those who are less concerned with the effects of the pandemic—and thus are associated with decreased stress—potentially explaining their protective association with sleep quality. Indeed, these findings echo work that has suggested that media consumption regarding the pandemic is associated with more severe symptoms of depression (57).

Despite evidence regarding the negative sleep quality effects of the COVID-19 pandemic, some evidence, particularly from early in the pandemic course, suggested that the net effect on sleep quality was salutary, so that most healthy adults were sleeping more – and better – than before the pandemic (41). Still, even in that study those most vulnerable to sleep impairment before the onset of the pandemic were most likely to experience sleep quality decline in the pandemic context (41).

Our study has several limitations. First, the generalizability of our findings may be limited by the non-representative nature of our population. This is a particularly important problem given the potential interaction between type of work, risk of COVID-19 exposure, and sleep quality (1). Second, as with any survey study, response bias and social desirability bias may affect the validity of the data, though the anonymous survey design may help mitigate these concerns. Third, our selection of independent variables was not exhaustive, and other important variables, such as family stress (58), underlying mental health diseases (59), and others may be important confounders. Fourth, the composite OPAS-C score is heterogeneous, capturing a range of attitudes on disparate pandemic responses such as fear and vaccination concerns; future studies validating the component subscale scores for use independently, and evaluating the ideal ways in which the composite scores should be used, would be beneficial. Finally, this cross-sectional study lacks a comparator group and cannot establish causation; therefore, we do not know whether the

associations we describe truly represent clinical risk factors. Future prospectively designed studies evaluating outcomes over several longitudinal timepoints with representative populations may be helpful.

Both impaired sleep quality and pandemic attitudes – including a tendency to eschew non-pharmaceutical interventions and vaccination – may be associated with an increased risk of COVID-19 infection or worsening long-term outcomes (56, 60). Therefore, the public health implications of these findings raise the specter of a synergistic interaction between poor sleep, COVID-19 attitudes, decision-making and ultimate outcomes. Sleep quality during the limited-duration circuit-break quarantine in the UK was impaired, and poor sleep was strongly associated with less desirable attitudes to the pandemic. The dose-response relationship between impaired sleep quality and pandemic attitudes has important implications for further research and suggests potential avenues for possible sleep quality and public health interventions in the future.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ascension Health IRB. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JK: study conception. JK and BK: data collection. EP-S, RF, and BK: critical editorial review. EP-S and RF: supervision. All authors contributed to the article and approved the submitted version.

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Perceived Stress, Resilience, and Wellbeing in Seasoned Isha Yoga Practitioners Compared to Matched Controls During the COVID-19 Pandemic

*Preeti Upadhyay[1], Shilpa Narayanan[1], Tanvi Khera[1], Lauren Kelly[1], Pooja A. Mathur[1], Akshay Shanker[1], Lena Novack[1], Ruth Pérez-Robles[1], Kim A. Hoffman[2], Senthil Kumar Sadhasivam[3] and Balachundhar Subramaniam[1]**

[1] *Beth Israel Deaconess Medical Center, Boston, MA, United States,* [2] *Oregon Health and Science University-Portland State University School of Public Health, Portland, OR, United States,* [3] *Riley's Children's Hospital, Indiana University, Bloomington, IN, United States*

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***Correspondence:**
Balachundhar Subramaniam
Bsubrama@bidmc.harvard.edu

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Background: Yoga practices, including breathing, meditation, and posture protocols (asanas), have been shown to facilitate physical and mental wellbeing.

Methods: Seasoned yoga practitioners were recruited from the Isha Foundation. Recruitment of the comparison group was achieved using snowball sampling and were not yoga practitioners. Participants in the non-yoga group were randomized to a 3-min Isha practice or a comparator group asked to perform 15-min of daily reading. Participants completed a series of web-based surveys (REDCap) at baseline, 6, and 12 weeks. These surveys include validated scales and objective questions on COVID-19 infection and medical history. The validated questionnaires assess for: perceived stress (PSS), mood states [anxiety and depression (PHQ-4), joy (DPES-Joy subscale)], mindfulness attention and awareness (MAAS), resilience (BRS), mental wellbeing (WEMWBS) and recovery from traumatic event (PTGI). Weekly activity diaries were employed as a tool for collecting compliance information from study participants. Perceived stress scale scores were identified as primary outcome for this study.

Findings: The median Perceived Stress Scale (PSS) score for the yoga practitioners compared to the active and placebo comparators was significantly lower at all time-points: baseline: 11 [IQR 7–15] vs. 16 [IQR 12–21] in both the active and placebo comparators ($p < 0.0001$); 6 weeks: 9 [IQR 6–13] vs. 12 [IQR 8–17] in the active comparator and 14 [IQR 9–18] in the placebo comparator ($p < 0.0001$); and 12 weeks: 9 [IQR 5–13] vs. 11.5 [IQR 8–16] in the active comparators and 13 [IQR 8–17] in the placebo comparator ($p < 0.0001$). Among the randomized participants that were compliant for the full 12 weeks, the active comparators had significantly lower median PSS scores than the placebo comparators 12 weeks [10 (IQR 5–14) vs. 13 (IQR 8–17), $p = 0.017$]. Further, yoga practitioners had significantly lower anxiety at all three-time points ($p < 0.0001$), lower depression at baseline and 6 weeks ($p < 0.0003$), and significantly higher wellbeing ($p < 0.0001$) and joy ($p < 0.0001$) at all three-time points, compared to the active and placebo comparator groups.

Interpretation: The lower levels of stress, anxiety, depression, and higher level of wellbeing and joy seen in the yoga practitioners compared to the active and placebo comparators illustrate the impact of regular yoga practices on mental health even during the pandemic.

Trial Registration: ClinicalTrials.gov, identifier: NCT 04498442.

Keywords: yoga, meditation, perceived stress, Isha Foundation, wellbeing

INTRODUCTION

The global toll of COVID-19 on physical and mental health has been severe, as the disease continues to disrupt lives and impact wellbeing (1, 2). Research has already documented that psychological distress (3, 4), anxiety (5), sleep disturbances (6), greater feelings of isolation (7), and problematic substance use have increased as a result of the pandemic (8). In addition, perceived stress has been shown to accompany COVID-19 infection and treatment (9). Adopting strategies to maintain or increase mental, emotional, and physical health during these difficult times will enable greater resilience in individuals as we begin to emerge from the pandemic (10, 11). In fact, the US Centers for Disease Control has emphasized the importance of managing stress during the pandemic time and avoiding maladaptive behaviors to cope with stress and anxiety (9).

Yoga practices, including breathing, meditation, and posture protocols (asanas), have been shown to facilitate enhanced physical and mental wellbeing (12, 13). Enhanced wellbeing is achieved through improvements in the modulation of the autonomic nervous system (14), improved sleep quality (15), and immunity (16), and reductions in stress (17, 18), anxiety (19), and depression (20, 21) in regular yoga practitioners. In a meta-analysis of 47 trials, researchers found evidence that meditation reduced multiple negative dimensions of psychological stress such as anxiety and depression (22). Similarly, in a study of yogic breathing practices, functional magnetic resonance imaging (fMRI) showed significantly decreased states of anxiety and negative affect and modulation of activity in brain regions involved in emotional processing, attention, and awareness (23). A significant decrease in perceived stress after a single yoga class (17) and after an 8-week course (18) suggests that yoga has both immediate and longer-term impacts on perceived stress during continued yoga practice. The Centers for Disease Control and Prevention reports that an increasing number of adults are practicing yoga and meditation to enhance wellbeing (24).

The Isha Foundation (25), an international school of yoga, teaches yogic practices designed to meet individual needs and improve wellbeing. The Isha Foundation's Inner Engineering course including seven online modules, and a 1-day in-person program were offered in the traditional modality before the pandemic and online-only during the pandemic. We enrolled 8,519 participants (6,892 regular Inner Engineering practitioners vs. 2,344 age, gender, and zip code matched controls) to test the program's effectiveness. We evaluated the stress and wellbeing of participants at three different times during this pandemic. Participants in the non-yoga group were not yoga practitioners and were randomized into either the *active comparator arm* or the *placebo comparator arm*. We randomized the non-yoga group to a simple 3-min breathing practice group and an active reading control group to assess the effect on perceived stress. We hypothesized that those undertaking the yogic practices would (a) have the least amount of perceived stress and (b) report higher levels of wellbeing than the control [specifically, the placebo comparator group (i.e., reading group)] over the study period of May 2020 to September 2020.

METHODS

We designed the study to comply with the then COVID-19 precautions imposed by federal and state governments in the U.S. Beth Israel Deaconess Medical Center Institutional Review Board approved this study.

Recruitment and Intervention

The methodology paper detailing the study has been published elsewhere (26). Briefly, seasoned Isha yoga practitioners were recruited by social media, websites, flyers, word of mouth, and email announcements from the Isha Foundation. Participants consented to study participation *via* REDCap. The second stage of recruitment used snowball sampling (27). Yoga practitioners were requested to nominate two friends or colleagues who did not practice yoga within the last month as age, gender, and zip-code matched controls (preferably from the same neighborhood). The study team reached out to those nominated and obtained REDCap consent from those who chose to enroll.

Non-meditator controls were randomized to an *active comparator arm* or the *placebo comparator arm*. Those in the *active comparator arm* were taught a 3-min yoga practice, Simha Kriya, which involved a specific breathing practice with rapid, deep breathing and breath retention designed during the pandemic to improve the pulmonary function. It was perceived as useful by 77% of healthcare workers participating in a study conducted at MD Anderson (Houston, TX) during the pandemic's peak (28). These participants were asked to perform Simha Kriya using a web-based application twice per day. Those randomized to the *placebo comparator arm* performed either reading activities or remained idle for 15-min a day throughout the study period.

Respondents in the observational arm (seasoned yoga practitioners) continued their usual yoga practices. On an average, seasoned yoga practitioners reported to have ∼5.6 years (SD: ± 7.2) of practice experience. Their average session

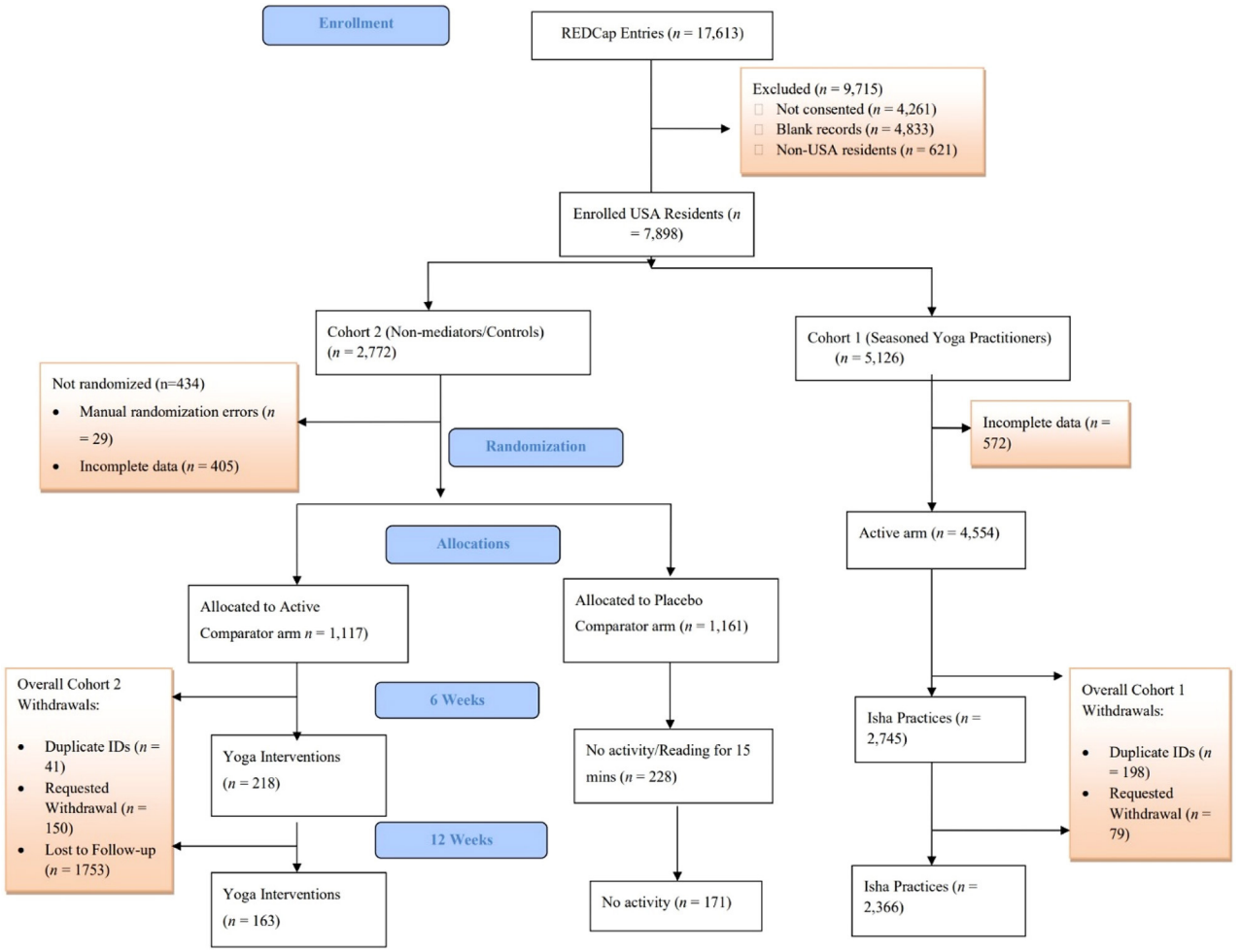


FIGURE 1 | CONSORT flow diagram.

duration was reported to be 6.6 h (SD: ± 5.7) each day. The expertise of yoga in seasoned practitioners varied greatly. Their expertise ranged from practitioners who recently completed inner engineering online course and performed simple yoga practices for 30-min each day to highly motivated practitioners with 6 h or more of dedicated meditation and yoga practices.

Data Collection and Measures

Participants completed a series of web-based surveys (REDCap) at baseline, 6, and 12 weeks. Data collection included weekly activity diaries, medical history, and eight validated neuropsychological scales assessing stress (Perceived Stress Scale, PSS), anxiety and depression (PHQ-4), joy predisposition (DPES-Joy Subscale), mindfulness awareness (MAAS), resilience (BRS), mental wellbeing (WEMWBS), and post-traumatic growth (PTGI). PSS is defined as the primary outcome, while BRS was the key secondary outcome.

Statistical Analysis

Descriptive statistics are presented to summarize the data. Continuous data were presented as median [interquartile range] after confirming with the Shapiro-Wilk test that data did not follow a normal distribution. Differences within groups between baseline and 6 weeks and 6 and 12 weeks were assessed with a Wilcoxon Signed-Rank test for paired data. Differences between two groups were assessed with a Wilcoxon Rank-Sum test and between three groups with a Kruskal–Wallis test. Categorical data were presented as frequencies and percentages and assessed with chi-square or Fisher's exact test, as appropriate.

All primary analyses were assessed using intention-to-treat principles. Further, differences between groups for the primary and key secondary outcomes (PSS and BRS) were also assessed using a Poisson Regression model with scaled deviance to adjust for potential confounding by region, employment status, and age. SAS 9.4 (SAS Institute Inc., Cary, NC) was used for all analyses with two-sided $p < 0.05$ considered statistically significant.

RESULTS

Of the 8,519 participants that agreed to participate, 6,892 participants were included in the baseline analysis because they were from the United States and had at least partially

TABLE 1 | Demographic characteristics.

	Active comparators (n = 1,177)	Placebo comparators (n = 1,161)	Yoga practitioners (n = 4,554)	*P*-Value
Gender, No. (%)				
Female	679 (57.7)	666 (57.4)	2,631 (57.8)	1.0
Male	497 (42.2)	494 (42.6)	1917 (42.1)	
Other	1 (0.1)	1 (0.1)	6 (0.1)	
Age				<0.0001
Median (IQR)	42 (33, 50)	41 (33, 50)	43 (36, 52)	
Mean (SD)	42.5 (13.0)	42.3 (12.8)	44.6 (11.7)	
Educational qualifications, No. (%)				0.20
Less than bachelor's degree	141 (12.0)	123 (10.6)	491 (10.8)	
Bachelor's degree	390 (33.1)	370 (31.9)	1,391 (30.5)	
Higher than bachelor's degree (Master's, Professional, Ph.D)	646 (54.9)	668 (57.5)	2,672 (58.7)	
Employment status, No. (%)				<0.0001
Employed full time	754 (64.0)	743 (64.0)	2,603 (57.2)	
Employed part time (self-employed, contingent worker)	163 (13.9)	160 (13.8)	928 (20.4)	
Not employed/Laid off	113 (9.6)	122 (10.5)	493 (10.8)	
Retired	53 (4.5)	64 (5.5)	252 (5.5)	
Other (disabled, student, military service)	94 (8.0)	72 (6.2)	278 (6.1)	
Region, No. (%)				<0.0001
Midwest	242 (20.6)	232 (20.0)	692 (15.2)	
North East	266 (22.6)	300 (25.9)	1,152 (25.3)	
South East	218 (18.5)	234 (20.2)	1,010 (22.2)	
South West	193 (16.4)	152 (13.1)	605 (13.3)	
West	257 (21.9)	240 (20.7)	1,092 (24.0)	
Unknown	1 (0.1)	3 (0.3)	3 (0.1)	

complete data. Of these, there were 1,177 active comparators, 1,161 placebo comparators, and 4,554 yoga practitioners. At 6 weeks, 218 (18.5%) of the active comparators, 228 (19.6%) of the placebo comparators, and 2,745 (60.3%) of the yoga practitioners remained in the study. At 12 weeks, these numbers reduced to 163 (13.8%), 171 (14.7%), and 2,366 (52%), respectively (**Figure 1**).

Baseline Characteristics

Around 57% of participants in each group were females with mean ages ranging from 42 to 45, and more than half of each group having a higher education than a Bachelor's Degree. Sixty-four percentage of active and placebo comparators were employed full-time and 14% part-time compared to 57 and 20%, respectively, among the yoga practitioners (**Table 1**). There were also significant differences in the regions that the groups reside in. Around 20% of the comparator groups were from the Midwest, but only 15% among yoga practitioners. These characteristics that were found to be significantly different were adjusted for in the primary analyses (Refer to **Figure 2** for geo-distribution at baseline, remaining charts available in **Supplementary Materials**).

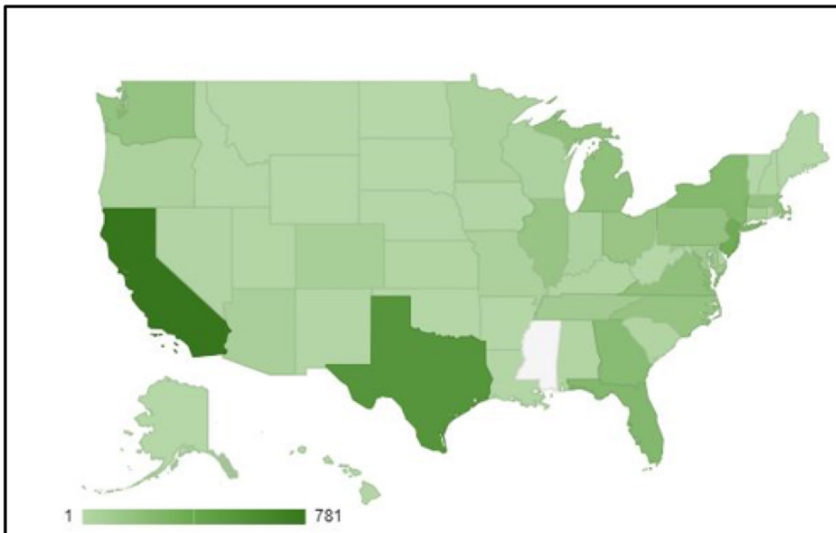
Primary Outcome—Perceived Stress During the Pandemic (PSS Scores)

At baseline, 6, and 12 weeks, yoga practitioners had significantly lower PSS scores than active and placebo comparator groups (**Figure 3**).

The median PSS score for the yoga practitioners compared to the active and placebo comparators was significantly lower at all time-points: baseline: 11 [IQR 7–15] vs. 16 [IQR 12–21] in both the active and placebo comparators ($p < 0.0001$); 6 weeks: 9 [IQR 6–13] vs. 12 [IQR 8–17] in the active comparator and 14 [IQR 9–18] in the placebo comparator ($p < 0{\cdot}0001$); and 12 weeks: 9 [IQR 5–13] vs. 11.5 [IQR 8–16] in the active comparators and 13 [IQR 8–17] in the placebo comparator ($p < 0.0001$) (**Table 2**). Adjusting for age, region, and employment status, the yoga practitioners, had a significantly lower PSS scores compared to the placebo comparators [31% reduction (R.R. 0.69 (95% CI 0.67–0·71)) at baseline, 30% reduction (R.R. 0.70 (95% CI 0.65–0.75)) at 6 weeks, and 29% reduction (R.R. 0.71 (95% CI 0.65–0·77)) at 12 weeks]. In the adjusted analysis, the active comparators did not have significantly different PSS scores compared to the placebo comparators at any time point (Refer to **Supplementary Table A** for further details).

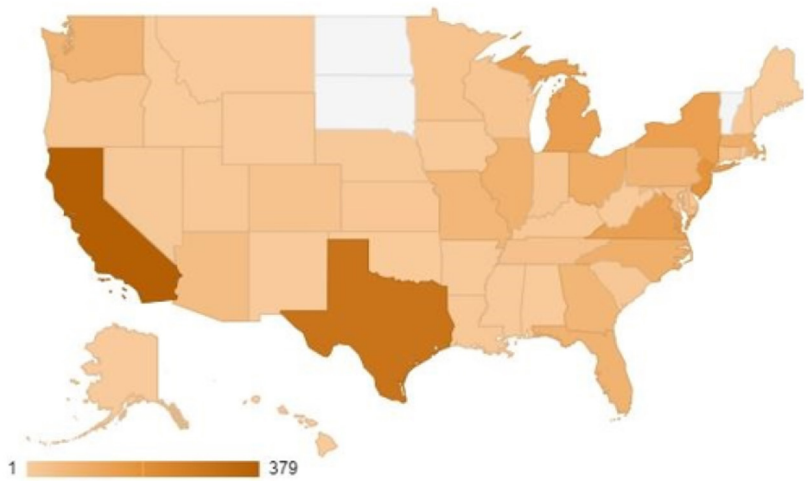
Within the Group Change in PSS Score

There was a statistically significant difference in median PSS scores between baseline and 6 weeks among all groups. The active comparators had a two-unit [IQR −5–1] decrease ($p < 0.0001$), the placebo comparators had a two-unit [IQR −5–1] decrease ($p < 0.0001$), and the yoga practitioners had a zero-unit [IQR −3–2] change ($p < 0.0001$). We also found a significant difference when comparing these median changes between the three groups



Yoga Practitioners - Baseline

Alabama	18	Nebraska	8
Alaska	3	Nevada	15
Arizona	64	New Hampshire	19
Arkansas	5	New Jersey	362
California	781	New Mexico	9
Colorado	71	New York	254
Connecticut	66	North Carolina	161
Delaware	14	North Dakota	2
Florida	256	Ohio	147
Georgia	235	Oklahoma	6
Hawaii	10	Oregon	44
Idaho	5	Pennsylvania	172
Illinois	153	Rhode Island	9
Indiana	40	South Carolina	27
Iowa	11	South Dakota	2
Kansas	17	Tennessee	101
Kentucky	29	Texas	537
Louisiana	11	Utah	13
Maine	4	Vermont	5
Maryland	106	Virginia	196
Massachusetts	165	Washington	168
Michigan	189	Washington D.C.	13
Minnesota	48	West Virginia	4
Missouri	49	Wisconsin	41
Montana	8	Wyoming	1



Controls - Baseline

Alabama	4	Missouri	67
Alaska	1	Montana	1
Arizona	46	Nebraska	8
Arkansas	7	Nevada	9
California	379	New Hampshire	10
Colorado	30	New Jersey	182
Connecticut	35	New Mexico	1
Delaware	5	New York	141
Florida	80	North Carolina	93
Georgia	71	Ohio	100
Hawaii	2	Oklahoma	10
Idaho	2	Oregon	19
Illinois	84	Pennsylvania	77
Indiana	20	Rhode Island	7
Iowa	7	South Carolina	13
Kansas	15	Tennessee	32
Kentucky	12	Texas	300
Louisiana	12	Utah	11
Maine	2	Virginia	138
Maryland	41	Washington	77
Massachusetts	94	Washington D.C.	7
Michigan	144	West Virginia	4
Minnesota	25	Wisconsin	22
Mississippi	6	Wyoming	1

FIGURE 2 | Geo-charts (baseline only).

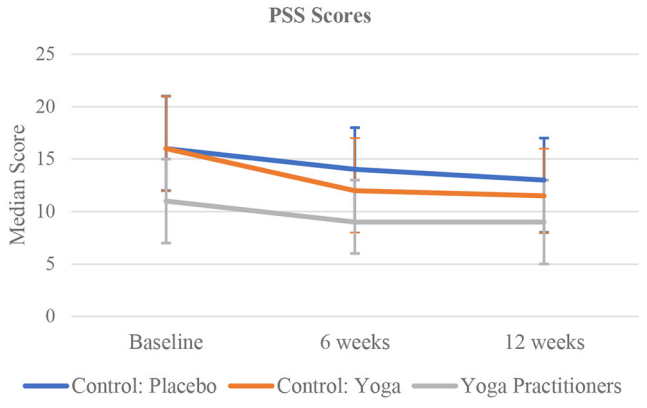


FIGURE 3 | Time trend comparison of PSS Scores in the three study group at all three time points.

($p < 0.0001$). There were no significant differences in PSS scores between 6 and 12 weeks for any of the groups.

Key Secondary Outcome—Brief Resilience Scores

The median BRS score at baseline for both the active comparators and placebo comparators was 2 [IQR 1.8–2.3] compared to 2 [IQR 1.8–2.2] for the yoga practitioners ($p < 0.0001$). There were no significant differences between median BRS scores at 6 or 12 weeks. There were also no significant differences between the BRS scores of the groups when adjusted for age, region, and employment status.

Other Secondary Outcomes

Based on the PHQ-4 scores, yoga practitioners had significantly lower anxiety at all three-time points ($p < 0.0001$), lower depression at baseline and 6 weeks ($p < 0.0003$), and significantly higher wellbeing ($p < 0.0001$) (**Figure 4**) and joy ($p < 0.0001$) at all three-time points, compared to the active and placebo comparator groups.

The results were analyzed for compliant participants only. At baseline, measures of negative affect (stress, anxiety, depression) and positive affect (wellbeing, joy, resilience) and mindfulness were comparable between these two groups (Refer to **Table 3** for further details).

Compared to the placebo comparators, the active comparators had lower median PSS scores at 6 weeks [11 (IQR 7–15) vs. 13 (IQR 8–17), $p = 0.082$] and at 12 weeks [10 (IQR 5–14) vs. 13 (IQR 8–17), $p = 0.017$] (**Figure 5**).

The active comparator group had higher median wellbeing scores at 6 weeks ($p = 0.048$), and 12 weeks ($p = 0.046$), and higher median joy at 6 weeks ($p = 0.029$), compared to the placebo comparator group (**Figure 6**). Other measures such as anxiety, depression, resilience, and mindfulness were similar between these two groups at 6 and 12 weeks (**Table 4**).

The period prevalence rates of COVID-19 between May 21 and Jun 21 among the active comparators, placebo comparators, and yoga practitioners are 0.4, 0.6, and 0.5%, respectively. The rates between July 5 and August 5 are 0.5, 0.4, and 0.3%, respectively. The rates between Aug 15 and Sep 15 were 0.6, 2.3, and 1.1%, respectively. At baseline, 19 (90.5%) of yoga practitioners with COVID-19 reported symptoms of either fever or shortness of breath compared to 2 (40%) of the active comparators and 4 (57.1%) of the placebo comparators ($p = 0.023$). There were no other significant differences in the frequency of symptoms reported between the groups at any other time point. There was no significant difference in the duration of symptoms reported nor in the Post Traumatic Growth Inventory Scores between groups at any time point.

Compliance

Compliance is defined as 3 days of activity each week for at least 3 weeks from baseline to 6 weeks, or a minimum of 6 weeks from baseline to 12 weeks. Based on the responses collected from the weekly updates, seasoned yoga practitioners completed their activity for an average of 6.1 days per week (SD:1.5), while active comparator arm only performed Simha Kriya for an average of 3.3 days per week (SD:3.0) and placebo comparator arm performed their chosen activity for an average of 3.8 days per week (SD:2.9) (Refer to **Supplementary Tables B–G** in **Supplementary Materials**).

Eighty of the 1,177 active comparators and 100 of the 1,161 placebo comparators were found to be compliant for the full 12 weeks. At baseline, there were no significant differences in the scores between the compliant active and placebo comparators. At 6 weeks, the active comparators had higher median wellbeing [55 (IQR 50–61) vs. 52 (IQR 45–58), $p = 0.048$] and median joy scores [5.5 (IQR 4.5–6) vs. 5 (IQR 4.2–5.8), $p = 0.029$]. compared to the placebo comparators. At 12 weeks, the active comparators had higher wellbeing [56 (IQR 49–61.5) vs. 53 (IQR 46–58), $p = 0.046$] and joy scores [5.5 (IQR 4.5–6) vs. 5 (IQR 4.2–5.8), $p = 0.029$]. compared to the placebo comparators. At 12 weeks, the active comparators also had lower median PSS scores compared to the placebo group with 10 [IQR 5–14] and 13 [IQR 8–17], respectively ($p = 0.017$) (**Table 4**).

Between baseline and 6 weeks, the median difference in PSS scores among both the compliant active and placebo comparators was a three-unit [IQR −5–0] decrease ($p < 0.0001$). There was a 1.5-unit [IQR −1–5] increase in wellbeing scores among the active comparators ($p = 0.0008$), and a two-unit [IQR −2–5] increase among the placebo comparators ($p = 0.0042$). For joy scores, there was a zero-unit [IQR −0.2–0.5] change among the active comparators ($p = 0.035$), but no significant change among the placebo comparators.

Between 6 and 12 weeks, the median difference in PSS scores among the compliant active comparators was a one-unit [IQR −5–2] decrease ($p = 0.025$). However, there was no significant change among the placebo comparators. Joy scores increased by 0.2 units [IQR −0.3–0.5] among the placebo comparators ($p = 0.037$), but there was no significant change among the active comparators. Mindfulness awareness (MAAS) scores increased by 0.2 units [IQR −0.2–0.6] between 6 and 12 weeks among the active comparators ($p = 0.0033$) but not the placebo comparators.

TABLE 2 | PSS scores—primary outcome (primary outcome for the 3 groups at all 3 time points).

	Baseline				Week 6				Week 12			
	Active comparators (*n* = 1,177)	Placebo comparators (*n* = 1,161)	Yoga practitioners (*n* = 4,554)	*P*-Value	Active comparators (*n* = 218)	Placebo comparators (*n* = 228)	Yoga practitioners (*n* = 2,745)	*P*-Value	Active comparators (*n* = 163)	Placebo comparators (*n* = 171)	Yoga practitioners (*n* = 2,366)	*P*-Value
PSS score, median (IQR)	(*n* = 1,176)[a] 16 (12, 21)	(*n* = 1,160) 16 (12, 21)	(*n* = 4,552) 11 (7, 15)	<0.0001	(*n* = 207) 12 (8, 17)	(*n* = 222) 14 (9, 18)	(*n* = 2,658) 9 (6, 13)	<0.0001	(*n* = 146) 11.5 (8, 16)	(*n* = 157) 13 (8, 17)	(*n* = 2,108) 9 (5, 13)	<0.0001

[a](*n* = *X*) *represents the number of patients with PSS scores in the specific group at the specific time point.*

DISCUSSION AND CONCLUSION

Seasoned yoga practitioners had better psychological status compared to the rest of the study population at all-time points. Lower levels of stress in seasoned yoga practitioners have also been documented in studies conducted by Tyagi et al. (29) and Peterson et al. (30). Significant lowering in levels of depression in yoga practitioners appeared in results of a randomized control trial study conducted by Prathikanti et al. (20).

Furthermore, when subjected to a short 3-min online guided breathing exercise (Simha Kriya), the control arm participants demonstrated significant changes in their perceived stress. The active comparator arm reported lower levels of stress at weeks 6 and 12. This result demonstrates the positive effect of a 3-min breathing and meditation practice on diminishing stress levels. Our findings are comparable to Doria et al. (31) where a yoga practice that includes a specific breathing technique reduced stress levels in patients suffering from generalized anxiety disorder. Vinchurkar et al. (32) found that short periods of yoga and meditation improved mental health. Other health benefits reported by Peterson et al. (30) include sleep quality improvement, higher levels of focus and attention, and physiological benefits such as stabilizing the cardiac autonomic nervous system in yoga practitioners. These studies emphasize the importance of a short period of exposure to mindfulness practices that can result in improved mental health in participants.

Next, a closer look at compliant participant scores in the cohort with brief exposure to yoga intervention (Simha Kriya) revealed a sustained improvement in PSS scores at week 6 and week 12 compared to non-compliant participants. These findings agree with those reported by Chang et al. (33) in a waitlisted RCT in college students during the pandemic. They reported that consistent practice of yoga for 3 or more times per week resulted in significant changes in stress, anxiety, depression, wellbeing, resilience, positive & negative affect scores. Sadhasivam et al. (34) found similar results in a study conducted wherein study participants of a four-day yoga retreat experienced improved focus, happiness, and positive wellbeing with reduced depression and anxiety. Scores increased immediately after the retreat compared with participants' baseline values assessed 2 weeks before the program ($p < 0.001$). All improvements were sustained 1 month after the program. Blood tests from participants ($n = 142$) also showed increased endocannabinoid levels (lipid mediators associated with enhanced mood and reduced anxiety/depression) as well as a brain-derived neurotrophic factor suggesting a role for these biomarkers in the underlying mechanism of yoga's protective effects.

With implementation of social distancing and work from home approaches to curb the spread of COVID-19 pandemic, telemedicine has become a cornerstone in healthcare delivery approaches (35, 36). Meditation and yoga are optimal choices for complementary health practices for promotion of mental and physical wellbeing (37). It is important to recognize that the current study has successfully demonstrated the scalability and accessibility of Simha Kriya as an intervention. While several

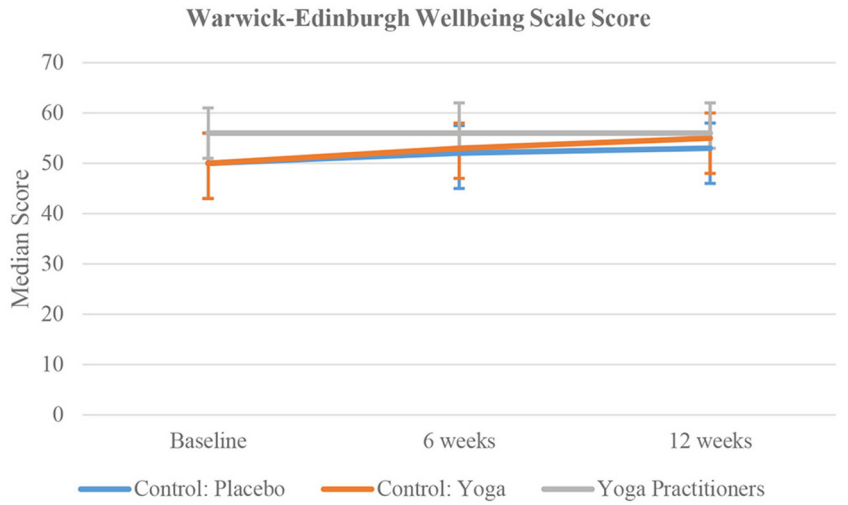


FIGURE 4 | Time trend comparison of WEMWBS Score in the three study group at all three time points.

studies are now studying the impact of remote administration of the mindfulness-based intervention, only a few have been able to successfully implement them (38, 39).

Study Strength

The study draws its strength from a large number of participants enrolled in the study. Small sample sizes and relatively self-selected population enrolling into mindfulness-based research studies often affect the scalability and generalizability of the studies' results. Furthermore, the complex study design enabled the flexibility of simply observing the seasoned yoga practitioners in their typical practice while simultaneously generating and testing a hypothesis on the effects of a short breathing practice on novice practitioners. The use of validated neuro-psychological scales lent validity to the self-reported survey responses and helped establish an association between yoga and mental health outcomes. Finally, as previously mentioned, despite being employed in a sub-group of control participants i.e., active comparator group, the study team was able to remotely deliver and provide a brief yet effective breathing practice in times of need.

Study Limitations

A limitation of our study is that we could not randomize all study participants. As the investigation was performed during peak COVID-19 infections in the U.S., it would have been unethical to advise routine yoga practitioners to forego their practices for the sake of the study's internal validity. In order to account for the various confounding variables on the data collected, the study team undertook the following measures:

1. Actively match for age, gender, and region between the two cohorts of seasoned yoga practitioners and controls,

2. Treating and analyzing the data collected from seasoned practitioners as an observational arm, and

3. Finally, collecting detailed information on intervention practiced, frequency of interventions, and duration of practice and accounted for these details in analysis phase.

The study team acknowledges that the two cohorts were not identical and that seasoned yoga practitioners had greater exposure to the mindfulness practices with an advantage of time and experience than the controls. As Davidson and Kaszniak (40) eloquently offer in their review; estimating mindfulness is complex by virtue of several confounding variables (e.g., mindfulness practice time, style of practice, home vs. retreat practice, formal vs. informal practice, age, and cultural variations etc.). These variables lead to variation in expectations from seasoned vs. novice practitioner's mindfulness quality and experience. Quantification of these variables is not possible with use of self reports alone.

Another limitation that can be identified is that only Isha School of yoga practitioners were invited to participate in this study, introducing an element of selection bias. However, since the comparator cohort composed of novice practitioners was subjected to randomization, selection bias did not truly impact the study's reported outcome measures. Seasoned yoga practitioners were treated as an observational cohort while the comparator arm participants: who are recruited by snowball sampling technique and have no prior meditation or yoga experience, were introduced to either intervention or control group activities based on the group they are allocated.

Lastly, many participants did not complete the study, and the participant attrition rates were high in all cohorts. The attrition rates amounted to ∼50% at each time point which is fairly consistent with the wide range for attrition reported in the literature, i.e., 8–60% (41, 42). The difficult time faced by the participants during the pandemic and the usual reasons could be a contributing cause.

TABLE 3 | Secondary outcomes (secondary outcomes for the 3 group at all 3 time points).

	Baseline				Week 6				Week 12			
	Active comparators (*n* = 1,177)	**Placebo comparators (*n* = 1,161)**	**Yoga practitioners (*n* = 4,554)**	***P*-Value**	**Active comparators (*n* = 218)**	**Placebo comparators (*n* = 228)**	**Yoga practitioners (*n* = 2,745)**	***P*-Value**	**Active comparators (*n* = 163)**	**Placebo comparators (*n* = 171)**	**Yoga practitioners (*n* = 2,366)**	***P*-Value**
Measures of negative affect[a]												
PHQ anxiety score, No. (%)	(*n* = 1,173)[d]	(*n* = 1,156)	(*n* = 4,547)	<0.0001	(*n* = 204)	(*n* = 218)	(*n* = 2,654)	<0.0001	(*n* = 144)	(*n* = 154)	(*n* = 2,088)	<0.0001
None	982 (83.7)	958 (82.9)	4,314 (94.9)		182 (89.2)	198 (90.8)	2,572 (96.9)		133 (92.4)	140 (90.9)	2,039 (97.7)	
Mild	154 (13.1)	162 (14.0)	192 (4.2)		17 (8.3)	16 (7.3)	76 (2.9)		10 (6.9)	13 (8.4)	44 (2.1)	
Moderate	37 (3.2)	36 (3.1)	41 (0.9)		5 (2.5)	4 (1.8)	6 (0.2)		1 (0.7)	1 (0.7)	5 (0.2)	
PHQ depression score, No. (%)	(*n* = 1,173)	(*n* = 1,156)	(*n* = 4,547)	<0.0001	(*n* = 204)	(*n* = 218)	(*n* = 2,654)	0.0003	(*n* = 144)	(*n* = 154)	(*n* = 2,088)	0.051
None	999 (85.2)	993 (85.9)	4,224 (92.9)		185 (90.7)	201 (92.2)	2,541 (95.7)		135 (93.8)	144 (93.5)	2,012 (96.4)	
Mild	159 (13.6)	145 (12.5)	294 (6.5)		17 (8.3)	16 (7.3)	106 (4.0)		9 (6.3)	10 (6.5)	74 (3.5)	
Moderate	15 (1.3)	18 (1.6)	29 (0.6)		2 (1.0)	1 (0.5)	7 (0.3)		0 (0.0)	0 (0.0)	2 (0.1)	
Measures of positive affect[b]												
Warwick-Edinburgh wellbeing	(*n* = 1,169)	(*n* = 1,146)	(*n* = 4,539)	<0.0001	(*n* = 195)	(*n* = 216)	(*n* = 2,623)	<0.0001	(*n* = 139)	(*n* = 152)	(*n* = 2,053)	<0.0001
scale score, median (IQR)	50 (43, 56)	50 (43, 56)	56 (51, 61)		53 (47, 58)	52 (45, 57.5)	56 (52, 62)		55 (48, 60)	53 (46, 58)	56 (53, 62)	
DPES score, median (IQR)	(*n* = 1,175)	(*n* = 1,154)	(*n* = 4,548)	<0.0001	(*n* = 200)	(*n* = 217)	(*n* = 2,650)	<0.0001	(*n* = 144)	(*n* = 153)	(*n* = 2,079)	<0.0001
	5 (4.2, 5.7)	5 (4.3, 5.7)	5.5 (4.8, 6.2)		5 (4.5, 5.8)	5 (4.2, 5.8)	5.7 (5, 6.2)		5.2 (4.4, 5.9)	5 (4.3, 5.7)	5.7 (5, 6.2)	
BRS score, median (IQR)	(*n* = 1,169)	(*n* = 1,151)	(*n* = 4,542)	<0.0001	(*n* = 198)	(*n* = 217)	(*n* = 2,639)	0.21	(*n* = 140)	(*n* = 153)	(*n* = 2,064)	0.20
	2 (1.8, 2.3)	2 (1.8, 2.3)	2 (1.8, 2.2)		2 (1.8, 2.2)	2 (1.8, 2.2)	2 (1.8, 2.2)		2 (1.8, 2.2)	2 (2, 2.2)	2 (1.8, 2.2)	
Mindfulness scores[c]												
MAAS score, median (IQR)	(*n* = 1,170)	(*n* = 1,153)	(*n* = 4,545)	<0.0001	(*n* = 200)	(*n* = 217)	(*n* = 2,642)	<0.0001	(*n* = 143)	(*n* = 153)	(*n* = 2,067)	<0.0001
	4.2 (3.4, 5)	4.2 (3.2, 5)	4.8 (4, 5.2)		4.6 (3.8, 5.2)	4.4 (3.6, 5.2)	4.8 (4.2, 5.4)		4.8 (4, 5.4)	4.6 (3.6, 5.2)	5 (4.2, 5.4)	
COVID positive participants only												
Post-Traumatic growth	(*n* = 5)	(*n* = 7)	(n=20)	0.28	(*n* = 1)	(*n* = 1)	(*n* = 12)	0.62	(*n* = 1)	(*n* = 3)	(*n* = 26)	0.68
inventory score, median (IQR)	65 (11, 68)	63 (45, 84)	72.5 (53.5, 86.5)		56 (56, 56)	54 (54, 54)	78.5 (52, 83.5)		48 (48, 48)	73 (28, 76)	72.5 (48, 81)	

[a]Decline in scores suggests successful impact of meditation practices, [b]Increase in scores suggests successful impact of meditation practices, [c]increase in scores suggests successful impact of meditation practices, [d](n = X) represents the number of patients with this score in the specific group at the specific time point.

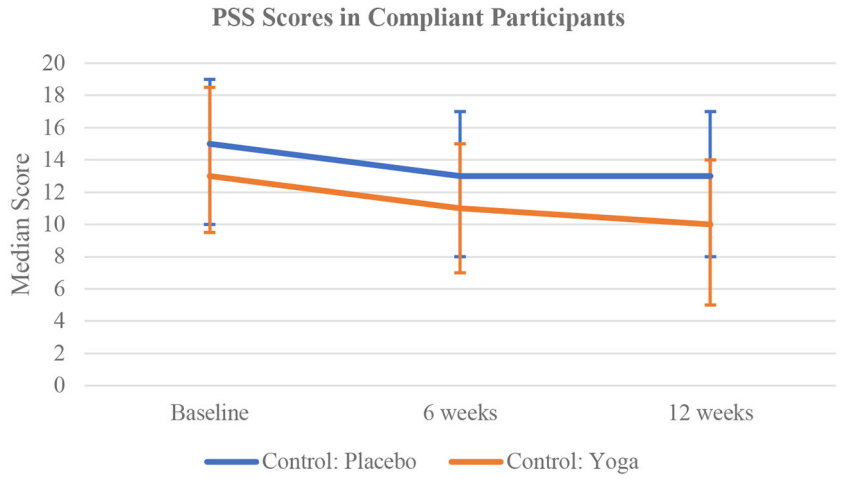


FIGURE 5 | Time trend comparison of PSS Scores in the compliant participants of non-meditator cohort at all three time points.

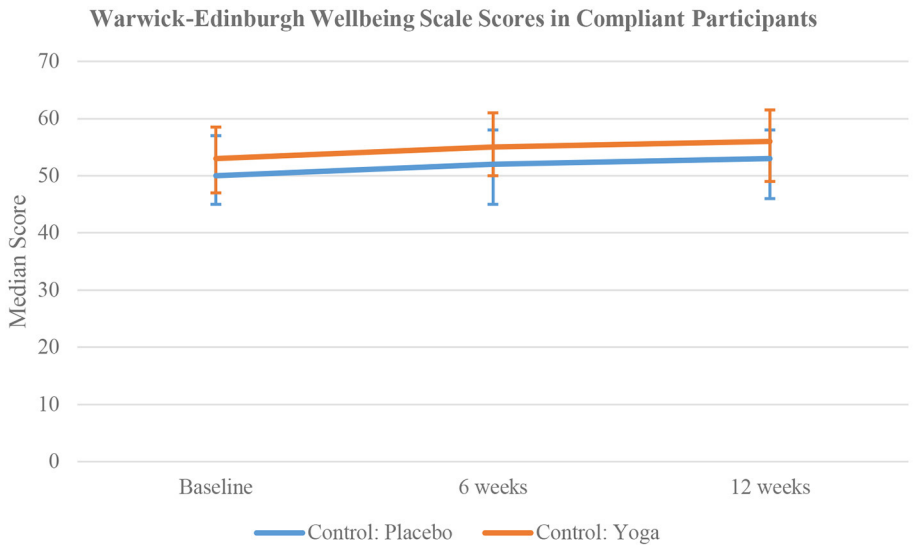


FIGURE 6 | Time trend comparison of WEMWBS Scores in the compliant participants of non-meditator cohort at all three time points.

Future Directions

The study team identifies a lack of objective physiological markers provided by wearable health-tracking devices as a limitation of the current study. The study team could not introduce data collection from these devices due to financial and time constraints when the study was introduced. Additionally, restrained physical communication and work from home added another layer of complexity in data collection from such devices. These were also the reasons why we refrained from any lab collections for the study. However, the study team aims at incorporating data points from these devices as a compliance marker in upcoming studies to make a more robust comparison.

With this study, the study team demonstrated that seasoned yoga practitioners had better psychological status compared to the rest of the study population at all-time points thereby signaling the protective effects of yoga practice, especially during the uncertain times of a pandemic. Further adherence to a brief 3-min breathing practice for as less as 3 days/week resulted in sustained improvements in stress and mental wellbeing of study participants. This offers an opportunity for providing Simha kriya as remotely delivered, accessible practice to all who suffer from COVID-19 as an adjunct therapy. Further clinical efficacy trails are warranted to establish the true impact of such breathing techniques.

TABLE 4 | Compliant participant comparison in the comparator group only (at 6 week and 12 week).

Scores	Week 6			Week 12		
	Active comparator ($n = 80$)	Placebo comparator ($n = 100$)	*P*-Value	Active comparator ($n = 80$)	Placebo comparator ($n = 100$)	*P*-Value
Measures of negative affect[a]						
PSS score, median (IQR)	($n = 78$)[d]	($n = 97$)	0.082	($n = 73$)	($n = 95$)	0.017
	11 (7, 15)	13 (8, 17)		10 (5, 14)	13 (8, 17)	
PHQ anxiety score, No. (%)	($n = 78$)	($n = 97$)	0.80	($n = 72$)	($n = 93$)	0.82
None	73 (93.6)	92 (94.9)		67 (93.1)	85 (91.4)	
Mild	4 (5.1)	4 (4.1)		4 (5.6)	7 (7.5)	
Moderate	1 (1.3)	1 (1.0)		1 (1.4)	1 (1.1)	
PHQ depression score, No. (%)	($n = 78$)	($n = 97$)	0.34	($n = 72$)	($n = 93$)	1.0
None	72 (92.3)	93 (95.9)		70 (97.2)	90 (96.8)	
Mild	6 (7.7)	4 (4.1)		2 (2.8)	3 (3.2)	
Moderate	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)	
Measures of positive affect[b]						
Warwick-Edinburgh wellbeing scale score, median (IQR)	($n = 78$)	($n = 97$)	0.048	($n = 72$)	($n = 93$)	0.046
	55 (50, 61)	52 (45, 58)		56 (49, 61.5)	53 (46, 58)	
DPES score, median (IQR)	($n = 78$)	($n = 97$)	0.029	($n = 72$)	($n = 94$)	0.32
	5.5 (4.5, 6)	5 (4.2, 5.8)		5.3 (4.5, 6)	5.2 (4.3, 6)	
BRS score, median (IQR)	($n = 78$)	($n = 97$)	0.56	($n = 72$)	($n = 94$)	0.56
	2 (1.8, 2.2)	2 (1.8, 2.2)		2 (1.8, 2.2)	2 (2, 2.2)	
Mindfulness scores[c]						
MAAS score, median (IQR)	($n = 78$)	($n = 97$)	0.099	($n = 72$)	($n = 94$)	0.087
	4.8 (4, 5.4)	4.4 (3.6, 5.2)		5 (4, 5.5)	4.8 (3.8, 5.2)	
COVID positive participants only						
Post-Traumatic growth inventory score, median (IQR)	($n = 1$)	($n = 1$)	N/A	($n = 1$)	($n = 2$)	1.0
	56 (56, 56)	54 (54, 54)		48 (48, 48)	52 (28, 76)	

[a]Decline in scores suggests successful impact of meditation practices, [b]Increase in scores suggests successful impact of meditation practices, [c]increase in scores suggests successful impact of meditation practices, [d](n = X) represents the number of patients with this score in the specific group at the specific time point.

CONCLUSION

We provide evidence that routine yoga practice during the COVID-19 pandemic did reduce stress and enhanced wellbeing in study participants who were exposed to some form of yoga activity during the 12-week study duration.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Commitee on Clinical Investigations at Beth Israel Deaconess Medical Center. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

BS, PU, and LN conceptualized the study's design. SN, TK, PM, and AS conducted data collection. PU, LN, and LK carried out the data analysis. PU did project administration/supervision. LN and LK verified the underlying data. All authors contributed to the writing, review, editing, confirm that they had full access to all the data in the study, and accept responsibility to submit for publication.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.813664/full#supplementary-material

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EDITED BY
Xenia Gonda,
Semmelweis University, Hungary

REVIEWED BY
Sebastian Contreras,
Max-Planck-Institute for Dynamics and Self-Organisation, Germany
David Alfredo Medina Ortiz,
University of Magallanes, Chile

*CORRESPONDENCE
Jonathan M. P. Wilbiks
jwilbiks@unb.ca

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Remember the past, plan for the future: How interactions between risk perception and behavior during the COVID-19 pandemic can inform future Canadian public health policy

Moira A. Law, Jonathan M. P. Wilbiks*, Sean P. Roach and Lisa A. Best

Department of Psychology, University of New Brunswick Saint John, Saint John, NB, Canada

The ongoing COVID-19 pandemic necessitated the implementation of numerous temporary public health policies, including social distancing, masking, and movement limitations. These types of measures require most citizens to follow them to be effective at a population level. This study examined population adherence to emergency public health measures using early data collected in the Spring of 2020, when all Canadian jurisdictions were under relatively strict measures. In total, 1,369 participants completed an online questionnaire package to assess adherence, perceptions of government response, and perceptions of COVID-19 risk. Results indicated that most Canadians were pleased with the government's handling of the early phases of the pandemic and immediately engaged new public health mandates. Willingness to change behaviors was unrelated to satisfaction with the government response. Similarly, behavioral adherence was also unrelated to satisfaction with government, or personal risk perceptions; however, adherence to public health guidelines was related to elevated psychological distress. As the pandemic continues, public health officials must balance the mental health of the population with the physical health concerns posed by COVID-19 when applying public health mandates.

KEYWORDS

COVID-19, public health policy, collective behavior, behavioral adherence, public mental health

Introduction

The current COVID-19 pandemic has been a novel situation with many unknowns, including how individuals would respond to the pandemic itself and how they would respond to associated public health recommendations, guidelines, and policies. Although public health measures vary in their effectiveness and can have effects on both physical and mental health (1, 2), adherence is typically high in emergency situations; for example, Tracy et al. (3) reported that when quarantine is required, the public generally supports governmental decisions. Nonetheless, because even the implementation of less restrictive measures can lead to distress among Canadian populations (4), public health authorities must strike a balance between physical and mental health risks. An understanding of how individuals perceive government responses to pandemics and, importantly, how that relates to their adherence with public health policies is vital. Although preventative regulations focus on preventing transmission of the SARS-CoV-2 virus, population-level adherence to such measures can be influenced by several factors that vary widely depending on global location; these factors include psychological wellbeing, personal risk perception, as well as impressions of government competence and health care system capacity. For instance, many countries in the Global South did not have the economic and organizational capacity to swiftly respond to the current pandemic, hence their citizenry's initial behavioral adherence reflected their vulnerable circumstances, such as poor employment conditions, as well as perceptions of government and interpersonal characteristics, including risk perception (5–7).

Although perceptions of specific health measures influence adherence to behaviors (8, 9), the factors influencing this relationship are not fully clear. Although increased risk perception, fear, and anxiety are associated with preventive actions, including frequent handwashing, social distancing, and self-isolation (2, 10, 11), higher adherence is not always associated with greater risk of disease spread. For example, during the 2009–2010 H1N1 outbreak of influenza in Hong Kong, although the risk of individuals contracting disease was low there was a widespread acceptance of avoidance behaviors (12).

During the H1N1 epidemic in Beijing, Xu and Peng (13) used a longitudinal design to examine people's perceptions of the disease and their behaviors at various stages of the pandemic. During the pre-pandemic phase, behaviors recommended by public health officials to reduce transmission were inversely related to personal risk perceptions, such that those persons with higher estimates of their own risks associated with contracting the disease, were less likely to engage in the recommended behaviors. During the rising phase, there was a positive relationship; individuals who believed they were at risk of infection were *more* likely to engage in such behaviors. Finally, at the peak of the pandemic, the association between risk perception and adherence was less clear; social distancing was positively associated with perceived risk, but hand hygiene was not. Thus, further investigation is required to clarify the factors that govern adherence to public health policies in emergency situations.

The purpose of this study was to examine the relationships between risk perception, psychological distress, perceptions of government performance, and behavioral adherence to public health directives during the COVID-19 pandemic in Canada, March 31–April 15, 2020. Research during the COVID-19 pandemic has indicated that women exhibit higher adherence to public health measures (5, 14), higher COVID-19 risk perceptions (15) and more psychological distress (16). Hence, we also surveyed sex difference among the observed associations.

Method

Participants

In total, 297 males and 1,072 females completed an online questionnaire package. The mean age of females was slightly lower than that of the males $M_{age} = 40.61$, $SD = 14.76$ vs. 43.48, $SD = 17.29$; $t_{(1,367)} = 2.85$, $p = 0.01$. In addition, 12 participants identified as neither male nor female and these participants were significantly younger, $M_{age} = 34.17$, $SD = 15.35$. Most participants reported that they were Caucasian, $n = 1{,}295$; 93.5%; 2.5% of participants reported that they were East Asian or Asian and ∼1% of participants reported that they were Black. Most participants were currently enrolled ($n = 257$) in or completed ($n = 551$) post-secondary education programs, with 464 participants who were enrolled in or had completed a graduate or professional program.

Materials

Behavioral adherence was measured using seven items rated on a 4-point Likert scale ranging from "always" to "never." Items assessed specific aspects of social distancing (e.g., I avoid crowded places) and hygiene behaviors (e.g., hand washing). For each item, participants also indicated (yes or no) if their behavior had changed because of COVID-19, with lower scores indicating higher adherence. The Cronbach's α was 0.76 and 0.64 for the adherence behaviors and change items, respectively.

Risk perception was evaluated using a five-item questionnaire rated on a five-point Likert scale (1 = strongly disagree) to assess perception of risk related to the virus, e.g., "I believe there is a high risk of death if someone contracted COVID-19." This measure had adequate reliability, with Cronbach's α = 0.72. COVID-19 Worry was assessed using

five questions adapted from Lau et al. (17). Participants used a 5-point Likert scale (1 = strongly disagree) to rate their panic, depression, and emotional stability as well as the degree to which they were worried about their personal and family safety. The reliability of this measure was high, Cronbach's $\alpha = 0.82$.

Public perception of government performance was assessed using a seven-item self-report questionnaire. Based on a scale from 1 to 10, with 5 considered a passing grade, participants assessed government performance reporting on how satisfied they were with the measures being taken to prevent the spread of the virus, the timeliness of measures, and the effectiveness of implemented measures.

Procedure

Data collection for this study took place between March 31 and April 15, 2020 when strict social distancing regulations were implemented in all Canadian provinces and territories. Participants were recruited from social media sites (i.e., Facebook, Twitter) and were directed to an online survey platform (Qualtrics). We recruited broadly and our questionnaire did not include questions to examine individual history of COVID-19 infection. After providing informed consent and answering basic demographic questions, participants completed the randomized questionnaire package. Questionnaire completion took ∼12 min. This study was reviewed and approved by the University of New Brunswick Research Ethics Board.

Data analysis strategy

SPSS V. 28 was used for data analysis. Prior to data analysis, data conditioning was conducted to ensure there were no out-of-range values or missing data. The assumptions underlying the statistical tests were examined. Correlational analyses were used to examine the associations between risk perception, psychological distress, perceptions of government performance, and behavioral adherence. *T*-tests were used to examine specific gender differences and a mixed model analysis of variance (ANOVA) was used to examine adherence as a function of gender and education.

Results

Canadians exhibited overall satisfaction with their government, with responses on the government performance questionnaire indicating a higher than acceptable rating ($M = 5.42$, $SD = 1.15$) (see Table 1 for descriptive statistics and correlations between study variables). A correlational analysis indicated that mean perception of Government Performance was significantly associated with lower overall Risk Perception, $r_{(901)} = -0.12$, $p < 0.001$, as well as perceived Personal, $r_{(900)} = -0.09$, $p = 0.005$, and Family, $r_{(899)} = -0.10$, $p = 0.002$, risk of contraction. Mean Risk Perception was associated with adherence to Personal Hygiene guidelines, $r_{(892)} = -0.09$, $p = 0.01$, but not with adherence to Social Distancing guidelines, $r_{(890)} = -0.03$, $p = 0.40$. Correlational analyses were also conducted to determine if negative psychological outcomes were related to adherence to government directives for social distancing and personal hygiene. The correlations between overall COVID-19 Worry and Social Distancing, $r_{(896)} = -0.12$, $p = 0.001$, and Personal Hygiene, $r_{(896)} = -0.12$, $p < 0.001$, indicated that individuals who experienced more COVID-19 Distress were more likely to follow guidelines.

Mean satisfaction with Government Performance was 5.42 ($SD = 1.15$); <20% of participants rated Government Performance negatively (Figure 1). Although there was no difference in satisfaction among males and females ($M = 5.33$ and 5.45, respectively; independent samples *t*-test: $t_{(1,110)} = 1.39$, $p = 0.17$), there was a statistically significant correlation between age and satisfaction with Government Performance, $r_{(1,382)} = 0.102$, $p < 0.001$, indicating that older participants reported higher satisfaction than did younger participants.

In addition to being satisfied with the governmental response, respondents were optimistic about the ability of the local health care system to manage the pandemic. Respondents reported that their local health system had sufficient space, $M = 3.82$, $SD = 1.12$, enough medical personnel, $M = 3.77$, $SD = 1.10$, and adequate personal protective equipment, $M = 4.01$, $SD = 1.04$. Further, participants believed that the Canadian government would be able to control the current pandemic, $M = 3.14$, $SD = 1.04$, although there was less confidence in the ability to manage a large scale COVID-19 outbreak, $M = 3.02$, $SD = 1.10$.

Virtually all participants reported that their behaviors had changed due to government directives and reflected social distancing and personal hygiene recommendations. Participants reported that their social distancing and personal hygiene behaviors changed in response to the pandemic (average reported change was 85.5%). Although there were sex differences in social distancing, the degree of behavioral change in response to COVID-19 was similar for males and females. The degree of behavior change varied across measures, with greater change for social distancing measures (e.g., respecting social distancing guidelines) and less change for food sharing, likely because participants avoided food sharing prior to the pandemic. Further, although there were differences in how satisfied participants were with specific governmental responses, dissatisfaction with the government did not affect the behavioral changes associated with preventing COVID-19.

Compared to males, females were more likely to comply with social distancing, $t_{(1,114)} = 3.08$, $p = 0.002$, and hygiene, $t_{(1,111)} = 3.10$, $p = 0.002$, guidelines. Further, correlational

TABLE 1 Mean (standard deviation) and correlations between variables of interest.

	Risk perception	COVID-19 worry	Government performance	Adherence: social avoidance	Social avoidance change	Adherence: hygiene	Hygiene change
Mean (sd)	3.08 (0.76)	3.41 (0.91)	5.42 (1.15)	3.71 (1.40)	0.76 (0.23)	1.26 (0.49)	0.81 (0.40)
Risk perception		0.444***	−0.125***	−0.014	0.054	−0.086**	0.006
COVID-19 worry			−0.067*	−0.109**	0.156***	−0.118***	0.142***
Government performance				−0.035	0.022	0.020	0.025
Social avoidance					−0.001	0.285***	−0.010
Social avoidance Change						−0.011	0.356***
Hygiene							0.100**

*p < 0.05, **p < 0.01, ***p < 0.001.
Social Avoidance and Hygiene were reverse scored, such that lower numbers indicated increased adherence.

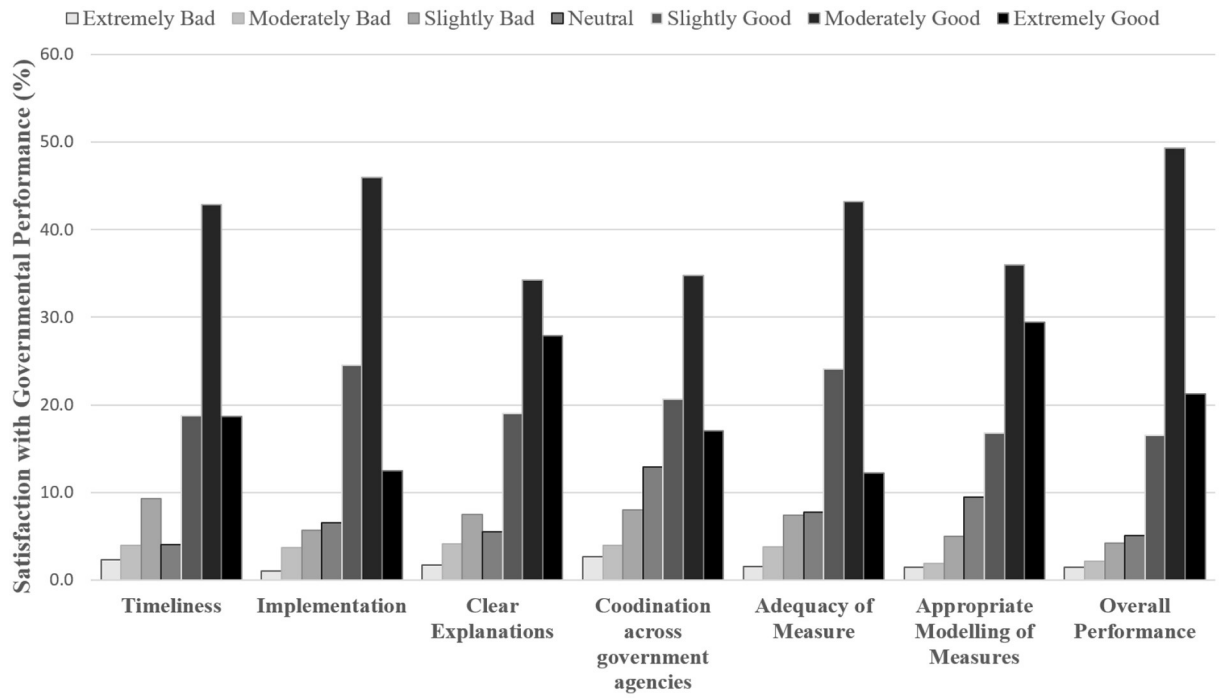

FIGURE 1
Satisfaction of participants with government measures (N = 1,386).

analyses indicated that older individuals were more likely to be satisfied with overall government performance, $r_{(1,110)} = 0.10$, $p < 0.001$, and adhere to social distancing, $r_{(1,113)} = 0.13$, $p < 0.001$, guidelines. To control for potential effects of age, a partial correlational analysis was used to examine the association perceived government performance and compliance with recommendations in the overall sample. The partial correlations between perceived satisfaction with government performance and overall compliance were not significantly associated with social distancing, $r_{(873)} = -0.036$, $p = 0.29$, or personal hygiene, $r_{(873)} = 0.04$, $p = 0.26$.

To examine specific differences in adherence to government directions as a function of demographic variables a 2 (sex) × 2 (education: university vs. no university) × 2 (measure type: social distancing, hygiene) mixed model analysis was conducted (see Table 2). There were statistically significant main effects

TABLE 2 Mean differences (and standard deviations) in adherence of government guidelines as a function of sex and education.

	No university education			University education		
I avoid...	**Males**	**Females**	**Total**	**Males**	**Females**	**Total**
...crowded places (i.e., to practice social distancing).	1.31 (0.56)	1.17 (0.42)	1.20 (0.46)	1.18 (0.46)	1.15 (0.41)	1.15 (0.42)
...going out unless necessary.	1.38 (0.63)	1.28 (0.55)	1.30 (0.57)	1.41 (0.63)	1.25 (0.54)	1.28 (0.57)
...shaking hands.	1.67 (1.00)	1.38 (0.78)	1.45 (0.84)	1.62 (0.97)	1.46 (0.83)	1.49 (0.86)
...sharing my food and drinks.	1.52 (0.76)	1.49 (0.72)	1.49 (0.73)	1.46 (0.66)	1.46 (0.67)	1.46 (0.68)
...sitting directly next to someone.	1.71 (0.88)	1.60 (0.78)	1.62 (0.81)	1.71 (0.87)	1.59 (0.82)	1.62 (0.83)
Social avoidance mean	1.52 (0.52)	1.38 (0.48)	1.41 (0.49)	1.48 (0.51)	1.38 (0.48)	1.40 (0.49)
I practice proper hygiene and regularly wash hands, minimum 20 s.	1.34 (0.54)	1.19 (0.42)	1.23 (0.45)	1.36 (0.55)	1.26 (0.51)	1.28 (0.52)

Adherence was rated on a 1 (always) to 4 (never) scale, with lower scores indicating higher adherence to guidelines.

of sex, $F_{(1,1106)} = 16.54$, $p < 0.001$, with females exhibiting greater overall compliance, and measure type, $F_{(1,1,106)} = 50.65$, $p < 0.001$, with participants reporting higher compliance with social distancing guidelines than with personal hygiene.

Discussion

During the initial stages of the COVID-19 pandemic, between March 31 and April 15, 2020, most Canadians (80%) surveyed were satisfied with the performance of their government. Notwithstanding limitations of generalizability due to this survey being launched on social media platforms this high approval rating was similar to a global sample of 25,992 adults aged 18–74 years surveyed during the week of April 23–26th that reported comparable satisfaction rates of their government response by Canadians (81%), Indians (87%), and Australians (84%); and much higher than Japanese (31%), Russians (38%) and French (43%) citizens (18). The absence of a gender difference with respect to government satisfaction was surprising given the documented disparities women have experienced during this state of emergency in terms of caregiving responsibilities (19), perceived risks to family members (4) and employment disruptions (20). Perhaps the anticipated gender differences would have emerged if data collection was longer than 2 weeks and later in the pandemic (21, 22). Another notable limitation of this study is the high number of female respondents, 78% (n = 1,072), reducing the generalizability of our findings and marking the need for replication with more representative samples. Higher female participation may have led to higher rates of reported psychological distress, behavioral adherence, and risk perceptions in this study (5, 22–26).

Most participants (85%) reported immediately changing their behaviors due to the pandemic, exhibiting widespread adherence to social distancing and personal hygiene recommendations. Interestingly, although there was no sex difference in governmental satisfaction, females adhered more closely than males to all public health policies from March 31–April 15, 2020. These findings are similar to studies conducted in March 21–26, 2020 (14) and March to December 2020 (5) and align with an earlier study that found women had higher risk perceptions for family members than for themselves during the earliest days of this outbreak; it was for the safety of loved ones rather than themselves that motivated behavioral changes (4). One year later, distressed concern for loved ones continued (23, 27) and may support public health maintaining a focus on compassionate messaging to motivate adherence behaviors as the pandemic continues (24, 25).

A notable limitation of this study is the high proportion of respondents with some or completed post-secondary education limiting the conclusions that can be drawn for the broader population. Unlike other studies that found higher adherence was related to higher levels of education (26, 28, 29), the current results did not indicate an association between levels of education and adherence to public health guidelines suggesting initial adherence may have been primarily motivated by emotional response rather than reason (30).

Global fear quickly rose as mainstream and social media's growing coverage on the spread of the SARS-CoV-2 virus abroad may have been affecting Canadian citizens well before March 2020 when the country went into lockdown (31). The current pandemic led to unprecedented connectivity to sources of information that were both reliable, e.g., public health briefings, and unreliable, e.g., social media, often to the detriment of the public's wellbeing (32, 33). Misinformation became mainstream (34) and even peer-reviewed scientific publications that generated initial overestimations of infection mortality rates contributed to the public's mounting angst (35). The interplay of social contagion via social media and disease spread may have been contributing to growing fear (36) that directed early adherence behaviors measured in this study and detected in other studies in the same time frame (4, 30, 33) neutralizing any effects of education and critical thinking early at this stage in this pandemic. Later studies provided compelling evidence that education is a moderator of employment conditions that affords

more choice in social distancing requirements (37, 38), giving rise to a significant disparity between the "laptop class" and front line workers (39) that may require government and public health coordination when considering social mitigation in the future, i.e., enhanced social assistance.

Older Canadians reported higher satisfaction and behavioral adherence with the government's early response to the pandemic, perhaps reflecting their knowledge of being at greater risks for adverse COVID outcomes (31) and their relief to see governmental responses unfolding quickly and in a unified manner (40). With most Canadian COVID-19 deaths reported among seniors (41) since this early data was collected it is expected adherence in this population will remain high. Strikingly, there was no relationship between government satisfaction and adherence with public health guidelines, which highlights the need for a better understanding of the factors and context influencing adherence behaviors that are vital to successful pandemic mitigation.

Individuals with an overall lower perception of personal and family risk assessed the government's response more positively, suggesting public health officials would be wise to deescalate the public's personal risk perceptions by continuing to provide timely and accurate information during future outbreaks (42). Surprisingly, overall risk perception was not associated with social distancing behaviors, e.g., standing 2 m apart, but significantly related to personal hygiene, e.g., hand washing directives. This was the opposite of findings from the peak of the H1N1 outbreak, in which social distancing was positively associated with perceived risk but hand hygiene was not (13). This is interesting as hygiene behaviors, such as hand washing (43, 44) and sneezing into elbow (45), have a well-established evidence base compared with social distancing behaviors (46). Future pandemic investigations should consider the extrinsic and intrinsic motivation of adherence behaviors across genders, different age groups, and those with elevated risk perceptions.

Finally, and not surprisingly, individuals who experienced elevated levels of worry and distress were more likely to adhere to public health guidelines and report that their behaviors changed in response to the current pandemic as noted in previous pandemics (2, 10, 11). Despite these results, public health officials should be reminded that excessive and prolonged stress interferes with adherence (47–50) and mental health professionals have been sounding the alarm on elevated mental health conditions as the pandemic has progressed (51–54). In addition to guidelines designed to curtail disease spread as new variants of the SARS-CoV-2 virus emerge, managing risk perceptions for various subpopulations, and incorporating broader definitions of health that supersede single factor analysis, e.g., physical health (40, 41) need to become integrated into public health management plans.

Canadian policy makers need to be cognizant of co-operating within international frameworks that will serve Canadians and other countries well and remain aware of issues regarding vaccine availability, systemic disadvantages, and daily individual struggles that are commonplace in other countries (55). Moderate policies that are not too strong or too weak optimize desired health outcomes (56). For instance, policies that reduce social contacts to a moderate level and avoid full lockdowns may achieve outcomes that protect the healthcare system and avoid economic consequences (57) while avoiding severe conditions that exacerbate psychological distress. This relationship between psychological distress and adherence to public health directives warrants continued monitoring as the effects of prolonged mitigation may evolve into serious pathology and adherence behaviors deteriorate due to psychological fatigue. In short, the secondary impacts of social mitigation, such as deterioration in mental health (4) and economic repercussions (46, 57) must be heavily factored into public health plans as the country continues to move forward.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Research Ethics Board at the University of New Brunswick Saint John. The patients/participants provided their written informed consent to participate in this study.

Author contributions

LB analyzed the data and created figures. ML wrote the initial draft of the manuscript. JW, SR, and LB revised the manuscript. All authors conceptualized the paper, designed the method, and collected data and have reviewed and approved the final submission.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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EDITED BY
Xenia Gonda,
Semmelweis University, Hungary

REVIEWED BY
Min Tan,
Affiliated Hospital of North Sichuan Medical College, China
Mahlagha Dehghan,
Kerman University of Medical Sciences, Iran

*CORRESPONDENCE
Caixia Xie
xiecaixia1999@163.com
Limei Liao
limeiliao@uestc.edu.cn

†These authors have contributed equally to this work

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Prevalence and influencing factors of psychological distress among nurses in sichuan, china during the COVID-19 outbreak: A cross-sectional study

Caixia Xie[1,6*†], Jia Zhang[2,6†], Jia Ping[2,6†], Xinyu Li[3,6], Yu Lv[4,6] and Limei Liao[5*]

[1]Department of Nursing, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [2]Department of Neurosurgery, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [3]General Practice Center, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [4]Department of Healthcare-Associated Infections Control Center, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [5]School of Medicine, University of Electronic Science and Technology of China, Chengdu, China, [6]Chinese Academy of Sciences Sichuan Translational Medicine Research Hospital, Chengdu, China

Background: The COVID-19 pandemic has spread across the world. Nurses have inevitably been influenced by it.

Purpose: To investigate the prevalence and influencing factors of psychological distress among nurses in Sichuan, China over the COVID-19 outbreak.

Methods: This study used a cross-sectional survey design. Thousand eight hundred and seventy nurses who worked in COVID-19-designated hospitals participated in the study during the pandemic. Data was collected online between February 8 and February 13, 2020. The self-designed General Information Questionnaire, the General Health Questionnaire-12, the Perception of Hospital Safety Climate Scale, and the Simplified Coping Style Questionnaire were used. The binomial logistic regression model was applied to assess the association between psychological distress and potential explanatory variables.

Findings: At the beginning of the epidemy of the COVID-19 outbreak, 12% of nurses were found to experience psychological distress. The main influencing factors were personal precautionary measures at work, discomfort caused by protective equipment, perception of the hospital safety climate, coping style, and professional title.

Conclusions: In the pandemic, wearing protective equipment correctly, a safe hospital climate, and positive coping style for nurses could be beneficial for nurses' mental health. Nurse managers should take measures to build a safe hospital climate.

KEYWORDS

mental health, nurses, COVID-19, psychological distress, prevalence and influencing factors

Introduction

The coronavirus (COVID-19) outbreak began in December 2019, resulting in significant loss of life across the world. Level 1 emergency status, the highest level, was announced, with the strictest infection control measures implemented. Sichuan, China, was affected by several cases from Wuhan and local transmission. Nurses were the primary implementers of the protective measures taken to control COVID-19 in Sichuan (1). In all three major coronavirus outbreaks of the last two decades (SARS, Ebola, and COVID-19), nurses' mental health has been affected (2). It was reported that during the COVID-19 outbreak, 34.4% of the medical and nursing staff working in Wuhan had mild psychological distress, 22.4% had moderate psychological distress, and 6.2% had severe psychological distress (3).

Psychological distress is an unpleasant emotional experience caused by several psychological (cognitive, behavioral, emotional), social, and spiritual factors. It can develop from and involve vulnerability, sadness, fear, anxiety, depression, social separation, and spiritual crisis (4). Psychological distress is reported to cause adverse effects on physical health including lowered immunity (5, 6), the inability to make the most accurate and optimal decisions for patients, which might impair their safety (7), reduced job and life satisfaction, and tension in interpersonal relationships (8, 9). Paying attention to the mental health of nurses during COVID-19 and exploring its influencing factors is essential for the formulation of mental health promotion strategies for nurses at both the individual and organizational levels. These will help nurses reduce any possible psychological distress and improve their mental health.

During the pandemic period of COVID-19, the psychological distress of nurses was affected by numerous individual and work-related factors, including their personality characteristics, age, gender, marital status, years of work experience, level of exposure to affected patients, self-efficacy, and presence of physical symptoms (2, 10, 11). However, the above studies did not explore whether characteristics of the workplace, such as the supply of protective materials, application of protective measures, and any possible discomfort caused by protective equipment, were influencing factors contributing to nurses' psychological distress.

Perception of a hospital's safety climate refers to employees' overall perception of the safety of their working environments (12). It was suggested that the perception of hospital climate may be related to nurses' psychological distress. Coping style refers to the method of dealing with stress and maintaining psychological balance. For nurses, participation in work related to COVID-19 is a significant stressor. It is suggested that nurses' different coping styles may have an impact on their psychological distress. Therefore, it is necessary to explore the influence of the supply of protective materials in the workplace, the application of personal protective measures, discomfort caused by protective equipment, perception of hospital safety climate, and coping style on nurses' psychological distress.

The main objectives of this study were to (1) describe the psychological distress of Chinese nurses in COVID-19-designated hospitals in Sichuan during the COVID-19 outbreak and (2) examine the main factors of psychological distress with a focus on work status, perception of hospital safety climate, and coping styles.

Methods

Design

This study used a cross-sectional survey design.

Participants

The sample size of logistic regression (binary outcome) generally follows the principle of 10 events per variable. There were 13 independent variables to be included in this study, so the number of positive events was at least $14 \times 10 = 130$. As per past research, when SARS broke out, the incidence of psychological distress among nurses was 27.5% (13). Therefore, we used a positive event rate of 27.5% for the sample calculation. Considering the loss of 10–20% of the sample, the minimum sample size required for this study was $N = 14 \times 10 \times (1+0.2) \div 27.5\% = 611$.

From February 8 to February 13, 2020, during the COVID-19 outbreak in China, a convenient sampling method was used. One COVID-19-designated hospital each from five regions, East, South, West, North and middle, of the Sichuan Province were selected. Nurses from these five hospitals were invited to participate in the study, and 1,870 nurses volunteered.

Data collection

Data was collected online through the Questionnaire Star platform, an online survey tool similar to Survey Monkey. Information about the investigation and the survey quick response code were sent through WeChat, a web-based social media application, to nurse managers in the five hospitals. This was then distributed to the nurses. The number of answers provided by the same IP address was limited, and each IP address could only answer the survey once. Therefore, repeat submissions and invalid data were effectively controlled. Four main questionnaires were used in this study. They are outlined as follows:

The general information questionnaire

The GIH is a self-designed instrument for demographic information and work status during the COVID-19 pandemic. The demographic characteristics included sex, age, marital status, number of children, nursing educational background, work year, and professional title. The work status information focused on direct contact with confirmed or suspected COVID-19 patients, the supply of protective materials in the workplace, application of personal protective measures, and any possible discomfort caused by protective equipment.

The general health questionnaire-12 (GHQ-12)

Psychological distress was measured using the 12-item GHQ-12, which is a widely used self-administered tool for emotional distress derived from the original 60-item version (14, 15). It consists of six positively phrased items and six negatively phrased items with four responses each, ranging from "better than usual" to "much less than usual." A cut-off score of four was selected to identify the presence of psychological distress, defined as a break from normal functioning (e.g., loss of sleep, loss of self-confidence, or the inability to make decisions) (16). The reliability of the GHQ-12 in the general population ranged from 0.71 to 0.86 (17). The internal consistency of the GHQ-12 in this study was 0.85.

The perception of hospital safety climate scale (PHSCS)

The perception of hospital safety climate was measured using the revised Chinese version of the PHSCS (18), which was initially used in the context of organizational commitment to management projects to reduce blood-borne pathogen exposure risk (12). It consists of 21 items and five dimensions: management support with six items, obstacles to safe work with three items, feedback and training with six items, cleanliness and tidiness with three items, and conflict and communication with three items. Each item has a score ranging from 1 (strongly diagree) to 5 (strongly agree) as per a 5-point Likert scale. The lower the score, the better the perception of the hospital safety climate. With an assessment of 391 nurses conducted, the internal consistency and retest reliability of the revised Chinese version of PHSCS were reported to be 0.87 and 0.84, respectively (18). The internal consistency of the revised Chinese version of the PHSCS in this study was 0.84.

The simplified coping style questionnaire (SCSQ)

This questionnaire (19) was based on the Ways of Coping questionnaire (20). It is a 20-item self-report questionnaire that includes two dimensions: an positive coping style with 12 items and a negative coping style with eight items. The items measured typical coping attitudes and methods using a four-point Likert scale (0 = never; 1 = sometimes; 2 = often; 3 = always). The SCSQ has been commonly used in China, and its test-retest coefficient is 0.89. The internal consistency coefficients (Cronbach's alpha) were reported to be 0.89 and 0.78 for the active and positive coping dimensions (19). In this study, they were 0.929 and 0.830, respectively.

Ethical considerations

This study was approved by the Human Research Ethics Committee of the Sichuan Provincial People's Hospital (Protocol No. 2020103). Completion of the online survey was considered consent to participate in the study, which was clearly stated in the instructions for the questionnaires.

Data analysis

Analyses were performed using the SPSS 22.0 statistical program (IBM Corp., Armonk, NY, USA). Categorical variables were expressed with frequency and percentages, and continuous variables were expressed using mean and standard deviation (SD). A Pearson's chi-square test and independent Students' *t*-test were performed to identify potential explanatory variables for psychological distress. The binomial logistic regression model was applied to assess the association between psychological distress and potential explanatory variables while adjusting for other identified predictors. This was carried out using a sequential modeling approach. *P*-values <0.05 were considered to be statistically significant.

Results

Participant characteristics

Totally, 1,870 nurses participated in the study. Characteristics of the subjects are presented in Table 1.

Descriptive statistics

Table 2 displays the incidence of psychological distress, scores of perception of hospital safety climate and coping style in nurses. With scores of the GHQ-12 equal to or greater than 4, 225 nurses (12%) experienced psychological distress. The mean and SD of the total score of the PHSCS was 98.1 ± 10.5 with management support dimension of 28.2 ± 3.2; obstacles to safe work of 13.5 ± 2.2; feedback and training of 28.6 ± 2.9; cleanliness and tidiness of 13.6 ± 2.1; and conflict and

TABLE 1 Characteristics of the subjects ($N = 1,870$).

Variable	Frequency (n)	Proportion (%)
Gender		
Male	69	3.7
Female	1,801	96.3
Age (years)		
<25	301	16.1
25∼30	709	37.9
31∼35	417	22.3
36∼40	204	10.9
>40	239	12.8
Marital status		
Unmarried	664	35.5
Married	1,206	64.5
Child/Children's situation		
No	767	41
Yes	1,103	59
Highest education		
College and below	641	34.4
Undergraduate and above	1,229	65.6
Work year		
<5	499	26.7
5–10	730	39.0
11–15	276	14.8
16–20	120	6.4
>20	245	13.1
Professional title		
Registered nurse	498	26.6
Primary	868	46.4
Intermediate	419	22.4
Senior	85	4.5
Protective supplies in your workplace		
Sufficient	130	7.0
Basically sufficient	1,256	67.2
Not Sufficient	484	25.9
Personal precautionary measures at work		
Adequate	713	38.1
Basically adequate	1,026	54.9
Inadequate	131	7.0
Discomfort caused by protective equipment		
No discomfort	606	32.4
Somewhat discomfort	988	52.8
Discomfort	276	14.8
Direct contact with confirmed or suspected cases		
No	169	9.0
Possible	1,371	73.4
Yes	330	17.6

communication of 14.2 ± 1.6. The mean and SD of the SCSQ with positive coping style was 24.7 ± 7.9; and the negative coping was 9.6 ± 5.3. The normality test showed that all quantitative data had normal distributions.

Univariate analysis

Pearson's chi-square tests and independent Student's *t*-tests were performed to identify potential variables for psychological distress. Table 3 compares the characteristics of the subjects between groups with and without psychological distress.

Logistic regression analysis

Logistic regression analysis identified six factors that were significantly associated with the presence of psychological distress (see Table 4). Nurses without any professional title had 48.8% lower odds of developing psychological distress when compared with nurses with a senior professional title (OR 0.512, 95% CI 0.207–1.267). Inadequacy in personal precautionary measures at work resulted in a significantly increased risk of psychological distress (taking "adequate" as a reference, OR 1.753 for "basically adequate," and OR 3.568 for "inadequate"). Discomfort caused by protective equipment was associated with an increased risk of psychological distress (taking taking "No discomfort" as a reference, OR 1.832 for "Somewhat discomfort," and OR 3.137 for "Discomfort"). The higher the score of perception of hospital safety climate and positive coping, the lower the incidence of psychological distress. The higher the score of negative coping, the higher the incidence of psychological distress.

Discussion

The prevalence of psychological distress

One interesting finding of the study was that 12% of the nurse respondents reported experiencing psychological distress, at the beginning of the epidemy of the COVID-19 outbreak. The study was conducted in COVID-19-designated hospitals in Sichuan, which was a region less affected by COVID-19.As of February 2020, it had recorded a total of 539 confirmed cases and three deaths. A recent study found that the prevalence of psychological distress among healthcare workers differed across regions with varying incidences of COVID-19 infections (21). This is reasonable because nurses in Sichuan may potentially feel safer than nurses in Hubei, for example, when evaluating the possibility of receiving a COVID-19 patient, since they are working in a less-affected area.

TABLE 2 Scores of the PHSCS and SCSQ, and percentages of psychological distress.

Variables	*N* (%)	Mean ± SD	Response range
Perception of hospital safety		98. 1 ± 10.5	
Climate			21–105
Management support		28.2 ± 3.2	6–30
Obstacles to safe work		13.5 ± 2.2	3–15
Feedback and training		28.6 ± 2.9	6–30
Cleanliness and tidiness		13.6 ± 2. 1	3–15
Conflict and communication		14.2 ± 1.6	3–15
Positive coping		24.7 ± 7.9	0–36
Negative coping		9.6 ± 5.3	0–24
Psychological distress		1.4 ± 1.7	0–2
No	1,646 (88.0%)		
Yes	224 (12.0%)		

Influencing factors of psychological distress

Personal precautionary measures at work

During COVID-19, taking personal precautionary measures at work was a crucial step for frontline nurses to avoid getting infected (22). The results revealed that the psychological distress of nurses with inadequate personal protective measures was 3.568 times higher than that of nurses with adequate personal protection. This suggests that the implementation of personal protective measures can predict nurses' psychological distress when dealing with such sudden infectious diseases. In this study, personal protective measures referred to the necessary preventive measures in different workplaces based on first-, second-, and third-level protection requirements, which play an important role in isolation protection and reducing the rate of nosocomial infection (23). For instance, the emergency department has to take the first level of protection, requiring nurses to wear work clothes, isolation clothes, work caps, disposable surgical masks, and latex gloves and carry out hand hygiene and standard prevention when caring for patients. In the fever and isolation clinics, nurses should wear medical protective masks, work clothes, protective clothing, work caps, and latex gloves and take droplet isolation and contact isolation based on the requirements of the second-level protection. When performing procedures that may produce aerosol in suspected or confirmed COVID-19 patients, nurses should be equipped with a face mask or comprehensive respirator on the basis of secondary protection, according to the requirements of third-level protection (24, 25). Due to the sudden nature of the outbreak, there was a lack of protection knowledge and skills (26), and thus nurses could not correctly apply protection measures at the beginning of the pandemic. For example, when wearing a protective mask, the air tightness did not meet the requirements needed (27), and when taking off protective clothing, exposure behavior often occurred (28). Therefore, it is particularly important to strengthen nurses' training in the correct implementation of protective measures (29).

Discomfort caused by protective equipment

The results of this study showed that more than half the nurses experienced some discomfort, and 14.8% of nurses felt constant discomfort, due to protective equipment. The psychological distress of nurses who felt discomfort caused by protective equipment was 3.14 times higher than that of nurses who did not feel it. Nurses must wear medical protective equipment to avoid catching COVID-19. This can cause several types of discomfort, such as (1) stuffiness and dyspnea, (2) decreased visual clarity and operation sensitivity, (3) insufficient diet and water intake at work, (4) facial pressure injury (30), and (5) a variety of skin problems such as acne, seborrheic dermatitis, and dry skin (31). In addition, the use of facial coverings also impairs direct communication and eye contact between nurses, their colleagues, and patients (32). Therefore, it is important to explore safe and effective strategies to reduce the discomfort and inconvenience caused by protective devices.It was proposed that the prophylactic use of thin hydrocolloid dressings on the bridge of the nose could effectively protect against pressure injuries when protective devices were used (33). Measures such as sweat absorption clothing and antiperspirant can be used to improve comfort and ease the burden faced by medical staff wearing protective clothing. Anti-fogging agents and indwelling films can work well to minimize goggle fogging (34). Research on the improvement of protective equipment, including protective masks and goggles, should be carried out in the future. It is also necessary to explore effective training and management strategies that will help reduce the discomfort caused by incorrect wearing of protective devices.

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TABLE 3 Univariate analysis of psychological distress in nurses.

	No. of respondents				Statistics	
	No psychological distress (*n*, %) (*n* = 1,645)	Psychological distress (*n*, %) (*n* = 225)	No psychological distress (Mean ± SD) (n = 1,645)	Psychological distress (Mean ± SD) (n = 225)	χ/t	*P*-value
Gender					2.593	0.107
Male	65 (4.0%)	4 (1.8%)				
Female	1,580 (96%)	221 (98.2%)				
Age (years)					38.454	<0.001
<25	286 (17.4%)	14 (6.2%)				
25∼30	198 (12%)	41 (18.2%)				
31∼35	642 (39%)	67 (29.8%)				
36∼40	351 (21.4%)	66 (29.3%)				
>40	168 (10.2%)	37 (16.5%)				
Marital status					15.957	<0.001
Married	1,034 (62.9%)	172 (76.4%)				
Unmarried	611 (37.1%)	53 (23.6%)				
Child/Children					24.058	<0.001
no	709 (43.1%)	58 (25.8%)				
yes	936 (56.9%)	167 (74.2%)				
Highest education					5.131	0.024
College and below	579 (35.2%)	62 (27.6%)				
Undergraduate and above	1,066 (64.8%)	163 (72.4%)				
Work year					32.221	<0.001
<5	644 (39.1%)	86 (38.2%)				
5–10	468 (28.4%)	30 (13.3%)				
11–15	232 (14.1%)	45 (20%)				
16–20	98 (6%)	22 (9.8%)				
>20	203 (12.4%)	42 (18.7%)				
Professional title					34.071	<0.001
Registered nurse	460 (28%)	38 (16.9%)				
Primary	775 (47.1%)	94 (41.8%)				
Intermediate	347 (21%)	72 (32%)				
Senior	64 (3.9%)	21 (9.3%)				
Protective supplies in your workplace					35.984	<0.001
Sufficient	120 (7.3%)	10 (4.5%)				
Basically sufficient	1,136 (69.1%)	120 (53.3%)				
Not Sufficient	389 (23.6%)	95 (42.2%)				
Personal precautionary measures at work					60.909	<0.001
Adequate	670 (40.7%)	43 (19.1%)				
Basically adequate	881 (53.6%)	145 (64.4%)				
Inadequate	94 (5.7%)	37 (16.5%)				
Discomfort caused by protective equipment					54.827	<0.001
No discomfort	572 (34.8%)	34 (15.1%)				
Somewhat discomfort	861 (52.3%)	128 (56.9%)				

(Continued)

TABLE 3 Continued

	No. of respondents				Statistics	
	No psychological distress (*n*, %) (*n* = 1,645)	Psychological distress (*n*, %) (*n* = 225)	No psychological distress (Mean ± SD) (n = 1,645)	Psychological distress (Mean ± SD) (n = 225)	χ/t	*P*-value
Discomfort	213 (12.9%)	63 (28%)				
Direct contact with confirmed or suspected cases						
No	1,241 (75.4%)	130 (57.8%)			31.566	<0.001
Possible	137 (8.3%)	32 (14.2%)				
Yes	267 (16.3%)	63 (28%)				
Perception of hospital safety climate			99.0 ± 10.0	91.6 ± 12.0	10.141	<0.001
Positive coping			25.1 ± 7.9	21.7 ± 6.6	6.252	<0.001
Negative coping			9.4 ± 5.4	11.0 ± 4.2	−4.222	<0.001

TABLE 4 Logistic regression analysis of psychological distress on nurses.

Variable	B	Standard Error	Wald	*P*-value	OR	95% CI
Professional title						
Senior					1.000	
Intermediate	−0.774	0.348	4.963	0.026	0.461	0.233–0.911
Primary	−1.131	0.394	8.215	0.004	0.323	0.149–0.699
Registered nurse	−0.67	0.462	2.097	0.148	0.512	0.207–1.267
Personal precautionary measures at work						
Adequate					1.000	
Basically adequate	0.561	0.197	8.126	0.004	1.753	1.192–2.578
Inadequate	1.272	0.285	19.881	<0.001	3.568	2.040–6.242
Discomfort caused by protective equipment						
No discomfort					1.000	
Somewhat discomfort	0.605	0.213	8.041	0.005	1.832	1.206–2.784
Discomfort	1.143	0.246	21.519	<0.001	3.137	1.935–5.086
Perception of hospital safety climate	−0.032	0.006	29.437	<0.001	0.968	0.957–0.980
Positive coping	−0.073	0.011	41.519	<0.001	0.930	0.910–0.951
Negative coping	0.095	0.017	29.381	<0.001	1.099	1.062–1.138

Perception of hospital safety climate

Perception of hospital safety climate refers to the employees' overall perception of the working environment, including safety decision making, safety practices, and safety procedures (12). In the 1990's, the "safety climate perception to nurse occupational safety management" (35) was first applied. The study reported that the perception of hospital safety climate directly affected the safety behavior of medical staff. The better the perception of hospital safety climate, the better the occupational protection behavior and the lower the occupational injury rate (36).

The regression analysis showed that the better the nurses' perception of a hospital's safety climate, the lower the incidence of psychological distress. During the pandemic period, nurses' perceptions of hospital safety climates were affected by many factors including the high risk of virus infection (37), sharp increase in the number of patients (38), prolonged working hours, lack of protective equipment, and safety promotion measures taken by hospitals (39). In the face of the pandemic, nurse managers should consider the importance of perception of hospital safety climate a priority for nurses' mental health, and they should take all recommended measures

to improve it in a timely and effective manner. This can include training for greater protection knowledge and skills (40), establishment of an inspection system for protective devices before work, and provision of adequate protective equipment (39).

Coping style

Positive coping refers to positive strategies to eliminate or avoid stressors or decrease stress (41), while negative coping refers to avoidance (e.g., ignoring problems) or deterioration rather than solving problems (42). The results of this study showed that 1,870 nurses had either positive (9.6 ± 5.3) and negative (1.4 ± 1.7) coping scores during the pandemic period, which indicated that the frontline nurses working in the hospital exhibited more positive responses.

Regression analysis of this study showed that positive coping was a protective factor for nurses' mental health, which is consistent with the results of a study by Ilić et al. (43). It may be that, in the pandemic, a sense of professional mission, professional honor (44), professional values (45), and self-esteem (46) helped nurses adopt a variety of positive coping styles (47). Of course, there were also some negative coping strategies demonstrated, such as fear or avoidance of patients with suspected or actual COVID-19 infections. Therefore, nursing managers should pay attention to the coping styles of nurses during such periods and guide them to adopt positive ones. Furthermore, negative coping styles can be reduced through training.

Professional titles

This study shows that the higher the professional title, the more severe the recorded mental health problems are. Those with higher professional titles have to demonstrate stronger critical care thinking abilities (3) and undertake more social roles, which leads to greater psychological pressure. For these reasons, they are more likely to experience psychological distress.

Limitations

Our study has several limitations. First, the study used a cross-sectional design. A causal link between main influencing factors and psychological distress over the COVID-19 outbreak was not established in this study. Second, the data was collected over 5 days at the beginning of the epidemy, without any longitudinal follow-up. With the fluctuation of the pandemic situation, nurses' psychological distress could oscillate.

Conclusions

At the beginning of the epidemy of the COVID-19 outbreak, the incidence of psychological distress was 12%. Personal precautionary measures at work, discomfort caused by protective equipment, perception of hospital safety climates, coping styles, and professional titles were the factors influencing nurses' psychological distress. When dealing with sudden infectious diseases such as COVID-19, nurse managers must ensure that the protective equipment provided is sufficient. They must also train nurses in the correct use of protective equipment while performing actual work. At the same time, medical institutions and nursing managers should take effective measures for safety decision making, safety practices, and safety procedures according to the current pandemic situation and the specific situations of medical institutions so as to improve nurses' perception of the hospital safety climate. Nurse managers should assess whether the mental state of nurses who usually use negative coping styles is suitable for COVID-19 work. The application of these measures may reduce the incidence of psychological distress among nurses during the COVID-19 outbreak. Any possible long-term psychological distress of nurses is worth further investigation.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

CX, JZ, and JP carried out the studies, participated in collecting data, drafted the manuscript and supervision whole process. LL, XL, and YL conducted data analysis and helped to draft the manuscript. All authors read and approved the final version of the manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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EDITED BY
Daria Smirnova,
Samara State Medical University, Russia

REVIEWED BY
Foong Ming Moy,
University of Malaya, Malaysia
Salmi Razali,
Universiti Teknologi MARA, Malaysia

*CORRESPONDENCE
Wendy Wan Ying Tay
drwendytay@gmail.com

†These authors have contributed equally to this work and share first authorship

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Eighteen months into the COVID-19 pandemic: The prevalence of depression, anxiety, and stress symptoms in Southeast Asia and the associated demographic factors

Wendy Wan Ying Tay[1*†], Jehanita Jesuthasan[1†], Kim Sui Wan[2], Tiffanie Ong[1] and Feisul Mustapha[2]

[1]Naluri Hidup Sdn Bhd, Kuala Lumpur, Malaysia, [2]Ministry of Health, Putrajaya, Malaysia

Mental health has become a growing concern in the wake of the COVID-19 pandemic. We sought to determine the prevalence of mental health symptoms 18 months after the pandemic's declaration. Our cross-sectional study conducted among 18- to 65-year-old adults (N = 33,454) in October 2021 using the Depression, Anxiety and Stress Scales (DASS-21) found a high prevalence of severe to extremely severe anxiety (49%), depression (47%) and stress (36%) symptoms in Malaysia, Indonesia, Thailand, and Singapore. Multiple logistic regression showed that female and non-binary genders were associated with increased odds of severe/extremely severe symptoms of anxiety (female: aOR 1.44 [95% CI 1.37–1.52]; non-binary aOR 1.46 [1.16–1.84]), depression (female: aOR 1.39 [1.32–1.47]; non-binary aOR 1.42 [1.13–1.79]), and stress (female: aOR 1.48 [CI 1.40–1.57]; non-binary aOR 1.42 [1.12–1.78]). In all three symptom domains, the odds of severe/extremely severe symptoms decreased across age groups. Middle- and high-income respondents had lower odds of reporting severe/extremely severe anxiety (middle-income: aOR 0.79 [0.75–0.84]; high-income aOR 0.77 [0.69–0.86]) and depression (middle-income: aOR 0.85 [0.80–0.90]; high-income aOR 0.84 [0.76–0.94]) symptoms compared to low-income respondents, while only middle-income respondents had lower odds of experiencing severe/extremely severe stress symptoms (aOR 0.89 [0.84–0.95]). Compared to residents of Malaysia, residents of Indonesia were more likely to experience severe/extremely severe anxiety symptoms (aOR 1.08 [1.03–1.15]) but less likely to experience depression (aOR 0.69 [0.65–0.73]) or stress symptoms (aOR 0.92 [0.87–0.97]). Respondents living in Singapore had increased odds of reporting severe/extremely severe depression symptoms (aOR 1.33 [1.16–1.52]), while respondents residing in Thailand were more

likely to experience severe/extremely severe stress symptoms (aOR 1.46 [1.37–1.55]). This study provides insights into the impacts of the COVID-19 pandemic on the point prevalence of psychological distress in Southeast Asia one and a half years after the beginning of the pandemic.

KEYWORDS

mental health, COVID-19, anxiety, depression, stress

Introduction

Mental health is a growing concern around the world. In the wake of the COVID-19 pandemic, significant concerns about its impact on mental illness have been raised. Social distancing measures, designed to limit the spread of the virus, and their accompanying impact on social support systems, can contribute to increased depression and anxiety. Moreover, psychological distress can also emerge from fears of infection and loss of employment resulting from economic instability (1).

During the pandemic, screen time increased dramatically, owing to reduced opportunities for face-to-face interaction and offline activities. These changes are likely to have also had a significant effect on mental health, given the association between internet usage and both depression and anxiety (2). Social media use in particular has been found to increase psychological distress. For example, high levels of social media usage, including addictive and compulsive use, and using large numbers of social media sites, can trigger social media fatigue, and, in turn, anxiety and depression (3–6). Moreover, high exposure to COVID-19 information online was shown to have a detrimental impact on mental health, particularly on anxiety symptoms (7–9).

In Southeast Asia during the COVID-19 pandemic, prevalence rates of anxiety and depression have been reported to be 31% and 16% for anxiety and depression, respectively, among the general population (10). Crucially, rates may be even higher among internet users specifically, for the reasons outlined above. Indeed, rates of problematic mental health symptoms in an Australian internet-based sample in March to April 2020 were especially high, at 79% (11). This highlights the importance of examining the prevalence of psychological distress among internet users.

Given the widespread impact of the pandemic on mental health, it is also crucial to identify the groups most affected. This can enable the development and delivery of support tailored to these individuals, in an effort to move toward precision public health. Studies have demonstrated that the impacts of the pandemic have not been equal across demographic groups. Wang et al.'s (12) study on the general population of seven Asian countries found that depression, anxiety, and stress scores varied between countries, age groups, genders, and education backgrounds. However, much of the research describing rates of psychological distress during the COVID-19 pandemic was conducted in the immediate months after the pandemic was announced (13, 14). The public health situation is perpetually evolving with new waves of outbreaks, changing social and movement restrictions, and increasing vaccination coverage. Consequently, the mental health status of the population should continue to be monitored to understand how the mental health impact of the pandemic is changing.

Our study therefore aims to determine the point prevalence of depression, anxiety, and stress symptoms in a Southeast Asian internet-based sample 18 months after the declaration of COVID-19 as a global pandemic and identify the factors associated with severe to extremely severe levels of these symptoms.

Method

Design and participants

This cross-sectional study was conducted in October 2021 using an online survey distributed to individuals in four countries in Southeast Asia, namely Malaysia, Indonesia, Singapore, and Thailand. Respondents were working-age adults (18- to 65-years-old) recruited through paid advertisements on social media platforms (Instagram and Facebook) and on Google Search and Google Display to complete the online survey on Naluri's website. There were no tokens or services provided for their participation in this study. Naluri is a Southeast Asian digital health company providing structured multidisciplinary health coaching to support and improve physical and mental health. Respondents who were outside of the target age range, lived outside of the four target countries, or did not answer all demographic questions were excluded.

Ethics approval was obtained from the Sunway Research Ethics Committee (ID 014/2021/IND/ER). All respondents provided digital informed consent and no personally identifiable information was collected.

Measures and instruments

The survey was composed of two parts: a demographics questionnaire and the 21-item Depression, Anxiety, and Stress Scales (DASS-21) (15). The demographics questionnaire asked

respondents to report their gender, year of birth, country of residence, and household income. Three domains of respondent's mental health (depression, anxiety, and stress) were measured using the DASS-21. The DASS-21 is a self-report questionnaire that includes three scales corresponding to the depression, anxiety, and stress domains of mental health. The depression scale assesses anhedonia, hopelessness, low energy, and dysphoria. The anxiety scale refers to autonomic arousal, including agitation and physiological symptoms. The stress scale measures chronic arousal, which entails irritability, tension, and nervousness. Each scale contains seven items, which the respondents score on a scale of 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time). The items for each subscale are summed and multiplied by a factor of two, yielding a score ranging 0 to 42 for each subscale. These scores can be categorized into five categories, namely normal, mild, moderate, severe, and extremely severe, using the cut-offs proposed by Lovibond and Lovibond (15). The primary outcome in the current study was the prevalence of severe/extremely severe depression (score $\geq$21), anxiety (score $\geq$15), and stress (score $\geq$26). We used severe/extremely severe symptoms as the cut-off for regression analyses as the identification of factors associated with this specific group of populations would allow targeted public health interventions.

The DASS-21 has been validated among Asians in previous research (16–19). To minimize reporting bias, the questions were presented in English, Malay, Chinese, Indonesian, or Thai using published translations based on the participant's preference. The Malay, Chinese, and Indonesia versions have been previously validated (19–21), while only the 42-item version of the DASS has been validated in Thai (22). The DASS-21 is in the public domain, so permission is not required to use it.

Respondent's demographic characteristics were age, gender, country of residence, and household income. The response options for gender were male, female, non-binary, and prefer not to answer. Non-binary gender refers to individuals who identify as neither male nor female. Age was used as a 4-level categorical variable using the categories 18–29, 30–39, 40–49, and 50–65. Household income was also used as a categorical variable, using the categories low, middle, and high income. Low income was defined as $\leq$ MYR 5,000, $\leq$ IDR 5,000,000, $\leq$ SGD 2,000, and $\leq$ THB 15,000 for residents of Malaysia, Indonesia, Singapore, and Thailand, respectively. High income was defined as $>$ MYR 11,000, $>$ IDR 12,000,000, $>$ SGD 18,000, and $>$ THB 50,000 for residents of Malaysia, Indonesia, Singapore, and Thailand, respectively. Respondents reporting incomes between these cut-offs were categorized as middle-income. For Singapore and Malaysia, household income level thresholds were defined based on government definitions (23, 24). For Indonesia and Thailand, middle income was defined as household income between the 20th to 80th percentile of the income distribution (25). Low income and age 18 to 29 years were chosen as the reference categories as these made up the largest portion of the sample. Malaysia was chosen as the reference category for country of residence as the study was designed and conducted by researchers based in Malaysia.

Data analyses

Data for depression, anxiety, and depression scores are presented in mean $\pm$ standard deviation (SD). Both frequency and percentages are reported for categorical variables. The 95% confidence intervals are also presented for the prevalence of depression, anxiety, and stress symptoms.

Simple logistic regressions were performed to examine the influence of each of the independent variables on the odds of experiencing severe to extremely severe symptoms of depression, anxiety, and stress. Variables with $p < 0.25$ were included in the multiple logistic regression model using forward likelihood ratio. The Omnibus test of model coefficients of determination, R^2, Hosmer & Lemeshow, classification table, and area under the Receiver Operating Characteristic (ROC) curve were reported. Data analyses were performed using statistical software (*R* version 4.02).

Results

Participant characteristics

Responses from 33,454 respondents who met the inclusion criteria were analyzed. The median age of our study population was 23 years (interquartile range 8). Sample characteristics are reported in Table 1. The majority of the sample was female (75.96%), 18- to 29-years-old (72.53%), and low-income (73.41%).

Prevalence of psychological distress

The prevalence of anxiety, depression, and stress symptoms for each level of severity in each country and across the sample is shown in Table 2. In our sample, 46.86% had severe to extremely severe symptoms of depression. Anxiety symptoms were experienced at a rate of 49.34%, while 36.19% of the sample had severe or above stress symptoms. In addition, 61.24% of the sample had severe or above symptoms in at least one of the three domains.

The prevalence of severe or above anxiety symptoms was highest in the Indonesian sample (53.09%), followed by the Malaysian (47.58%) and Thai (46.80%) samples, while the Singaporean sample had the lowest prevalence (44.78%). Similar proportions of the samples from Singapore, Thailand, and Malaysia reported depression symptoms (50.43, 49.94,

and 48.32%, respectively), while a smaller proportion of the respondents from Indonesia experienced these symptoms (43.05%). Rates of stress were higher among respondents from Thailand (42.64%) than among those from Malaysia, Indonesia, or Singapore (33.58, 33.88, and 31.32%, respectively).

Factors associated with severe/extremely severe psychological symptoms

Simple logistic regressions revealed that all four demographic variables were factors significantly associated with severe to extremely severe symptoms for depression, anxiety, and stress (Supplementary Table 1). All four variables were therefore entered into multiple logistic regression models for the three outcome variables, the results of which are shown in Tables 3–5.

For anxiety, females and non-binary respondents had odds of 1.44 and 1.46, respectively, of having severe or above symptoms of anxiety compared to males. In addition, the odds of meeting this cut-off decreased with age: compared to 18- to 29-year-olds, the odds of symptoms of this severity were 0.55, 0.38, and 0.22 among 30- to 39-year-olds, 40- to 49-year-olds, and 50- to 65-year-olds, respectively. Respondents from Indonesia were 8% more likely than those from Malaysia to experience severe or higher symptoms. Compared to respondents in the low-income category, those in the middle-income and high-income categories were 21 and 23% less likely to report severe or above anxiety symptoms, respectively.

With regards to depression symptoms, female and non-binary respondents had odds of 1.39 and 1.42 of reporting symptoms at or above the severe cut-off compared to males, respectively. Increasing age was associated with decreased odds of severe to extremely severe symptoms. Indeed, compared to 18- to 29-year-olds, 30- to 39-year-olds were 46% less likely to experience symptoms of this severity, while 40- to 49-year-olds and 50- to 65-year-olds were 66 and 80% less likely to experience these symptoms, respectively. Residents of Indonesia were 31% less likely than residents of Malaysia to experience these symptoms, but residents of Singapore were 33% more likely than residents of Malaysia to do so. Middle and high income were both associated with approximately 15% lower odds of experiencing severe or above symptoms compared to low income.

For the stress dimension, females and non-binary respondents were 48 and 42% more likely than males to have severe to extremely severe stress symptoms, respectively. In addition, 30- to 39-year-olds were less than two-thirds as likely as 18- to 29-year-olds to report symptoms meeting the severe cut-off. In addition, the odds of 40- to 49-year-olds and 50- to 65-year-olds experiencing symptoms of this severity compared to the youngest age group were 0.44 and 0.23, respectively. Residents of Indonesia were 8% less likely to experience severe or above stress symptoms compared to residents of Malaysia, while residents of Thailand were 46% more likely to experience these symptoms. Finally, the odds of being above the severe cut-off for middle-income respondents were 0.89 that of low-income respondents.

Discussion

Psychological distress 18 months post-pandemic declaration

The current study indicates that there is a high prevalence of psychological distress in a Southeast Asian internet-based sample in October 2021, 18 months after the declaration of COVID-19 as a global pandemic. In our sample, 46.86% experienced severe or above symptoms of depression, 49.34% experienced symptoms of anxiety, and 36.19% experienced symptoms of stress above the severe cut-off. These high prevalences are concerning and highlight a widespread impact of the COVID-19 pandemic on mental health in Southeast Asia, as well as an enduring high point prevalence of psychological distress. While we anticipated findings consistent with previous studies identifying elevated mental health problems since the beginning of the pandemic (26) and high rates of negative psychological symptoms among internet users (11), the magnitude of the psychological distress identified in our study is alarming.

Sociodemographic differences in mental health

Our study also showed that this impact of the pandemic on the point prevalence of mental severe symptoms of psychological distress 18 months after the pandemic's onset is seen particularly in female and non-binary respondents, as well as younger adults and those from low-income households. Female respondents' odds of experiencing severe or above symptoms of anxiety, depression, and stress compared to men ranged between 1.39 and 1.48. This finding is in line with previous findings on gender differences in psychopathology during the COVID-19 pandemic in Southeast Asia (27, 28). Several factors are likely to have contributed to higher anxiety, depression, and stress in females during the pandemic. Indeed, there are gender differences in stress response systems and females tend to have a greater arousal response to stress (29). In addition, during times of disaster, including disease outbreaks, the burden of productive, reproductive, and community work borne by women tends to increase (30), leading to a deterioration of their wellbeing as they take up greater responsibilities (31). In Singapore, for example, mothers were found to be more likely than fathers

TABLE 1 Respondent characteristics and mean depression, anxiety, and stress scores.

		N	%	Mean anxiety score (SD)	Mean depression score (SD)	Mean stress score (SD)
Gender	Male	7,726	23.09%	14.11 (9.71)	18.03 (11.94)	18.72 (10.57)
	Female	25,411	75.96%	16.42 (10.23)	20.67 (12.09)	21.31 (10.64)
	Other	317	0.95%	16.79 (9.68)	22.18 (10.62)	23.34 (9.29)
Age	18–29	24,264	72.53%	17.16 (9.97)	21.46 (11.72)	21.94 (10.28)
	30–39	6,701	20.03%	13.35 (9.85)	17.49 (12.28)	18.49 (10.95)
	40–49	2,001	5.98%	10.91 (9.73)	14.03 (12.00)	15.62 (10.98)
	50–65	488	1.46%	8.01 (8.01)	11.10 (10.99)	12.37 (9.96)
Country	Malaysia	10,319	30.85%	15.34 (10.72)	20.49 (12.85)	19.38 (11.27)
	Indonesia	12,590	37.63%	16.87 (10.03)	19.02 (12.07)	20.46 (10.45)
	Singapore	1,063	3.18%	15.01 (10.24)	21.45 (11.95)	19.96 (10.05)
	Thailand	9,482	28.34%	15.29 (9.56)	20.85 (11.16)	22.65 (10.08)
Income	Low	24,559	73.41%	16.61 (10.20)	20.60 (12.10)	20.99 (10.66)
	Middle	7,181	21.47%	14.08 (9.72)	18.80 (11.88)	20.08 (10.61)
	High	1,714	5.12%	13.17 (9.76)	17.81 (12.23)	19.86 (10.98)
Total sample		33,454	100.00%	15.89 (10.15)	20.07 (12.10)	20.73 (10.67)

to have poor to moderate work-family balance during the pandemic (32), illustrating the unequal impact of the pandemic and social distancing measures. Furthermore, evidence indicates that females are more likely than males to believe in COVID-19 conspiracy theories – including threatening ones, which can lead to anxiety and distress (33) and may have also contributed to the gender difference observed in our study.

Our findings of increased odds of severe psychological symptoms in non-binary respondents are consistent with the high rates of mental health problems in transgender and non-binary individuals documented in other studies (34, 35). The pattern of gender differences in our study, in which the prevalence of psychological distress was lowest among males and highest among non-binary individuals, is also the same as that reported in a recent international, multicenter study (33). Little is known about the prevalence of psychological distress in non-binary people in Southeast Asia, however, and our study is one of the first to identify the prevalence of depression, anxiety, and stress in this population. These findings are crucial as mental health challenges in this group are attributed to a variety of social and structural factors, including stigma, social exclusion, and a lack of social support, that are especially common in several Southeast Asian countries where the gender non-conforming community is highly stigmatized (36). Moreover, the COVID-19 pandemic is likely to have exacerbated the mental health challenges experienced by non-binary individuals as protective factors against psychological problems, including gender-affirming healthcare and social connectedness (34, 37), were less available during the pandemic. Many non-binary and transgender individuals have also reported decreased time living according to their gender during the pandemic, leading to increased symptoms of depression and anxiety (38). The high rates of severe depression, anxiety, and stress symptoms in non-binary individuals highlights the importance of ensuring that non-gender conforming individuals continue to have access to gender-affirming healthcare and social support (38).

Moreover, the current study found that younger adults have been disproportionately affected in all three dimensions of mental health, in line with previous research on emerging adults (18- to 29-year-olds) during the pandemic (28, 39). Previous work has shown that younger adults are more concerned than older adults about the threat of COVID-19 on multiple areas including physical health, mental wellbeing, and financial resources (40). Younger adults were especially vulnerable to mental health problems during the pandemic, as it exacerbated the instability and uncertainty that already characterize the transitional period of emerging adulthood (41). Indeed, a sample of Malaysian university students identified financial constraints and uncertainty about the future as some of the main stressors they faced during the pandemic and lockdown (42). Moreover, 18- to 24-year-olds were disproportionately affected by job loss during the pandemic (43, 44), which can have a significant impact on mental health outcomes including anxiety, depression, and life satisfaction (45). Importantly, young adults are also more likely to be more negatively impacted by the stressful and challenging circumstances created by the pandemic because their coping skills tend to be less developed than those of older adults (46). A study of UK adults reported that, during the pandemic, older adults were less likely to use avoidant coping strategies than younger adults (47), and demonstrated more resilience, a key protective factor against psychological distress (48). In addition, use of negative coping

TABLE 2 Prevalence of depression, anxiety, and stress symptoms at each level of symptom severity in each country and across the sample.

		Anxiety		Depression		Stress	
		N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Malaysia	**Normal**	2,889	28.00 (27.13–28.88)	2,481	24.04 (23.22–24.88)	3,939	38.17 (37.23–39.12)
	Mild	615	5.96 (5.51–6.44)	948	9.19 (8.64–9.76)	1,119	10.84 (10.25–11.46)
	Moderate	1,905	18.46 (17.72–19.23)	1,904	18.45 (17.71–19.22)	1,796	17.40 (16.68–18.15)
	Severe	1,216	11.78 (11.17–12.43)	1,402	13.59 (12.93–14.27)	2,062	19.98 (19.22–20.77)
	Extremely severe	3,694	35.80 (34.87–36.73)	3,584	34.73 (33.81–35.66)	1,403	13.60 (12.94–14.28)
Indonesia	**Normal**	2,311	18.36 (17.69–19.05)	3,219	25.57 (24.81–26.34)	4,267	33.89 (33.07–34.73)
	Mild	884	7.02 (6.58–7.49)	1,344	10.68 (10.14–11.23)	1,649	13.10 (12.52–13.70)
	Moderate	2,711	21.53 (20.82–22.26)	2,607	20.71 (20.00–21.43)	2,408	19.13 (18.44–19.83)
	Severe	1,696	13.47 (12.88–14.08)	1,850	14.69 (14.08–15.33)	2,494	19.81 (19.12–20.52)
	Extremely severe	4,988	39.62 (38.76–40.48)	3,570	28.36 (27.57–29.15)	1,772	14.07 (13.47–14.70)
Singapore	**Normal**	281	26.43 (23.83–29.22)	199	18.72 (16.45–21.23)	370	34.81 (31.96–37.77)
	Mild	77	7.24 (5.79–9.01)	89	8.37 (6.81–10.24)	144	13.55 (11.58–15.79)
	Moderate	229	21.54 (19.13–24.16)	239	22.48 (20.03–25.14)	217	20.41 (18.05–22.99)
	Severe	128	12.04 (10.18–14.19)	164	15.43 (13.34–17.77)	211	19.85 (17.52–22.40)
	Extremely severe	348	32.74 (29.94–35.66)	372	35.00 (32.14–37.96)	121	11.38 (9.57–13.48)
Thailand	**Normal**	2,094	22.08 (21.26–22.94)	1,674	17.65 (16.9.0–18.44)	2,353	24.82 (23.95–25.70)
	Mild	777	8.19 (7.65–8.77)	975	10.28 (9.68–10.92)	1,173	12.37 (11.72–13.05)
	Moderate	2,174	22.93 (22.09–23.79)	2,098	22.13 (21.3–22.98)	1,912	20.16 (19.36–20.99)
	Severe	1,293	13.64 (12.96–14.35)	1,648	17.38 (16.63–18.16)	2,370	24.99 (24.13–25.88)
	Extremely severe	3,144	33.16 (32.21–34.12)	3,087	32.56 (31.62–33.51)	1,674	17.65 (16.90–18.44)
Total	**Normal**	7,575	22.64 (22.20–23.1)	7,573	22.64 (22.19–23.09)	10,929	32.67 (32.17–33.17)
	Mild	2,353	7.03 (6.76–7.31)	3,356	10.03 (9.71–10.36)	4,085	12.21 (11.86–12.57)
	Moderate	7,019	20.98 (20.55–21.42)	6,848	20.47 (20.04–20.91)	6,333	18.93 (18.51–19.36)
	Severe	4,333	12.95 (12.6–13.32)	5,064	15.14 (14.76–15.53)	7,137	21.33 (20.90–21.78)
	Extremely severe	12,174	36.39 (35.87–36.91)	10,613	31.72 (31.23–32.23)	4,970	14.86 (14.48–15.24)

styles was shown to be associated with psychological problems among a sample of Chinese youth during the COVID-19 pandemic (49).

We also identified that high- and middle-income levels were associated with decreased odds of experiencing severe anxiety, depression, and stress symptoms compared to lower income levels. These findings are consistent with existing evidence of a relationship between low socioeconomic status and mood and anxiety disorders (50, 51). This relationship can be explained by the social causation hypothesis, which posits that low income can precipitate mental illness by causing adversity, stress, and a reduced capacity to cope (52). In addition, social support has been shown to moderate the relationship between economic hardship and mental health (53). This is important in the context of the COVID-19 pandemic during which many people lost their social support systems and may help explain the high rate of psychological distress in our sample, as the majority was low-income and may have been especially impacted by the lack of social support in this period of economic difficulty.

Regional differences in mental health

The prevalence of severe stress symptoms was highest among respondents from Thailand, who had significantly higher odds of stress symptoms than Malaysian respondents. This finding is in line with Wang et al.'s (12) recent study on depression, anxiety, and stress symptoms in seven Asian countries, including Malaysia and Thailand, which also reported the highest stress scores among Thai respondents. Interestingly, however, unlike in Wang et al.'s (12) study, this pattern did not hold for anxiety and depression: in our study, residing in Thailand was associated with non-significantly different odds of depression or anxiety symptoms compared to residing in Malaysia.

The inter-country difference in stress may be associated with differences in the status and economic impact of the COVID-19 pandemic between the countries. While Thailand has the second lowest total reported COVID-19 cases per million (30,389 cases) among the four countries included in the study, after Indonesia [15,404 cases; (54)], the country experienced one of

TABLE 3 Factors associated with severe/extremely severe anxiety symptoms.

Variable		(95% CI)	Odds ratio	95% CI Lower	95% CI Upper	*p*
Gender	Male	42.14 (41.04–43.25)	1.00			
	Female	51.49 (50.87–52.11)	1.44	1.37	1.52	<0.001
	Other	52.68 (47.03–58.27)	1.46	1.16	1.84	0.001
Age	18–29	54.54 (53.91–55.17)	1.00			
	30–39	38.73 (37.56–39.91)	0.55	0.52	0.58	<0.001
	40–49	29.39 (27.41–31.44)	0.38	0.35	0.42	<0.001
	50–65	18.44 (15.16–22.23)	0.22	0.17	0.28	<0.001
Country	Malaysia	47.58 (46.61–48.55)	1.00			
	Indonesia	53.09 (52.21–53.96)	1.08	1.03	1.15	0.003
	Singapore	44.78 (41.77–47.83)	1.11	0.97	1.28	0.113
	Thailand	46.79 (45.79–47.80)	0.96	0.91	1.02	0.226
Income	Low	52.31 (51.68–52.93)	1.00			
	Middle	41.80 (40.66–42.96)	0.79	0.75	0.84	<0.001
	High	38.45 (36.14–40.80)	0.77	0.69	0.86	<0.001

Omnibus test $X^2 = 1409.22$, $p < 0.001$; Nagelkerke R^2 =5.5%; Hosmer & Lemeshow test $X^2 = 31.36$, $p < 0.001$; Classification table 58.3% correct; Multicollinearity checks indicated no multicollinearity between the associated factors; ROC area = 0.582.

TABLE 4 Factors associated with severe/extremely severe depression symptoms.

Variable		% (95% CI)	Odds ratio	95% CI Lower	95% CI Upper	*p*
Gender	Male	39.99 (38.9–41.10)	1.00			
	Female	48.86 (48.25–49.48)	1.39	1.32	1.47	<0.001
	Other	53.63 (47.97–59.20)	1.42	1.13	1.79	0.002
Age	18–29	51.56 (50.93–52.19)	1.00			
	30–39	37.65 (36.49–38.83)	0.54	0.51	0.58	<0.001
	40–49	27.74 (25.79–29.76)	0.34	0.31	0.38	<0.001
	50–65	18.24 (14.97–22.02)	0.20	0.16	0.25	<0.001
Country	Malaysia	48.32 (47.35–49.29)	1.00			
	Indonesia	43.05 (42.18–43.92)	0.69	0.65	0.73	<0.001
	Singapore	50.42 (47.37–53.47)	1.33	1.16	1.52	<0.001
	Thailand	49.94 (48.93–50.95)	1.04	0.98	1.10	0.240
Income	Low	48.51 (47.88–49.14)	1.00			
	Middle	42.95 (41.80–44.10)	0.85	0.80	0.90	<0.001
	High	39.61 (37.30–41.98)	0.84	0.76	0.94	0.002

Omnibus test $X^2 = 1406.13$ $p < 0.001$; Nagelkerke $R^2 = 5.5\%$; Hosmer & Lemeshow test $X^2 = 23.72$, $p = 0.003$; Classification table 57.7% correct; Multicollinearity checks indicated no multicollinearity between the associated factors; ROC area = 0.609.

the worst economic downturns in Asia because of the pandemic. Thailand had the largest year-on-year GDP contraction of the four countries included in the study in 2021, at 6.1%, compared to 5.4% in Malaysia (55). Over 70% of Thai households experienced income loss and 23% of Thai respondents in a recent survey reported having lost their job (56), which is associated with increased likelihood of experiencing depressive and/or anxiety symptoms (57). As Thai respondents in our study did not have significantly different odds of anxiety or depression compared to Malaysian respondents, this suggests that the low COVID-19 case count may have had a protective effect on depression and anxiety rates amid these challenging conditions, for example by highlighting the value on human life of the measures contributing to economic uncertainty. Odds of severe/extremely severe stress were nonetheless highest among respondents living in Thailand, indicating that their mental health was not unaffected by the poor economic conditions.

Living in Indonesia was associated with significantly lower odds of experiencing severe symptoms of stress and depression, but significantly higher odds of anxiety symptoms, compared to living in Malaysia. This pattern is interesting and indicates that while the economic and health conditions in Indonesia may be

TABLE 5 Factors associated with severe/extremely severe stress symptoms.

Variable		% (95% CI)	Odds ratio	95% CI Lower	95% CI Upper	*p*
Gender	Male	29.26 (28.25–30.30)	1.00			
	Female	38.21 (37.61–38.81)	1.48	1.40	1.57	<0.001
	Other	43.22 (37.72–48.88)	1.42	1.12	1.78	0.003
Age	18–29	39.67 (39.06–40.29)	1.00			
	30–39	29.38 (28.30–30.49)	0.64	0.60	0.68	<0.001
	40–49	22.34 (20.54–24.24)	0.44	0.39	0.49	<0.001
	50–65	13.32 (10.50–16.73)	0.23	0.18	0.30	<0.001
Country	Malaysia	33.58 (32.67–34.50)	1.00			
	Indonesia	33.88 (33.06–34.72)	0.92	0.87	0.97	0.003
	Singapore	31.23 (28.47–34.13)	1.04	0.90	1.20	0.551
	Thailand	42.65 (41.65–43.65)	1.46	1.37	1.55	<0.001
Income	Low	36.90 (36.30–37.51)	1.00			
	Middle	34.23 (33.13–35.34)	0.89	0.84	0.95	<0.001
	High	34.25 (32.01–36.56)	0.99	0.89	1.11	0.909

Omnibus test $X^2 = 1035.36$, $p < 0.001$; Nagelkerke $R^2 = 4.2\%$; Hosmer & Lemeshow test $X^2 = 36.82$, $p < 0.001$; Classification table 63.8% correct; Multicollinearity checks indicated no multicollinearity between the associated factors; ROC area = 0.605.

less detrimental to residents' mental health in certain areas, there is some variability in the effect. The lower prevalence of stress and depression in Indonesia may be explained by the country being relatively less affected by the pandemic in terms of year-on-year GDP contraction in 2021 [2.1%; (55)] and reported COVID-19 case numbers, as Indonesia has reported the lowest total case count of the four countries (54). Interestingly, our findings are in spite of Indonesians experiencing a higher level of pandemic-related movement and social restrictions than Malaysians at the time of the study (i.e., October 2021), and these restrictions could explain the higher rates of anxiety among Indonesian respondents. This also suggests that longer-term trends play an important role in shaping mental health, rather than just the current situation. Moreover, at this point in the pandemic when individuals have already experienced strict movement restrictions, the impact of these may not be as stark as early after the declaration of the pandemic, in particular if these measures have been shown to mitigate the health emergency.

Compared to respondents residing in Malaysia, those residing in Singapore had higher odds of depression, but not significantly different odds of anxiety or stress. Singapore had the highest total number of COVID-19 cases per million (48,986) and was the only country with rising daily case numbers in October 2021 (54), which brought about the implementation of stricter social distancing measures at the end of September 2021. In addition, while mobility data from Google (58) indicates that in the months leading up to the period of the study, movement patterns in Malaysia, Indonesia, and Thailand were returning to pre-pandemic levels – albeit still showing differences in some areas – this trend was not reflected in Singapore (Supplementary Figure 1). The elevated odds of depression, but non-significantly different odds of stress and anxiety, in Singapore suggest that the enduring nature of restricted mobility combined with high number of reported COVID-19 cases may be especially conducive to symptoms of depression, by increasing feelings of loneliness and hopelessness, which are both associated with depression (59).

Deteriorating mental health status in 2021 compared to 2020

As we extrapolate our findings on Southeast Asian adults temporally, our study reveals a higher prevalence of psychological distress 18 months after the declaration of the pandemic compared to the first year of the pandemic (12, 60). Similar to our approach, Wong and colleagues (60) measured the mental health of the Malaysian public cross-sectionally between May and September 2020, using the DASS-21 administered through the internet. Their study revealed a progressive increase in the proportion of respondents experiencing problematic psychological symptoms over the 5-month study period. The highest prevalence of respondents reporting moderate of above symptoms of depression (59.2%), anxiety (55.1%), and stress (30.6%) was in the last month of the study period. One year on from Wong et al.'s study, this upward trend seems to have continued, with our study reporting an even higher prevalence of moderate to extremely severe depression (66.77%), anxiety (66.04%), and stress (50.98%) among Malaysian respondents.

This temporal increase in psychological distress is also apparent when comparing the DASS scores from our study with those reported by Wang et al. (12) in Thailand and Malaysia in the period after COVID-19 became an epidemic in each country. Indeed, for both countries, mean scores for depression, anxiety, and stress were 0.7 to 11.6 points higher in our study. The smallest difference was for the stress score

in Thailand and the largest difference was for the depression score in Malaysia. This increase in scores over time is consistent with evidence of a deterioration in mental health in Italian and Spanish samples throughout the pandemic (61, 62) and suggests that individuals in Southeast Asia are experiencing pandemic burnout as a result of the stress associated with the health crisis compounding over time (63). It should be noted, however, that the differences in the prevalence of psychological distress between our study and those conducted earlier in the pandemic could reflect differences in the samples' socio-demographic characteristics, rather than temporal changes. Indeed, our sample included a higher proportion of younger adults and low-income individuals than Wang et al.'s (12) or Wong et al.'s (60), both socio-demographic characteristics associated with symptoms of depression, anxiety, and stress.

Together with previous literature, our findings demonstrate the persistence of the mental health impact of the pandemic on Southeast Asians more than one year after its onset (12, 60). This lingering impact seems to be consistent with what has been observed in previous viral outbreaks, including the 1918–1919 influenza pandemic, the Severe Acute Respiratory Syndrome (SARS) outbreak in 2002, and the Middle East Respiratory Syndrome (MERS) outbreak starting in 2012 (64–66). Indeed, Mamelund (67) described an increase in the number of first-time hospitalizations for influenza-related mental disorders by an annual factor of 7.2 in the 6 years after the 1918 influenza pandemic. While many have attributed the psychological impact of viral outbreaks to stressors during and after quarantine such as fear of infection, frustration and boredom, inadequate supplies or information, finances, and stigma (1), others have emphasized the role of biological factors associated with viral infections, such as inflammation, in contributing to psychological morbidity, including anxiety disorder, insomnia, and dementia (66, 68, 69). These factors may better explain the temporal deterioration in psychological symptoms and longitudinal cohort studies including these biological factors are therefore needed to further examine the progression of the mental health impact of the COVID-19 pandemic over time.

Strengths and limitations

This study utilized the internet as the medium of dissemination of survey questions. As a result, a large sample was recruited within a month, over a large geographical area, otherwise not feasible with face-to-face recruitment. In addition, by including the residents of four Southeast Asian countries experiencing different socioeconomic conditions and COVID-19-related social restrictions, this study provides insights into how different dimensions of psychological distress are related to these variables.

However, several limitations of this study should be acknowledged when considering its findings. First, this study utilized a wholly internet-based approach and people with no access to the internet were excluded. However, the countries in which this study was conducted have a high proportion of population using the internet: 89.6% in Malaysia, 75.9% in Singapore, 77.8% in Thailand, and 53.7% in Indonesia (70). Second, the self-selected nature of the sample is a possible source of bias. Recruitment materials for the survey highlighted the value of gaining insights into one's own mental health status through participation, and consequently, individuals opting to participate in the study may be more likely than the target population to suspect that they are experiencing psychological distress. This may have led to an over-representation of the prevalence of the psychological symptoms measured in the study. Third, the cross-sectional nature of the study prevents us from ascertaining a cause-effect relationship between the pandemic and respondents' mental health status. Moreover, in measuring mental health status at only one point in time, this study is unable to determine whether or not the elevated point prevalence reflects long-lasting symptoms among the individuals whose mental health was negatively impacted early in the pandemic. Fourth, while there are many factors contributing to mental wellbeing, including ethnicity, education level, the physical environment, and social support networks (71), this study only included four demographic factors (age, gender, country of residence, and income level). The small number of independent variables included in the regression is likely to account for the model's low R^2. Despite the model's low explanatory power, however, the independent variables included in it are significant, which helps identify high-risk populations. Finally, our sample consists of a higher proportion of females (76%) and adults aged 18 to 29 years (74%) than the general population, limiting the representability of our findings.

Conclusions

Overall, this study provides evidence of the differing impact of the COVID-19 pandemic across demographic groups in Southeast Asia, consistent with global trends. The prevalence of depression, anxiety, and stress symptoms in an Southeast Asian internet-based sample is high 18 months after the declaration of COVID-19 as a global pandemic. Females, non-binary respondents, younger adults, and those from low-income households are more likely to experience severe to extremely severe symptoms in all three dimensions of mental health. Moreover, our findings on the differences in the mental health status of respondents between countries suggest that a complete picture comprising economic conditions, the public health situation, and social and movement restrictions should be considered in order to understand the effects of a disaster such as a pandemic on the mental health of the population. Crucially, comparison of our findings with those of other Southeast Asian studies in the year following the declaration of the pandemic further indicates that the mental health status of this population has deteriorated over time.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Sunway Medical Centre Independent Research Ethics Committee. The participants provided their informed consent digitally to participate in this study.

Author contributions

WT and FM conceptualized the study. WT and JJ acquired the data. JJ performed the statistical analysis with help from KW. JJ, WT, KW, and FM contributed to the interpretation of the results. JJ wrote the original draft of the manuscript with contributions from WT. KW, FM, and TO reviewed and edited the manuscript. All authors approved the final version of the manuscript.

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Conflict of interest

Authors WT, JJ, and TO are employed by Naluri Hidup Sdn Bhd. The authors declare that this study received funding from Naluri Hidup Sdn Bhd. The funder had the following involvement in the study: study design, collection, analysis, interpretation of data, the writing of this article and the decision to submit it for publication.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.863323/full#supplementary-material

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EDITED BY
Xenia Gonda,
Semmelweis University, Hungary

REVIEWED BY
Mohammad Farris Iman Leong Bin Abdullah,
Universiti Sains Malaysia (USM), Malaysia
Uma Suryadevara,
University of Florida, United States

*CORRESPONDENCE
Jinguo Zhai
zhaijinguo@163.com

†These authors have contributed equally to this work

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A mental health survey among young front-line clinicians in high-risk areas during the COVID-19 sporadic epidemic in China

Xingbo Suo[1†], Yang Zhang[1†], Qingxia Liu[2†], Gaofeng Zhao[3], Yanan Zhu[4], Yan Liu[1] and Jinguo Zhai[1*]

[1]Department of Psychiatry, Jining Medical University, Jining, China, [2]Department of Psychiatry, Harbin Medical University, Harbin, China, [3]Shandong Daizhuang Hospital, Jining, China, [4]Harbin First Hospital, Harbin, China

Background: The sporadic coronavirus disease (COVID-19) epidemic has placed enormous psychological stress on people, especially clinicians. The objective of this study was to examine depression, anxiety, quality of life (QOL), and related social psychological factors among young front-line clinicians in high-risk areas during the COVID-19 sporadic epidemic in China and to provide a reference for formulating reasonable countermeasures.

Methods: In this cross-sectional study, demographic information, COVID-19-related questions, anxiety (Generalized Anxiety Disorder-7, GAD-7), depression (Patient Health Questionnaire-9, PHQ-9), insomnia (Insomnia Severity Index, ISI), stress (Perceived Stress Scale-10, PSS-10), and QOL (World Health Organization Quality of Life-brief version, WHOQOL-BREF) were collected. Binary logistic regression analysis was used to test the relationships between anxiety and/or depression and other related problems. Multiple linear regression analysis was used to test the relationships among factors influencing QOL.

Results: A total of 146 young front-line clinicians were included. The prevalence rates of depression, anxiety, and anxiety-depression comorbidity were 37.7% (95% CI = 29.7–45.6%), 26.0% (95% CI = 18.8–33.2%), and 24.0% (95% CI = 17.0–31.0%), respectively. Severe stress (OR = 1.258, 95% CI = 1.098–1.442, $P < 0.01$) and insomnia (OR = 1.282, 95% CI = 1.135–1.447, $P < 0.01$) were positively correlated with depression. Severe stress (OR = 1.487, 95% CI = 1.213–1.823, $P < 0.01$) and insomnia (OR = 1.131, 95% CI = 1.003–1.274, $P < 0.05$) were positively correlated with anxiety. Severe stress (OR = 1.532, 95% CI = 1.228–1.912, $P < 0.01$) was positively correlated with anxiety-depression comorbidity. However, insomnia (OR = 1.081, 95% CI = 0.963–1.214, $P > 0.05$) was not correlated with anxiety-depression comorbidity. The belief that the vaccine will stop the COVID-19 pandemic (OR = 0.099, 95% CI = 0.014–0.715, $P < 0.05$) was negatively correlated with anxiety and anxiety-depression comorbidity (OR = 0.101, 95% CI = 0.014–0.744, $P < 0.05$). Severe stress (B = −0.068, 95% CI = −0.129 to −0.007, $P < 0.05$) and insomnia (B = −0.127, 95% CI = −0.188 to −0.067, $P < 0.01$) were negatively correlated with QOL. The belief that the vaccine could provide protection (B = 1.442, 95% CI = 0.253–2.631, $P < 0.05$) was positively correlated with QOL.

Conclusions: The prevalence of depression, anxiety, and even anxiety-depression comorbidity was high among young front-line clinicians in high-risk areas during the COVID-19 sporadic epidemic in China. Various biological and psychological factors as well as COVID-19-related factors were associated with mental health issues and QOL. Psychological intervention should evaluate these related factors and formulate measures for these high-risk groups.

KEYWORDS

COVID-19, young front-line clinicians, mental health, sporadic, high-risk areas

Introduction

In March 2020, the World Health Organization (WHO) announced coronavirus disease (COVID-19) to be a pandemic (1). Globally, to date (January 4, 2022), this destructive pandemic has spread rapidly across 226 countries/regions, and 296,496,809 confirmed cases of COVID-19 have been reported to the WHO (2). To contain this global outbreak, the Chinese government adopted a series of strict and effective public health measures, such as encouraging people to wear protective masks, self-isolation, and the cancellation of mass gatherings (3). At present, the epidemic situation in China has now largely been brought under control, and epidemic prevention and control have become the norm (4). However, there are still sporadic cases that occur in some places in China, and a higher risk of infection and stricter isolation measures were borne by the people in these areas. Due to the spread of the COVID-19 sporadic epidemic, parts of Harbin Municipality have been defined as high-risk areas of the epidemic since September 25, 2021. There was no doubt that it would seriously affect the local people's mental health and quality of life (3).

Clinicians are at the core of epidemic preparedness and control in high-risk areas during periods of sporadic epidemic situations. In contrast to the general population, front-line clinicians may have greater psychological stress in high-risk areas during the COVID-19 sporadic epidemic. Multiple past studies have demonstrated that during the Severe Acute Respiratory Syndrome (SARS), Influenza A (H1N1), and Middle East Respiratory Syndrome (MERS) outbreaks, front-line medical staff were at higher risk of psychological problems, including but not limited to anxiety, depression, and posttraumatic stress disorder (PTSD) (5–11). They are predisposed to high workloads, unpredictable work patterns, and a higher risk of infection (12–16). In addition, clinicians are easily ostracized by people around them after work because the general population easily misunderstands that clinicians are especially susceptible to carrying the virus when returning home (14). Clinicians may also be worried about becoming infected or infecting their families (14). Stress from these various sources will increase the risk for depression or anxiety if it cannot be effectively allayed (15, 17). Moreover, previous studies have shown that compared with older clinicians, young clinicians' lack of practical experience and confidence in clinical management may lead to insufficient resilience to deal with psychological problems and more serious emotional exhaustion (18, 19). Therefore, mental health conditions such as depression and anxiety may be worse among young front-line clinician populations than among senior clinician populations (20–22). In addition, the term "quality of life" (QOL) is the subjective perception of wellbeing and wholeness (23). Due to the lack of evidence-based practice related to sporadic epidemic management, even less is known about the factors that worsen or improve QOL. A study has shown that young people may have poorer QOL relative to older people during the COVID-19 epidemic (24). The mental health status and QOL of young front-line clinicians should receive more attention, so we chose this group as the main study population. Although many research articles on the psychological status and QOL of clinicians have been published during the epidemic (25–30), there has been no study on young front-line clinicians during the COVID-19 sporadic epidemic in high-risk areas.

Currently, there is a need for testimony of mental health problems during the sporadic epidemic situation to identify those at high risk and to investigate the related psychological factors and social resources that can alleviate this threat. Therefore, we carried out this study to examine depression, anxiety, QOL, and related social psychological factors among young front-line clinicians in high-risk areas during the COVID-19 sporadic epidemic in China.

Methods

Participants

Participants who met the following eligibility criteria were included: (1) clinicians, (2) aged between 18 and 40 years, (3) could read a Chinese questionnaire, and (4) WeChat users. Informed consent was obtained from all subjects before filling in the questionnaire, and this study was approved by the Research

Ethics Committee of the Shandong Daizhuang Hospital (Second Affiliated Hospital of Jining Medical University) in Shandong China.

The sample size was calculated with the following formula (31): $N = (Z\alpha^2 \times P \times (1–P))/d^2$. The confidence level (Z) was equal to 1.96 at the significance level of $\alpha = 0.05$, P was the estimated proportion, and d was the tolerated margin of error and was calculated to be 0.10. A previous study found depression and anxiety prevalence rates to be 27.9 and 31.6%, respectively, in the general population (32). As no study has shown the prevalence of anxiety and depression among young Chinese clinicians during the COVID-19 pandemic, to achieve sufficient statistical power, we used $P = 0.279$ to calculate the sample size and found 77 subjects to be needed in this study.

Data collection

This cross-sectional study was conducted between September 27th and 30th, 2021, in two hospitals in Harbin Municipality, Heilongjiang Province in China. Due to the risk of infection during the COVID-19 pandemic, face-to-face interviews could not be executed. In this study, we used an online-based survey *via* the WeChat-based survey program "Questionnaire Star" to collect data (33), mainly drawing on the fact that WeChat is the largest social communication media with more than 1 billion users in China (34). In the study, our research assistants forwarded the questionnaire to various WeChat groups of young clinicians to collect information. The questionnaire required each question be answered before it could be submitted. The same IP address could be used only once to complete the questionnaire.

Measurements

Sociodemographic variables

Using the questionnaire, we collected sociodemographic data, including gender, marriage, education level, inhabitation, and fertility.

Explanatory variables

Following previous studies on the influenza vaccine (35, 36), several standardized questions related to COVID-19 were used in this study, including (1) "Do you worry about family and friends being infected with COVID-19?" (No/Fair/Very much); (2) "Do you think COVID-19 vaccines could protect you from COVID-19?" (No/No idea/Yes); (3) "What do you think of the long-term side effects of the COVID-19 vaccines?" (Not safe with obvious side effects/No idea/Safe with no or minimal side effects); and (4) "What do you think the vaccine will stop the global epidemic?" (No/No idea/Yes).

Insomnia severity was assessed by the validated Chinese version of the 7-item Insomnia Severity Index (ISI), which has been widely used in clinical research, with a total score ranging from 0 to 28. Insomnia was defined with a cutoff point of 8, i.e., ISI $\geq$ 8 (37, 38). The Cronbach's alpha of the scale was 0.842.

Stress severity was assessed by the validated Chinese version of the 10-item Perceived Stress Scale (PSS-10), which has been widely used in clinical research with a total score ranging from 0 to 40. Higher scores indicate greater stress severity (39, 40). The Cronbach's alpha of the scale was 0.915.

Outcome variables

Depression severity was assessed by the validated Chinese version of the 9-item Patient Health Questionnaire (PHQ-9), which has been widely used in clinical research, with a total score ranging from 0 to 27. Depression was defined with a cutoff point of 5, i.e., PHQ-9 $\geq$ 5 (37, 41). The Cronbach's alpha of the scale was 0.896.

Anxiety severity was assessed by the validated Chinese version of the 7-item Generalized Anxiety Disorder (GAD-7), which has been widely used in clinical research, with a total score ranging from 0 to 21. Anxiety was defined with a cutoff point of 5, i.e., GAD-7 $\geq$ 5 (42, 43). Anxiety-depression comorbidity was defined with a cutoff point of 5, i.e., both PHQ-9 $\geq$ 5 and GAD-7 $\geq$ 5. The Cronbach's alpha of the scale was 0.945.

The overall QOL was assessed by the sum of the first two item scores of the Chinese version of the World Health Organization Quality of Life-brief version (WHOQOL-BREF), with a total score ranging from 2 to 10. Higher scores indicate a greater QOL (44). The Cronbach's alpha of the scale was 0.801.

Data analysis

All data were analyzed by using the Statistical Package for Social Science (SPSS) version 25.0. EXCEL was adopted to manage the data. Because the diseases of the subjects were different, we compared demographic variables and questionnaires between the anxiety-depression comorbidity and no anxiety or depression groups, between the anxiety and no anxiety groups, and between the depression and no depression groups. Categorical variables were compared by the chi-square test. Shapiro Wilk (S-W) was used to test the normality of quantitative variables. The variables that were compliant with normality were subjected to independent *t*-tests, while those that did not meet normality were subjected to Mann–Whitney U tests. Variables with statistical significance in the significance test were included in the binary logistic regression analysis, which was used to identify the factors associated with depression, anxiety, and anxiety-depression comorbidity. Spearman's rank-order analysis was used to test the relationship between depression and anxiety. Multiple linear regression

analysis was used to assess the associations of factors influencing QOL. Statistical significance tests were two-tailed, and $P < 0.05$ was considered statistically significant.

Results

Sociodemographic and clinical characteristics

A total of 154 young front-line clinicians were enrolled in the current analysis. A total of 146 participants met the inclusion criteria and were finally included in our study, with a response rate of 94.8%. The sociodemographic and clinical characteristics of the study participants are shown in Table 1. Regarding sociodemographic characteristics, 61.64% ($n = 90$) of the total sample were female clinicians.

The prevalence of depression was 37.7% (95% CI = 29.7–45.6%). The mean total score of the PHQ-9 was 4.32 (SD = 4.79). The prevalence of anxiety was 26.0% (95% CI = 18.8–33.2%). The mean total GAD-7 score was 2.84 (SD = 4.05). The prevalence of combined depression and anxiety was 24.0% (95% CI = 17.0–31.0%). The mean total ISI score was 4.79 (SD = 4.43). The mean total PSS-10 score was 14.96 (SD = 4.25). Spearman's rank-order correlation analysis revealed that depression and anxiety had a significant correlation (correlation coefficient = 0.73, $P < 0.01$).

Subgroup analysis

The depression and non-depression groups: The difference significance test revealed that young front-line clinicians with depression were more likely to suffer from severe stress ($P < 0.01$) and insomnia ($P < 0.01$) in high-risk areas during the COVID-19 sporadic epidemic. The prevalence of depression varied significantly across education levels ($P < 0.05$) and inhabitation ($P < 0.01$). In addition, responses to the questions about attitudes toward the long-term side effects of the COVID-19 vaccines were significantly different between the depression and non-depression groups ($P < 0.05$) (Table 1).

The anxiety and non-anxiety groups: The difference significance test revealed that young front-line clinicians with anxiety were more likely to have more severe stress ($P < 0.01$) and insomnia ($P < 0.01$) in high-risk areas during the COVID-19 sporadic epidemic. The prevalence of anxiety was significantly different by inhabitation ($P < 0.05$). Responses to the questions about attitudes toward COVID-19 vaccines except for the protective effects of COVID-19 vaccines were significantly different between the two groups (all $P < 0.05$) (Table 1).

The depression and anxiety comorbid and non-comorbid groups: The difference significance test revealed that young front-line clinicians with anxiety were more likely to suffer from severe stress ($P < 0.01$) and insomnia ($P < 0.01$) in high-risk areas during the COVID-19 sporadic epidemic. The prevalence of anxiety-depression comorbidity was significantly different by inhabitation ($P < 0.05$). In addition, responses to the questions about attitudes toward COVID-19 vaccines except for the protective effects of COVID-19 vaccines were significantly different between the two groups (all $P < 0.05$) (Table 1).

Factors influencing anxiety, depression, and anxiety-depression comorbidity

Table 2 presents the results of the binary logistic regression analysis. In the multivariate analysis, severe stress (OR = 1.258, 95% CI = 1.098–1.442, $P < 0.01$) and insomnia (OR = 1.282, 95% CI = 1.135–1.447, $P < 0.01$) were positively correlated with depression. Severe stress (OR = 1.487, 95% CI = 1.213–1.823, $P < 0.01$) and insomnia (OR = 1.131, 95% CI = 1.003–1.274, $P < 0.05$) were positively correlated with anxiety. The belief that the vaccine will stop the global epidemic (OR = 0.099, 95% CI = 0.014–0.715, $P < 0.05$) was negatively correlated with anxiety. Severe stress (OR = 1.532, 95% CI = 1.228–1.912, $P < 0.01$) was positively correlated with anxiety-depression comorbidity. Insomnia (OR = 1.081, 95% CI = 0.963–1.214, $P > 0.05$) was not correlated with anxiety-depression comorbidity. The belief that the vaccine will stop the global epidemic (OR = 0.101, 95% CI = 0.014–0.744, $P < 0.05$) was negatively correlated with anxiety-depression comorbidity.

Factors influencing overall quality of life

Table 3 presents the results of multiple linear regression analysis. In the analysis, severe stress (B = −0.068, 95% CI = −0.129 to −0.007, $P < 0.05$) and insomnia (B = −0.127, 95% CI = −0.188 to −0.067, $P < 0.01$) were negatively correlated with overall QOL. The belief that the vaccine could provide protection (B = 1.442, 95% CI = 0.253–2.631, $P < 0.05$) was positively correlated with overall QOL.

Discussion

To our knowledge, this is the first survey on the mental health status of young front-line clinicians in high-risk areas during the COVID-19 sporadic epidemic. In this study, we found that the prevalence rates of depression and anxiety among young clinicians were 37.7 and 26.0%, respectively. A study on the psychological status of Chinese adults during the epidemic showed that the prevalence of anxiety and depression in the general population was 7.6 and 11.3%, respectively (3). The different prevalence rates may be related to the higher

TABLE 1 The sociodemographic and clinical characteristics of the study participants.

Variable	No DEP ($N = 91$) N%	DEP ($N = 55$) N%	P	No ANX ($N = 108$) N%	ANX ($N = 38$) N%	P	No DEP or ANX ($N = 111$) N%	Comorbid DEP and ANX ($N = 35$) N%	P
Gender (female)	59 (64.8)	31 (56.4)	0.308	68 (63.0)	22 (57.9)	0.581	71 (64.0)	19 (54.3)	0.305
Education level									
Bachelor's degree	23 (25.3)	8 (14.5)	0.040*	25 (23.1)	6 (15.8)	0.352	26 (23.4)	5 (14.3)	0.132
Master's degree	57 (62.6)	45 (81.8)		72 (66.7)	30 (78.9)		73 (65.8)	29 (82.9)	
Doctoral degree	11 (12.1)	2 (3.6)		11 (10.2)	2 (5.3)		12 (10.8)	1 (2.9)	
Marriage (single)	77 (84.6)	49 (89.1)	0.446	91 (84.3)	35 (92.1)	0.226	94 (84.7)	32 (91.4)	0.312
Fertility (none)	83 (91.2)	53 (96.4)	0.232	99 (91.7)	37 (97.4)	0.231	102 (91.9)	34 (97.1)	0.284
Inhabitation									
Alone	17 (18.7)	9 (16.4)	0.001**	22 (20.4)	4 (10.5)	0.011*	22 (19.8)	4 (11.4)	0.003**
With family	33 (36.3)	6 (10.9)		34 (31.5)	5 (13.2)		36 (32.4)	3 (8.6)	
Others	41 (45.1)	40 (72.7)		52 (48.1)	29 (76.3)		53 (47.7)	28 (80.0)	
Worried about being infected with COVID-19									
No	33 (36.3)	14 (25.5)	0.149	39 (36.1)	8 (21.1)	0.019*	39 (35.1)	8 (22.9)	0.046*
Fair	49 (53.8)	30 (54.5)		59 (54.6)	20 (52.6)		61 (55.0)	18 (51.4)	
Very much	9 (9.9)	11 (20.0)		10 (9.3)	10 (26.3)		11 (9.9)	9 (25.7)	
Thought COVID-19 vaccines could provide protection									
No	20 (22.0)	14 (25.5)	0.403	26 (24.1)	8 (21.1)	0.232	26 (23.4)	8 (22.9)	0.303
No idea	65 (71.4)	40 (72.7)		75 (69.4)	30 (78.9)		78 (70.3)	27 (77.1)	
Yes	6 (6.6)	1 (1.8)		7 (6.5)	0 (0.0)		7 (6.3)	0 (0.0)	
Though vaccines are safe									
Not safe with obvious side effects	7 (7.7)	13 (23.6)	0.012*	11 (10.2)	9 (23.7)	0.018*	12 (10.8)	8 (22.9)	0.039*
No idea	69 (75.8)	38 (69.1)		79 (73.1)	28 (73.7)		81 (73.0)	26 (74.3)	
Safe with no or minimal side effects	15 (16.5)	4 (7.3)		18 (16.7)	1 (2.6)		18 (16.2)	1 (2.9)	
Though vaccines will stop the global epidemic									
No	14 (15.4)	16 (29.1)	0.101	19 (17.6)	11 (28.9)	0.040*	19 (17.1)	11 (31.4)	0.040*
No idea	58 (63.7)	32 (58.2)		65 (60.2)	25 (65.8)		68 (61.3)	22 (62.9)	
Yes	19 (20.9)	7 (12.7)		24 (22.2)	2 (5.3)		24 (21.6)	2 (5.7)	
	M (Q)	**M (Q)**	***P***	**M (Q)**	**M (Q)**	***P***	**M (Q)**	**M (Q)**	***P***
Insomnia	2.0 (5.0)	7.0 (6.0)	<0.001***	3.0 (5.0)	7.0 (8.0)	<0.001***	3.0 (5.0)	7.0 (6.0)	<0.001***
	μ (SD)	**μ (SD)**	***P***	**μ (SD)**	**μ (SD)**	***P***	**μ (SD)**	**μ (SD)**	***P***
stress	13.59(3.96)	17.22(3.75)	<0.001***	13.8(3.86)	18.26(3.55)	<0.001***	13.86(3.87)	18.43(3.53)	<0.001***

ANX, anxiety; DEP, depression; M, median; Q, quartiles; μ, mean; SD, standard deviation.
$p < 0.05$ was considered statistically significant.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

TABLE 2 The binary logistic regression analysis of depression, anxiety, and combined depression and anxiety in the study participants.

Variable	Depression			Anxiety			Combined depression and anxiety		
	P	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI
Education level (ref: bachelor's degree)									
Master's degree	0.716	1.228	0.406–3.714	–	–	–	–	–	–
Doctoral degree	0.638	0.588	0.065–5.358	–	–	–	–	–	–
Inhabitation (ref: alone)									
With family	0.133	0.320	0.073–1.413	0.941	1.074	0.162–7.114	0.527	0.516	0.067–4.008
Others	0.225	2.012	0.650–6.222	0.128	3.401	0.703–16.447	0.123	3.459	0.716–16.713
Worried about being infected with COVID-19 (ref: no)									
Fair	–	–	–	0.382	1.707	0.515–5.659	0.550	1.447	0.432–4.848
Very much	–	–	–	0.182	2.883	0.609–13.655	0.238	2.600	0.531–12.718
Though vaccines are safe (ref: not safe with obvious side effects)									
No idea	0.991	1.008	0.256–3.971	0.282	3.496	0.357–34.196	0.418	2.533	0.268–23.958
Safe with no or minimal side effects	0.183	3.272	0.571–18.736	0.334	3.584	0.269–47.676	0.507	2.387	0.183–31.162
Though vaccines will stop the global epidemic (ref: no)									
No idea	–	–	–	0.706	0.781	0.216–2.824	0.425	0.591	0.162–2.155
Yes	–	–	–	0.022*	0.099	0.014–0.715	0.024*	0.101	0.014–0.744
Insomnia	<0.001***	1.282	1.135–1.447	0.044*	1.131	1.003–1.274	0.187	1.081	0.963–1.214
Stress	0.001**	1.258	1.098–1.442	<0.001***	1.487	1.213–1.823	<0.001***	1.532	1.228–1.912

CI, confidential interval; OR, odds ratio; Ref, reference group.
$p < 0.05$ was considered statistically significant.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

risk of infection, unpredictable work patterns, and the high psychological stress of clinicians in high-risk areas during the epidemic. In addition, isolation measures lead to the absence of interpersonal communication. If anxiety and depression are more likely to occur, they worsen in the absence of interpersonal communication (45). Another meta-analysis showed that the prevalence of anxiety and depression among clinicians was 21.73 and 25.37%, respectively, during the epidemic (46). The high prevalence of anxiety and depression among young clinicians could be attributed to them having more anxiety characteristics, more difficulty relaxing, and more difficulty adapting to changes than older clinicians (20, 21). Young people show lower levels of wellbeing and optimism than older people, which may also be a risk factor for their vulnerability to anxiety and depression (22).

Our study showed a significant correlation between depression and anxiety ($P < 0.01$). The connection between depression and anxiety is duplex; anxiety can lead to depression, and vice versa (47, 48). This may be related to the decrease in the anterior regions of the default mode network and the increased connectivity in the posterior regions (49). Previous studies have shown that anxiety-depression comorbidity was highly prevalent during the SARS pandemic (50). In this study, the comorbidity rate of depression and anxiety disorder was 23.97%. Because of the similar pathogenesis underlying depression and anxiety (51), we speculate that anxiety-depression comorbidity may be the result of the COVID-19 sporadic epidemic in terms of mental illness.

Insomnia is more severe in individuals with depression or anxiety. According to relevant studies, insomnia can damage emotional regulation and increase the risk of depression or anxiety (52–54). However, the relationship between insomnia and depression or anxiety may be bidirectional (52). Many studies point out that depression or anxiety can reduce the quality of sleep, leading to insomnia (17, 55, 56). Serotonergic and dopaminergic dysfunctions may be the common underlying mechanism of insomnia and mental disorders (57). In addition, depression, anxiety, and insomnia may also have a common genetic basis (58). Interestingly, no correlation was found between anxiety-depression comorbidity and insomnia in this study. This is different from the results of previous studies (47, 58). The differences may be due to the use of different survey tools or different study populations. However, this was only a preliminary result that needs further confirmation from additional studies. Faced with the sporadic epidemic, the working hours and labor intensity of clinicians in high-risk areas have increased, leading to insufficient rest time and psychological distress. In conclusion, COVID-19 plays an important role in triggering or aggravating mental health conditions such as depression, anxiety, and insomnia.

TABLE 3 Multiple linear regression analysis of quality-of-life related factors.

Variable	B	*P*	95% CI	VIF
Gender (ref: male)	−0.206	0.383	−0.673 to 0.260	1.204
Education level (ref: bachelor's degree)				
Master's degree	−0.412	0.148	−0.971 to 0.147	1.541
Doctoral degree	−0.003	0.995	−0.944 to 0.938	1.683
Marriage (ref: single)	−0.811	0.080	−1.719 to 0.098	2.286
Fertility (ref: none)	0.027	0.964	−1.121 to 1.174	1.967
Inhabitation (ref: alone)				
With family	−0.408	0.261	−1.123 to 0.308	2.346
Others	−0.418	0.179	−1.030 to 0.195	2.169
Worried about being infected with COVID-19 (ref: no)				
Fair	0.199	0.450	−0.322 to 0.720	1.578
Very much	0.784	0.050	−0.001 to 1.570	1.707
Thought COVID-19 vaccines could provide protection (ref: no)				
No idea	0.514	0.081	−0.065 to 1.092	1.583
Yes	1.442	0.018*	0.253 to 2.631	1.510
Thought vaccines are safe (ref: not safe with obvious side effects)				
No idea	0.258	0.458	−0.429 to 0.946	2.165
Safe with no or minimal side effects	0.262	0.557	−0.618 to 1.141	2.143
Thought vaccines will stop the global epidemic (ref: no)				
No idea	0.052	0.876	−0.603 to 0.706	2.374
Yes	0.323	0.415	−0.457 to 1.103	2.085
Depression	−0.047	0.353	−0.146 to 0.052	5.216
Anxiety	−0.062	0.249	−0.168 to 0.044	4.270
Insomnia	−0.127	<0.001***	−0.188 to −0.067	1.678
Stress	−0.068	0.029*	−0.129 to −0.007	1.573

B, regression coefficient; CI, confidential interval; Ref, reference group; VIF, variance inflation factor.
$p < 0.05$ was considered statistically significant.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Our study showed that stress is a risk factor for anxiety and/or depression. This is consistent with the findings of previous studies (59). Therefore, to promote the mental health of clinicians, it is necessary to develop personalized intervention measures to reduce stress during the COVID-19 sporadic epidemic.

Our study showed that QOL was determined by the interaction between protective factors (e.g., the belief that the vaccine could provide protection) and risk factors (e.g., severe insomnia and stress conditions). Adequate sleep and reasonable stress relief are considered indispensable elements of health, general wellbeing, and proper daily functioning. Stress and insomnia might reduce clinicians' QOL by leading to cognitive dysfunction (60), physical discomfort (61), and job burnout (62). Further studies on the sleep patterns and stress management strategies of young front-line clinicians in high-risk areas are needed to develop strategies to prevent or alleviate problems and improve the QOL.

Currently, the absence of proven treatments for COVID-19 has led the world's population to pin their hopes for vaccines (63). After the outbreak of the epidemic, the Chinese government urgently developed a vaccine, and the Chinese population reflected the strong demand and high acceptance of the importance of COVID-19 vaccines (64). A global survey of potential acceptance of the COVID-19 vaccine showed that Chinese people's acceptance of the vaccine was nearly 90% (64). Our study showed that young front-line clinicians in high-risk areas who thought that the vaccine could stop the global epidemic were less prone to anxiety and anxiety-depression comorbidity. Raising confidence in and awareness of vaccines may help address the mental health problems of young front-line clinicians in high-risk areas. Although our sample comprised young front-line clinicians, not all clinicians work in infectious diseases departments, and some have relatively poor knowledge of vaccines. The dissemination of misinformation could have a significant impact on confidence in the COVID-19 vaccine, further exacerbating mental health problems among

the young front-line clinician population (65, 66). Therefore, national and local regulatory authorities need to conduct health education and outreach through authoritative sources to carefully explain the effectiveness of the vaccine, the duration of the antibody, and the importance of achieving group immunity. This increases confidence that the COVID-19 vaccine will end the global epidemic, reduce the prevalence of anxiety and/or anxiety-depression comorbidity, and effectively alleviate specific concerns or misconceptions in high-risk areas.

Limitation

Our study has several limitations. First, due to the cross-sectional study design, it was difficult to make a causal inference. Second, the sample size of this study was limited, and single-area studies may have limited applicability and generalizability to clinicians in other high-risk areas. Third, due to the sudden occurrence of the COVID-19 disaster, we were unable to assess the psychological status of the respondents before the sporadic epidemic. Fourth, depression, anxiety levels, and other related factors, such as sleep disturbance and stress levels, were measured by self-report questionnaires, without objective indicators of related factors in this study. Finally, social support plays a pivotal role in reducing the likelihood of psychological impact and QOL (67), but it was not evaluated in this study.

Conclusion

We identified the main mental health problems of young front-line clinicians in high-risk areas during the COVID-19 sporadic epidemic in China. Depression, anxiety, anxiety-depression comorbidity, and QOL were associated with many factors, including insomnia, stress, and a portion of attitudes toward the COVID-19 vaccine. Due to the reasonable epidemic prevention and control measures and popularization of vaccination taken by the Chinese government, there has been no recent large-scale outbreak of the epidemic in China. The sporadic epidemic may become the most important problem for the prevention and control of the epidemic in the future. Therefore, establishing early targeted mental health interventions for young clinicians in high-risk areas during the COVID-19 sporadic epidemic situation should be part of global preparedness efforts.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

XS and YZha contributed to the study design, analyzed the data, and wrote this manuscript. QL and YZhu did the online survey, data collection, and logical check. GZ, YL, and JZ revised the manuscript. All authors reviewed and approved the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Wulf Rössler,
Charité Universitätsmedizin
Berlin, Germany

*CORRESPONDENCE
Pedro Morgado
pedromorgado@med.uminho.pt

†These authors have contributed equally to this work and share senior authorship

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Editorial: COVID-19 pandemic: Mental health, life habit changes and social phenomena

Pedro Morgado[1,2]*, Xenia Gonda[3,4], Daria Smirnova[5†] and Konstantinos N. Fountoulakis[6†]

[1]Life and Health Sciences Research Institute (ICVS), School of Health Sciences, University of Minho, Braga, Portugal, [2]ICVS-3Bs PT Government Associate Laboratory, Braga/Guimarães, Portugal, [3]Department of Psychiatry and Psychotherapy, Semmelweis University, Budapest, Hungary, [4]NAP-2-SE New Antidepressant Target Research Group, Hungarian Brain Research Program, Semmelweis University, Budapest, Hungary, [5]International Centre for Education and Research in Neuropsychiatry, Samara State Medical University, Samara, Russia, [6]Third Department of Psychiatry, School of Medicine, Faculty of Health Sciences, Aristotle University of Thessaloniki, Thessaloniki, Greece

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Editorial on the Research Topic
COVID-19 pandemic: Mental health, life habit changes and social phenomena

The SARS-CoV-2 virus brought dramatic changes into daily life, subjecting society to the new and unforeseen era. The COVID-19 pandemic introduced challenges to governments, healthcare systems (including mental healthcare services), clinicians, and researchers worldwide, including management of healthcare sector investigations and international multicenter projects (1–5).

The COMET study was one of the largest quasi-epidemiological projects in the field of psychiatry which evaluated the impact of COVID-19 pandemic and its related lockdown conditions on the mental health of the 40 countries' population and was supported by the World Psychiatric Association. Study findings proved that pandemic was not just a threat to physical health but also presented severe stresses that broadly impacted the mental health and social lifestyles of people (6–9) (Panfil et al.). Its negative influence on the mental health of different vulnerable population groups has been described since the early beginning of the pandemic in 2020 (10–17).

This Research Topic was intended to describe the impact of COVID-19 pandemic on the population's mental health, life habits, daily beliefs, and social behaviors, as well as to discuss the urgent needs to face this evolving environment in the future. The 69 papers comprising this Research Topic, accepted from authors representing several countries and continents, examine the consequences of pandemic-associated factors investigated from multiple angles and points of view, and providing a really manifolded and

detailed insight, not only broadening our understanding of the pandemic-related situation, the consequences of the lockdown conditions and similar crises, but also widening our knowledge in social, clinical psychiatry, and epidemiology of mental disorders.

COVID-19 has increased economic uncertainty, and not only negatively affected mental health, but also severely limited access to health services, which produced a cumulative burden in broad populations. The impact was differential and seemed to influence more significantly women (Batista et al.; Vrublevska et al.; Xie et al.; Alhazmi et al.; Bonzini et al.; Zhang et al.; Chutiyami et al.; Pisanu et al.; Eleftheriou et al.; Biswas et al.), younger people (Panfil et al.; Batista et al.; Chutiyami et al.; Pisanu et al.; Liu et al.), city inhabitants (Meyer et al.), and those persons who had experienced mental health problems in the past (Panfil et al.; Vrublevska et al.; Jang et al.; Ali et al.). Several studies identified depression (Meyer et al.; Jang et al.; Kim et al.) (18), anxiety (Vrublevska et al.; Alhazmi et al.; Folayan et al.; Fu et al.) (19), stress/distress (Krajewska-Kułak et al.; AlRasheed et al.) (19), burnout phenomenon (Chen, Bai, et al.) (20), post-traumatic stress disorder signs (Chutiyami et al.; De Pasquale et al.) (21), sleep disturbances (Folayan et al.; AlRasheed et al.), obsessive-compulsive symptoms (18, 22), and internet/mobile phone addiction (Jiang et al.; Moniri et al.) as the most common problems in the area of mental health observed in the general population.

The mental health of patients diagnosed with COVID-19 was also impacted by factors related to the pathophysiology of the SARS-CoV-2 infection and by various stressors multiplied during the quarantine period, and after release from quarantine. Anxiety and/or mood disturbances with psychomotor retardation as well as symptoms of impaired consciousness, memory, and insight were frequent and may be considered neuropsychiatric manifestations of COVID-19 (Sorokin et al.). Patients diagnosed with SARS-CoV-2 reported concerns about recovery and complications, stress related to social isolation measures, issues associated with the treatment environment, limited information about COVID-19 and infodemic, financial difficulties, stigma, discrimination, increased violence and conflicts within a family (Park et al.; Li et al.). Besides epidemiological findings, some of the presented papers describe background mechanisms which may also help to identify the targets for prevention and intervention in similar crisis situations.

During the pandemic, healthcare professionals were subject to extreme demands which pose significant short- and long-term effects on their mental health. Studies from several countries demonstrated the broad impact of the current pandemic on healthcare workers' mental health. A meta-review found that anxiety, depression, and stress/post-traumatic stress disorder were the most reported COVID-19 pandemic-related mental health conditions affecting healthcare workers (Chutiyami et al.). Other problems such as insomnia, burnout, fear, obsessive-compulsive disorder, somatization symptoms, phobia, cognitive failures, substance abuse, and suicidal thoughts were also reported (Chutiyami et al.; Mehri et al.). Those working in high-risk settings presented poorer mental health outcomes (Zhang et al.) (20).

Fortunately, not all that experience of stressful events related to the COVID-19 pandemic showed adverse consequences of it. In this vein, coping is defined as cognitive and behavioral efforts to deal with the demands of particular stressful situations minimizing their potential negative impacts. Physical exercises (Zhu et al.), yoga (Upadhyay et al.), and self-care activities (Gavurova et al.) within the daily routine were found beneficial. The most used coping or adjustment mechanisms were the avoidance-oriented coping with stress, emotion-oriented coping, and task-oriented coping (Twardowska-Staszek et al.). Interestingly, suppression has been shown as an adaptive response to the worry associated with uncertainty, at least, in the short-term context (Khatibi et al.). Among healthcare workers, the most-reported coping strategies include individual/group psychological support, family/relative support, training/orientation, and the adequacy of personal protective equipment (Chutiyami et al.).

The impact of the pandemic on society was significant but the ability to build effective responses was even more surprising. In a few months, a new and effective vaccine was developed and administered to millions worldwide significantly reducing the burden of the disease. Several diagnostic and therapeutic interventions were also developed both for COVID-19 symptoms and sequels as well as for its mental health consequences (Lee et al.; Asanjarani et al.; Hoseinzadeh et al.; Guelmami et al.; Schröder et al.).

As the knowledge of the virus increased and the correct information spread, the adaptation to stress also improved (23). In the early phases of the pandemic, public adherence to public health measures was high (Law et al.) but the spread of rumors, fake news, and misinformation was a challenge to governments, health authorities, and scientific institutions (Chen, Rong et al.) (24). Vaccination was particularly affected by misinformation. However, receiving information concerning COVID-19 vaccination from healthcare workers and scientific experts was associated with greater vaccination acceptance and decreased stress concerning COVID-19 vaccination (Zheng et al.; Vasileva et al.; Maciaszek et al.). Indeed, those who got the vaccine presented lower levels of depressive symptoms during the second wave of the infection outbreak (Zheng et al.; Benedetti et al.).

COVID-19 pandemic represents a public health emergency that exposed the dire consequences of inequality, affecting more negatively those who were more vulnerable before and at the beginning of the pandemic. Thus,

economic support played a relevant role in the reduction of the negative impact of the pandemic contributing to alleviating symptoms of depression and anxiety (Yao et al.).

Humanity has learned a lot from this (perhaps, not so much) unexpected experience. The time is now to identify how we can be more resilient to future challenges. Current challenging times request us to rethink and to act.

Author contributions

PM wrote the first draft. All authors wrote and approved the final manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Covid-19, Lockdown and Self-Isolation: Evaluation of Deliberate Self-Harm Admissions

Callum Shields[1], Jack Bernard[1], Omer Idris Mirza[1], David Reeves[2], Adrian Wells[3] and Anthony Heagerty[4]*

[1] Manchester University Foundation Trust, Manchester, United Kingdom, [2] Division of Population Health, Health Services Research and Primary Care, Manchester, United Kingdom, [3] School of Psychological Science, Section of Clinical and Health Psychology University of Manchester Rawnsley Building, Manchester, United Kingdom, [4] Division of Cardiovascular Sciences, Faculty of Biology, Medicine and Health, University of Manchester Core Technology Facility, Manchester, United Kingdom

Background: COVID 19 is still presenting a clear and dynamic global threat. The United Kingdom remains one of the hardest hit countries from the pandemic. In January 2021 parliament announced that the UK will be entering a full national lockdown. This paper explores what effect lockdown measures had on rates of deliberate self-harm presentations to one NHS trust in Manchester UK.

Methods: This paper compared the number of cases of deliberate self-harm which presented to the emergency department of Manchester Royal Infirmary for March-May in 2018, 2019 and 2020. This was achieved by utilising coding from emergency department data and reviewing hospital records surrounding each case.

Results: 2018 recorded a total of 101 admissions as a result of DSH with all causes admissions of 8,514 making the proportions of admissions due to self-harm 1.19%. In 2019, 9,038 patients were admitted, of these, 130 (1.44%) were identified as DSH. In 2020 the total number of admissions fell to 5,676 with 118 admitted due to self-harm, representing 2.08% of admissions. The absolute number of admissions remained stable however the proportion of admissions due to self-harm was significantly higher in 2020 ($p < 0.001$). Other significant findings include a higher proportion of male admissions compared to females in 2020 (58.5%) and a decrease in the normal of cases relating to paracetamol overdose in 2020.

Discussion: The findings demonstrated by this study do not indicate that lockdown is an absolute risk for DSH behaviours however it does illustrate the stable nature of these cases despite and dramatic decline in all cause admissions. The rate of increase of deliberate self-harm accelerated significantly between March and May in 2020. Steps must be taken to avoid a similar situation following the 2021 lockdown and beyond – focus on improving access to certain virtual services may help to achieve this goal.

Keywords: COVID-19, self harm, lockdown, mental health, stress, deliberate self harm, suicide

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Edited by:
Yuka Kotozaki,
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Reviewed by:
Jitendra Rohilla,
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Kristiana Siste,
University of Indonesia, Indonesia
Carlo Antonio Bertelloni,
University of Pisa, Italy

****Correspondence:***
Callum Shields
callum.shields@mft.nhs.uk

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BACKGROUND

COVID 19, the disease caused by the novel variant of the Sars-Cov-2 virus is still presenting a clear and dynamic global threat. Despite the glimmers of hope offered by the roll out of several vaccines, the virus is still sweeping through many international communities (1).

During the first wave of the pandemic in spring 2020 the UK Government enforced the first nation-wide lockdown to help combat the spread of the virus. This led to severe social restrictions, prohibiting mixing between households and a blanket closure of almost all hospitality and leisure industries. These measures remained in force from March-May after which gradual relaxation of the rules occurred (2). Moving forward to 2021, the United Kingdom (UK) remains one of the hardest hit countries from the pandemic and figures show a peak incidence of over 60,000 daily cases in January. Additionally, a near 25,000 hospital admissions due to the virus occurred in the first week of 2021, when coupled with the usual winter pressures exerted on the NHS, there was growing concern that our healthcare system would exceed breaking point (3). It is for this reason Parliament announced on the 4th of January that the UK will be entering a full national lockdown akin to the measures enforced during the first peak of the pandemic in spring 2020 (4). These restrictions are to be in place until at least April and although a provisional date of June 21st has been established for a return to normal, future lockdown periods remain a real possibility (5). This is evidenced by the emergence of multiple variant strains of COVID-19, the possibility of vaccine resistance and the need to accommodate normal winter pressures (6). With the prospect of further periods of strict health protection laws on the horizon, it is prudent to reflect on the original 2020 lockdown to examine what effects it had on the mental health of the population. Indeed, many papers have examined the impact these restrictions had on mental health of the population generally (7–11). Less have commented on how this impact has translated into severe manifestations such as suicidal behaviours and deliberate self-harm (DSH).

Historically, it has been documented that extreme social phenomena such as pandemics increase the burden on mental health. During the Spanish flu pandemic, the literature reports that one repercussion stemming from this is higher than normal levels of suicidal behaviours (12). Many papers have attempted to postulate the underlying aetiology behind these spikes in morbidity. Accounts from the time comment on the culpability of an acute influenza induced delirium or psychosis (13). Whereas, more contemporary papers state that societal factors such as loss employment or curbs on social freedoms are more likely responsible (12, 14). Furthermore, a recent study published in the Lancet highlighted the potential effects of a long-COVID syndrome on psychiatric disorders at 6 months post infection. This paper reported a statistically significant hazards ratio of 1.47 in the development of mood disorders amongst COVID patients compared to those with seasonal influenza (15). Given these links, this paper examines the effects of the initial lockdown period in the UK and the number of DSH admissions. This was done with reference to the World Health Organisation definition of self-harm:

> "an act with non-fatal outcome, in which an individual deliberately initiates a non-habitual behaviour that, without intervention from others, will cause self-harm, or deliberately ingests a substance in excess of the prescribed or generally recognised therapeutic dosage, and which is aimed at realising changes which the subject desired via the actual or expected physical consequences" (16).

Primary Aim

To determine what, if any, effect lockdown measures had on the number of deliberate self-harm admissions.

Methods

We compared the number of admissions from the Emergency Department of Manchester University Foundation Trust (Manchester Royal Infirmary) from March 1st to May 31st 2018, 2019, and 2020 and identified patients with a diagnosis of self-harm. This study period was chosen to reflect the most stringent lockdown restrictions present in the UK, specifically referencing the prohibition of social mixing between households hence representing the greatest degree of isolation (2).

Many papers have utilised survey methods to establish a general deteriorative trend in mental health during the pandemic (7–11). This study therefore focused specifically on cases which required admission to hospital for further treatment. This criterion was chosen to allow the data to embody severe cases of DSH over the study period. This was to allow reflection on the metric of self-harm behaviours of a degree severe enough to warrant admission.

We used local emergency departmental coding data to identify all cases coded as DSH for the study periods, as well as all cause presentations for the same period.

Inclusion criteria for the study were as follows:

1. Age over 16, this study focused solely on attendances to the adult emergency department.
2. Attendance coded as "Overdose and poisoning," "Self-harm" or "Major trauma" on the emergency department admission sheet.
3. Attendances that were of a degree/severity to warrant admission into the hospital.
4. Reference to deliberate intent of self-harm contained within the emergency department admission summary sheet. This was achieved by examining the "nurse triage" or "clinician's comments" section of the summary sheet and identifying which patients had acted with the intent to cause harm to themselves. This filtered out presentations for accidental injuries or overdoses, for example when an individual had mistakenly taken too many paracetamol tablets.

From this dataset we then used hospital EPR systems to extract key facets of each presentation – length of stay, mode of self-harm, intensive care involvement, death – to compare each year. The mode of self-harm contained several categories defined below:

1. Major trauma – Involved serious injuries from self-inflicted traumas most commonly jumping from heights or stabbings.
2. Self-mutilation – Injuries of a lesser severity than major trauma such as superficial incisions or wounds.
3. Household products – Involving ingestion of items found within the house such a bleach.
4. Alcohol – Cases which involved alcohol.
5. Recreational drugs – Cases which involved the use of drugs such as cannabis/cocaine.
6. Medication – Cases involving prescription medication such as anti-depressants, analgesia or any other pharmaceutical drug. The cases which referenced paracetamol were also included within this category.
7. Paracetamol – Cases specifically referencing the use of paracetamol.

Each case reported in the results represented a unique admission. Some cases did contain more than one mechanism of injury e.g., self-inflicted wound and paracetamol overdose. This provides explanation for the mismatch between the total number of cases and the overall counts for the underlying mechanism.

Statistical Analysis

Analysis focused principally on comparing numbers and rates of DSH admissions between years (2018, 2019, and 2020) and calendar months (March, April, May), and in relationship to patient characteristics. The admissions data was in the form of counts and with the exception of age the factors of interest were categorical, for which statistical inference was undertaken using Pearson Chi^2 analysis; to test for age differences we used one-way analysis of variance.

To examine if the characteristics of admitted patients differed between years, we pooled the data across the 3 months of observations within each year prior to analysis. When testing for differences in admission numbers and rates between years, to minimise multiple testing we first conducted an overall test for equality across years within months and only if that was rejected went on to test each month separately. An alpha value for statistical significance of 5% was used throughout.

RESULTS

Patient Demographics

The total number of admissions for DSH across the 3 years were 101, 130 and 118 for 2018, 2019, and 2020, respectively. These cases were then stratified for age, sex, ethnicity and marital status to discern any meaningful demographic differences across the study periods. The results are summarised in **Table 1**.

The groups were well-matched in terms of marital status and ethnic category with even distribution across the 3 years. A Pearson Chi^2 test comparing the percentage single (vs. any other marital status) between the 3 years was not statistically significant (Chi^2 3.16, df = 2, $p = 0.206$), nor was a comparison of the percentage of British or Irish ethnicity, vs. any other (Chi^2 2.39, df = 2, $p = 0.302$). However, mean age differed between the years (F = 3.65, df = 2:346, $p = 0.027$) with the 2020 group being somewhat older, as did the ratio of male to female admissions (Chi^2 9.89, df = 2, $p = 0.007$), with an increase in male representation in 2020.

TABLE 1 | Demographic differences across study years by age, sex, marital status and ethnic category for DSH admission cohort.

Year	2018	2019	2020	Mean
Age (average)	34.4	36.0	39.4	36.6
Sex *N*(%)				
Male	39 (38.6)	56 (43.1)	69 (58.5)	54.7 (46.7)
Female	62 (61.4)	74 (56.9)	49 (41.5)	61.7 (53.3)
Marital status *N*(%)				
Single	82 (81.2)	93 (71.5)	92 (78.0)	89 (76.9)
Married	6 (5.9)	11 (8.5)	10 (8.5)	9 (7.6)
Divorced	2 (2.0)	6 (4.6)	2 (1.7)	3.3 (2.8)
Widowed	2 (2.0)	3 (2.3)	0 (0.0)	1.7 (1.4)
Not stated	9 (8.9)	17 (13.1)	14 (11.8)	13.3 (11.3)
Ethnic category *N*(%)				
British	77 (76.2)	88 (67.7)	90 (76.3)	85 (73.4)
Irish	1 (1.0)	2 (1.5)	0 (0.0)	1 (0.8)
African	3 (3.0)	2 (1.5)	1 (0.8)	2 (1.8)
Caribbean	2 (2.0)	1 (0.8)	1 (0.8)	1.3 (1.2)
Chinese	0 (0.0)	1 (0.8)	3 (2.5)	1.3(1.1)
Indian	0 (0.0)	2 (1.5)	0 (0.0)	0.7 (0.5)
Pakistani	2 (2.0)	7 (5.4)	4 (3.4)	4.3 (3.6)
Mixed ethnicity	0 (0.0)	4 (3.1)	1 (0.8)	1.7 (1.3)
Any other ethnic background	8 (7.9)	13 (10.0)	10 (8.5)	10.3 (8.8)
Not stated	8 (7.9)	10 (7.7)	8 (6.8)	8.7 (7.5)

DSH Admissions March 1st – May 31st 2018

A total of 101 admissions as a result of DSH with all causes admissions of 8,514. This makes the proportions of admissions due to self-harm 1.19% with a monthly distribution of 0.84% (March), 1.18% (April) and 1.52% (May) – see **Figure 1** for full comparison. The average age in this group was 34.4 years and the average length of admission was 2.6 days. There were no deaths within this cohort however 14 (13.9%) of cases resulted in ITU/HDU input. In terms of coding, 15 (14.9%) were classified as major trauma, 18 (17.8%) as self-mutilation, 3 (3.0%) involved household items, 21 (20.8%) referenced alcohol involvement whilst 8 (7.9%) involved recreational substances. Medication was involved in 81 (80.2%) cases with 46 (45.5%) of these relating to paracetamol overdoses – see **Figure 2** for comparison of mechanisms of harm by year.

DSH Admissions March 1st – May 31st 2019

In 2019, a total of 9,038 patients were admitted via the emergency department, 130 were identified as being due to self-harm thus equating to 1.44% of admissions. Broken down by month to 1.27% (March), 1.38% (April) and 1.68% (May) – **Figure 1**. In this cohort the average age was 36 years, and the average

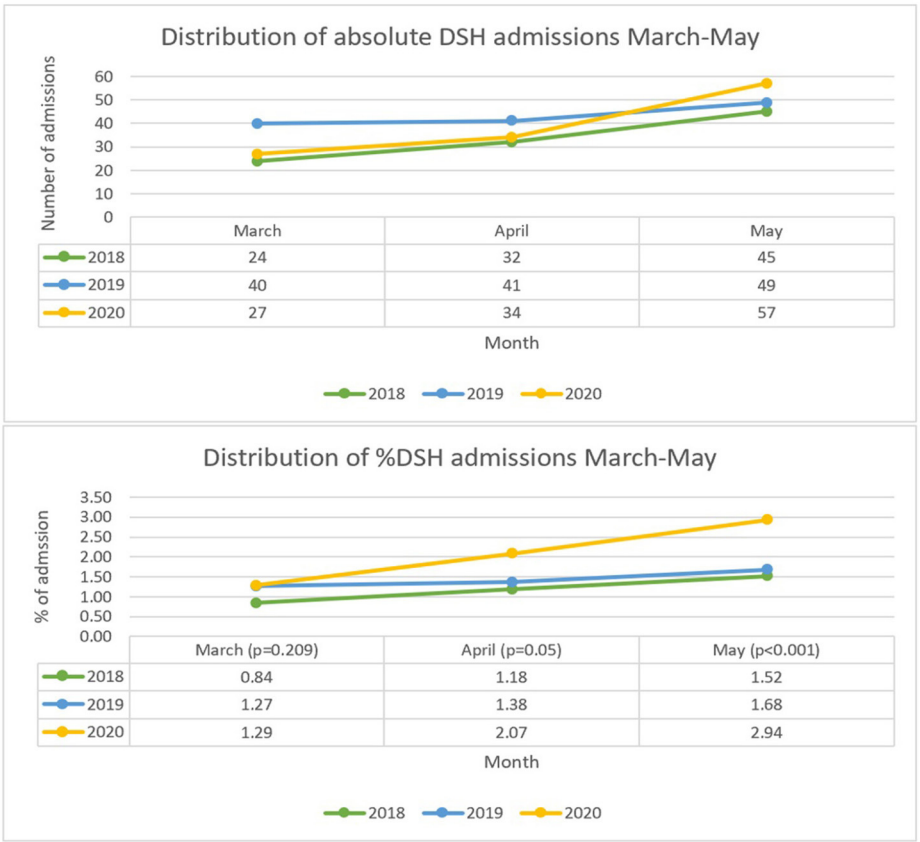


FIGURE 1 | Graphs comparing absolute and proportion of DSH by month and year.

length of hospital admission was 5.4 days. There were 2 (1.5%) deaths within this group and 12 (9.2%) had ITU/HDU involvement. Major trauma was cited in 14 (10.8%) of cases, 19 (14.6%) as self-mutilation, 5 (3.9%) involved household products. Alcohol was implicated in 32 (24.6%) of cases and recreational drugs in 8 (6.2%). A total of 77 (59.2%) cases involved medication overdoses with 63 (48.5%) involving paracetamol – **Figure 2**.

DSH Admissions March 1st – May 31st 2020

During lockdown in 2020 the total number of admissions fell to 5,676 a 33% decrease from 2018 and 37% decrease from 2019. The number diagnosed with self-harm was 118 representing 2.08% of all cause admissions – 1.29% (March), 2.07 (April), 2.94 (May) – **Figure 1**. The average age was 39.5 years and length of stay was 3.3 days. One (0.9%) death resulted from the self-harm in this year and 6 (5.1%) required escalation to HDU/ITU care. During 2020, major trauma accounted for 17 (14.4%) cases, 18 (15.3%) from self-mutilation and 3 (2.5%) from household items. Alcohol was involved in 29 (24.6%) of cases and 11 (9.3%) featured recreational drugs. Medication overdose was cited in 84 (71.2%) cases with 36 (30.5%) related to paracetamol overdoses – **Figure 2**.

Comparison of Years

Absolute Numbers of DSH Admissions

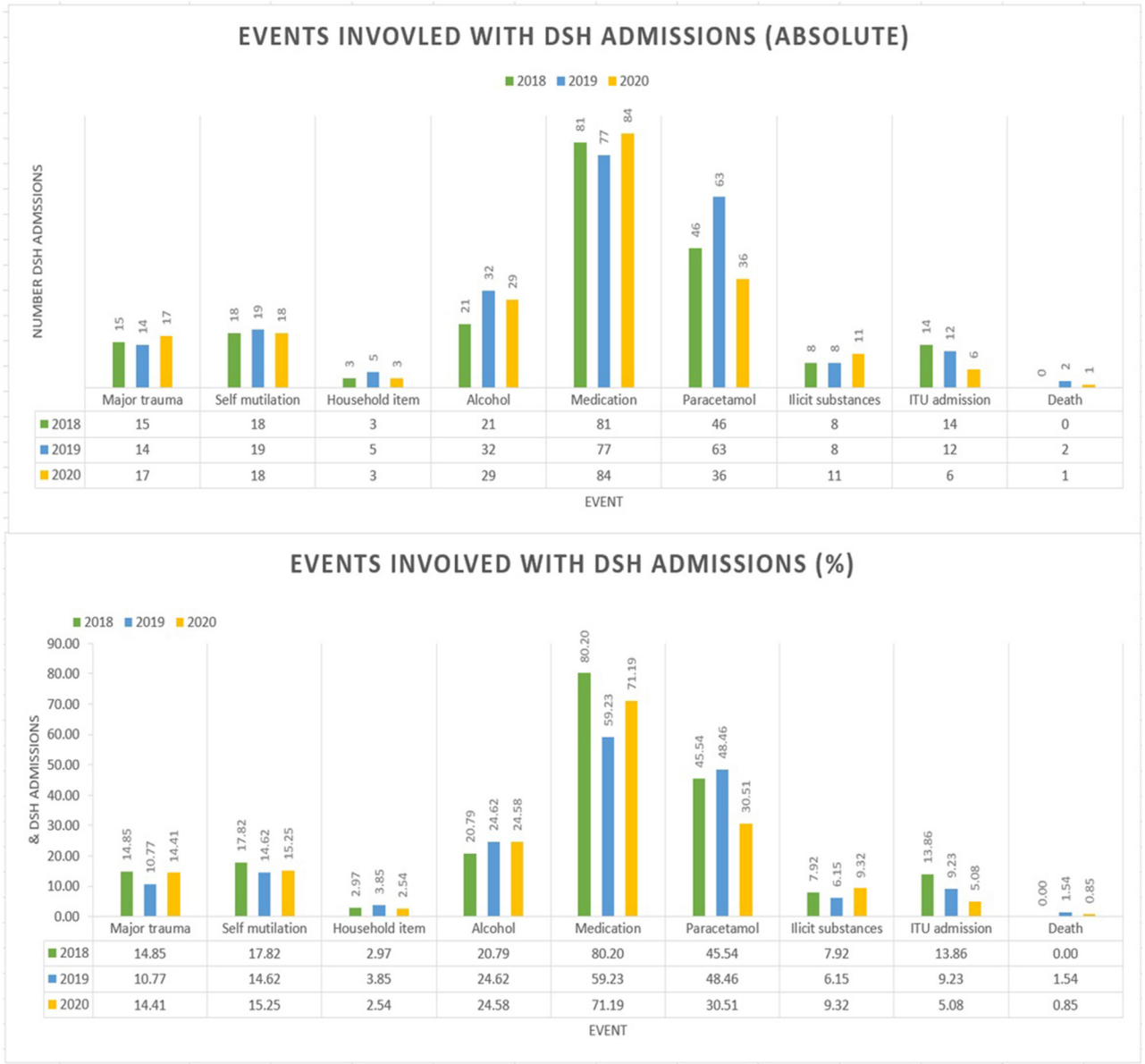
Numbers of DSH admissions in the months of March, April and May did not differ significantly between years (overall Chi^2 7.51, df = 6, $p = 0.277$). By contrast, total admissions for all causes differed between years, both overall and within each month separately (overall Chi^2 882.1, df = 6, $p < 0.001$; March Chi^2 219.4, df = 2, $p < 0.001$; April Chi^2 408.8, df = 2, $p < 0.001$; May Chi^2 254.0, df = 2, $p < 0.001$). The main contributing factors were the large reductions in all-cause admissions in April and May 2020 compared to 2019.

Proportions of DSH Admissions

Analysed as proportions of all emergency department admissions, rates of admissions for DSH differed between years (overall Chi^2 22.9, df = 6, $p < 0.001$). Under month-specific analysis, rates for March did not differ between years (Chi^2 3.14, df = 2, $p = 0.209$); but did differ for April (Chi^2 5.86, df = 2, $p = 0.05$), and May (Chi^2 13.9, df = 2, $p < 0.001$), largely driven by increased rates in April and May 2020 of 50 and 75%, respectively, compared to 2019.

Events Involved in DSH Admissions

Comparison of the rates at which each type of event was involved in DSH admissions found a significant difference



	Major trauma	Self mutilation	Household item	Alcohol	Medication	Paracetamol	Ilicit substances	ITU admission	Death
2018	15	18	3	21	81	46	8	14	0
2019	14	19	5	32	77	63	8	12	2
2020	17	18	3	29	84	36	11	6	1

	Major trauma	Self mutilation	Household item	Alcohol	Medication	Paracetamol	Ilicit substances	ITU admission	Death
2018	14.85	17.82	2.97	20.79	80.20	45.54	7.92	13.86	0.00
2019	10.77	14.62	3.85	24.62	59.23	48.46	6.15	9.23	1.54
2020	14.41	15.25	2.54	24.58	71.19	30.51	9.32	5.08	0.85

FIGURE 2 | Graphs showing events involved with DSH admissions by year.

between years for medication (Chi^2 12.04, df = 2, $p = 0.002$) and paracetamol (Chi^2 9.14, df = 2, $p = 0.01$) related event. It is notable that compared to 2019, the rate of medication overdose increased while paracetamol overdose decreased, despite the latter representing a major component of the former.

DISCUSSION

The number of admissions for DSH remained relatively steady across the study years. This indicates that, for the study cohort, the absolute risk of DSH did not change considerably during the lockdown period compared with previous years. One interesting facet to this finding however is the steadfastness of DSH admissions despite a radical decline in all cause admissions. As mentioned above, 2020 saw a respective drop of 33 and 37% in all cause admissions compared to 2018 and 2019. This has led to a statistically significant increase in the proportion of admissions due to DSH in 2020 compared to previous years. The large fall in overall medical admissions was a feature observed by many hospitals during the lockdown period and from a patient perspective may be attributed to fear of catching Covid-19 and a desire by many not to "bother" the NHS during a time of crisis (17). Furthermore, hospitals may have employed more stringent admission criteria than usual due to the potential bed crisis that loomed shortly after the first lockdown began. Nonetheless, even with this significant reduction in all cause

admissions, the number of DSH admissions proved unmalleable. This resistance may go some way in exemplifying the underlying aetiology of DSH behaviours. One of the driving factors behind an individual's desire to self-harm emanates from a help seeking mechanism. Indeed, a review by Edmondson et al. discerned that 87% of questionnaire studies linked self-harm practice as a way of expressing emotional pain to others (18). So, acknowledgement of the harm by a third party is an integral part of the underlying disease process for some individuals and hence explains the continued impulse to attend the emergency department. One of the main factors allaying people's desire to attend hospital during the pandemic is due to anxiety around catching Coronavirus. It is well-documented that individuals displaying suicidal behaviours, such as DSH, are more likely to participate in self-destructive patterns and have a lower regard for self-worth (19, 20). This unrelenting internal view directly opposes the COVID catching anxiety experienced by other patients, thereby helping them to overcome this barrier to attendance. Both reasons help to explain why the denominator of all causes admissions has reduced whilst the numerator for DSH admissions has remained stable.

A similar study conducted in Birmingham UK demonstrated an absolute increase in the presentations of deliberate self-harm to the emergency department. This study noted a rise in the percentage of these presentations from 1.98% to 3.69% ($p < 0.001$) when comparing 2019 to 2020 (21). These results may suggest a substantive negative impact of lockdown on mental health. However, this percentage increase only translates to an extra 10 cases overall which, as the authors state, could be attributed to normal year on year variation rather than directly because of lockdown. Additionally, data from Oxford and Derby conversely showed a 37% decline in the mean weekly number of self-harm presentations in 2020 compared to 2019. This equated to an average reduction of 18 cases per week during the lockdown period (22). Given that during this period the UK remained in a nationally standardised lockdown protocol it is unlikely that either local restrictions or fear of COVID itself account for these geographical differences. A possible explanation for this discord could be related to the regional variance of social factors such as economic instability. Financial security is a commonly cited variable linked with mental health, especially during a pandemic era (23). A report from the Office of National Statistics (ONS) highlighted the disparity of furloughed employees by geographical region. With Birmingham totalling 416,900, followed by 407,900 in Manchester, 103,000 in Oxford 37,500 for Derby (24). In addition to furlough there is also large regional variation in unemployment during the first half of 2020, again with the West Midlands (Birmingham) most severely affected at a rate of 4.6%. This compares to 3.7% in the North West (Manchester), 3.3% in the South West (Oxford) and 4.5% in the East Midlands (Derby) (25). This variation in the levels of financial uncertainty experienced by individuals due to lockdown may go some way in explaining the difference in mental resilience noted between locations within the UK.

On an international level a study from Japan which also centred around suicidal behaviours found that during the final quarter of 2020, suicide rates increased significantly compared with the same quarter in the previous 4 years. The maximal effect was demonstrated in October where there was an increase of 0.4 per 100,000 in the rate of suicide (26). One difficulty in applying data from global platforms is the inherent differences in the management of the pandemic by each nation. Length/extent of lockdown restrictions, prevalence and mortality of COVID and economic factors will all contribute strongly to the mental resilience of citizens (23, 27). Therefore, it is difficult to generalise findings from one country to the global stage. When viewed collectively the literature remains inconsistent on the effect lockdown may have on suicidal behaviours within the UK, thus further research from multiple national centres to explore this question is justified.

Several other studies have utilised survey methods to investigate suicidal ideation and mental health more generally and have established more consistent trends. A UK study conducted in April 2020, which surveyed 17,452 individuals, showed an 18.9% increase in reports of psychological distress compared with the previous years (7). A survey from Spain found that COVID had a severe psychological impact on 30.4% of participants (8). These findings are echoed at a global level with articles from other countries such as Italy, China and Korea displaying similar worrying trends (9–11). These studies bolster the notion that subjective mental health has been negatively affected by the pandemic. What remains unclear is whether lockdown is the paramount contributing factor of these observations or if they translate into the increased manifestation of extreme behaviours such as DSH and suicide.

Perhaps the most concerning statistic discerned from our data is the rate of growth of presentations from March to May 2020 (111% increase in the raw number of admissions and a 128% increase in proportion of admissions). Conferring evidence to suggest that, as the length of lockdown increases, the burden upon mental health also sharply increases. This is particularly relevant now, during the formative stages of the new lockdown and acts as a warning of the potential psychological toll which may materialise in the coming months. It is therefore imperative that measures to combat this possible scenario are employed. One study from Italy postulated the role of increased access to teletherapy as a mechanism to empower individuals to alter their outlook on stressful situations thus partially alleviating their sense of anxiety (28). Indeed, some NHS trusts have already begun to champion this style of consultation and by raising awareness and increasing the availability of this service may help to remedy the effects of lockdown (29). Moreover, a study from Finland demonstrated that coping mechanisms which emanated from close personal relationships proved to be the most significant strategy to maintain psychological well-being during the COVID crisis (30). Therefore, by increasing access and education relating to virtual communication platforms, which allow family units to stay connected, may prove beneficial.

From a demographic perspective this study highlighted a statistically significant increase in the ratio of DSH cases which were male in 2020. This finding is contrary to not only historical data about DSH prior to the pandemic but also from studies conducted during COVID times. It is widely accepted that females are at an increased risk of DSH. A study from The Lancet referenced a 2.9% difference in the prevalence of DSH between sexes in 2014 ($p = 0.0002$) (31). This trend is further evidenced by the Adult Psychiatry Morbidity Survey conducted

by NHS digital which found that 10% of women reported a severe common mental disorder compared with only 6% of men (32). This gender discrepancy has been further widened by the events stemming from COVID 19. A UK longitudinal study showed that the deterioration in psychological distress score was 6.9 percentage points higher in women than men in 2020 (33). Indeed, a UCL study expressly reports an increased tendency to self-harm amongst the female population during the initial lockdown period (34). This paper finds no overt reason why males in Manchester have demonstrated a higher risk of DSH behaviours compared to other populations. From March-April 2020, Manchester was subject to the same restrictions as other parts of the country and Government reports indicate both men and women were equally affected by the economic burden of COVID (35). Whilst this may represent a spurious occurrence, the significance emanating from the *p*-value warrants further investigation into possible factors which may be influencing this result. Although the average age did show a statistically significant increase in 2020, each cohort remained within the same general age bracket and therefore this finding was not deemed to be of clinical significance.

The number of observed overdoses involving paracetamol significantly decreased from 45.55%/48.46% of DSH admissions in 2018/2019, respectively to 30.51% in 2020. A possible underlying explanation for this finding stems from the accessibility of paracetamol in the second quarter of 2020. The UK Government's decision to enforce a lockdown in March 2020 sparked widespread fear within the general population. This fear was translated into a fierce survival instinct leading to the stockpiling of many products by individuals within society. Paracetamol was one such commodity and this resulted in sporadic shortages of the drug across many areas of the UK (36). Furthermore, the ability to gain access to paracetamol was further hampered by the closure of many high street shops consequentially coupled with the long queues originating from essential shops which remained open (37). Both factors listed above hindered the access to paracetamol and may have tempered the impulsivity associated with many cases of substance overdose.

There are some important limitations to this study. It is difficult to assess whether the increasing proportion of deliberate self-harm was due to imposed lockdown measures or from the direct effects of the virus. Many people have suffered unexpected bereavement or have themselves become deconditioned as a result of COVID infection. These factors are also likely to influence the mental resilience of the population and may contribute towards the observed increase outlined in this paper. Additionally, this may have perpetuated the observed trend in the rate of growth of admissions beyond the relaxation of lockdown in 2020 and represents a vital area of study for other papers. The data was gathered from one NHS trust in Manchester, a large metropolitan city known to struggle with higher-than-average rates of COVID 19 infection. It is therefore difficult to generalise our findings to the entire UK population. Further studies examining similar data from other regions would be useful in determining the scale of the problem identified in this study. Finally, due to the retrospective nature of this study, there is potential for bias, especially around case selection. Some may have been missed due to error in coding which may affect results.

CONCLUSION

While it is undoubtably true that, from a public health perspective, control of the virus must be given paramount concern, it cannot be said that resources should not be devoted to mitigating the negative ramifications of these strategies. Our study has demonstrated a relative stability in the number of DSH admissions across the 3 years, despite a radical decline in all cause admissions in 2020. Moreover, this paper has found an accelerating trend of DSH admissions with increasing time under lockdown. This confers an unmet need for psychological support in the general population during these unprecedented circumstances and highlighted the need for prompt action to curtail the psychological harm which may ensue from future. Possible interventions which will help achieve this goal centre around increasing awareness and education around technologies which help to provide access to therapies and maintain vital support networks.

ETHICS STATEMENT

This paper represents a service level audit involving usual care. In view of this review and approval by a research ethics committee was not required according to institutional or national guidelines. This was validated by an online tool provided by NHS Health Research Authority (38).

AUTHOR CONTRIBUTIONS

CS: lead author, data collection, study design, and article write up. AH and AW: contribution to writing and interpretation of data. DR: statistical analysis. OM and JB: data collection. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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BRIEF RESEARCH REPORT
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The Psychometric Properties of the Stress and Anxiety to Viral Epidemics-6 Items: A Test in the U.S. General Population

Sangha Lee[1], *Jihoon Lee*[2], *Soyoung Yoo*[3], *Sooyeon Suh*[4]*, *Seockhoon Chung*[2]* and *Sherman A. Lee*[5]

[1] Department of Psychiatry, Ajou University Medical Center, Ajou University School of Medicine, Suwon, South Korea, [2] Department of Psychiatry, Asan Medical Center, University of Ulsan College of Medicine, Seoul, South Korea, [3] Department of Convergence Medicine, University of Ulsan College of Medicine, Seoul, South Korea, [4] Department of Psychology, Sungshin Women's University, Seoul, South Korea, [5] Department of Psychology, Christopher Newport University, Newport News, VA, United States

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Edited by:
Daria Smirnova,
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Semmelweis University, Hungary

***Correspondence:**
Sooyeon Suh
alysuh@sungshin.ac.kr
Seockhoon Chung
schung@amc.seoul.kr

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Objectives: Many individuals around the world are suffering from psychological distress due to the COVID-19 outbreak. The aim of this study is to explore the validity and reliability of the English version of Stress and Anxiety to Viral Epidemics-6 (SAVE-6), which measures the anxiety response of the general population to the viral epidemic.

Methods: A cross-sectional web-based study with self-reporting measures was conducted. A total of 314 United States residents were recruited via online platform in exchange for payment. The participants were asked to an anonymous questionnaire, collecting information on demographics, psychiatric history, SAVE-6, Patient Health Questionnaire-4 (PHQ-4), and the Coronavirus Anxiety Scale.

Results: The result from confirmatory factor analysis (CFA) demonstrated that a single-factor model [$\chi^2_{(9)} = 11.53$, $p = 0.24$] yielded excellent fit for all of indices [χ^2/df ratio = 1.28; CFI = 1.00; TLI = 1.00; SRMR = 0.02; RMSEA = 0.03 (0.00, 0.07; 90% CI)] and yielded strong internal consistency reliability (Cronbach's $\alpha = 0.88$). The results from multigroup CFAs showed that there were no gender differences [$\Delta\chi^2_{(6)} = 3.20$, $p = 0.78$, ns] and no race differences [$\Delta\chi^2_{(6)} = 3.60$, $p = 0.73$, ns] between the models, along with excellent model fits.

Conclusions: The results of this study support the reliability and validity of SAVE-6 with strong psychometric properties for the English version of the U.S. population.

Keywords: COVID-19, stress, anxiety, scale, psychometry

INTRODUCTION

A novel coronavirus disease 2019 (COVID-19) is a new infectious disease that occurred in Wuhan City, Hubei Province, China in December 2019. After the first outbreak, the COVID-19 has rapidly spread to neighboring countries, and in March of the following year, the World Health Organization (WHO) declared a pandemic, the highest level of warning of transmission, meaning the stage of a global pandemic. According to the World Health Organization, globally,

as of September 9, 2021, there have been 221,648,869 confirmed cases of COVID-19, including 4,582,338 deaths, affecting 212 countries and territories. Especially in the United States of America, 41,300,407 confirmed cases of COVID-19 with 670,458 deaths have been reported [1].

The spread of COVID-19 has posed a great threat across social systems such as healthcare, public security, and the economy. Such rapid social change has had a profound effect individual mental health. The public has been exposed to constant fear and anxiety due to daily corona-related news (1). The fear of COVID-19 appears to be due to uncertainty about how much the current epidemic will deteriorate (2). According to a survey of Americans (3), 62% of respondents were more worried about COVID-19 than seasonal flu.

In addition, the public has experienced social isolation due to social distancing, working from home, and school closure, which can lead to various psychological problems such as personal stress, anxiety, depression, fear, anger, loneliness, frustration (4). Previous research has shown that people in quarantine suffered various psychological issues such as stress, fear, and depression (5). From the pandemics in the past, we have learned that there were more people affected by mental health than those affected by infections (6) and that mental health effects may be more lasting than the epidemic itself (7).

In response to these psychological crises brought about by COVID-19, researchers have developed measures to assess stress, anxiety, and fear specific to the pandemic. For example, Taylor et al. (8) developed a 36-item COVID Stress Scales (CSS) to measure a series of fears related to COVID-19. It demonstrated good validity and reliability in five factors, but the sample was limited to the US and Canadian populations and some items are believed to reflect sociocultural contexts (e.g., xenophobia toward Asians, insufficient supply in grocery stores). Another measure called the Fear of COVID-19 Scale (FCV-19S), proposed by Ahorsu et al., was designed to assess an individual's fear of COVID-19 with only seven items (9). Although FCV-19S is shorter (10), it contains items that focus primarily on physical reactions and appears to be limited to COVID-19 (e.g. "My hands become clammy when I think about coronavirus-19," "My heart races or palpitations when I think about getting coronavirus-19").

We originally developed Stress and Anxiety to Viral Epidemics-9 items (SAVE-9) scale, a nine-item scale to assess stress and anxiety of healthcare workers in response to the viral epidemic (11). It has the advantage of being a compact psychological scale that can be used in many various pandemic situations, and it was validated in various languages including Russian (12), Italian (13), Japanese (14), Turkish (15), and German (16). In a previous study, the SAVE-9 scale was divided into two factors; factor I- anxiety about viral epidemics (namely, SAVE-6), and factor II-work-related stress associated with viral epidemics. Although SAVE-9 is a well-established scale for measuring stress associated with viral epidemics, it is necessary to check the validity of the six-item item targeting the general public as it is for a specific occupational group. This scale is expected to be useful not only in the stress caused by COVID-19 but also in other pandemic situations that may occur in the future. We explored whether the SAVE-6 is useful for evaluating the anxiety related to the viral epidemic among the general population in Korea (17), and we found that it is a valid and reliable scale that may be used in the general population in Korea, Lebanon (18), and special population in Korea including cancer patients (19) and medical students (20). In this study, we aimed to assess the reliability and convergent validity of the English version of the SAVE-6 scale among the U.S. population.

[1] Available online at: https://covid19.who.int/ (accessed September 9, 2021).

TABLE 1 | Sample characteristics.

Characteristics	Statistics
Gender	
Male	150 (47.8%)
Female	164 (52.2%)
Race	
White	247 (78.7%)
Black	28 (8.9%)
Asian	20 (6.4%)
Hispanic	16 (5.1%)
Other	3 (1.0%)
COVID-19 diagnosis	
Yes	106 (33.8%)
No	208 (66.2%)
Knowledge of someone who died of COVID-19	
Yes	193 (61.5%)
No	121 (38.5%)
Plans on getting vaccinated for COVID-19	
Yes	247 (78.7%)
No	67 (21.3%)
Age	*M* = 39.53; *SD* = 11.46 (19–65)
Symptoms ratings	
Depression	*M* = 2.94; *SD* = 1.82 (0–6)
Generalized anxiety	*M* = 2.92; *SD* = 1.76 (0–6)
Suicidal ideation	*M* = 1.35; *SD* = 1.33 (0–4)
Substance use	*M* = 1.60; *SD* = 1.42 (0–4)
Coronaphobia	*M* = 7.87; *SD* = 5.91 (0–19)
Viral anxiety	*M* = 12.36; *SD* = 5.73 (0–24)

MATERIALS AND METHODS

Participants and Procedure

The data was collected via the online survey on December 11, 2020, from 314 adults residing in the United States, were used in this IRB approved study. The participants were recruited via Amazon MTurk in exchange for payment ($0.25) and were eligible if they provided consent and furnished complete information. Most of the participants (*Mage* = 39.53) were white (78.8%), female (52.2%), never diagnosed with COVID-19 (66.2%), knew someone who died of COVID-19 (61.5%), and plan on getting vaccinated for COVID-19 (78.8%) when they become available (see **Table 1**).

Measures

To get composite scores, item ratings within a measure were combined together. Higher composite scores imply that a condition is more prevalent.

Basic Information

Participants were asked to report their age, gender, race, COVID-19 diagnosis, whether or not they knew someone who died of COVID-19, and whether or not they plan on getting vaccinated for COVID-19 when they are available.

Psychological Distress and Substance Use

Clinical depression and generalized anxiety were rated using the Patient Health Questionnaire-4 (PHQ-4) (21). Participants rated each items how frequently, within the past 2 weeks (0 = not at all to 3 = nearly every day), they experienced symptoms of depression (e.g., "feeling down, depressed, or hopeless.") with two items ($\alpha = 0.78$) and generalized anxiety (e.g., "feeling nervous, anxious, or on edge.") ($\alpha = 0.74$). Passive suicidal ideation was measured with the single item, "I wished I was already dead so I did not have to deal with the coronavirus." While substance use coping was measured with the single item, "I used alcohol or other drugs to help me get through the fear and/or anxiety caused by the coronavirus." Participants indicated how frequently, within the past 2 weeks (0 = not at all to 4 = nearly every day), they experienced suicidal thoughts and used alcohol or drugs to cope with coronavirus related fear and anxiety.

Coronaphobia

Clinical symptoms of anxiety that are tied to coronavirus related thoughts or information were measured using the Coronavirus Anxiety Scale (CAS) (22). Participants indicated how frequently, within the past 2 weeks (0 = not at all to 4 = nearly every day), they experienced symptoms of coronaphobia (e.g., "I felt dizzy, lightheaded, or faint, when I read or listened to news about the coronavirus.") with five items ($\alpha = 0.93$).

Viral Anxiety

General anxiety responses to the viral pandemic were measured using the Stress and Anxiety to Viral Epidemics-6 (SAVE-6) (17). Participants indicated their level of agreement (0 = never to 4 = always) with pandemic-related anxiety questions (e.g., "Are you afraid the virus outbreak will continue indefinitely?") using six items ($\alpha = 0.88$). See **Table 2** for item properties.

Statistical Approach

A series of statistical analyses were used to examine the psychometric properties of the SAVE-6, a measure of viral anxiety. SAVE-6 total score differences in gender (men vs. women), race (whites vs. non-whites), COVID-19 diagnosis (yes vs. no), knowledge of someone who died of COVID-19 (yes vs. no), and plans on getting vaccinated for COVID-19 (yes vs. no), were examined using independent samples *t*-tests. SAVE-6 total score correlations with age and distress-related constructs (e.g., suicidal ideation) were examined using Pearson's product-moment correlations. Factor analysis was performed in two steps. In the first step, exploratory factor analysis (EFA) was conducted to determine using principal component analysis with Oblimin rotation to determine loadings of items and their dimensions. In the second step, a bootstrap (2,000 samples) maximum likelihood confirmatory factor analysis (CFA) was modeled on the six items of the SAVE-6 to examine the instrument's factorial validity for a unidimensional structure. Multigroup CFAs were run to determine if the SAVE-6 is measuring viral anxiety in the same way for men and women, as well as whites and non-whites. Satisfactory model fit for a CFA model was defined by a chi-square/df value < 2, a standardized root-mean-square residual (SRMR) value ≤ 0.05, root-mean-square-error of approximation (RMSEA) value ≤ 0.10, and comparative fit index (CFI) and Tucker Lewis Index (TLI) values ≥ 0.90 (23, 24). Measurement invariance was defined by both adequate model fit statistics and a non-significant value ($p \geq 0.05$) on a chi-square difference test. All of the statistical analyses were calculated using SPSS version 26.0, except for the confirmatory factor analyses (CFA), which were run using AMOS version 25.0.

TABLE 2 | Results of exploratory factor analysis (EFA) of the SAVE-6 using principal component analysis with Oblimin rotation ($n = 314$).

Item	Factor 1
SAVE-6 item 2	0.795
SAVE-6 item 4	0.780
SAVE-6 item 3	0.743
SAVE-6 item 1	0.737
SAVE-6 item 5	0.717
SAVE-6 item 6	0.714
Eigenvalue	3.797
% of Variance	63.283
Cumulative variance	63.283

RESULTS

Descriptive Statistics, Group Comparisons, and Correlations

The descriptive statistics reveal that the majority of the sample were highly distressed during the COVID-19 pandemic. Specifically, 62.4% experienced clinical levels of depression (≥3) [Kroenke et al. (21)], 64.0% experienced clinical levels of generalized anxiety (≥3) (21), 51.6% experienced coronaphobia (≥9) (22), and 38.9% experienced high viral anxiety (≥15) (17). In addition, 58.6% had suicidal ideation and 65.3% coped with their fear and anxiety over the coronavirus using drugs or alcohol. Most of the participants plan on getting vaccinated for COVID-19 in the future (78.7%) and knew someone who died of COVID-19 (61.5%).

Viral anxiety was significantly greater among those with a COVID-19 diagnosis [$t_{(260.04)} = 7.34$, $p < 0.001$], those who knew someone who died of COVID-19 [$t_{(312)} = 9.35$, $p < 0.001$], and those who plan on getting the vaccine for COVID-19 [$t_{(94.81)} = 4.78$, $p < 0.001$]. Demographically, viral anxiety was slightly associated with age ($r = 0.12$), but not gender [$t_{(312)} = 0.23$, $p = 0.82$, ns] and race [$t_{(91.23)} = 0.04$, $p = 0.97$, ns]. In terms of distress-related constructs, viral anxiety was strongly associated with substance use coping ($r = 0.61$) and suicidal ideation

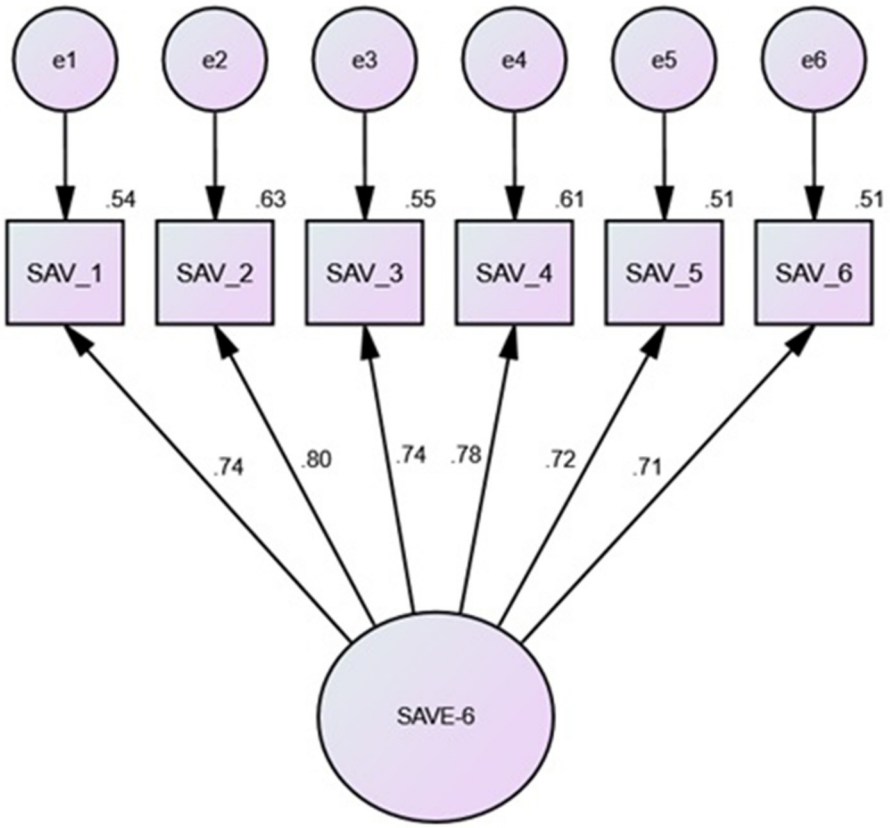

FIGURE 1 | Confirmatory Factor Analysis. Note. Model based on bootstrap Maximum Likelihood (ML) estimations (2000 samples). All of the standardized coefficients are significant at the .05 level. SAV_1 = continuation fear; SAV_2 = health fear; SAV_3 = infection worry; SAV_4 = physical sensitivities; SAV_5 = avoidance worry; SAV_6 = transmission worry.

TABLE 3 | Item properties of the SAVE-6.

Items	Response scale					Descriptive		Item metrics		
	0	1	2	3	4	M	SD	ITC	R^2	CID
1 Are you afraid the virus outbreak will continue indefinitely?	8.6%	15.9%	35.4%	25.8%	14.3%	2.21	1.14	0.69	0.48	0.86
2 Are you afraid your health will worsen because of the virus?	11.8%	19.7%	31.2%	29.3%	8.0%	2.02	1.13	0.74	0.55	0.86
3 Are you worried that you might get infected?	8.6%	18.8%	36.9%	20.7%	15.0%	2.15	1.15	0.69	0.50	0.86
4 Are you more sensitive toward minor physical symptoms than usual?	13.7%	20.7%	25.2%	27.4%	13.1%	2.05	1.25	0.72	0.53	0.86
5 Are you worried that others might avoid you even after the infection risk has been minimized?	21.0%	19.4%	24.5%	25.2%	9.9%	1.83	1.29	0.67	0.46	0.87
6 Do you worry your family or friends may become infected because of you?	14.6%	15.9%	29.9%	24.8%	14.6%	2.09	1.26	0.67	0.45	0.87

Cronbach's Alpha is 0.88 for total SAVE-6 measure; # Item Number; 0, never; 1, rarely; 2, sometimes; 3, often; 4, always; M, Mean; SD, Standard Deviation; ITC, Corrected Item-Total Correlation; R^2, Squared Multiple Correlation; CID, Cronbach's Alpha if item is deleted.

($r = 0.59$). As expected, and in support of the SAVE-6's construct validity, viral anxiety was shown to be associated with COVID-19 related experiences (i.e., COVID-19 diagnosis, knowledge of someone who died of the disease, and plans to get vaccinated) and distress-related constructs (e.g., suicidal ideation).

Initial Exploratory Factor Analysis

Table 2 and **Figure 1** show the results of exploratory factor analysis of the SAVE-6 using principal component analysis with Oblimin rotation ($n = 314$). The analysis revealed one factors with an Eigenvalue > 1, explaining 63.3% of total variance. All included variables loaded highly on the factor.

Confirmatory Factor Analyses

The SAVE-6 items were found to be acceptable for factor analysis after a preliminary examination of the data (25). Specifically, the data did not exhibit issues pertaining to sample size, missing data, non-normality, multicollinearity, or singularity. The correlation matrices were also shown to be factorable (Bartlett's test of sphericity $= p < 0.001$; Kaiser-Meyer-Olkin test $= 0.90$).

A CFA was used to see if the SAVE-6's six anxiety components could be combined into a unidimensional construct. The results demonstrated that a single-factor model [$\chi^2_{(9)} = 11.53$, $p = 0.24$] yielded excellent fit for all of indices [χ^2/df ratio = 1.28; CFI = 1.00; TLI = 1.00; SRMR = 0.02; RMSEA = 0.03 (0.00, 0.07; 90% CI)] and yielded strong internal consistency reliability (Cronbach's $\alpha = 0.88$). Thus, these results support the factorial validity of the SAVE-6 measure (**Table 3**).

Then, multiple sets of CFAs were run to check if SAVE-6's viral anxiety structure is measured in the same way on the demographic variables of gender (male vs. female) and race (white vs. non-white). The results show that there is no gender difference, which is evidenced by an excellent fit of the model. [$\chi^2_{(18)} = 23.10$, $p = 0.19$] for all of the indices [χ^2/df ratio = 1.28; CFI = 0.99; TLI = 0.99; SRMR = 0.03; RMSEA = 0.03 (0.00, 0.06; 90% CI)] and a non-significant increase in χ^2 value [$\Delta\chi^2_{(6)} = 3.20$, $p = 0.78$, ns] between the models. The results also demonstrated no race differences, which were evidenced by excellent model fit [$\chi^2_{(18)} = 25.87$, $p = 0.10$] for all of the indices [χ^2/df ratio = 1.44; CFI = 0.99; TLI = 0.98; SRMR = 0.02; RMSEA = 0.04 (0.00, 0.07; 90% CI)] and a non-significant increase in χ^2 value [$\Delta\chi^2_{(6)} = 3.60$, $p = 0.73$, ns] between the models. Thus, these results demonstrate measurement invariance by showing that the SAVE-6 measures viral anxiety the same way across gender and race groups.

Evidence Based on Relations to Other Variables

The SAVE-6 scale score was significantly correlated with PHQ-4 anxiety subscale ($r = 0.67$, $p < 0.001$), PHQ-4 depression subscale ($r = 0.64$, $p < 0.001$), or CAS scale ($r = 0.74$, $p < 0.001$).

DISCUSSION

The aim of the current study was to assess the psychometric properties of SAVE-6, a newly developed scale designed to evaluate the anxiety level associated to COVID-19 pandemic. The psychometric properties of the SAVE-6 were assessed in a representative sample of 314 adults who were between 19 and 65 years of age in the USA. The current study confirmed and extended previous reports of reliability and validity (17).

The result indicated that the internal consistency of SAVE-6 (Cronbach Alpha=.88) is excellent and adequate for CFA (Bartlett's test of sphericity = $p < 0.001$; Kaiser-Meyer-Olkin test = 0.90). The SAVE-6 score significantly correlated with depression and GAD scores, as well as another anxiety scale specific to COVID-19 (CAS), indicating good convergent validity. Previous studies have reported that people who have been diagnosed with COVID-19 or who knew someone who died of COVID-19 were more likely to meet the anxiety and depression criteria (26). Corona-related structures and viral anxiety in this study appeared to be higher in those with corona-related experiences, which seems to be consistent with these existing studies. Perceived stress associated with the coronavirus is a strong predictor of higher dysfunction and can predict symptoms of depression and anxiety disorders. In addition, we were able to confirm measurement invariance in all groups using multiple-group CFA. As shown in the results, gender and race did not seem to affect the response pattern of SAVE-6. Therefore, it can be concluded that the SAVE-6 is a reliable measure that assesses psychological issues associated with a viral epidemic across cultures.

The SAVE-6 is a rating scale which can measure the anxiety response specifically to the viral epidemic. It includes items asking anxiety symptoms such as "Are you afraid the virus outbreak will continue indefinitely?," "Are you afraid your health will worsen because of the virus?," or "Are you worried that you might get infected?" We believe the anxiety symptoms measured with this scale might be viral anxiety and not anxiety stemming from other factors. Although several measures have recently been published for COVID-19-related fears and anxiety, SAVE-6 differs from other measures in several ways. The COVID-19 Stress Scale developed by Taylor et al. include social contexts such as socioeconomic consequences of COVID, xenophobia, and compulsive checking (8). Other rating scales have been proposed to assess the symptoms of anxiety and associated physiological arousal (the Coronavirus Anxiety Scale) (22), nervousness, muscle tensions, or behaviors of avoidance (the COVID-19 Anxiety Questionnaire) (27), or avoidance, checking, and worried behaviors (the COVID-19 Anxiety Syndrome Scale) (28). Even other scales such as FCV-19S (9) or Coronavirus Pandemic Anxiety Scale (CPAS-11) (29) are similar to SAVE-6 in that it is evaluating the primary fear/anxiety of coronavirus, SAVE-6 differs in that it responds not only to the COVID-19 but also to other virus pandemics. With the possibility of another unpredictable pandemic that may occur in the future, we believe the scale will have additional utility in the future. We have explored the validity of the SAVE-6 among the general population in Korea (17), and it has reported that the scale has reliable psychometric properties. The SAVE-6 has been validated in other languages (18). In particular, the English version of SAVE-6 is expected to be highly utilized in a number of English-speaking countries.

This study has some limitations. First, all data was collected via online self-report surveys, which may have potential bias or errors. Further research involving various methods of assessment, such as face-to-face interviews or focus group interviews may enrich the analysis. Second, at the time of our survey, other measures were being reviewed and yet to be published, so the concurrent validity with them could not be confirmed. If the concurrent validity with the aforementioned scales can be reviewed later, it will help to increase the validity of SAVE-6. Third, some demographic characteristics such as education level, employment status, medications, history of psychiatric illness, and income level were not available. Since they were not included in covariates, some possible confounding factors may remain. Despite the limitation, the results of this study support the reliability and validity of SAVE-6 with strong psychometric properties for the English version of the U.S. population.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Institutional Review Board of Christopher Newport University. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

SC, SS, and SAL: conceptualization and writing—review and editing. SAL: methodology, formal analysis, data curation, and visualization. JL, SY, and SL investigation. SAL and SL: writing—original draft preparation. SS: supervision. SC: project administration and funding acquisition. All authors have read and agreed to the published version of the manuscript.

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Sleep Quality and Mental Health of Medical Students in Greece During the COVID-19 Pandemic

Anna Eleftheriou[1†], Aikaterini Rokou[1†], Aikaterini Arvaniti[2], Evangelia Nena[3] and Paschalis Steiropoulos[4]*

[1] Medical School, Democritus University of Thrace, Alexandroupolis, Greece, [2] Department of Psychiatry, Medical School, Democritus University of Thrace, Alexandroupolis, Greece, [3] Laboratory of Social Medicine, Medical School, Democritus University of Thrace, Alexandroupolis, Greece, [4] Department of Pulmonology, Medical School, Democritus University of Thrace, Alexandroupolis, Greece

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Daria Smirnova,
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***Correspondence:**
Paschalis Steiropoulos
steiropoulos@yahoo.com

[†] These authors have contributed equally to this work and share first authorship

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Background-Aim: Medical students have been greatly affected by the COVID-19 pandemic due to their educational program, which comprises theoretical knowledge and also clinical duties, making them vulnerable to viral exposures and possibly affecting their everyday life. The aim of this study was to explore changes in sleep and mental health parameters among medical students in Greece during the second year of the pandemic.

Methods: This cross-sectional study comprised students of all medical schools in Greece (n = 7), using an anonymous online survey. Participants completed the following questionnaires: Pittsburgh Sleep Quality Index (PSQI), Athens Insomnia Scale (AIS), Fatigue Severity Scale (FSS), General Anxiety Disorder-7 (GAD-7), Patient Health Questionnaire-9 (PHQ-9). Statistical analysis was conducted with the use of SPSS v.26 (IBM SPSS, Armonk NY, USA).

Results: Out of the 562 received responses, 559 met the inclusion criteria. The largest proportion of the respondents came from 4th-year (27.8%) and the majority of the sample were females (69.8%). Only 5.9% of the participants reported having been infected by SARS-COV-2. Most of the respondents experienced insomnia (65.9%, mean AIS score: 7.59 ± 4.24), poor sleep quality (52.4%, mean PSQI score: 6.6 ± 3.25) and increased fatigue (48.5%, mean 35.82 ± 11.74). Moderate to severe symptoms of anxiety (mean 9.04 ± 5.66) and depression (mean 9.36 ± 6.15) were noted. Suicidal ideation was found in 16.7% of the sample, while use of sleeping pills in the previous month was reported by 8.8% (n = 47). Further analysis revealed independent associations between sleep and mental health parameters. Higher AIS score was associated with greater FSS score; higher PSQI scores with higher GAD-7 and PHQ-9 scores. Additionally, female students were found to be significantly more affected than males by the COVID-19 pandemic, displaying higher levels of insomnia, sleep disturbances, anxiety and depression. In addition, those with a history of COVID-19 infection or in close proximity with a positive case reported significantly more significant post-traumatic symptoms in IES-COVID-19 questionnaire.

Conclusions: In the aftermath of the COVID-19 pandemic, prevalence of sleep and mental health disorders among Greek medical students is significant, highlighting the need for better surveillance of students' wellbeing and subsequent counseling, with special focus on female students and other affected groups.

Keywords: COVID-19, medical students, sleep quality, mental health, pandemic

INTRODUCTION

The ongoing COVID-19 pandemic, which was officially declared by the World Health Organization on March 11, 2020, has caused significant changes in multiple aspects of everyday life (1, 2). Government agencies around the world have responded to this unprecedented situation by implementing measures like mandatory mask use, social distancing, travel ban and curfew, retail stores closure, contact tracing, virus detection tests and quarantine (3–5). Since the first months of the implementation of those measures, a significant impact has been described on the mental health and sleep quality of the general population (6, 7).

It was previously reported that the prolonged confinement, in combination with the growing health concerns, have resulted in a reduction in the duration and the quality of sleep of the general population. These findings were, also, positively associated with depressive symptoms (8). Similar findings were reported in Greece, with symptoms of depression and being at higher levels in certain groups, such as the younger in age (9).

A special sub-group of the population, which has been greatly affected by the above-mentioned measures, are university students. One of the first measures applied was the suspension of the operation in all educational institutions, followed by the implementation of e-learning. Also, for medical students, the clinical practice and laboratory exercise of their curriculum were paused, leading to great changes in the educational process and consequently, in their daily life (10, 11).

The new major health risk, the strict preventive measures, and the radical changes in the lifestyle of medical students are reflected on the quality of their sleep and on their mental state, as described previously (12–15). Specifically, medical students, who were concerned about the effects of COVID-19 on education and work, reported higher rates of poor sleep quality (12). Additionally, according to studies conducted during the first months of the pandemic, they presented increased rates of depression and severe anxiety, fear of stigmatization due to association with the hospital environment and anxiety of meeting the demands of the new educational reality. These findings were more likely to be more common among the female population (13–15).

However, studies conducted during the second pandemic wave, when an outburst of COVID-19 cases was reported worldwide are scarce. During that time, even stricter preventive measures were enforced, since vaccinations had not been authorized. Simultaneously, on-line education was applied for the Autumn-Winter semester of the Academic Year 2020–2021, and only medical students of the final year were allowed to resume their clinical practice. The above-mentioned developments in the course of the pandemic have caused alterations in everyday life and probably could be associated with different findings in sleep and mental health of students.

The aim of the present study was to evaluate the impact of the situation that arose during the second year of COVID-19 pandemic, on the quality of sleep and mental health i.e., anxiety and depression, of medical students in Greece.

MATERIALS AND METHODS

Protocol and Registration

In order to enroll to the study, participants had to confirm their consent in the electronic page of the questionnaire, after being informed of the goals and the procedure of the study. Anonymity was also ensured. Prior to the initiation of the study, ethical approval was acquired (Prot. Nr. 4/22-04-2021).

Participants

This study targeted undergraduate medical students, who completed an anonymous web-based questionnaire. The inclusion criteria were (i) currently attending one of the seven Medical Schools in Greece (ii) over 95% completion of survey questions. Answers from students pending graduation were also accepted.

Study Design

This cross-sectional study was conducted between the 22nd of April and 31st of May 2021. During this time, members of our research team shared a post twice in several Facebook groups of students studying in the seven Medical Schools and Departments of the country, namely Aristotle University of Thessaloniki (AUTH), Democritus University of Thrace (DUTH), National and Kapodistrian University of Athens (NKUA), University of Crete (UoC), University of Ioannina (UoI), University of Patras (UPatras), and University of Thessaly (UTH). This Facebook post contained an introductory text, in which the purpose of the study was stated alongside the intention to ensure the anonymity of the participants and invited group members to participate in the study voluntarily. The post, also, provided the link to the online questionnaire, after students confirmed their consent.

Measures

General Information

The initial part included questions about name of the attending University and year of studies, demographics, history of infection and hospitalization due to COVID-19.

Sleep Questionnaires

The Greek versions of the following validated questionnaires were included in the survey: Pittsburgh Sleep Quality Index (PSQI) (16), Athens Insomnia Scale (AIS) (17) and Fatigue Severity Scale (FSS) (18).

PSQI is a widely used self-administered questionnaire, which assesses subjectively the sleep quality of the participant over the course of the last month. PSQI measures sleep disturbances through 7 dimensions: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. It contains 19 questions and cut-off is 5. Additional sleep disturbances can be mentioned in the relevant open-end question. Total scores range from 0 to 21 with higher scores indicating increasingly poor sleep quality (16).

AIS is a self-administered psychometric questionnaire, which assesses sleep difficulty and particularly insomnia. It contains 8 items; questions are rated on a Likert scale from 0 to 3 and total scores $\geq$6 indicate insomnia. Higher scores suggest severe symptoms of insomnia (17).

FSS is a self-administered questionnaire, which assesses fatigue. It contains 9 items and each one of them is scored on a 7-point Likert scale ranging from 1 to 7 (completely disagree to completely agree). Cut-off is 36 and higher scores indicate greater severity, frequency and impact of fatigue on daily life (18).

Mental Health Questionnaires (Symptoms of Anxiety, Depression and PTSD After COVID-19 Infection)

The participants answered the validated Greek versions of three psychometric questionnaires: General Anxiety Disorder-7 (GAD-7) (19), Patient Health Questionnaire-9 (PHQ-9) (19, 20). They also answered the Impact of Event Scale Questionnaire adapted for COVID-19 (IES-COVID19) (21, 22). Only those who had personally been infected or those who had a positive case in their familial or amical environment completed the latter.

GAD-7 is a self-administered questionnaire that assesses the severity of anxiety symptoms. It contains 7 items which are scored based on a 4-point Likert scale from 0 to 3, with higher scores indicating more severe anxiety symptoms. Cut points of 5, 10, 15 correspond to mild, moderate and severe anxiety symptoms, respectively. Scores of 10 or greater suggest a potentially clinical condition (19).

PHQ-9 is a self-administered questionnaire, which assesses depression symptoms over the course of the past 2 weeks and may be used as a tool for diagnosing clinical depression. It contains 9 items which are scored based on a 4-point Likert scale from 0 to 3, with higher scores indicating more severe depression symptoms. Cut points of 5, 10, 15, 20 correspond to mild, moderate, moderately severe and severe depression symptoms, respectively. Scores of 10 or greater suggest a potentially clinical condition (19, 20).

IES-COVID19 is a 15-item self-administered questionnaire, which is designed to assess subjective distress during the past 7 days over experiencing a COVID-19 infection either personally or of the immediate environment. Every item is rated on a 4-point scale (0: not at all, 1: seldom, 3: sometimes and 5: often). Higher scores indicate a higher psychological impact of the COVID-19 infection (21, 22). The IES-COVID 19 could be used in a preventive manner by screening individuals at high risk for developing PTSD.

TABLE 1 | General characteristics of the participants.

	Number (N)	Percentage (%)
Participants (valid answers)	559	
Sex (M/F)	164/389	
Medical university		
AUTH	79	14.2
DUTH	117	21
NKUA	107	19.2
UoC	95	17
UoI	45	8.1
UPatras	66	11.8
UTH	49	8.8
Academic year		
1st	71	12.7
2nd	71	12.7
3rd	78	14
4th	155	27.8
5th	81	14.5
6th	80	14.3
Pending graduation	22	3.9
COVID-19 infection		
No infection	328	58.7
Only personally infected	16	2.9
Infection only in members of the close environment	198	35.2
Infection both personally and in the close environment	17	3

AUTH, Aristotle University of Thessaloniki (Thessaloniki, Greece); DUTH, Democritus University of Thrace (Alexandroupolis, Greece); NKUA, National and Kapodistrian University of Athens (Athens, Greece); UoC, University of Crete (Heraklion, Greece); UoI, University of Ioannina (Ioannina, Greece); UPatras, University of Patras (Patras, Greece); UTH, University of Thessaly (Larissa, Greece).

Statistical Analysis

Statistical analysis was conducted with the use of SPSS v.26 (IBM SPSS, Armonk NY, USA). Normality of distribution was checked with Kolmogorov-Smirnov test and appropriate analyses were applied. Descriptive and analytic statistics were used. Statistical significance was set at $p < 0.05$ level.

RESULTS

General Characteristics

In total, 562 answers were received, out of which, 559 were eligible for analysis (completion rate 99.46%). **Table 1** displays the characteristics of the participants. As seen, all Universities were represented, with variable participation rates. The majority were females, with a larger participation coming from students of the 4th year. Thirty-three (5.9%) respondents have been infected by SARS-COV-2 and 215 (38.4%) reported at least one positive case of COVID-19 in their approximate environment.

TABLE 2 | Reported sleep disturbances (open-end answers only).

Sleep disturbances	Number of participants
Stress–Anxiety*	30
Negative thoughts–overthinking	13
Use of technology	5
Palpitations	5
Tension	5
Fear	3
Loneliness	3
Headaches	2
Anger	2
Melancholy–sadness	2
Panic attack	1
Sleep paralysis	1

About possible COVID-19 infection, increased workload, examinations.

COVID-19 Pandemic, Sleep Quality and Sleep Characteristics

The second part of the survey assessed the sleep quality of the participants spanning over a period of 1 week −1 month before its completion. Most of the respondents ($n = 368$, 66%) experienced insomnia, according to their AIS score (mean 7.59 ± 4.24), with females being significantly more affected (mean AIS female score: 7.88 ± 4.2, mean AIS male score: 6.88 ± 4.4, $p = 0.012$).

More than half of participants ($n = 293$, 52.4%) evaluated their sleep as being of poor quality, according to PSQI score. Sleep disturbances were reported by almost all participants (499/559 participants), including fragmented sleep, snoring, difficulty in breathing and nightmares. Additional sleep disturbances, as mentioned in the relevant open-end question, were anxiety, stress, and loneliness as demonstrated in more detail in **Table 2**. Interestingly, 8.8% ($n = 47$) of university students stated that they have used sleep- promoting medication during the past month. Almost half of the participants reported increased levels of fatigue ($n = 270$, 48.5%, mean: 35.82 ± 11.74).

Comparisons between students of different academic years revealed statistically significant variations in the duration of their sleep (i.e., third PSQI component). Specifically, students of the 6th year reported significantly shorter sleep duration ($p = 0.003$).

COVID-19 Pandemic and Mental Distress

The third part of the survey addressed the effects of the COVID-19 pandemic on different aspects of mental health. The majority of participants ($n = 377$, 67.6%) reported moderate to severe symptoms of anxiety (mean 9.04 ± 5.66). More specifically, 28.4% reported moderate symptoms, 23.1% moderately severe symptoms and 16.2% severe symptoms.

Similar results regarding depression symptoms were found (mean score: 9.36 ± 6.15), with 22.6% having moderate depression symptoms, 13.9% moderately severe depression symptoms, and 7.2% severe depression symptoms. Mild depression symptoms were reported in 30.6% of the respondents. Notably, a non-neglectable percentage ($n = 92$, 16.7%) of the participants, regardless of gender ($p = 0.579$), reported being affected by recurrent suicidal thoughts (several days: 9.8%, More than half of the days: 3.3%, nearly every day: 3.6%). Comparison analysis between COVID-19 infection status and depression levels (as indicated by PHQ-9) showed that students who had both themselves and their immediate environment infected, experienced symptoms in a more severe way (not infected: 9.03 ± 6.3 vs. only immediate environment infected: 9.89 ± 5.54, infected both themselves and their immediate environment: 12.29 ± 8.89; $p = 0.022$).

Comparison between genders revealed that females were experiencing significantly more severe symptoms in all mental health measures scores (GAD-7 mean score females: 9.4 ± 5.66, males: 8.16 ± 5.64, $p = 0.02$, PHQ-9 mean score females: 9.95 ± 6.16, males: 7.93 ± 5.98, $p = 0.001$, IES-COVID19 mean score females: 25.50 ± 13.53, males: 20.69 ± 12.21, $p = 0.018$).

Additionally, female students infected by COVID-19 or in close proximity with a positive case of the disease, reported significantly more frequently bad dreams ($p = 0.025$), and persistent negative thoughts or images ($p = 0.031$, $p = 0.048$, respectively) according to IES-COVID19 scores.

Correlations Between Sleep and Mental Parameters

As a next step, a correlation analysis between sleep and mental health parameters was conducted, revealing numerous independent associations among them as shown in **Table 3**. There was a statistically significant correlation between all scales. Higher levels of insomnia (according to the AIS score) were associated with greater severity and frequency of fatigue (as described by the FSS score); poor quality of sleep (resulting from PSQI) was associated with higher levels of anxiety and depression symptoms (as indicated by the GAD-7 and PHQ-9 scores).

DISCUSSION

Our study captures the alterations in sleep quality and mental health of medical students in Greece during the second year of the COVID-19 pandemic. Overall, regarding sleep parameters, the respondents reported impaired sleep quality due to multiple sleep disturbances and decreased sleep duration; this was more obvious among 6th year medical students. Higher levels of insomnia, especially in females and increased fatigue in daily life were also reported. These alterations in sleep parameters were correlated with moderate to severe deterioration of mental health. Respondents presented also moderate to severe symptoms of anxiety and depression, to the point that a significant proportion admitted recurrent suicidal thoughts.

So far, contradictory findings are available in the literature regarding alterations in students' sleep schedule and sleep quality and the majority refers to the first year of the COVID-19 pandemic until the end of December 2020. A recent study conducted in 7 countries showed a prevalence of poor sleep among students worldwide and deficient sleep duration in more than one out of four students (23). These findings are in

TABLE 3 | Correlations between sleep and mental parameters.

		AIS score	FSS score	PSQI score	GAD-7 score	PHQ-9 score
AIS Score	Pearson correlation coefficient (r)	1	0.496	0.684	0.556	0.633
	p		<0.001	<0.001	<0.001	<0.001
FSS score	Pearson correlation coefficient (r)	0.496	1	0.426	0.506	0.609
	p	<0.001		<0.001	<0.001	<0.001
PSQI score	Pearson correlation coefficient (r)	0.684	0.42	1	0.487	0.566
	p	<0.001	<0.001		<0.001	<0.001
GAD-7 score	Pearson correlation coefficient (r)	0.556	0.506	0.487	1	0.704
	p	<0.001	<0.001	<0.001		0.000
PHQ-9 score	Pearson correlation coefficient (r)	0.633	0.609	0.566	0.704	1
	p	<0.001	<0.001	<0.001	<0.001	

AIS, Athens Insomnia Scale; FSS, Fatigue Severity Scale; PSQI, Pittsburgh Sleep Quality Index; GAD-7, General Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9.

accordance with other studies that describe reduced night sleep duration and sleep efficiency due to sleep disturbances (24–26). Analogous conclusions have been drawn specifically for medical students and have been linked to disturbed daytime function (27). Notably, the senior medical students experienced significantly more intensely these alterations (12). However, in other studies insignificant changes in sleep quality (28) and an overall improvement in daily performance have been reported (29). Increased daytime napping though seems to offset sleep latency, thus total sleep duration remained unaffected (24). Increased total sleep time has also been mentioned, compared to the pre-pandemic period, especially among 6th year medical students (29). In our study, however, this specific population group reported the lowest sleep duration compared to students from other academic years. This can be possibly attributed to the resumption of their clinical practice and the clinical responsibilities during the pandemic, which may be linked with fear and anxiety, as previously shown (30).

Besides sleep schedule, during the COVID-19 health crisis, the mental health of students has been significantly affected. In our study 67.6 and 43.7% of the sample reported moderate to severe symptoms of anxiety and depression respectively. According to a recent systematic review by Batra et al. (31) performed in 15 countries, anxiety and depression levels reached 39.4 and 31.2% among university students, respectively. This study was conducted almost 1 year before our study, and thus during this period the psychological distress and depression have accumulated, possibly explaining the difference in our results (31). Interestingly, in two of the studies included in this systematic review almost one out of three and two out of three students, respectively, had suicidal ideation, which is surprisingly high compared to our results (32, 33). In our study, 16.7% of the respondents suffered from recurrent suicidal thoughts, which is in accordance with previous findings (34, 35). Furthermore, during the pandemic period, a rise in depression has been noted, with its severity and prevalence varying between different studies (12, 36–38). Additionally, the prevalence of PTSD symptoms, in those studies, was similarly elevated (31), with a higher degree of anxiety being attributed to increased concern about the impact of the COVID-19 pandemic (39) and the presence of a confirmed COVID-19 case in the proximal familial and friendly environment (40). This is also the case among medical students (36, 41), who experienced analogous levels of stress and anxiety symptoms (36, 37). According to our findings, infection in the immediate environment is associated with depression in a more severe way and PTSD symptoms, mainly in females.

Published literature associating gender and mental health is inconclusive, for example in the study by Xie et al. (12), males reported depressive symptoms more frequently, whereas Liu et al. found no statistically significant difference between gender with regards to anxiety and depression (37). However, Batra et al. (31) in their systematic review found that female students experienced higher levels of anxiety and stress. These results are consistent with our study. An interesting finding was that females having experienced COVID-19 either personally or in their proximal environment were significantly more affected than their male counterparts. A possible explanation could be that women in general, are more likely to report experiencing higher levels of anxiety (42) and that they are more affected by traumatic events (31).

Another finding in our study was the positive and independent correlation between insomnia, fatigue, dysfunctional sleep, depressive and anxiety symptoms. Previous studies confirm the association between sleep abnormalities and deteriorated mental health in students during the COVID-19 health crisis (26, 36). This comes as no surprise, since similar correlations have already been established, even before the pandemic. In a cross-sectional study of 95 medical students in Saudi Arabia stress, anxiety and depression were strongly linked with poor sleep (43). It was also reported that inadequate sleep duration and consequently fatigue may affect mental health to such a degree, that recurrent suicidal thoughts and even suicidal attempts may occur more frequently (44). Additionally, it has been demonstrated, both in the general population and specifically in medical students, that insomnia can be predictive of depression and anxiety (45, 46).

In a large study of the general population in Greece, Switzerland, Austria, Germany, France and Brazil, conducted during the first wave of the pandemic, total sleep time decreased and sleep quality in general improved in participants from

Greece, compared to other countries (47). At the same time, insomnia affected 37.6% in a sample of the Greek population, which was significantly increased compared to the pre-pandemic period (48). As far as mental health is concerned, levels of anxiety and depression were notably elevated during the first COVID-19 wave. Fountoulakis et al. reported a significant increase in anxiety symptoms in over 45% and depressive symptoms in almost 40% of the participating Greek citizens (49). According to Patsali et al. major depression in the general population reached 12.43% (50). Focusing on Greek students, during the first pandemic wave, they experienced overall lower sleep quality despite an increase in their sleep duration (33). Our findings suggest an even higher prevalence of insomnia in our selected population (medical students) compared to the general population, affecting 65.9% of the participants. Kaparounaki et al. noted anxiety in 73%, depression in 60.9% and suicidal ideation in 20.2% in a Greek university sample (33). Meanwhile in a study conducted in the University of Patras by Sazakli et al., anxiety symptoms during COVID-19 pandemic decreased to 35.8% and depressive symptoms increased to 51.2% (51). Interestingly, in our study, anxiety levels were significantly higher and reached 67.6%. This also the case with our reported levels of depression, where overall 74.3% of the participants experienced it to some degree and 43.7% admitted having moderate to severe symptoms.

Our study certainly has limitations. Firstly, participation rate was relatively low; however, it is representative of the experiences of medical students since respondents came from all Greek Medical Schools. Additionally, examined parameters were assessed with the use of self-administered questionnaires in an on-line survey. On the other hand, we have used a large number of diagnostic tools, validated for the Greek population, and already used in several studies and thus are ensuring standardized results. In addition, this is, to the best of our knowledge, the first study to assess the impact of COVID-19 pandemic on sleep parameters of medical students in Greece, in association with a large series of sleep and mental health parameters.

CONCLUSIONS

In the aftermath of the COVID-19 pandemic, Greek medical students experienced, in a greater degree, sleep and mental health disorders such as insomnia, fatigue, poor sleep quality, anxiety, post-traumatic stress and depression. Thus, the need for better surveillance of students' wellbeing and subsequent counseling is even more evident now. A special focus must be given to the most affected groups such as female students.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, upon request.

ETHICS STATEMENT

The study protocol, which involved human participants, was reviewed and approved by University General Hospital of Alexadroupolis Scientific Board. The patients/participants provided their informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AE, AR, and PS designed the study and wrote the manuscript. AA and EN contributed to the interpretation of the results and provided critical feedback. All authors contributed to the article and approved the submitted version.

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Suppression May Improve Adaptation to Worry When Facing Uncertainty: Studying COVID-19 Pandemic

Ali Khatibi[1,2], Louise Sharpe[3], Mohsen Dehghani[4,5], Erfan Ghalibaf[6], Parham Hosseinchi[6], Mahdi Mazidi[7], Seyran Ranjbar[4,7], Zoha Deldar[8], Carlos Gevers-Montoro[9,10], Pouyan Alizadeh[11], Shaghayegh Alidoust[6], Arghavan Babaei[6], Fattaneh Telkabadi[6] and Tahereh Ghadiri[12,13,14]*

[1] Centre of Precision Rehabilitation for Spinal Pain, University of Birmingham, Birmingham, United Kingdom, [2] Centre for Human Brain Health, University of Birmingham, Birmingham, United Kingdom, [3] Faculty of Science, School of Psychology, University of Sydney, Sydney, NSW, Australia, [4] Department of Psychology, Shahid Beheshti University, Tehran, Iran, [5] Neuroepidemiology Unit, School of Population and Global Health, University of Melbourne, Melbourne, VIC, Australia, [6] Institute for Cognitive Science Studies, Tehran, Iran, [7] Centre for the Advancement of Research on Emotion, School of Psychological Science, The University of Western Australia, Perth, WA, Australia, [8] Department of Psychology, McGill University, Montreal, QC, Canada, [9] Department of Anatomy, Université du Québec à Trois-Rivières, Trois- Rivieres, QC, Canada, [10] Madrid College of Chiropractic—Real Centro Universitario María Cristina, Madrid, Spain, [11] Family Research Institute, Shahid Beheshti University, Tehran, Iran, [12] Department of Neuroscience and Cognition, Faculty of Advanced Medical Sciences, Tabriz University of Medical Sciences, Tabriz, Iran, [13] Neurosciences Research Centre, Tabriz of Medical Sciences, Tabriz, Iran, [14] Shefa Neuroscience Research Centre, Khatam Alanbia Hospital, Tehran, Iran

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***Correspondence:**
Ali Khatibi
ali.khatibi@gmail.com

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The COVID-19 pandemic has been associated with increased uncertainty, fear and worry in everyone's life. The effect of changes in daily life has been studied widely, but we do not know how emotion-regulation strategies influence adaptation to a new situation to help them overcome worry in the face of uncertainty. Here, 1,064 self-selected Farsi speaking participants completed an online battery of questionnaires that measured fear of virus and illness, worry, intolerance of uncertainty, and emotion regulation (two subscales: reappraisal, suppression). We also documented the number of daily COVID-19 cases and deaths due to COVID-19 on the day in which participants completed the questionnaire. Our findings suggest a correlation between contamination fear and the number of daily-confirmed cases ($r = 0.11$), and the number of reported deaths due to COVID-19 ($r = 0.09$). Worry mediated the relationship between intolerance of uncertainty and fear of virus and illness ($b = 0.16$, $0.1141 < CI < 0.2113$). In addition, suppression moderated the relationship between intolerance of uncertainty and worry ($p < 0.01$). Our results suggest that suppression (at least in the short term) can be an adaptive response to the worry associated with uncertainty. Suppression can reduce worry, which in turn can decrease fear of contamination and improve adaptation to social distancing requirements. Although, the observed correlations were significant, but considering the sample size, they are not strong, and they should be interpreted cautiously.

Keywords: pandemic, intolerance of uncertainty, emotion regulation, suppression, COVID-19

INTRODUCTION

Pandemics, particularly those associated with a novel virus, affect both the mental and physical well-being of people over time (1). Given that the virus was not previously known, information from different sources was vague and unclear, and sometimes conflictual. The lack of clear and accurate information about the virus led to ambiguity about how to manage it, for both governments and individuals. As information about the virus came to light, it seemed clear that COVID-19 had a longer incubation period compared to other coronaviruses (up to 14 days) and that people were contagious prior to experiencing any symptoms. In addition, it became clear early that some people were unaffected by the virus (i.e., asymptomatic), but tested positive for COVID-19 and could transmit the virus. COVID-19 proved to be highly contagious, which led to increases in cases becoming exponential once community spread began. These characteristics heighten ambiguity making assessments of risk difficult, particularly as risk changed very rapidly in specific regions during waves of community transmission.

As a result, many jurisdictions introduced various degrees of lockdown in order to limit the spread of COVID-19. These lockdowns, while generally associated with a gradual decline in cases that allowed jurisdictions to "flatten the curve," nevertheless led to the closure of businesses, schools and other non-essential services in many places. Around the world, many people had to quarantine, many lost their jobs or had to adapt to work from home, some while supporting children in their remote learning. These mitigation measures, while effective in reducing cases of COVID-19, came at considerable expense to the social and economic circumstances of individuals in the community. Moreover, even those regions that were able to quickly stem community spread initially (e.g., Singapore, New Zealand, and Australia) have experienced "second waves" of the virus, in some cases worse than the initial wave, which adds to the uncertainty that has characterised the pandemic internationally.

There is a voluminous literature on the impact of uncertainty on people's mental health, and in particular, on their anxiety symptoms (2). Research clearly suggests that intolerance of uncertainty is a key factor in the experience of worry and anxiety (3). Indeed, research shows that in the context of COVID-19, intolerance of uncertainty is unsurprisingly associated with greater fear of COVID-19 (4) and health anxiety (5) and less positivity in the face of the pandemic (6). Ouellet et al. (7) recently tested a new model relating to the role of intolerance of uncertainty in anxiety, more generally. They hypothesised that people who have high levels of intolerance of uncertainty are more likely to worry. In particular, they proposed that the relationship between intolerance of uncertainty and worry is mediated by cognitive avoidance and other emotion regulation difficulties.

Models of emotion regulation have posited two major strategies that are central to emotion regulation: suppression and reappraisal (8). Suppression is a strategy that is typically employed to deal with stress when an individual sees the requirements of a situation as unmanageable. Suppression has consistently been found to be associated with increased worry and is a similar construct to cognitive avoidance, as operationalised in Ouellet et al. (9) model. Reappraisal, on the other hand, is a cognitive strategy that aims to view a situation in a different way that minimises resultant stress. In contrast to suppression, the use of reappraisal is associated with lower levels of anxiety. Meta-analyses confirm that suppression and cognitive reappraisal are reliably associated with anxiety as predicted, such as social anxiety disorder (10, 11). The degree, however, to which suppression and reappraisal moderate the impact of intolerance of uncertainty on worry and COVID-19-related fear has yet to be studied.

Further, in the context of health, worry is typically focused on health-related concerns, such as the experience of physical symptoms. In health anxiety, it is the interpretation of ambiguous physical symptoms as threatening that is thought to trigger health anxiety and the cascade of thoughts, emotions and behaviours that maintain heightened anxiety [see (12)]. These misinterpretations of ambiguous symptoms are frequently operationalised as anxiety sensitivity (AS), since it is often physical manifestations of anxiety that are misinterpreted (13). Research suggests that both anxiety sensitivity and intolerance of uncertainty are associated with an increase in health anxiety (14). Further, a recent study demonstrated that anxiety sensitivity was a predictor of COVID-19-related fear (15). However, the relationships between intolerance of uncertainty, anxiety sensitivity, worry and emotion regulation strategies have not been studied together as predictors of COVID-19 related fear.

The overall aim of this study was to examine relevant theoretical predictors of COVID-19 related fear, taken from models of anxiety, health anxiety and emotion regulation, as described above in a general population using an online battery of questionnaires. Considering the literature, we were interested in the examination of the relationship between intolerance of uncertainty, anxiety and emotion regulation. We hypothesised that COVID-19 related fear would be predicted by intolerance of uncertainty, anxiety sensitivity, suppression, cognitive reappraisal and worry. We further hypothesised that emotion regulation strategies would moderate the relationship between intolerance of uncertainty and worry, which would, in turn will predict COVID-19-related fear.

METHODS

Participants

Participants were recruited through advertisements in social media, including WhatsApp, Instagram, and Twitter. Participants needed to be over the age of 18, but no other exclusion criteria were applied. All participants gave informed consent electronically. A total of 1,090 participants responded to the advertisement and opened the online questionnaires, all provided complete responses. Among them, 1,064 responses were identified as unique and valid after checking the catch questions. The study was conducted in accordance with the Declaration of Helsinki. The study was approved by the Ethics Committee of the Department of Psychology at Shahid Beheshti University.

Questionnaires and Procedure

A battery of questionnaires comprised of the following questionnaires in order of appearance was presented online to participants. Three catch (attention check) questions were placed between questionnaires to assure the quality of responses. Individuals with two or more incorrect responses were excluded from the study ($n = 26$). The link to online questionnaires was shared on social media, such as WhatsApp, Instagram and Twitter, between April 8 and 20th, 2020 in Farsi. At the time of the survey in Iran, the lockdown was in place, major travel between cities was prohibited and many businesses, all the schools and universities, public places like mosques and shrines were closed. Additionally, people were advised to leave home only to get essential foodstuffs or medical attention. Based on the reports from local authorities, the total confirmed cases of COVID-19 on April 8th were 62,589 people in Iran and increased by April 20th to 82,211 positive cases. At the end of this period, 5,118 people in Iran had died from coronavirus (retrieved from: https://www.worldometers.info/coronavirus/).

Fear of Illness and Virus Evaluation

FIVE (16) is a 35-item questionnaire measuring an individual's fear of contamination and illness, fear of social distancing, behaviours related to illness and virus fear, and impact of illness and virus fears. We used this measure to assess COVID-related fear. In subscales about fear of contamination (e.g., I am afraid I might die if I get a bad illness or virus) and fear about social distancing (e.g., I am afraid I will be sad and lonely because of bad illness or virus), participants rated their fear on Likert Scale (0 = I am not afraid of this at all, 3 = I am afraid of this all the time). In the subscale on behaviours related to illness and virus fear (e.g., I ask people if they are sick), participants rated how often they have done things that show adherence to mitigation measures in the last week on a Likert scale (0 = I haven't done this in the last week, 3 = I did this all the time last week). In the subscale on the impact of illness and virus, participants rated how true a statement is about them [e.g., On average in the last week, being afraid of an illness or virus has caused me to feel very strong emotions in my body (e.g., anger, anxiety, sadness, irritable feelings, etc.)] on a Likert scale (0 = not for me at all, 3 = definitely true). This measure has been translated and validated in Iran, and the Farsi version has been proved to be a valid and reliable measure. The alpha for the total score is equal to 0.82. The alpha for each subscale is fear of contamination ($\alpha = 0.790$), fear of social distancing ($\alpha = 0.863$), behaviours related to illness ($\alpha = 0.699$), and the impact ($\alpha = 0.747$). Subjects were asked to answer the questionnaire having the COVID-19 pandemic in their mind.

Intolerance of Uncertainty Scale-Short Form (IUS-12)

Intolerance of Uncertainty Scale [IUS-12; (17)] is a 12-item scale measuring an individual's reaction to ambiguous situations, impending uncertainty, and an unknown future on a five-point Likert scale (1 = not at all characteristic of me; 5 = entirely characteristic of me) (17). The questionnaire provides a total score based on two factors namely: prospective anxiety (composed of seven items) and inhibitory anxiety (composed of five items). The Farsi version of the questionnaire has been used in several previous studies and shown to be a valid and reliable measure (18). Cronbach's alpha in the current sample was = 0.89.

Penn State Worry Questionnaire

The Penn State Worry Questionnaire [PSWQ; (19)] is a 16-item scale measuring an individual's disposition to worry, as well as the frequency, intensity, and tendency for worry. Participants rate items on a five-point Likert scale (1 = not at all typical of me; 5 = very typical of me). The questionnaire produces a total score with higher scores representing greater levels of pathological worry (19). The Farsi version of the questionnaire has been used in several previous studies and proven to be a valid and reliable measure [Cronbach's alpha = 85; (20, 21)]. Cronbach's alpha in the current sample was = 0.78.

Emotion Regulation Questionnaires (ERQ-10)

The Emotion Regulation Questionnaire [ERQ; (22)] is a 10-item scale that measures the habitual use of two emotion regulation strategies: reappraisal and suppression. Participants rate items on a seven-point Likert scale (1 = "strongly disagree," 4 = "neutral," and 7 = "strongly agree"). Higher mean scores on each of these subscales indicates that the strategy is more strongly endorsed (22). The Farsi version of the questionnaire has been used in several previous studies and has been shown to be a valid and reliable measure [Cronbach's alpha = 91, (23, 24)]. Cronbach's alpha in the current sample was = 0.75.

Anxiety Sensitivity Index (ASI-3)

The Anxiety Sensitivity Index [ASI−3; (25)] is an 18-item scale that measures the tendency to fear symptoms of anxiety resulting from the belief that such sensations could have harmful consequences. Participants rate items on a five-point Likert scale (0 = very little; 4 = very much). The physical and cognitive subscales were used for the current study. The Farsi version of the questionnaire has been used in several previous studies and has been demonstrated to be a valid and reliable measure [Cronbach's alpha = 0.90, (26)]. Cronbach's alpha in the current sample was = 0.91.

General Self-Efficacy Scale

The General Self-Efficacy Scale [GSE; (27)] scale is a 10-item scale measuring general self-efficacy as a prospective and operative construct on a four-point Likert-type scale (1 = not at all true; 4 = completely true). The scale produces a total score, with higher scores representing greater self-efficacy (27). The Farsi version of the questionnaire has been used in several previous studies and proven to be a valid and reliable measure [Cronbach's alpha = 0.85; (28, 29)]. Cronbach's alpha in the current sample was = 0.89.

Patient Health Questionnaire (PHQ-9)

The Patient Health Questionnaire [PHQ-9; (30)] is a 9-item questionnaire measuring depressive symptoms on a four-point Likert scale (0 = not at all; 3 = nearly every day). The questionnaire scores range from 0 to 27, with scores of ≥5, ≥10, ≥15, representing mild, moderate and severe levels of depressive symptoms (30). The Farsi version of the

questionnaire has been used in several previous studies and has been shown to be a valid and reliable measure [Cronbach's alpha = 0.88; (31)]. Cronbach's alpha in the current sample was = 0.87.

Data Preparation and Analyses

Data pre-processing, correlations, and group comparisons were completed in R (v 4.0.0.). SPSS (v25 statistical package IBM SPSS Statistics, Armonk, NY, USA) has been used for the remainder of the analyses. For our preliminary analyses, we calculated correlations between fear of illness and virus and other measures, as well as inter-correlations of the subscales of the FIVE. Mediation analyses were conducted in SPSS using the PROCESS macro (32). The dependent variable was fear of illness and virus. We tested whether worry mediated the relationships between intolerance of uncertainty and COVID-related fear. As such, a hierarchical regression equation was constructed with intolerance of uncertainty entered on the first step of the equation, and worry entered on the second step. This allowed the direct and indirect effects of worry to be calculated to test for mediation. Individuals who had two or more incorrect responses to the catch questions were excluded from the final analyses. This left a final sample of 1,064. In relevant analyses, age, gender, and other demographic variables have been included in the model. Where applicable, a Bonferroni correction for multiple comparisons was applied and the results reported here are after those corrections.

RESULTS

A total of 1,064 responses (97.6% of total) were identified as valid and unique (see procedure) and included in our final analyses. Among these participants, the majority identified themselves as female (n = 704; 66.2%), 357 (33.6%) identified as male and 3 (0.3%) participants as other. Nearly half of the sample were single (n = 521; 49%), 500 (47%) were married, 40 (3.8%) were divorced, and 3 (0.3%) were widowed. Participants were aged between 18 and 76 years (Mean ± SD = 34.50 ± 9.9). The sample was relatively well educated, with 16 (1.5%) participants having less education than a high school diploma, 96 (9%) having completed only a high school diploma, 406 (38.2%) having a bachelor's degree, 374 (35.2%) and the remainder having completed postgraduate qualifications (n = 172; 16.2%). The vast majority of participants (n = 900; 84.6%) did not report existing health conditions. The remainder had a range of conditions that led them to be at risk of COVID-19, such as diabetes (n = 15), MS (n = 13), cancer (n = 4), or cardiovascular disease (n = 18). All participants were Farsi speaking, 983 (92.4%) participants were living in Iran. The total number of confirmed cases, the number of daily cases at the time of completion, the total number of deaths and the daily number of deaths at the time of completion of the questionnaire was calculated by collecting the data from official publicly available stats announced on https://www.worldometers.info/coronavirus/.

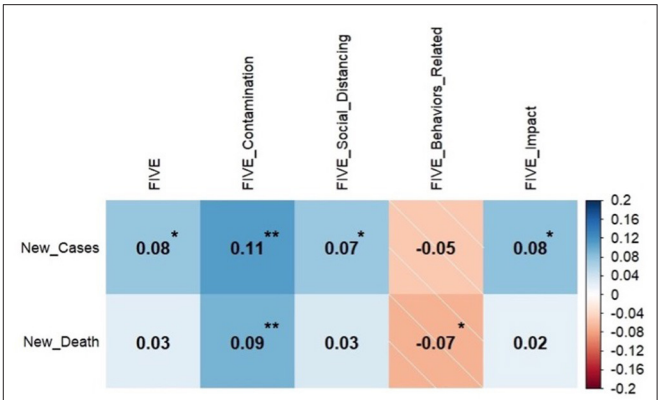

FIGURE 1 | Correlation between the number of confirmed cases and death due to COVID-19 and fear of illness and virus evaluation (N = 983, *p < 0.05, **p < 0.01).

The Effect of Place of Living on Fear of Corona Virus and COVID-19 Impact

Group comparisons revealed that participants living in Iran had a higher level of fear of contamination as measured by FIVE (n = 983; M = 5.16 ± 2.8) compared to those living outside of Iran (n = 81; M = 4.4 ± 2.8); $t_{(1,062)}$ = 2.14, p = 0.03, Cohen's d = 0.271). In addition, those who were living in Iran had a higher level of fear of the impact of COVID-19 on their lives (M = 2.6 ± 2.2) than those living abroad (M = 2.1 ± 2.2); $t_{(1,062)}$ = 1.96, p = 0.05, Cohen's d = 0.227). Based on these findings, we excluded those participants who lived outside Iran. Hence, the results are based on 983 people who responded and lived in Iran at the time of data collection.

Correlation Analysis

Figure 1 presents the between FIVE's total score and subscales' scores and the number of new cases and death at the time of completing the questionnaire. As can be seen, there is a significant positive correlation between the number of new cases, FIVE's total score, fear of contamination, fear of social distancing, and fear of the impact of the condition on the person's life. There was a positive correlation between fear of contamination and the number of announced deaths. Finally, there was a significant negative correlation between the number of new death and adherence to safe behaviours. Further correlational analysis revealed that age was significantly and negatively correlated with intolerance of uncertainty (−0.09, p = 0.004), worry (−0.11, p = 0.001), anxiety sensitivity (−0.16, p < 0.001). Age was positively correlated with emotion regulation reappraisal subscale (0.11, p = 0.001) and general self-efficacy (0.13, p < 0.001). However, all correlations were small.

All subscales of the FIVE questionnaire were intercorrelated (rs < 0.26, ps < 0.001). High correlations between the FIVE total score and subscales scores and all other measures were all identified. There were significant correlations (all ps < 0.001) between the FIVE total scores and intolerance of uncertainty (0.5), worry (0.47), emotion regulation reappraisal (−0.24),

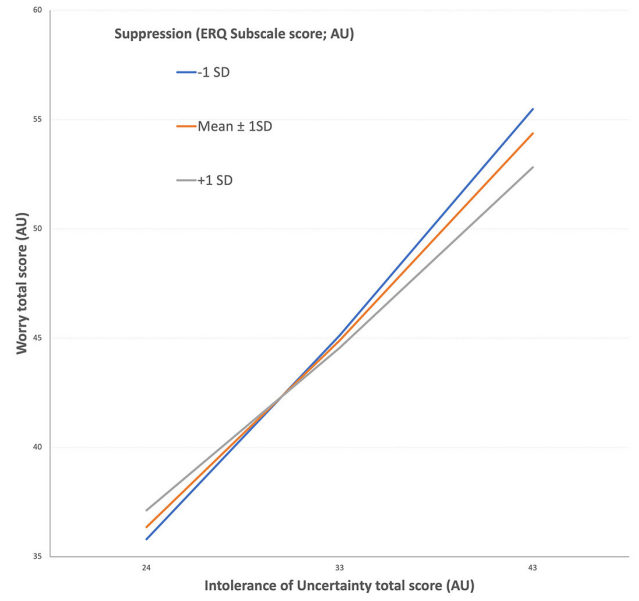

FIGURE 2 | Suppression (Emotion Regulation Questionnaire subscale, ERQ) moderates the relationship between Intolerance of Uncertainty (X axis) and Worry (Y axis). The figure displays the relationship between worry and intolerance of uncertainty among those with low, mid, and high levels of suppression. In low to medium levels of intolerance of uncertainty, high and low suppression groups don't show significant differences in worry, but in high levels of intolerance of uncertainty, higher suppression is associated with lower worry, while lower suppression is associated with higher levels of worry. AU, Arbitrary Unit.

anxiety sensitivity: physical and cognitive concerns (0.5), and general self-efficacy (−0.35). The pattern of correlation between all the FIVEs' subscales and the measures described above was the same with a similar correlation coefficient and p-values < 0.001.

In the interpretation of the findings of correlation analyses, it should be noted that considering the sample size the results (rs < 0.5) were weak to moderate. Weak to moderate correlation findings are required to be replicated in different samples and populations to be tested for their validity.

Mediation Analysis

We tested whether worry (PSWQ) mediated the relationship between intolerance of uncertainty on COVID-related fear, as measured by the total score on the FIVE. Mediation analysis (Model 4) showed that the total effect of intolerance of uncertainty on FIVE total score (path c) was significant [$F_{(1,981)} = 323.00$, $p < 0.001$, $R^2 = 0.25$; b = 0.48, $t_{(981)} = 17.97$]. The effect of intolerance of uncertainty on worry (path a) was also significant [$F_{(1,981)} = 770.09$, $p < 0.001$, $R^2 = 0.44$; b = 0.94, $t_{(981)} = 27.75$]. Worry predicted COVID-related fear (path b) (b = 0.17, $t_{(980)} = 7.02$, $p < 0.001$). The direct effect of intolerance of uncertainty on COVID-related fear remained significant (b = 0.32, $t_{(980)} = 9.12$, $p < 0.001$), but the indirect effect (path a*b) was also significant (b = 0.16, $0.1141 < CI < 0.2113$), indicating that worry partially mediated the relationship between intolerance of uncertainty and COVID-related fear. In order to ensure that the effects of our analyses were robust, we re-ran the analyses, including anxiety sensitivity and self-efficacy in the model as covariates. When we did so, the pattern of results was unchanged, with all previously significant effects remaining significant. When the above analysis repeated with the inclusion of the age and gender as covariates, no new interaction was found and the observed effects remained significant (indirect effect of IUS on COVID-related fear through worry: b = 0.15, $0.1063 < CI < 0.1997$).

Post-hoc Analyses: Moderated Mediation

Since suppression was not correlated with COVID-related fear, as we had predicted, we were interested to see whether the relationship between suppression and COVID-related fear might vary as a function of worry or intolerance of uncertainty. As such, we constructed a *post-hoc* moderated mediation analysis (Model 7) to test the moderating role of emotion suppression on the mediatory role of worry in the relationship between intolerance of uncertainty and COVID-related fear. There was a significant interaction between suppression, IUS and worry as the dependent variable [$F_{(3, 979)} = 262.92$, $p < 0.01$, b = −0.02, $t_{(979)} = -2.99$]. The indirect effect of suppression on the interaction between IUS and worry was significant for all levels of emotion suppression (see **Figure 2** below). Similarly, when age and gender were included as covariates into the above-mentioned analysis, the observed significant interaction remained significant [$F_{(5, 977)} = 168.81$, $p < 0.01$, b = −0.02, $t_{(977)} = -3.02$).

This finding suggests that higher levels of intolerance of uncertainty result in higher levels of worry when people use suppression as an emotion regulation strategy ***less***. Consistent with this, amongst those high in intolerance of uncertainty who use suppression more as an emotion regulation strategy have ***lower*** levels of worry. That is, for those with high levels of intolerance of uncertainty, suppression appeared to be a strategy that minimised worry, and in turn COVID-related anxiety.

DISCUSSION

In the current study, we examined the factors that are associated with fear in the context of the COVID-19 pandemic. We showed that the case and death rate were positively correlated with individuals' COVID-related fear. Lower adherence to mitigation measures was associated with a higher death rate as well. High fear of contamination was also associated with higher intolerance of uncertainty, lower use reappraisal for emotion regulation, and lower perceived self-efficacy. However, these correlations were small, according to the usual conventions of interpreting the size of correlations. Consistent with our hypotheses, worry mediated the relationship between intolerance of uncertainty and fear of COVID-19. Furthermore, the use of suppression as the strategy for emotion regulation moderated the relationship between intolerance of uncertainty and worry. Contrary to expectations, this shows that for those who had high levels of intolerance of uncertainty, the more they used suppression as an emotion regulation strategy, the less they tended to worry.

While the finding that worry mediated the relationship between intolerance of uncertainty and COVID-related anxiety was predicted, the fact that suppression was associated with less worry amongst those high in intolerance of uncertainty was surprising. The most robust findings in the literature regarding emotion regulation strategies demonstrate that the use of cognitive reappraisal is associated with better emotional outcomes (such as anxiety), while the use of suppression is linked to poorer emotional outcomes (22). In the context of the current pandemic, the findings of our study suggest a somewhat different relationship. That is, more use of suppression as an emotion regulation strategy was associated with a lower contribution of intolerance of uncertainty to worry. This suggests among individuals with high levels of intolerance of uncertainty, suppression may have been helpful in lowering the worry during this acute stressor. It is worthwhile noting that our study was conducted cross-sectionally at a time of high uncertainty in a new pandemic. Some studies suggest that while in short-term suppression can under some circumstances reduce the effect of uncertainty on worry. However, in the longer term, suppression can nevertheless lead to other negative outcomes, such as a worsening in self-evaluation over time (33). We cannot exclude this possibility in this cross-sectional study. On the other hand, others have proposed that the flexibility to choose an appropriate strategy for the situation might be an adaptive approach to emotion regulation (34). According to this view, in real high-risk situations where a negative outcome is likely (such as in a pandemic), the use of suppression to try and reduce worry might be helpful, even though in less dangerous situations this approach would no longer be helpful. Given that this study occurred in the early stages of a pandemic in a country where, at the time, there was very rapid community spread with high death rates, our results could be accounted for by the flexibility argument. That is, there is uncertainty, and suppression may act to reduce the focus on the realistic appraisal of uncertainty associated with COVID-19. Prospective research, however, is needed to confirm this explanation.

As predicted, worry partially mediated the relationship between intolerance of uncertainty and fear of COVID. Intolerance of uncertainty describes an individual's negative beliefs when facing uncertainty (35). Previous research in our group has demonstrated that negative interpretation bias in both clinical and subclinical populations contribute to an increase in intolerance of uncertainty (36, 37). The nature of the COVID-19 pandemic increased both actual and perceived uncertainty in society. COVID-19 is a particularly unpredictable illness with high variability in how symptoms appear from person to person, the level of immunity created in people after infection, and the long and varied incubation period. Given that worry is a cognitive phenomenon that attempts to solve a perceived problem, one might expect worry to increase when there is uncertainty related to future events (35, 38). Previous studies suggest that intolerance of uncertainty contributes to increases in worry in a non-clinical population (35), but this relationship has not been studied in the context of a real-world stressor. Results of the current study confirm that the relationship between intolerance of uncertainty, worry and fear of an illness can be extrapolated to a truly uncertain environment. We showed that while an increase in intolerance of uncertainty contributed to an increase in worry, worry contributed to an increase in COVID-related fear. These findings have important clinical implications as previous studies suggest we can influence worry, and one evidence-based method to do this would be through cognitive bias modification (CBM). Numerous studies now confirm that modification of interpretation bias can result in changes in the level of worry by reducing negative interpretations (39, 40). Indeed, both a systematic review of meta-analyses (41) and a recent network meta-analysis (42) indicate that CBM for interpretation bias is an effective method of reducing anxiety. Importantly, CBM for interpretation can be delivered online and repeated over several sessions, which makes it highly scalable. In situations like a pandemic where increased uncertainty can reliably be predicted to result in increased worry and for some individuals the development of excessive fear, CBM for interpretation could be a useful tool to reduce the impact of the pandemic on COVID-related fear. Importantly, when demographic variables such as age and gender were included into the analyses, the observes effects remained significant and direction of findings did not change. This may suggest that the observed effects are independent from the age and gender, but future studies may focus on them using designs specified to assess their impact.

Notwithstanding the specific contribution of this study to the literature, there are some limitations that need to be considered when interpreting the findings. Like all other online studies, the context and the environment in which participants completed the questionnaires was not controlled. We tried to include catch questions and excluded participants answering questions from outside of Iran to minimise the effect of different contexts. In addition, participants required the internet and knowledge related to it to access the questionnaire. This limitation resulted in the inability of specific groups that either don't have access to the internet or don't have the knowledge to work with online material, and this may have affected the generalizability of the results. Furthermore, this is a cross-sectional study, and longitudinal designs are needed to disentangle the results related to suppression in this study. Finally, factors that may contribute to behaviours in lockdown or social distancing can be more complicated to be included in a single study. Future studies may include socioeconomic factors in their study and investigate their influence.

Taken together, this study has a unique contribution to the studies on the psychological impact of COVID-19 in the general population. Our sample consisted of over 900 unique and validated responses. Our findings suggest that suppression can be an important factor in stressful conditions that may influence the adaptation of a person to the situation. That is, the use of suppression appeared to reduce worry amongst those who scored highest in intolerance of uncertainty. Hence, our findings suggest that at least for some people who find tolerating uncertainty difficult in times of uncertainty, suppression can reduce worry, and in turn COVID-related

anxiety. Furthermore, these relationships remained significant when controlling for other possible predictors of COVID-related anxiety, such as anxiety sensitivity and self-efficacy, which were themselves associated with COVID-related anxiety. This finding suggests that suppression could be a strategy that can be adaptive in environments where a real risk exists for those who find it difficult to tolerate uncertainty and high levels of uncertainty are present. Furthermore, these results confirm that worry is a proposed mechanism through which intolerance of uncertainty impacts COVID-related fear.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee at the Department of Psychology, Shahid Beheshti University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AK was involved in design, data collection, supervision, analysis, writing, and finalisation. LS and MD were involved in data analysis, design, and writing. MM, SR, ZD, CG-M, FT, PA, SA, and AB were involved in the design, data collection, and writing. EG and PH were involved in the design, data collection, analyses, and writing. All authors contributed to the article and approved the submitted version.

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A Comparison of COVID-19 Stigma and AIDS Stigma During the COVID-19 Pandemic: A Cross-Sectional Study in China

Manyun Li[1], Jiang Long[2], Xuyi Wang[1], Yanhui Liao[3], Yueheng Liu[1], Yuzhu Hao[1], Qiuxia Wu[1], Yanan Zhou[4], Yingying Wang[1], Yunfei Wang[1], Qianjin Wang[1], Yuejiao Ma[1], Shubao Chen[1] and Tieqiao Liu[1]**

[1] Department of Psychiatry, and National Clinical Research Center for Mental Disorders, The Second Xiangya Hospital of Central South University, Changsha, China, [2] Shanghai Mental Health Center, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [3] Department of Psychiatry, Sir Run Run Shaw Hospital, School of Medicine, Zhejiang University, Hangzhou, China, [4] Department of Psychiatry, Hunan Brain Hospital (Hunan Second People's Hospital), Changsha, China

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Edited by:
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***Correspondence:**
Tieqiao Liu
liutieqiao123@csu.edu.cn
Shubao Chen
chenshubao@csu.edu.cn

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Objective: To understand the current situation of stigmatizing attitudes toward Coronavirus Disease 2019 (COVID-19) in China and compare it with acquired immunodeficiency syndrome (AIDS).

Methods: Convenient sampling and vignette-based methods were used to recruit participants on WeChat. A demographic form and adopted stigma scale were used to collect participants' demographic information and stigmatizing attitudes toward COVID-19 and AIDS.

Results: A total of 13,994 questionnaires were included in this study. A high portion of participants tend to avoid contact with individuals affected with COVID-19 (74.3%) or AIDS (59.0%), as well as their family members (70.4% for COVID-19 and 47.9% for AIDS). About half of the participants agreed that affected persons could not only cause problems to their own family but also have adverse effects on others (59.6% and 55.6% for COVID-19, 56.9 and 47.0% for AIDS). The agreements with statements about perceived stigma were similar but slightly higher than those about personal stigma in both COVID-19 and AIDS. Participants' agreements with all statements regarding personal and perceived stigma attitudes between COVID-19 and AIDS were all statistically significant ($p < 0.001$). Participants obtained COVID-19-related information mainly from social media (91.3%) and newspaper or television (77.1%) during the epidemic, and 61.0% of them thought information from newspapers or television was the most reliable.

Conclusion: Several similarities and differences of people's attitude toward COVID-19 and AIDS were found. Avoidance, blame, and secondary discrimination to diagnosed persons and their surrounding persons were the main representations of COVID-19-related stigma. Stigma of COVID-19 had less moral link but more public panic. Experience from HIV-related stigma reduction and prevention can be applied to reduce COVID-19-related stigma.

Keywords: COVID-19, AIDS, stigma, physical avoidance, public panic

INTRODUCTION

Novel Coronavirus Disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-COV-2). The disease spectrum caused by this virus ranges from asymptomatic, fever, cough, and fatigue to severe acute respiratory distress syndrome (ARDS), and even death (1). According to a report of 72,314 cases in China, 81% patients' symptom was sorted as mild, 14% were severe that need ventilation in an intensive care unit (ICU), and 5% were critical that had respiratory failure, septic shock, and/or multiple-organ dysfunction or failure (2). SARS-COV-2 spreads mainly via respiratory and closed contact (3) and is infectious during the latent period (4) which ranges from 2 to 14 days (median: 4–5 days) (5). As the strong infectivity (median $R_0 = 5.7$, 95% CI: 3.8–8.9) and fast transmission of SARS-COV-2 (6), COVID-19 soon spread around the world. The WHO proclaimed COVID-19 as a public health emergency and designated it a pandemic on March 11, 2020 (7). There are several vaccines available for COVID-19 which could provide protection for those older than 16 to some extent (8). However, some variations of SARS-COV-2 have been detected globally and the efficacy of vaccines has absolute marked differences (9, 10).

Stigma was first proposed by Erving Goffman in 1963, which was defined as a "sign" or an attribute that reduces an individual's status in the eyes of society (11). It was also interpreted as a mark of shame and disapproval that result in a person apart from others (12). It refers to people's negative emotional experience of disease, including personal stigma and perceived stigma. Personal stigma is a process of stereotype, prejudice, and discrimination, while perceived stigma indicates that someone is approved of the public discrimination against the group (13). Extreme fear of a disease and self-defense may be related to stigma. Mental disorders, physical disability, and emerging infectious diseases have been reported with different degrees of stigma (14). Stigma has always been a major focus throughout the pandemic of an infectious disease (3). The impact of infectious disease stigma is no less than the disease itself. Not only does it influence the patients' quality of life and social ability, but it also affects the publics' attitude toward disease prevention, service delivery, medical resource allocation, and health policymaking (15). Isolation measures were taken during the outbreak of COVID-19, which effectively decreased the morbidity and mortality of COVID-19 but may increase stigma inversely (16). Some scholars pointed that compared with other regions, people resident in the infectious area were more likely to be prejudiced and discriminated (17). The fear of getting infected of COVID-19 and self-defense might contribute to stigmatizing attitude (18), and the stigma of this infectious disease may inversely lead to delayed help-seeking. COVID-19-related stigma may pose a serious threat to COVID-19 patients and survivors, as well as their families and surrounding people. Several incidents of stigmatization, even physical violence toward patients, survivors, and medical workers, have occurred during this pandemic all around the world (19). There were numerous studies investigating sleeping disorder, anxiety, depression, post-traumatic stress disorder, and other mental disorders related since the outbreak of COVID-19; however, few have focused on COVID-19-related stigma (20). Since there is no effective therapy toward COVID-19 so far, people's attitude to COVID-19 is worth investigating.

Acquired immunodeficiency syndrome (AIDS), caused by human immunodeficiency virus (HIV), is another kind of infectious disease transmitted mainly *via* unprotected sexual activity, contaminated blood transfusion, and contaminated needles and from mother to child during pregnancy (21). Numerous studies about AIDS and its stigma have been done (22), and several systematic reviews have been published (23, 24). Previous stigma-related studies on AIDS reported that HIV-positive individuals were more vulnerable to receive stigma from others, which usually contain health, moral, and racial dimensions and promoted stigma including intrapersonal, interpersonal, and social aspects (25). Both COVID-19 and AIDS are infectious diseases with no definite therapy, and suffering from COVID-19 or AIDS will cause a certain damage to both individuals and our society. Therefore, we try to learn COVID-19 stigma by comparing with AIDS stigma, as Logie thought that we can learn the experience of studying AIDS stigma and leverage the approaches used to reduce AIDS stigma to address COVID-19 stigma (26).

Hence, we conducted this study with the aims of (1) investigating publics' stigmatizing attitudes toward COVID-19 and (2) comparing publics' stigmatizing attitudes between COVID-19 and AIDS to find the similarities and differences. From this study, we hope to provide some theoretical basis for psychological intervention toward COVID-19 stigma and further policymaking.

MATERIALS AND METHODS

Participants

Participants were recruited online, and inclusion criteria were (1) age $\geq$16, (2) can fully understand the informed consent and questionnaire, (3) willing to participate in the survey and can sign the informed consent online.

Procedures and Materials

Data were obtained using the convenient sampling method through a WeChat-based questionnaire including demographic questionnaire, a stigma scale that was adopted from the Explanatory Model Interview Catalog-Community Stigma Scale (EMIC-CSS) (27), and Depression Stigma Scale (DSS) (28). Participants' demographic information such as gender, age, education, and occupation was collected through a demographic questionnaire. The 18-item stigma-related scale consists of personal stigma aspect and perceived stigma aspect with nine items separately (seen in **Supplementary Table S1**) and was used to measure participants' stigma attitudes toward COVID-19 and AIDS. A vignette-based survey method was used in this study. A hypothetical case diagnosed with

COVID-19 and a case diagnosed with AIDS were listed separately, followed by 18 questions evaluating participants' personal and perceived stigma toward the hypothetical case. Participants were asked to choose their own answers from "strongly agree," "agree," "uncertain," "disagree," and "strongly disagree." The vignettes and stigma-related questions were as follows.

Vignette of COVID-19: "Li Ming (pseudonym) has been living in Wuhan. After the outbreak of COVID-19, he consciously isolated himself at home and wore a mask when he went out occasionally. Li Ming recently had a fever, cough and other symptoms. He was diagnosed with new coronavirus pneumonia and has been hospitalized. Li Ming did not know he was infected with the virus until he has been diagnosed."

Vignette of AIDS: "Zhang Yi (pseudonym) has been living in Wuhan. After the outbreak of the COVID-19, he consciously isolated himself at home and wore a mask when he went out occasionally. Zhang Yi recently had a fever, fatigue and other symptoms. He was diagnosed with AIDS and has been hospitalized. Zhang Yi did not know he was infected with HIV until he has been diagnosed."

Public's personal stigma attitudes were measured by the following nine questions: (1) If I were him, I would prefer to keep people from knowing about my situation; (2) I'm not willing to provide home service (such as delivery) for him or visit his home; (3) I think that he was affected by the disease because of his carelessness; (4) I think that his situation will cause problems to his family; (5) I think that his situation will have an adverse effect on others; (6) I will look down on him; (7) I try to avoid contact with him, especially physical contact; (8) I try to avoid contact with his family; and (9) I will look down on his family because of his situation.

Public's perceived stigma attitudes were measured by replacing "I think/will…" with "Most people think/will…" of the above nine questions.

We also investigated the usual source that participants used to get the COVID-19-related knowledge during the epidemic to estimate the role of each medium in spreading information.

Ethical Considerations

The study protocol was approved by the Ethics Committee of Second Xiangya Hospital, Central South University. Informed consents were listed on the first page of the questionnaire independently. Before answering questions, potential participants were asked to read informed consents carefully and determined whether they were willing to participate in this study. Those who click "yes" would obtain the whole questionnaire to complete, while others were displayed an end page of this study and appreciation.

Statistical Analysis

Frequency and percentage were used to describe demographic data while percentage frequencies and 95% confidence interval (CI) were computed for stigma items. Categories of "strongly agree" and "agree" were merged into "agreement" for descriptions. A paired *T*-test was used to compare participants' stigmatizing attitudes between the two vignettes. All data analyses were conducted in SPSS 25.0, and $p < 0.05$ was considered as statistically significant.

TABLE 1 | Demographic characteristics of participants ($N = 13,994$).

	n	(%)
Gender		
Male	7,757	55.4
Female	6,237	44.6
Age	30.4 ± 9.6	
Residence		
Countryside	4,765	34.1
City	9,229	65.9
Residence during the epidemic		
Hubei province	1,864	13.3
Other province in China except Hubei	12,017	85.9
Overseas	113	0.8
Education (years)		
≤9	901	6.4
≤12	5,352	38.3
≤16	6,273	44.8
>16	1,468	10.5
Marriage		
Single	5,968	42.6
Married	7,423	53.1
Others (divorced/widowed)	603	4.3
Income per year (thousand)		
≤50	5,815	41.6
60–100	5,256	37.6
110–190	2,091	14.9
≥200	832	5.9
Occupation		
Clinical staff	1,790	12.8
Civil servant	964	6.9
Employees	4,517	32.3
Medical students	1,017	7.3
Non-medical students	1,783	12.7
Self-employed	2,999	21.4
Others	924	6.6

RESULTS

Demographic Information

In total, 19,355 questionnaires were collected and 5,341 were excluded after manual review. The screening principles were as follows: (1) <2 s to finish each item, (2) ≥2 questionnaires from the same IP (only the first one was retained), (3) obvious errors, e.g., a 17-year-old person chooses "married" in the marriage item. Finally, 13,994 participants (55.4% male) were included with the efficiency of 72.3%. The average age was (30.44 ± 9.63) (x ± s); 65.9% of the participants were from city. Over 54.3% participants were with the educated year longer than 12 years, and 13.3% were residents in Wuhan province during the epidemic. More demographic details are seen in **Table 1**.

Personal Stigma Toward COVID-19 and AIDS

Participants' own attitudes toward COVID-19 and AIDS are presented in **Table 2**. Participants were most likely to agree to avoid contact either with people diagnosed with COVID-19 or with their family members, as 74.3% participants strongly agreed or agreed to avoid contact with people diagnosed with COVID-19 and 70.4% strongly agreed or agreed to avoid contact with their family, while 59.0 and 47.9% participants tended to avoid contact with individuals diagnosed with AIDS and their families. Participants' agreements with the above two statements between COVID-19 and AIDS were significantly different. The third highest agreed statement toward COVID-19 was "I think his situation will cause problems to his family" (59.6%), while 56.9% endorsed with the statement toward AIDS. There was also a high proportion of participants that thought that sufferers would have an adverse effect on others (55.6% for COVID-19 and 47.0% for AIDS). Endorsement with unwillingness to provide home service (such as delivery) or visit his home was 39.5% for COVID-19 and 35.1% for AIDS patients. Participants' agreement with keeping people from knowing their situation was 21.2% for COVID-19 and 38.4% for AIDS. Belief that suffering from COVID-19 or AIDS was patients' own fault was 23.0% for COVID-19 and 39.3% for AIDS. Agreement with the statement that they would look down upon the individuals with disease was 11.6% for COVID-19 and 17.8% for AIDS. Even 14.5% participants for COVID-19 and 17.8% for AIDS agreed that they would look down on patients' family because of the patients' situation. Participants' agreements with all of the above statements about their own attitudes between COVID-19 and AIDS were statistically significant ($p < 0.001$).

Perceived Stigma Toward COVID-19 and AIDS

Participants' agreements with statements about public attitudes are described in **Table 3**. Over 70% participants tended to agree that others would try to avoid contact with COVID-19 individuals (76.4%) and their family (74.3%), while the proportions of agreements in vignette of AIDS were 61.3% for individuals and 49.8% for their family. In the COVID-19 vignette, most participants agreed that the patients would cause problems to their family (64.0%) and have side effects on others (59.2%), while in the AIDS vignette, the percentages of agreement were 59.9 and 53.5%, separately. Belief that most people were unwilling to provide home service (such as delivery) for the individual or visit his home was 51.6% for COVID-19 vignette, and 43.2% for AIDS vignette. More detailed information is described in **Table 3**. Participants' agreements with all of the above statements about most other people's attitudes between COVID-19 and AIDS were also statistically significant ($p < 0.001$).

Usual Source to Get COVID-19-Related Knowledge

Participants received COVID-19-related information was mainly from social media (91.3%), newspaper or television (77.1%), initiative network inquiring (53.7%), and community publicity (32.6%) during the epidemic. Among that, over 60% of participants obtained most of the information from social media while 61.0% participants regarded the newspaper and television as the most reliable resource; details are listed in **Table 4**.

DISCUSSION

This study explored publics' stigmatizing attitudes toward COVID-19 during the epidemic and compared it with stigmatizing attitudes toward AIDS. The results showed that for COVID-19 beliefs about avoiding contact with individuals with COVID-19 and their families, individuals with COVID-19 would cause problems to or have an adverse effect on their families and others were much higher than other statements either in personal stigma or perceived stigma. For perceived stigma, unwillingness to provide home service or visit the home of individuals with COVID-19 was also among the highly agreed statements. Participants' highly agreed statements toward AIDS were similar with COVID-19 but had a slightly lower proportion, which were significantly different.

In the personal stigma dimension of COVID-19, people tend to keep distance with individuals diagnosed with COVID-19, which is in accordance with the study by Sing Lee (29); they found that social distance might be related to severe acute respiratory syndrome (SARS) stigma. As close contact was one of the common transmission methods of COVID-19 (30), the Chinese government took several effective measures to stop people from contacting each other immediately after the outbreak of COVID-19, such as isolation, social distancing, community containment, and travel restriction (3). These policies effectively lower the transmission rate of COVID-19 but may produce stigmatization at the same time. Isolated individuals are more likely to suffer from stigmatization and social rejection (31). Some researchers claimed that stigma might negatively affect those with COVID-19 as well as their families, friends, caregivers, and communities (3). They might be experiencing "secondary" or "associative" stigma (32). There were several reports about COVID-19-related stigma to healthcare providers. In this study, numerous participants reported unwillingness to provide home service, which is similar to the existing views that the stigmatized group may experience stigmatizing behaviors such as isolation, refusal to provide service, and bullying (33). A relieving discovery was the low agreements about the statement of "I will look down on him or his family." This may be because COVID-19 spreads mainly through respiratory, and stigmatization against an individual is relatively lower than avoiding physical contact. It should be noted that in this study, 21.2% participants tended to keep it a secret if they were diagnosed with COVID-19, which can seriously expand the transmission and mislead the government into making wrong decisions about the epidemic and increase the difficulty of epidemic control.

In perceived stigma dimension, agreements with statements about COVID-19 were roughly similar to the statements described in personal stigma, but the proportion of each statement was slightly higher. That might be because people tend

TABLE 2 | Percentage and 95% CI of participants who "agree" or "strongly agree" with statements about their own attitudes toward the person described in the vignette ($N = 13,994$).

Statements	COVID-19		AIDS		p^a
	n	%	*n*	%	
If I were him, I would prefer to keep people from knowing about my situation	2,968	21.2 (20.6–21.9)	5,368	38.4 (37.6–39.2)	<0.001
I will look down on him	1,627	11.6 (11.1–12.2)	2,485	17.8 (17.1–18.4)	<0.001
I think his situation was caused by his own fault	3,224	23.0 (22.3–23.7)	5,502	39.3 (38.5–40.1)	<0.001
I think his situation will cause problems to his family	8,340	59.6 (58.8–60.4)	7,962	56.9 (56.1–57.7)	<0.001
I will look down on his family because of his situation	2,035	14.5 (14.0–15.1)	2,403	17.2 (16.5–17.8)	<0.001
I think his situation will have an adverse effect on others	7,779	55.6 (54.8–56.4)	6,704	47.0 (46.2–47.8)	<0.001
I will try to avoid contact with him, especially physical contact	10,401	74.3 (73.6–75.0)	8,254	59.0 (58.2–59.8)	<0.001
I will try to avoid contact with his family	9,853	70.4 (69.7–71.2)	6,575	47.9 (47.1–48.7)	<0.001
I am not willing to provide home service (such as delivery) for him or visit his home	5,523	39.5 (38.7–40.3)	4,912	35.1 (34.3–35.9)	<0.001

[a] *The p value of paired-t test.*

TABLE 3 | Percentage and 95% CI of participants who "agree" or "strongly agree" with statements about most others people's attitudes toward the person described in the vignette ($N = 13,994$).

Statements	COVID-19		AIDS		p^a
	n	%	*n*	%	
Most people think he would prefer to keep people from knowing about his situation	3,382	24.2 (23.4–24.9)	6,389	45.7 (44.8–46.5)	<0.001
Most people will look down on him	2,343	16.7 (16.1–17.4)	4,431	31.7 (30.9–32.4)	<0.001
Most people think that his situation was caused by his own fault	5,527	39.5 (38.7–40.3)	7,597	54.3 (53.5–55.1)	<0.001
Most people think that his situation will cause problems to his family	8,951	64.0 (63.2–64.8)	8,379	59.9 (59.1–60.7)	<0.001
Most people will look down on his family because of his situation	2,608	18.6 (18.0–19.3)	3,442	24.6 (23.9–25.3)	<0.001
Most people think that his situation will have an adverse effect on others	8,288	59.2 (58.4–60.0)	7,388	53.5 (52.7–54.3)	<0.001
Most people try to avoid contact with him, especially physical contact	10,688	76.4 (75.7–77.1)	8,579	61.3 (60.5–62.1)	<0.001
Most people try to avoid contact with his family	10,399	74.3 (73.6–75.0)	6,976	49.8 (49.0–50.7)	<0.001
Most people aren't willing to provide home service (such as delivery) for him or visit his home	7,224	51.6 (50.8–52.5)	6,050	43.2 (42.4–44.1)	<0.001

[a] *The p value of paired-t test.*

TABLE 4 | Usual source that participants got COVID-19 related knowledge during the epidemic (*n*, %).

	Newspapers/TV	Social media	Initiative network inquiring	Community publicity
Channels to get epidemic information	10,786 (77.1)	12,777 (91.3)	7,514 (53.7)	4,556 (32.6)
Channel to obtain most of the information	3,169 (22.6)	8,441 (60.3)	1,860 (13.3)	524 (3.7)
The most reliable channel	8,535 (61.0)	3,685 (26.3)	1,185 (8.5)	589 (4.2)

to answer the questions in an acceptable way to cater to public requirements (34).

AIDS stigma has been investigated by many scholars. In this survey, we found a number of similarities and differences between AIDS and COVID-19 stigma. A large proportion of participants were inclined to agree with avoidance of patients and their surrounding people and hold the opinion that patients would encumber others. This might be due to the similarity of infectivity and the psychological perspective that the negative emotions aroused by the two diseases generate similar patterns of stigmatization (35). Participants were more likely to keep it a secret if they suffered from AIDS compared with COVID-19 for both personal and perceived stigma. Policy and moral condemnation may contribute to this difference. The Chinese government has already made some punishment policies to reduce the incidence of concealment and omission during the pandemic of COVID-19. Ways of transmission are quite different between these two diseases—primarily sexual and blood-to-blood for AIDS and primarily droplet transmission for COVID-19 (3). Hence, AIDS is usually conceptually linked to morality and equated with sexual promiscuity, homosexuality, drug abuse, and personal irresponsibility (36), while people with COVID-19 are less morally condemned. A higher proportion of participants thought that individuals with AIDS were more likely to be responsible for their situation and be looked down upon, but they may cause less problem to others compared with people with COVID-19. This might also relate to the different transmission methods of the two diseases and may indicate that stigma of COVID-19 had less moral link but more public panic.

Public response is closely related to the information they get and media report. Media report can powerfully influence public attitudes. Social media and newspapers/TV are the main usual source for the public to get information about COVID-19. Social media could affect people's attitudes of risk perception while legacy media could affect public perceptions of protective behaviors. When the COVID-19 crisis was reported on TV or social media, some information might be misunderstood. Misinformation and rumors may produce public anxiety and panic and lead to a series of related behaviors such as prohibiting medical workers from going back home for fear of being infected. These media platforms are supposed to enhance public awareness without increasing fear and panic (37). Hence, measures should be taken to ensure the correct dissemination of information and reduce rumors during and after the pandemic.

In the present era, increasing our ability to reduce the stigmatization associated with emerging infectious diseases is required in controlling such diseases. A variety of methods have been taken with the attempt to reduce stigmatization associated with AIDS, such as basic public education about AIDS, publicized symbolic acts by public leaders or famous people, media campaigns, and designation of December 1 as World AIDS Day. These efforts have achieved some success (38). Our study showed many similarities between COVID-19-related stigma and AIDS-related stigma; therefore, we could use the anti-AIDS-related stigma approaches to reduce COVID-19 stigma. Anti-stigma approaches toward mental disorders could also be considered. A pilot study on an anti-stigma course toward mental disorders, which consisted of three components, namely, social contact, role-playing, and critical reflection strategies, showed that participants' stigma attitudes were significantly reduced after the 18-week anti-stigma course (39). Another study examining the potential impact of an anti-stigma intervention on help-seeking attitudes, which included education about depression, information about help-seeking, and contact with a person with lived experience, showed improvements in help-seeking attitudes (40). Our data indicate that providing accurate COVID-19-related information through social media and newspapers/TV may be effective as these are the main sources they used to get COVID-19-related information. Public education may be another useful approach, and the above-mentioned participants' highly agreed statements should be taken into consideration.

To our knowledge, this is the first study to compare COVID-19 related stigma with AIDS related stigma. This survey has some limitations that need to be noticed. Firstly, convenience sampling method was used to collect data from the public by anonymous internet questionnaires, which might be the major limitation. Compared with random sampling method, convenience sampling method might easily lead to sampling error and bias, so that our respondents cannot represent well the population level. The sampling error may lead to inaccuracy conclusions. However, we tried to get as large a sample size as we can and be more cautious with our conclusions in order to avoid inaccuracy conclusions. Secondly, this was a cross-sectional study conducted during the pandemic, which can only reflect participants' attitude toward COVID-19 during the outbreak in China. Public's attitudes toward COVID-19 may change as we know more about this disease; we now are conducting a follow-up study to further investigate it. Thirdly, COVID-19 and AIDS are both infectious diseases but differ in transmission. There is no definite answer to whether the stigmatizations between these two diseases are completely comparable. A previous study has compared Chinese health professionals' attitudes toward patients with AIDS vs. patients with hepatitis B and found that health professionals had negative biases against AIDS patients and less willingness to interact with AIDS patients compared with hepatitis B patients (41), which indicates that stigmatizing attitudes toward COVID-19 and AIDS may be comparable to some extent. Logie also pointed out that we can use the experience of studying AIDS-related stigma and the approaches used in order to explore COVID-19-related stigma (26). Fourthly, we did not compare publics' stigma toward COVID-19 with stigma against non-communicable diseases such as mental disorders in this study. More efforts will be made to the comparison mentioned above in our future study. Another limitation is that the scale we used was adopted from the Explanatory Model Interview Catalog-Community Stigma Scale, which may not evaluate all aspects of COVID-19-related stigma. Hence, we just illustrate COVID-19-related stigma by describing the proportion of agreement with statements of the listed stigma-related items. Further non-convenience sampling and longitudinal study should be done to investigate more aspects of COVID-19-related stigma.

CONCLUSIONS

Several similarities and differences in people's attitude toward COVID-19 and AIDS were found in this cross-sectional study. Avoidance, blame, and secondary discrimination to diagnosed persons and their surrounding persons were the main representations of stigma. Stigma of COVID-19 had less moral link but more public panic. Social media, television, and newspapers played a cardinal role in dissemination during the pandemic. Experience from AIDS-related stigma reduction and prevention can be applied to reduce COVID-19-related stigma. Social media, television, and newspapers should be made the best use, and the abovementioned highly agreed statements should be taken into consideration in further anti-stigma campaigns.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The study protocol was approved by the Ethics Committee of Second Xiangya Hospital, Central South University. Informed consents were listed on the first page of the questionnaire independently. Before answering questions, potential participants were asked to read informed consents carefully and determined whether they were willing to participate in this study. Those who click yes would obtain the whole questionnaire to complete while others were displayed an end page of this study and appreciation.

AUTHOR CONTRIBUTIONS

This study was conceptualized by TL, SC, YaL, and XW. The database was organized by YZ, YiW, YM, and YuL. Data analysis was done by ML and YuW. The manuscript with inputs was drafted by ML and YH. Reviewed by TL, SC, and JL. All authors read and approved the final manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.782501/full#supplementary-material

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COVID-19 Vaccine-Related Psychological Stress Among General Public in China

Yong-Bo Zheng[1,2†], Jie Sun[1,3†], Lin Liu[1†], Yi-Miao Zhao[4,5], Wei Yan[1], Kai Yuan[1], Si-Zhen Su[1], Zheng-An Lu[1], Yue-Tong Huang[1], Lin Liu[4,5], Na Zeng[4,5,6], Xi-Mei Zhu[1], Yi-Miao Gong[1], Xiao Lin[1], Shi-Qiu Meng[4], Samuel Yeung Shan Wong[7], Mao-Sheng Ran[8], Jie Shi[3], Le Shi[1], Thomas Kosten[9,10,11,12], Yan-Ping Bao[4,5*] and Lin Lu[1,2,4*]*

[1] NHC Key Laboratory of Mental Health (Peking University), National Clinical Research Center for Mental Disorders (Peking University Sixth Hospital), Peking University Sixth Hospital, Peking University Institute of Mental Health, Beijing, China, [2] Peking-Tsinghua Centre for Life Sciences and PKU-IDG/McGovern Institute for Brain Research, Peking University, Beijing, China, [3] Pain Medicine Center, Peking University Third Hospital, Beijing, China, [4] National Institute on Drug Dependence and Beijing Key Laboratory of Drug Dependence, Peking University, Beijing, China, [5] School of Public Health, Peking University, Beijing, China, [6] Beijing Friendship Hospital, Capital Medical University, Beijing, China, [7] JC School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong, Hong Kong SAR, China, [8] Department of Social Work and Social Administration, University of Hong Kong, Hong Kong, Hong Kong SAR, China, [9] Department of Psychiatry, Baylor College of Medicine, Houston, TX, United States, [10] Department of Pharmacology, Baylor College of Medicine, Houston, TX, United States, [11] Department of Neuroscience, Baylor College of Medicine, Houston, TX, United States, [12] Department of Immunology, Baylor College of Medicine, Houston, TX, United States

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Daria Smirnova,
Samara State Medical University, Russia

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Northwestern University, United States
Victor Mazereel,
KU Leuven, Belgium

***Correspondence:**
Yan-Ping Bao
baoyp@bjmu.edu.cn
Lin Lu
linlu@bjmu.edu.cn
Thomas Kosten
kosten@bcm.edu

[†] These authors have contributed equally to this work

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Background: The COVID-19 pandemic is our generation's greatest global challenge to our public health system. Vaccines are considered one of the most effective tools available for preventing COVID-19 infection and its complications and sequelae. Understanding and addressing the psychological stress related to COVID-19 vaccination may promote acceptance of these vaccines.

Methods: We conducted an online survey from January 29 to April 26, 2021 to explore stress levels related to COVID-19 vaccination among the general public in China. Participants were asked to evaluate their psychological stress of considering whether or not to get vaccinated at the beginning period of the COVID-19 mass vaccination, after getting access to the information about the vaccine, as well as after getting vaccinated, using visual analog stress scale. Multiple linear regression analysis was performed to explore factors potentially associated with COVID-19-related psychological stress levels before and after getting vaccinated.

Results: A total of 34,041 participants were included in the final analysis. The mean stress score concerning COVID-19 vaccination was 3.90 ± 2.60 among all participants, and significantly decreased over time. In addition, the vaccine-related stress level significantly decreased after accessing information about the COVID-19 vaccine (N = 29,396), as well as after getting vaccinated (N = 5,103). Multivariable regression analysis showed higher stress levels related to COVID-19 vaccination in participants who were younger, having lower education level, having history of chronic diseases, mistrusting vaccine's efficacy, experience of vaccine allergy events, being affected by the COVID-19 epidemic, and having mental illness symptoms. Moreover, mistrust in vaccine efficacy and experience of vaccine allergy events had a long-term impact on psychological stress levels about COVID-19 vaccination even after getting vaccinated.

Conclusions: The current findings profiled the COVID-19 vaccine-related psychological stress among the general public in China. Population-specific management and interventions targeting the stress related to COVID-19 vaccination are needed to help governments and policy makers promote individual's willingness to get vaccinations for public well-being during the COVID-19 pandemic.

Keywords: COVID-19 vaccine, psychological stress, vaccination, health knowledge, general public, China

INTRODUCTION

The COVID-19 pandemic is our generation's greatest global challenge to our public health system. As of October 15th, 2021, over 239.4 million people were infected and over 4.8 million individuals were dead of COVID-19 worldwide (1). In China, the number of confirmed infectors was 125.2 thousand, and the number of deaths was about 5.7 thousand as of October 17th, 2021 (2). The Chinese government has implemented timely and effective containment measures since the outbreak of the COVID-19 pandemic, thus the pandemic was long term well-controlled since March 2020 (2). Vaccines are considered one of the most effective tools available for preventing COVID-19 infection and its complications and sequelae (3). Since the first human clinical trial of a COVID-19 vaccine commenced on March 3rd, 2020 (4), a total of 296 COVID-19 vaccines have been developed as clinical and pre-clinical candidates by August 20th, 2021 (1). Despite the validated safety and efficacy of several COVID-19 vaccines, public concern about potential adverse events associated with vaccines still exists (5–7), and affects individuals' willingness, hesitance and refusal to get COVID-19 vaccination (8, 9). Reducing psychological stress or concerns about COVID-19 vaccine would foster confidence and acceptance of vaccination (10). Therefore, it is important to understand COVID-19 vaccine-related stress and identify vulnerable populations with a high stress level to achieve vaccination campaigns success.

Information about COVID-19 vaccine was widely publicized by expert professionals, social media, and government (11, 12). Fake news and insufficient information about COVID-19 vaccine were one of the main causes of adverse psychological responses, and sufficient and transparent news may potentially relieve the associated psychological stress and promote the acceptance of vaccination in some countries (12–14). However, it is unclear how public attitudes toward and psychological stress about COVID-19 vaccines will change when faced with the spread of large amounts of conflicting information about the COVID-19 vaccine (15, 16). It is imperative to profile the details of the psychological stress about COVID-19 vaccination and to explore associated risk factors at the early stages of mass vaccination in China, a country with the largest population in the world.

The World Health Organization declared that over 6.49 billion vaccine doses were already administrated worldwide by October 14th, 2021 (1), and the Chinese government officially announced the number had reached 2.23 billion doses by October 16th, 2021 in China (17). With a substantial number of participants getting vaccinated, their psychological status after vaccination should also be monitored. Despite COVID-19 vaccines being safe for most people aged 18 years and older, rare adverse events still occur. Mild side effects, such as arm soreness, mild fever, tiredness, and headaches are reported after vaccination (18, 19). Moreover, the efficacy of vaccines had not been well-validated in general public before mass vaccinations, and the debate on the efficacy continued even among people who got vaccinated (20). Understanding, describing and addressing the change of psychological stress levels after taking the COVID-19 vaccine among the general public may help the government and policy makers to provide comprehensive and accurate information to those who are hesitant or resistant to getting vaccinated, and build up their confidence in the ongoing vaccination campaign. However, to our knowledge, no current studies have investigated the general public's COVID-19 vaccine-related psychological stress after getting vaccinated.

Based on these considerations, this study had three objectives. First, we sought to identify psychological stress levels and risk factors associated with COVID-19 vaccination when considering getting vaccinated among the general population in China. Second, we sought to determine the influence of accessing information about COVID-19 vaccines on the psychological stress level about vaccination in the general populations. Third, we aimed to explore the change in COVID-19 vaccine-related psychological stress before and after vaccination, as well as to distinguish vulnerable individuals for continued COVID-19 vaccine-related psychological stress after getting vaccinated.

METHODS

Study Design

This was a cross-sectional, nationwide study conducted via an online survey from January 29 to April 26, 2021, a period when mass vaccination was conducted in China. A self-report questionnaire was designed to investigate COVID-19 vaccine-related psychological stress level among the general public in China, and delivered through Joybuy (http://www.jd.com/), as detailed elsewhere (21, 22). Joybuy platform provides online health products and services with 0.50 billion active users in March, 2021 in China. The study followed the American Association for Public Opinion Research (AAPOR) reporting guidelines and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. It was approved by the ethics committee of Peking University Sixth Hospital (Institute of Mental Health). Written informed

consent was received online before the respondents began the questionnaire.

Participants

The respondents were all registered members of Joybuy. A total of 74,588 individuals clicked on the survey link, and 34,291 respondents provided informed consent and submitted the questionnaires. Among 34,291 respondents, 4,203 of them provided repeated surveys, and merely the former one was reserved. Two hundred and fifty respondents who were younger than 18 years, were also excluded because obtaining online informed consent from their parents may be not realistic. Finally, a total of 34,041 respondents were included, with the response rate of 46.0% and the effective rate of 99.3%.

Outcome Measures

The primary outcomes were psychological stress scores, assessed using a visual analog stress scale (23). The stress score ranged from 0 to 10 points, in which 0 represented no stress level and 10 indicated highest level of stress. All participants were asked to evaluate their psychological stress of considering whether or not to get vaccinated at the beginning period of the COVID-19 mass vaccination. Participants who proactively accessed information about the COVID-19 vaccine were asked to evaluate their psychological stress levels after getting access to the information about the vaccine. Moreover, the psychological stress levels of COVID-19 vaccine after getting vaccinated were evaluated among the vaccinated participants.

Additionally, participants were asked to report their sources of stress of considering whether or not to get vaccinated, with the following multiple-choices (16, 24, 25): adverse effects after vaccination of themselves or their families; information about severe adverse effects caused by the vaccine; coverage of vaccine safety incidents reported by the media; misinformation about vaccine-related research reported by the media. The vaccinated populations were also asked to report their sources of stress after getting vaccinated, with the following multiple-choices (24, 25): adverse effects after vaccination of themselves or their families; the efficacy of the vaccine; the safety and quality of the vaccine.

Covariates

The covariates could be briefly categorized into the following five parts: (1) demographic characteristics and medical conditions, including gender, age, living area (urban vs. rural), education attainment, marital status, and monthly family income, history of chronic diseases, history of mental disorders, and family history of mental disorders; (2) experiences related to the COVID-19 epidemic, including suspect or confirmed infection, infection status of family members or friends, participation in frontline work, job loss due to the COVID-19 epidemic, risk in epidemic regions, experience of quarantine, self-evaluated risk of getting infected, as well as attitudes toward the epidemic in China; (3) information related to the COVID-19 vaccine, including trust in its efficacy after getting vaccinated, experience of being actively involved in getting flu vaccinations, family members experience of being actively involved in getting flu vaccinations, and history of allergic events from previous vaccinations; (4) current mental status: anxiety, depression, insomnia, and posttraumatic stress disorder (PTSD) symptoms; (5) investigation period. According to previous literature (21, 26), cutoff scores of 5 for the Generalized Anxiety Disorder−7 scale, 5 for the Patient Health Questionnaire−9, 8 for the Insomnia Severity Index, and 33 for the Posttraumatic Stress Disorder Checklist for DSM-5 were adopted to detect symptoms of anxiety, depression, insomnia, and PTSD.

Statistical Analysis

Descriptive statistics were used to present demographic data as well as the sources of psychological stress associated with COVID-19 vaccination. Among all participants, one-way analysis of variance (ANOVA) was used to compare differences of the psychological stress levels among the 3 time groups (Jan. 29–Feb. 28 vs. Mar. 1–Mar. 30 vs. Apr.1–Apr.26). For vaccinated participants, the two-way repeated measures ANOVA with one between-subjects factor (3 time groups: Jan. 29–Feb. 28 vs. Mar. 1–Mar. 30 vs. Apr.1–Apr.26) and one within-subject factor (before vaccination vs. after vaccination) was used to test the differences of psychological stress levels before and after getting vaccinated COVID-19 vaccine at 3 time period. Similarly, repeated measures ANOVA was used to test the differences in psychological stress levels before and after accessing information at 3 time period. Bonferroni *post hoc* analysis was further conducted when the interaction was statistically significant, and *p* values were adjusted using Bonferroni correction with the level of significance of $p < 0.05$ for the comparison.

The mean scores and standard deviation of psychological stress levels associated with COVID-19 vaccination before and after getting vaccinated were calculated and presented in different populations. Analysis of variance and independent *t*-tests were used to compare the psychological stress levels of COVID-19 vaccination before and after getting vaccinated among stratified populations. To explore factors potentially associated with COVID-19-related psychological stress levels before and after getting vaccinated, multiple linear regression analysis was performed, and β values and 95% CIs are presented. No statistical method to handing missing data was used in this analysis because of the limited missing data. Respondents with missing data were furtherly excluded in the multiple linear regression analysis. All of the variables that were statistically significant in the unadjusted model were entered into the multivariable models that explored risk factors associated with vaccine-related stress before and after getting vaccinated. Multicollinearity between the independent variables was checked by calculating the variance inflation factor (VIF), and VIF > 5 indicated multicollinearity (27). Separate models excluding highly correlated covariates were performed if included independent variables were multicollinear. The level of significance was $p < 0.05$. All of the statistical analyses were performed using SPSS statistical software version 22 (IBM Corp).

RESULTS

Demographic Characteristics

34,041 participants from 34 provinces in China were included in the final analysis, of whom 40.4, 51.1, and 8.5% responded

TABLE 1 | Characteristics and population-stratified COVID-19 vaccine-related psychological stress level when considering vaccine uptake among all participants.

Factors	Total, no. (%)	Stress score (*SD*)	*P*
Overall	34,041 (100.0)	3.90 (2.60)	
Gender			0.842
Female	18,309 (53.8)	3.90 (2.55)	
Male	15,732 (46.2)	3.89 (2.66)	
Age			<0.001
18–39 years	20,727 (60.9)	3.96 (2.61)	
40–59 years	12,713 (37.3)	3.82 (2.57)	
≥60 years	601 (1.8)	3.50 (2.67)	
Living area			0.992
Urban	26,942 (79.1)	3.90 (2.59)	
Rural	7,099 (20.9)	3.90 (2.63)	
Level of education			<0.001
Less than college	7,084 (20.8)	4.04 (2.67)	
College degree or higher	26,957 (79.2)	3.86 (2.58)	
Marital status			0.951
Married	26,392 (77.5)	3.90 (2.59)	
Unmarried	7,649 (22.5)	3.90 (2.64)	
Monthly family income, ¥[a]			<0.001
0–4,999	8,438 (24.8)	4.09 (2.68)	
5,000–11,999	15,961 (46.9)	3.91 (2.57)	
≥12,000	9,642 (28.3)	3.71 (2.58)	
History of chronic diseases			<0.001
No or unknown	30,938 (90.9)	3.87 (2.60)	
Yes	3,103 (9.1)	4.14 (2.62)	
History of mental disorders			<0.001
No or unknown	33,873 (99.5)	3.89 (2.60)	
Yes	168 (0.5)	4.90 (2.76)	
Family history of mental disorders			<0.001
No or unknown	33,614 (98.7)	3.89 (2.60)	
Yes	427 (1.3)	4.78 (2.73)	
Have you been infected with COVID-19?			<0.001
No	33,937 (99.7)	3.89 (2.60)	
Suspect or confirmed infected	104 (0.3)	5.13 (2.72)	
Have any of your family members or friends been infected with COVID-19?			<0.001
No	33,618 (98.8)	3.89 (2.60)	
Yes	423 (1.2)	4.73 (2.68)	
Have you been a frontline worker since august 2020?			0.161
No	28,261 (83.0)	3.91 (2.57)	
Yes	5,780 (17.0)	3.85 (2.75)	
Has the epidemic led to your job loss since august 2020?			<0.001
No	31,253 (91.8)	3.84 (2.59)	
Yes	2,788 (8.2)	4.53 (2.68)	
Risk in epidemic regions			<0.001
Low	33,346 (98.0)	3.87 (2.59)	
Middle/High	695 (2.0)	5.20 (2.60)	
Have you ever experienced quarantine since august 2020?			<0.001
No	30,160 (88.6)	3.85 (2.59)	
Yes	3,881 (11.4)	4.25 (2.68)	
Evaluate your risk of getting infected in the future			<0.001
Low	30,602 (89.9)	3.78 (2.59)	
Middle/High	3,439 (10.1)	4.90 (2.52)	
Attitudes toward the epidemic in China [b]			<0.001
Positive	14,373 (42.2)	3.63 (2.64)	
Neutral	18,117 (53.2)	4.06 (2.52)	
Negative	1,551 (4.6)	4.45 (2.89)	
Do you trust in efficacy of COVID-19 vaccine?			<0.001
No	1,472 (4.3)	5.15 (2.86)	
Moderate	5,887 (17.3)	4.64 (2.47)	
Highly	26,682 (78.4)	3.66 (2.56)	
Have you ever been actively involved in getting flu vaccination?			0.165
No	22,526 (66.2)	3.91 (2.75)	
Yes	11,515 (33.8)	3.87 (2.57)	
Have your family members ever been actively involved in getting flu vaccination?			<0.001
No	18,551 (54.5)	3.96 (2.58)	
Yes	15,490 (45.5)	3.82 (2.63)	
Have you ever had any allergy events from previous vaccinations?			<0.001
No	29,991 (88.1)	3.74 (2.55)	
Yes	4,050 (11.9)	5.06 (2.69)	
Anxiety symptoms			<0.001
No	26,848 (78.9)	3.50 (2.52)	
Yes	7,193 (21.1)	5.39 (2.35)	
Depressive symptoms			<0.001
No	26,178 (76.9)	3.49 (2.52)	
Yes	7,863 (23.1)	5.25 (2.40)	
Insomnia symptoms			<0.001
No	24,693 (72.5)	3.51 (2.55)	
Yes	9,348 (27.5)	4.93 (2.43)	
PTSD symptoms			<0.001
No	24,009 (70.5)	3.40 (2.53)	
Yes	10,032 (29.5)	5.10 (2.37)	

(Continued)

TABLE 1 | Continued

Factors	Total, no. (%)	Stress score (*SD*)	*P*
Investigation period			<0.001
January 29, 2021–February 28, 2021	13,739 (40.4)	4.17 (2.58)	
March 1, 2021–March 31, 2021	17,396 (51.1)	3.76 (2.60)	
April 1, 2021–April 26, 2021	2,906 (8.5)	3.45 (2.57)	

COVID-19, coronavirus disease 2019; PTSD, posttraumatic stress disorder; SD, standard derivation.

[a] *1 ¥ = USD$0.14.*

[b] *Participants who thought the COVID-19 epidemic would end within 1 year, 1–10 years, and over 10 years or long lasting were defined as positive, neutral, and negative attitudes toward, respectively.*

to the survey during Jan. 29–Feb. 28, Mar. 1–Mar. 30, and Apr. 1–Apr. 26, respectively. Of the total sample, most of the participants were female (53.8%), aged between 18 and 39 (60.9%), lived in an urban area (79.1%), had a college degree or higher (79.2%), and were married (77.5%). 29,396 participants (86.4%) actively accessed information about the COVID-19 vaccine. 78.4 and 17.3% of the participants highly and moderately trusted the efficacy of the COVID-19 vaccine and agreed that vaccination was an effective measure for COVID-19 prevention, 4.3% did not trust the efficacy of the COVID-19 vaccine. 5,103 (15.0%) participants had been vaccinated against COVID-19, and about one third of the participants (11,515) had obtained a flu vaccination. 4,050 participants (11.9%) reported their experience of vaccine allergy events. In addition, 21.1, 23.1, 27.5, and 29.5% of participants reported symptoms of anxiety, depression, insomnia, and PTSD, respectively. The demographic characteristics, medical conditions, COVID-19 epidemic-related information, vaccine-related information, and mental status of the total samples are presented in **Table 1**, and of the vaccinated participants in **Supplementary Table 1**.

The Sources of COVID-19 Vaccine-Related Psychological Stress

81.3% of all participants experienced any psychological stress about vaccination. The sources of this psychological stress about the COVID-19 vaccine were ranked as follows (**Figure 1A**): 57.3% were concerned about the adverse effects after vaccination of themselves or their families; 35.7% were concerned by the news of severe adverse effects associated with the vaccine; 27.0% were concerned by vaccine safety incidents reported in the media; and 14.7% of participants were concerned by some misinformation from vaccine-related research. After getting the COVID-19 vaccine, 58.6% of participants had psychological stress and the reasons for psychological stress about the COVID-19 vaccination were ranked as follows (**Figure 1B**): 43.6% of participants were concerned about the adverse effects in themselves or their families after vaccination; 25.6% of participants worried about the efficacy of vaccine; and 17.7% of participants concerned the safety and quality of vaccine.

The COVID-19 Vaccine-Related Psychological Stress Levels

The mean stress score concerning COVID-19 vaccination was 3.90 ± 2.60 among all participants. The stress levels about vaccination were significantly decreased from Jan. 29 to Apr. 26 (Jan. 29–Feb. 28: 4.17 ± 2.58, Mar. 1–Mar. 30: 3.76 ± 2.60, Apr. 1–Apr. 26: 3.45 ± 2.57; [$F_{(2,34038)} = 142.90$, $p < 0.001$, **Figure 2A**]), and *post hoc* analysis found that comparisons of vaccine uptake stress levels between any 2 months were significantly different, with all $p < 0.001$ by using Bonferroni's correction.

The 29,396 participants who actively accessed information about COVID-19 vaccines, significantly decreased their psychological stress levels after accessing associated information when compared to stress levels before the access, and the levels also decreased over time from Jan. 29 to Apr. 26 (information accessing: [$F_{(1,29393)} = 295.39$, $p < 0.001$]; time: [$F_{(2,29393)} = 162.32$, $p < 0.001$]; interaction of information accessing and time: [$F_{(2,29393)} = 7.11$, $p = 0.001$; **Figure 2B**]). *Post hoc* analysis found that the stress level was significantly decreased after accessing the information when compared to that before at all 3 months (before vs. after: from 4.13 ± 2.55 to 4.00 ± 2.48 during Jan. 29–Feb. 28, from 3.71 ± 2.58 to 3.52 ± 2.50 during Mar. 1–Mar. 30, from 3.44 ± 2.54 to 3.19 ± 2.52 during Apr.1–Apr. 26, all $p < 0.001$ by Bonferroni's correction), and was decreased during the 3 months from Jan. 29 to Apr. 26.

In addition, the 5,103 vaccinated participants had significantly decreased psychological stress levels about COVID-19 vaccination after getting vaccinated than before vaccination at all 3 months (vaccine uptake: [$F_{(1,5100)} = 231.29$, $p < 0.001$]; time: [$F_{(2,5100)} = 65.22$, $p < 0.001$]; interaction of vaccine uptake and time: [$F_{(2,5100)} = 2.06$, $p = 0.127$]; from 3.79 ± 2.91 to 3.41 ± 3.07 during Jan. 29–Feb. 28, from 2.89 ± 2.66 to 2.38 ± 2.70 during Mar. 1–Mar. 30, from 2.61 ± 2.56 to 2.15 ± 2.61 during Apr. 1–Apr. 26; **Figure 2C**).

Associated Factors With the COVID-19-Related Psychological Stress Level

Table 2 shows the associated factors with the level of COVID-19 vaccine-related psychological stress when considering getting vaccinated at the beginning period of the COVID-19 mass vaccination among general public. Multiple linear regression analysis showed that older adults ($\beta = -0.38$, $p < 0.001$) displayed a lower level of COVID-19-related psychological stress. Participants with a history of chronic diseases ($\beta = 0.10$, $p = 0.031$) and low education level ($\beta = -0.08$, $p = 0.019$) had significantly higher psychological stress levels. Several epidemic-related factors were associated with psychological stress levels about COVID-19 vaccination, including experience of job loss due to the COVID-19 epidemic ($\beta = 0.24$, $p < 0.001$), quarantine experience ($\beta = 0.11$, $p = 0.008$), and self-evaluated high risk of COVID-19 infection ($\beta = 0.50$, $p < 0.001$). In addition, individuals with neutral or negative attitudes toward the epidemic in China had increased psychological stress levels (neutral: $\beta = 0.26$, $p < 0.001$; negative: $\beta = 0.38$, $p < 0.001$)

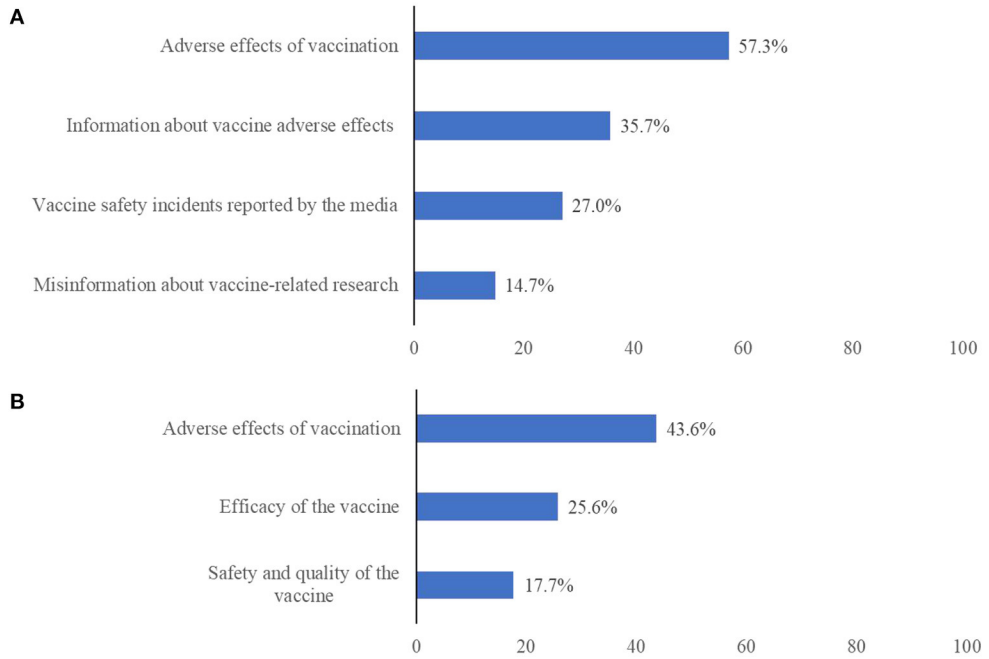

FIGURE 1 | The sources of psychological stress associated with COVID-19 vaccine uptake **(A)** at the beginning period of the COVID-19 mass vaccination ($N = 34{,}041$), and **(B)** after vaccination ($N = 5{,}103$).

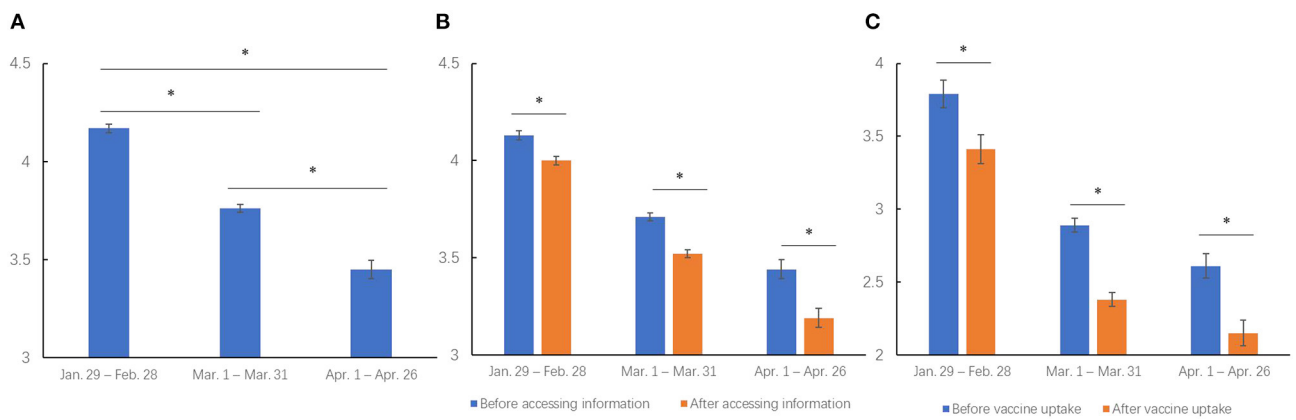

FIGURE 2 | COVID-19 vaccine-related psychological stress levels **(A)** at the beginning period of the COVID-19 mass vaccination ($N = 34{,}041$), **(B)** before and after accessing information about vaccination ($N = 29{,}396$), **(C)** before and after getting vaccinated ($N = 5{,}103$) from Jan. 29 to Apr. 26, 2021. *indicated statistically significant with $p < 0.05$.

compared to those with positive attitudes toward the epidemic in China.

Regarding the information about the COVID-19 vaccine, trust in the COVID-19 vaccine's efficacy was associated with an individual's psychological stress level about vaccination. Specifically, individuals with moderate or high trust in the efficacy of the COVID-19 vaccine in the prevention of infection displayed a lower psychological stress level (moderate: $\beta = -0.26$, $p < 0.001$; highly: $\beta = -0.98$, $p < 0.001$) compared to the participants who mistrusted the COVID-19 vaccine. In addition, participants with experiences of family members who were actively involved in flu vaccination reported lower psychological stress levels, compared with participants without these experiences ($\beta = -0.07$, $p = 0.006$). Participants with experience of vaccine allergy events had a significantly elevated psychological stress level ($\beta = 0.71$, $p < 0.001$). Participants with any mental symptoms (anxiety: $\beta = 0.71$, $p < 0.001$; depression: $\beta = 0.20$, $p < 0.001$; insomnia: $\beta = 0.32$, $p < 0.001$; PTSD: β

TABLE 2 | Multivariable linear regression of factors associated with psychological stress levels of COVID-19 vaccination at the beginning period of the COVID-19 mass vaccination among general public.

	β (95% CI)	*P*	VIF
40–59 years (ref: 18–39 years)	0.001 (−0.054, 0.056)	0.974	1.08
≥60 years (ref: 18–39 years)	**−0.378 (−0.575, −0.180)**	**0.001**	1.05
College degree or higher (ref: less than college)	**−0.079 (−0.145, −0.013)**	**0.019**	1.12
5,000–11,999 monthly family income, ¥[a] (ref: 0–4,999 monthly family income)	0.007 (−0.058, 0.072)	0.833	1.62
≥12,000 monthly family income, ¥[a] (ref: 0–4,999 monthly family income)	−0.058 (−0.132, 0.016)	0.123	1.71
History of chronic diseases (ref: no)	**0.100 (0.009, 0.190)**	**0.031**	1.06
History of mental disorders (ref: no)	−0.054 (−0.425, 0.317)	0.776	1.05
Family history of mental disorders (ref: no)	0.093 (−0.140, 0.327)	0.433	1.05
Suspect or confirmed infected with COVID-19 (ref: no)	−0.267 (−0.744, 0.211)	0.274	1.07
Family members or friends infected with COVID-19 (ref: no)	0.202 (−0.035, 0.438)	0.095	1.06
Job loss due to the COVID-19 epidemic (ref: no)	**0.237 (0.142, 0.332)**	**<0.001**	1.04
Middle/high- risk in epidemic regions (ref: low-risk)	0.166 (−0.020, 0.351)	0.080	1.07
Quarantine experience (ref: no)	**0.111 (0.029, 0.193)**	**0.008**	1.05
Self-evaluated middle/high risk of getting infected (ref: low risk)	**0.504 (0.417, 0.591)**	**<0.001**	1.07
Neutral attitudes toward the epidemic in China (ref: positive)	**0.256 (0.203, 0.309)**	**<0.001**	1.09
Negative attitudes toward the epidemic in China (ref: positive)	**0.376 (0.250, 0.503)**	**<0.001**	1.08
Moderate trust in efficacy of the COVID-19 vaccine (ref: distrust)	**−0.259 (−0.396, −0.121)**	**<0.001**	4.17
Highly trust in efficacy of the COVID-19 vaccine (ref: distrust)	**−0.978 (−1.105, −0.851)**	**<0.001**	4.25
Family members experience of actively involved in getting flu vaccination (ref: no)	**−0.072 (−0.123, −0.020)**	**0.006**	1.02
Experience of vaccine allergy events (ref: no)	**0.707 (0.626, 0.788)**	**<0.001**	1.07
Anxiety symptoms (ref: no)	**0.713 (0.605, 0.820)**	**<0.001**	2.97
Depressive symptoms (ref: no)	**0.203 (0.096, 0.310)**	**<0.001**	3.16
Insomnia symptoms (ref: no)	**0.315 (0.243, 0.387)**	**<0.001**	1.61
PTSD symptoms (ref: no)	**0.772 (0.694, 0.850)**	**<0.001**	1.95
Investigation period	**−0.209 (−0.250, −0.167)**	**<0.001**	1.03

COVID-19, coronavirus disease 2019; PTSD, posttraumatic stress disorder; VIF, variance inflation factor.
[a] *1 ¥ = USD$0.14.*
Bold values indicated statistically significant with p < 0.05.

= 0.77, $p < 0.001$) had significantly higher psychological stress levels about COVID-19 vaccination. Moreover, psychological stress level about vaccination decreased over time during the investigation period ($\beta = -0.21$, $p < 0.001$).

The factors associated with psychological stress levels about COVID-19-vaccine after vaccination among the vaccinated participants are presented in **Table 3**. VIF of all factors suggested no significant collinearity. Participants with high trust in the efficacy of the COVID-19 vaccine showed significantly lower psychological stress levels ($\beta = -0.43$, $p = 0.007$). Significantly higher psychological stress levels occurred among those with high psychological stress levels at the beginning period of vaccination ($\beta = 0.73$, $p < 0.001$), experiences of vaccine allergy events ($\beta = 0.55$, $p < 0.001$), anxiety symptoms ($\beta = 0.51$, $p < 0.001$), and PTSD symptoms ($\beta = 0.35$, $p < 0.001$).

DISCUSSION

The present study investigated COVID-19 vaccine-related psychological stress levels among the general population in China based on a nationwide, large-sample survey. The psychological stress level of COVID-19 vaccination significantly decreased over time, after accessing information about the COVID-19 vaccine, as well as after getting vaccinated. Several risk factors contributing to the psychological stress level of COVID-19 vaccination when considering getting vaccinated were identified, including younger age, lower education level, history of chronic diseases, mistrust in vaccine efficacy, experience of vaccine allergy events, being affected by the COVID-19 epidemic, and having mental illness symptoms. Moreover, mistrust in vaccine efficacy and experience of vaccine allergy events had a long-term impact on psychological stress levels about COVID-19 vaccination even after getting vaccinated. These findings provide a comprehensive profile of COVID-19 vaccine-related psychological stress levels before and after getting vaccinated and may contribute to promoting the willingness to be vaccinated and improve the general population's well-being during the COVID-19 pandemic.

The psychological stress level of COVID-19 vaccination may lead to the hesitation and rejection of vaccination (28). Due to the COVID-19 experience and ignorance about vaccines, the psychological stress about COVID-19 vaccination was common at the beginning of COVID-19 mass vaccinations. Despite the widely validated efficacy of the COVID-19 vaccine, some individuals still mistrusted the efficacy of the COVID-19 vaccine (5–7, 29). Participants who held negative attitudes

TABLE 3 | Multivariable linear regression of factors associated with COVID-19 vaccine-related psychological stress after vaccination among the vaccinated participants.

	β (95% CI)	*P*	VIF
COVID-19 vaccine related stress level before getting vaccinated	**0.725 (0.706, 0.744)**	**<0.001**	1.24
40–59 years (ref: 18–39 years)	−0.014 (−0.111, 0.083)	0.777	1.09
≥60 years (ref: 18–39 years)	−0.178 (−0.584, 0.229)	0.391	1.04
College degree or higher (ref: less than college)	−0.099 (−0.231, 0.033)	0.143	1.16
5,000–11,999 monthly family income, ¥[a] (ref: 0–4,999 monthly family income)	−0.067 (−0.190, 0.056)	0.285	1.78
≥12,000 monthly family income, ¥[a] (ref: 0–4,999 monthly family income)	−0.126 (−0.262, 0.009)	0.068	1.87
History of mental disorders (ref: no)	0.251 (−0.393, 0.896)	0.445	1.07
Family history of mental disorders (ref: no)	−0.059 (−0.476, 0.358)	0.781	1.08
Suspect or confirmed infected with COVID-19 (ref: no)	0.181 (−0.536, 0.898)	0.620	1.09
Family members or friends infected with COVID-19 (ref: no)	0.290 (−0.062, 0.642)	0.106	1.08
Job loss due to COVID-19 epidemic (ref: no)	0.129 (−0.071, 0.329)	0.206	1.07
Middle/high- risk in epidemic regions (ref: low-risk)	0 (−0.383, 0.382)	0.998	1.08
Quarantine experience (ref: no)	0.108 (−0.030, 0.246)	0.124	1.06
Self-evaluated middle/high risk of getting infected (ref: low risk)	0.079 (−0.079, 0.237)	0.325	1.06
Neutral attitudes toward the epidemic in China (ref: positive)	−0.022 (−0.117, 0.074)	0.657	1.07
Negative attitudes toward the epidemic in China (ref: positive)	0.019 (−0.234, 0.272)	0.883	1.06
Moderate trust in efficacy of the COVID-19 vaccine (ref: distrust)	−0.135 (−0.489, 0.220)	0.457	3.21
Highly trust in efficacy of the COVID-19 vaccine (ref: distrust)	**−0.417 (−0.722, −0.112)**	**0.007**	3.30
Experience of actively involved in getting flu vaccination (ref: no)	0.055 (−0.039, 0.148)	0.250	1.02
Experience of vaccine allergy events (ref: no)	**0.551 (0.385, 0.717)**	**<0.001**	1.18
Anxiety symptoms (ref: no)	**0.514 (0.313, 0.715)**	**<0.001**	2.77
Depressive symptoms (ref: no)	0.060 (−0.135, 0.255)	0.544	2.88
Insomnia symptoms (ref: no)	0.074 (−0.057, 0.204)	0.267	1.49
PTSD symptoms (ref: no)	**0.350 (0.210, 0.489)**	**<0.001**	1.80
Investigation period	**−0.084 (−0.162, −0.007)**	**0.033**	1.05

COVID-19, coronavirus disease 2019; PTSD, posttraumatic stress disorder; VIF, variance inflation factor.

[a] *1 ¥ = USD$0.14.*

Bold values indicated statistically significant with $p < 0.05$.

toward the efficacy of the COVID-19 vaccine had significantly higher psychological stress levels about vaccination. However, previous research has suggested that accessing information about COVID-19 vaccine generally had both good and bad effects, since fake news increased psychological stress levels, while accurate information reduced individuals' psychological stress levels (12, 15, 16). Promoting the efficacy of the COVID-19 vaccine built up the confidence and reduced the psychological stress of vaccination (10). The results of this survey showed that the psychological stress level decreased after vaccination, which indicates that the observed safety of vaccination in real life may relieve the misinformation and associated psychological stress level. Therefore, combating misinformation and disseminating accurate information about the COVID-19 vaccine will reduce psychological stress levels about COVID-19 vaccination in the general population and promote vaccination programs.

Consistent with early findings (12), the results of this study showed that the fear of adverse effects was another strong source of increased psychological stress about the COVID-19 vaccination even after getting vaccinated. Participants with experiences of vaccine allergy events had a significantly elevated psychological stress level when considering getting the COVID-19 vaccine (18, 19). Severe adverse effects generally occurred immediately or over a short period after getting vaccinated (18, 19), and the psychological stress level of COVID-19 vaccination among the vaccinated participants with no adverse effects decreased after vaccination. However, some participants still experienced psychological stress even after getting COVID-19 vaccination due to the participants mistrusting the efficacy of the vaccination and experiencing vaccine allergy events. The findings further imply the importance of guarantee the efficacy and safety of the vaccines (10, 12). For participants with consistent psychological stress about the COVID-19 vaccine, specific strategies and policies should be made to help relieve their psychological stress even after getting vaccinated.

Moreover, we found that family members' experiences of involvement in flu vaccination had a positive effect on individual's psychological stress about COVID-19 vaccination. We proposed that families, as a unit, to get vaccinated may be helpful to relieve other family members' psychological stress about the COVID-19 vaccination. In addition, acceptance of the vaccine among family members, especially parents, would have a positive effect on their children's vaccination in the future (30).

Except for information about the vaccine, the pandemic itself may have long-term impacts on individuals' psychological status (21, 31). In this study, epidemic-related factors, including job loss due to the COVID-19 epidemic, experience of quarantine, self-evaluated high risk of getting infected, and negative attitudes toward the epidemic in China were associated with elevated psychological stress levels when considering the COVID-19 vaccination. The COVID-19 pandemic may have both negative (e.g., increased risk of vaccine-preventable diseases outbreaks) and positive effects (e.g., need for a coronavirus vaccine may increase people's appreciation for vaccines in general) on individual willingness for vaccination; however, it still unclear which effect is dominant (32). This study indicates that mental health status during the COVID-19 pandemic will impact psychological stress levels about COVID-19 vaccination in the general population. Individuals with health issues (e.g., chronic physical or mental illness) were at greater risk of being infected with COVID-19, thus these populations deserve to be in the priority groups for vaccination (33). Given the urgent need and psychological stress of vaccination among the general population, it is crucial for government and policy makers to facilitate COVID-19 vaccination and reduce the relevant psychological stress.

This study showed that some demographic factors and history of chronic diseases may also influence the psychological stress of vaccination. Older adults were regarded as the critical group for determining the success of this vaccine campaign (34). In this study, older adults had decreased COVID-19 vaccine-related psychological stress levels. However, the old adults were generally found to be less willing to get vaccinated (35). We suspect that the discrepancy of acceptance and psychological stress about COVID-19 vaccination could be related to the co-existence of better stress resilience and vaccine apathy among older adults (13). Similarly, individuals with low education levels had greater psychological stress levels about vaccination, which could be explained by poor awareness and health literacy, lower trust and interaction with healthcare professionals, and cost-based concerns among them (36). Generally, comorbidity did not affect individuals' acceptance of vaccine uptake (8), but may increase unrelated psychological stress about their comorbid illnesses. Thus, more strategies and interventions should be developed to relieve psychological stress about vaccination in those with history of chronic disease.

The current findings have potential implications for vaccine rollout policies in China and other countries. First, to build public confidence in vaccine programs and relive vaccine related stress, the government officials should guarantee the safety and effectiveness of vaccines (25). Second, as the main avenues of delivering COVID-19 vaccine-related information, the social media should disseminate accurate and proper information about the COVID-19 vaccine (11). Third, the government and health authorities should keep more supervision on specific targeted populations, even after getting vaccinated. Last but not least, more researches on vaccine-related psychological problems were proposed.

The strengths of this study include its extensive geographic coverage across China, and large sample size. Participants with different characteristics were recruited from all 34 province-level regions in China. In addition, to the best of our knowledge, this is the first study that systematically investigated the COVID-19 vaccine-related psychological stress level. However, our study has several limitations. First, this was an online survey via Joybuy platform, and we used a convenience sampling method. Although this study had extensive geographic coverage across China and a large sample size, most respondents were young, highly educated, living urban areas, with no history of mental disorders, non-infectors, as well as actively involved in accessing information about the vaccine; thus, the representativeness of the sample might be limited, and self-selection bias would exist. Second, we assessed the psychological stress levels using self-reported visual analog scales, rather than well-constructed tools. Third, this was a cross-sectional study. Therefore, associations between psychological stress levels when considering vaccine uptake and risk factors cannot necessarily be considered causal relationships. Fourth, the recall bias cannot be avoided, as the stress vaccine-related stress at different occasions were recalled and self-reported by individuals at one-time point investigation.

CONCLUSIONS

The current findings profiled the COVID-19 vaccine-related psychological stress among the general public in China. This information can provide help for policy making, recognition of vulnerable populations, and framework design for population-specific management to reduce the COVID-19 vaccine-related psychological stress levels and promote the acceptance of the vaccine and improve public health well-being during the COVID-19 pandemic.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding authors.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Peking University Sixth Hospital. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

Y-BZ, JSu, TK, Y-PB, and LLu designed the protocol. Y-BZ, LL (third author), Y-MZ, Y-TH, and LL (tenth author) were involved in data collection. Y-BZ, Y-MZ, S-ZS, Z-AL, and NZ analyzed the data. Y-BZ, JSu, LL (third author), WY, and KY drafted the manuscript. X-MZ, XL, S-QM, SW, M-SR, JSh, LS, TK, Y-BZ,

and LLu revised the manuscript. All the authors have read and approved the final version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.774504/full#supplementary-material

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BRIEF RESEARCH REPORT
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The Persian Language Version of the Obsession With the COVID-19 Scale for Adolescents

Faramarz Asanjarani[1], *Monika Szczygieł*[2]* *and Amna Arif*[3]

[1] Department of Counseling, Faculty of Education and Psychology, University of Isfahan, Isfahan, Iran, [2] Department of Neurocognitive Psychology, Faculty of Pedagogy and Psychology, Institute of Psychology, Pedagogical University, Kraków, Poland, [3] Department of Education, Social Sciences and Humanities, University of Management and Technology, Lahore, Pakistan

Objective: The worldwide pandemic of coronavirus disease (COVID-19) has caused significant public health burdens and psychological dysfunctions. In this challenging time, adolescents require special care. The Persian version of the Obsession with COVID-19 Scale (OCS) for adolescents was developed to screen for dysfunctional obsession associated with the coronavirus during the global pandemic. The structure and internal consistency of the OCS were established.

Design and Measures: Although there are different language versions of the OCS, this is the first study to validate the psychometric properties of the OCS in Iranian adolescents. Seven hundred and nine students (369 girls) participated in the study. Demographic questions and the OCS were administered.

Results: The findings provided support for the existence of a unidimensional structure that met the criteria for configural, metric, and full scalar invariance across gender (girls and boys), inhabitancy (urban and rural), and infection experience (infected and non-infected). The OCS is short and highly reliable measurement. However, further research is necessary to establish the validity of the scale in Iranian population.

Conclusions: The development of such valid scales is an essential part of both research and practice during times of crisis, like a global pandemic. Diagnosis of pandemic related to obsessive thoughts in adolescents is needed as the COVID-19 pandemic is still ongoing and as experts point out, it can be expected that the effects of the pandemic will be observed in the coming years. The Persian version makes it possible to conduct international comparative research on the anxiety related to the COVID-19 pandemic.

Keywords: COVID-19, obsession, mental health, adolescent, validation

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Indian Veterinary Research Institute (IVRI), India
Pardis Rahmatpour,
Alborz University of Medical Sciences, Iran
Mustafa Amin,
Universitas Sumatera Utara, Indonesia

***Correspondence:**
Monika Szczygieł
monika.szczygiel@up.krakow.pl

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INTRODUCTION

Impacts of COVID-19 on Daily Life and Mental Health

Since December 2019, the coronavirus epidemic, also known as COVID-19, originated from Wuhan, China, and spread rapidly worldwide (1). Scientifically, the virus is referred to as Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) (2). The most common COVID-19 symptoms are fever, fatigue, dry cough, myalgia, dyspnea, etc., and can develop 2–14 days after

infection through respiratory droplets and close contact (1, 3). In this article, we will refer to this disease as COVID-19.

The rapid emergence of the COVID-19 outbreak worldwide has dramatically changed daily behavior, significantly impacting the population's physical, social, mental, and financial well-being (4). Across the world, individuals must navigate school closures, employment insecurity, and social behavior changes, which are likely to negatively affect their mental health and coping abilities (5, 6). Recognizing that increased stress can lead to maladaptive behaviors to cope with stress and anxiety, health professionals highlighted the need for all individuals to manage stress and maintain their mental health during this highly uncertain period (6, 7).

Some of the most common social problems of the COVID-19 outbreak are fear of contracting this highly contagious virus, fear of losing loved ones, the spread of misinformation about COVID-19, the lack of medical treatment, the lack of adequately equipped units to treat patients, problems with lock-out [e.g., prolonged home isolation and social distancing; (8) insecurity, fear of unemployment, loss of income, etc.], depression, anxiety, phobia, insomnia, trauma, etc., are also common consequences associated with the COVID-19 outbreak (9). As a result, an increase in the suicide rate is common during and after the pandemic, which has also been reported during the COVID-19 pandemic (10, 11). Studies indicated that mental health problems and mediators increase the risk of suicide (12). It has also been reported that the physical performance of individuals and immunological stabilities are related to psychological states (3). However, studies reported increased psychological problems and low quality of life across nations and professions (e.g., healthcare professionals to general people) (13).

While studies are increasingly focusing on the mental health effects of pandemics on adults, relatively few studies focus on the effects of pandemics on children and adolescents (14). A study conducted by Chen et al. (15) showed that COVID-19 affects symptoms of mental disorders, including obsessive-compulsive disorder (OCD), fear, hypochondria, depression, and neurasthenia in college students. Adolescents may struggle with thoughts of a pandemic by observing the changing life situation at home as well as at school. In this study, which is part of a larger cross-cultural study, we investigated the factor structure and reliability of the Obsession with COVID-19 Scale [OCS; (16)] for Iranian adolescents. Below we present our rationale regarding why it is essential to focus on the emotional sphere of adolescents.

Pandemic and Adolescents

In times of pandemic, as in disasters, there is an increased risk of Post Traumatic Stress Disorder (PTSD), depression, and anxiety (17). In a survey of 8,079 Chinese adolescents aged 12–18 years, Zhou et al. (18) reported a high prevalence of depression (43%), anxiety (37%), and combined symptoms of depression and anxiety (31%). In addition, Odriozola-González et al. (19) reported that during the current pandemic, adolescents experience a new period of insecurity: worry about their relatives' health and work, the ubiquitous problem of death, sudden separation from friends, and school interruption. In a sample of universities in Spain, many students experienced moderate to extremely severe anxiety (21%) and depression (34%) during the first weeks of quarantine. Another psychological impact of the epidemic on adolescents is post-traumatic stress disorders that affect brain development. PTSD in children is associated with changes in fronto-limbic circuits that may contribute to increased threat reactivity and weaker emotion regulation (20).

Anxiety is also a common psychological problem experienced by adolescents during epidemics. According to Cao et al. (21), having a relative or acquaintance infected with COVID-19 was a risk factor for anxiety in a Chinese undergraduate student population (21). Studies also show that absenteeism in children and adolescents is associated with reduced physical activity, more screen time, irregular sleep patterns, and less appropriate diets (22).

Outbreaks may also be linked to increased suicide rates (23). Family confinement can trigger domestic violence during the COVID-19 pandemic. Some countries, such as France and Brazil, have reported an increase in reported domestic violence cases; children are at greater risk of abuse or neglect when they live in a home where there is domestic violence. It is reported that women and girls are more exposed to gender-based violence, including sexual violence, during this period (24). A pandemic situation is something that affects overall functioning. Adolescents face worries that may overwhelm their emotional coping resources. Therefore, it is crucial to screen students with high levels of obsessive thoughts related to COVID-19 and give them immediate help.

Current Study

Fear and obsession can increase the damage done by the disease itself. The emergence of COVID-19 (25) and its epidemic nature have exacerbated worldwide concerns that, in some cases, lead to stigma (26). A characteristic nature of infectious disease compared to other conditions is fear. Obsession and fear are directly related to the rate and environment of transmission (quickly and invisibly) and morbidity and mortality. With a high level of anxiety, individuals may not think clearly and rationally when reacting to COVID-19. Therefore, it is necessary to investigate the level of obsession with COVID-19 to provide better services for those involved. Adolescence, for which the consequences of a pandemic may have particularly negative emotional effects, deserve special attention. Therefore, we decided to test psychometric properties of the OCS (16) in Iranian adolescents.

Iran has been one of the first countries to report the outbreak of COVID-19 and has been since affected by the pandemic. Therefore, adolescents for a long time may feel tense and loneliness because they cannot spend time with friends as previously (5). Prolonged loneliness can lead to depression and anxiety disorders (13). The OCS (16) was the first measure developed to assess maladaptive coronavirus anxiety and obsession with the COVID-19. The OCS has been validated in the United States (16), Bangladesh (i.e., CAS) (27), Turkey (28), Pakistan (29), and Korea (30). It is unidimensional scale that consists of four items: "I had disturbing thoughts that I may have caught the coronavirus; I had disturbing thoughts that certain people I saw may have the coronavirus; I could not stop thinking

about the coronavirus, and I dreamed about the coronavirus." The research conducted so far indicated excellent psychometric properties of the OCS and international comparability of the results. As the psychological effects of the COVID-19 pandemic are observed worldwide, it is vital to expand the use of the scale in more countries. Since the pandemic affects people all over the world, it is possible to compare the feelings, beliefs and behaviors of people from different cultural contexts. Iran was one of the first countries to be affected by the virus and is still struggling with high number of mortality and social consequences, such as school closure. This study, which aimed to assess the psychometric properties of a scale measuring obsessive thoughts about a pandemic in Iranian adolescents, is an important contribution to the development of tools for individual diagnosis and comparative research.

Therefore, the study's main objective is to investigate the factor structure of the OCS in the Iranian sample. We tested the unidimensional factor model in accordance with previous findings. We were interested in testing the structure among the whole sample and checking whether there is the same structure regardless of the various group. Therefore, we tested measurement invariance across gender (girls, boys), inhabitancy (urban, rural), and infection experience (infected, non-infected). Finally, we calculated the reliability of the OCS in the whole sample and tested subgroups. We assumed that the OCS is unidimensional, the structure is comparable between various groups, and the scale has acceptable internal consistency. We also tested whether there are differences between various groups in the level of obsessive thought. We assumed that girls may have a higher score in the OCS than boys, that adolescents who were infected (or someone from their family members was infected) may report more obsessive thought than those from a non-infected group and there are no significant differences between adolescents from rural and urban areas.

METHODS

Participants and Procedure

This study was part of a bigger project comparing Iran and Pakistan regarding COVID-19 stress and its effects on the adolescents population. For the purpose of this study, we used convenience cluster sampling. Students were selected from different parts of Markazi province, Iran, to include both rural and urban participants. Before the translation of the scale, author of the OCS was contacted by the first author to receive permission. After receiving the permission, the official steps of translating the scale were followed (explained in the measure section). Then, students were contacted through their school, and after receiving their parental consent, parents and adolescents were asked to complete an informed consent form. Then, students were able to complete the questionnaires using the link sent to their mobile phones. The questionnaires were designed using an Iranian online website called Porsline (*www.porsline.ir*). The link was sent to 1,000 students. After screening missing data, 709 students (girls $n = 369$, boys $n = 339$) were included in the study. We followed WHO definition of adolescence and include in this period students from 10 to 19 years old. Participants mostly aged 12–16 y.o., however, there were four students at age 11, 17, 18, and 19. All of them attended guidance school or high school. Recruitment of the participants was both from rural ($n = 297$) and urban ($n = 412$) Iran. To determine this, we asked the students if they were from the cities or the countryside. Among them, 131 people indicated that the student or one of the close family members had been infected COVID-19, 578 participants or their family members were not infected.

Measures

Demographic Questionnaire

As the study was part of a larger project, participants were asked to complete a demographic questionnaire, which included the following questions: gender (52% girls, 48% boys), inhabitancy (42% rural, 58% urban), age, the device used for online classes (92% mobile phones, 8% tablet), internet type (100% mobile network), and whether COVID-19 has infected them or their family members (82% non-infected, 18% infected).

Obsession With COVID-19 Scale-Persian Version

The OCS is a recently developed, 4-point measure of persistent and disturbing thinking about COVID-19 that demonstrates solid reliability and validity using two U.S. samples (16). To translating the OCS, the scale was initially translated by two bilingual English translators. Both translators were experts in psychology (one M.A. and one Ph.D.). The agreement between the two translators was investigated to ensure inter-rater reliability. Inter-rater reliability is related to the stability of the translation reported by two or more translators from the same measurement (31). The original OCS scale was compared with the translated version, achieving acceptable inter-rater reliability among the two raters. Next, the final Persian translation was back-translated into English by bilingual Persian/English speaker and was approved by one of the authors, an expert in psychology and a fluent English speaker. Before main study, four students and one expert were asked to complete the questionnaire to see if the language was appropriative for their ages. Using a scale from 0 (not at all) to 4 (almost every day), respondents reported how often they thought persistent and disturbing about COVID-19 over the past 2 weeks. Higher scores indicate more obsessive thinking about COVID-19.

Methods of Data Analysis

To check whether the structure of the OCS was unidimensional as it was theoretically assumed, we used confirmatory factor analysis (CFA). The results were calculated in *lavaan* [R package (32)]. To evaluate the model-to-data fit, we applied common fit indices and evaluation criteria that indicate good model fit: χ^2–non-significant, the root means the square error of approximation (RMSEA)—smaller than 0.08, the standardized root mean squared residual (SRMR)—smaller than 0.08, the comparative fit index (CFI)—above 0.95, and the Tucker-Lewis index (TLI)—above 0.95 (33, 34). Factor loadings (β) should be above the minimum recommended value > 0.40 (35).

Because the assumption of multivariate normality was violated, Mardia's test: skewness 2925.86, $p < 0.001$, kurtosis 66.10, $p < 0.001$, and variables were

TABLE 1 | Descriptive statistics and CFA in the Iranian sample.

	Item	*M*	*SD*	Range	Skew	Kurtosis	Item-scale *r*	*β* CFA
1	I had disturbing thoughts that I may have caught the coronavirus.	0.77	0.89	0–4	1.16	0.90	0.85	0.83
2	I had disturbing thoughts that certain people I saw may have the coronavirus.	0.91	0.97	0–4	1.07	0.70	0.84	0.77
3	I could not stop thinking about the coronavirus.	1.26	1.09	0–4	0.70	−0.28	0.83	0.69
4	I dreamed about the coronavirus.	0.10	0.39	0–3	4.62	24.64	0.49	0.41

N = 709; all factor loadings and item-scale Pearson's r correlations are on the level p < 0.001.

TABLE 2 | Descriptive statistics and factor loadings in subgroups.

	Girls	Boys	Urban	Rural	Non-infected	Infected
Descriptive statistics OCS						
N	369	339	297	412	578	131
M	0.82	0.70	0.78	0.74	0.75	0.81
SD	0.69	0.63	0.67	0.66	0.65	0.74
Range	0–3	0–3	0–3	0–3	0–3	0–3
Skewness	0.94	1.17	1.00	1.08	1.00	1.15
Kurtosis	0.29	1.26	0.50	0.86	0.60	0.73
Multivariate normality (Mardia test)						
Skewness	1452.50***	1444.10***	1196.23***	1719.92***	527.94***	2441.20***
Kurtosis	43.14***	0.42***	41.76***	45.34***	22.91***	61.11***
β						
OCS1	0.84	0.81	0.78	0.87	0.89	0.81
OCS2	0.78	0.75	0.79	0.76	0.75	0.77
OCS3	0.71	0.64	0.68	0.69	0.71	0.68
OCS4	0.44	0.43	0.35	0.45	0.61	0.35

****p < 0.001.*

ordinal, we used the Diagonally Weighted Least Squares estimator [DWLS; (36)] to test structure of the OCS.

We applied the following criteria to evaluate measurement invariance models. We tested configural invariance in a model with no equality constraints imposed based on common model fit indices. We established metric invariance by fitting models where factor loadings on respective items were constrained to be equal across the groups. Finally, we examined scalar invariance based on constraint intercepts to be equal across the groups. To evaluate models, we used Chen's (37) recommendations: difference of fit indices between nested models in a large sample size ($N > 300$) should be smaller than 0.015 for RMSEA, 0.03 for SRMR, and 0.01 for CFI and TLI. We also applied the principle that the χ^2/df ratio should be smaller than 3 to evaluate model as proper (38). To test internal consistency we assessed the Cronbach's alpha level with 95% *CI* and composite reliability [tested via online calculator (39)]. For all tests that we run, we adopted an alpha level of 0.05. The number of observations is sufficient to carry out the planned analyzes (40). Student's *t*-test and Mann-Whitney' *U* test were conducted to compare the OCS scores between groups (gender, inhabitancy, infection). Cohen's *d* was calculated to provide effect size for *t* and *U* test: 0.20 small effect, 0.50 medium effect, 0.80 large effect (41).

RESULTS

Descriptive statistics and the structure of the OCS were established. The unidimensional model that consists of four items obtained the required value of chi-square: $\chi^2_{(2)} = 0.37$, $p = 0.831$, $N = 709$, and the model-to-data fit indices were very satisfactory: RMSEA = 0 [0, 0.044, 90% *CI*], SRMR = 0.01, CFI = 1.00, and TLI = 1.00. All factor loadings were adequate because their values varied from 0.41 to 0.83. Item-scale Pearson's correlations varied from $r = 0.49$ to $r = 0.85$ (see **Table 1**) and indicate good properties of the scale.

Then, we tested whether the OCS had the same measurement characteristics across all groups involved in the study (gender, inhabitancy, infection experience). Multivariate normality of the OCS in all groups was tested (see **Table 2**). The results indicated that the assumption was violated. Because the variables were ordinal, we applied the DWLS estimator in all tested models (36).

First, measurement invariance across gender was established. The results indicated perfect model fit-to-the data for girls and boys. Moreover, in accordance with adopted criteria, equivalence on the configural, metric, and scalar level was fulfilled (see **Table 3**). All factor loadings were acceptable (>0.4, see **Table 2**). Then, we tested measurement invariance across inhabitancy. The results indicated an excellent model fit for adolescents from urban and rural areas. Additionally, the results confirmed

TABLE 3 | Measurement invariance of the OCS across gender, inhabitancy, and infection groups.

	N	*df*	χ^2	RMSEA [90% *CI*]	SRMR	CFI	TLI
Gender							
Girls	369	2	0.08	0 [0–0]	0.007	1	1
Boys	339	2	0.65	0 [0–0.077]	0.023	1	1
Configural	–	4	0.72	0 [0–0.007]	0.013	1	1
Metric	–	7	1.47	0 [0–0]	0.017	1	1
Scalar	–	10	1.69	0 [0–0]	0.018	1	1
Inhabitancy							
Urban	297	2	0.48	0 [0, 0.074]	0.019	1	1
Rural	412	2	0.09	0	0.008	1	1
Configural	–	4	0.57	0	0.01	1	1
Metric	–	7	1.09	0	0.013	1	1
Scalar	–	10	2.83	0	0.018	1	1
Infection							
Infected	131	2	0.03	0	0.008	1	1
Non-infected	578	2	0.42	0 [0, 0.051]	0.012	1	1
Configural	–	4	0.45	0	0.01	1	1
Metric	–	7	4.89	0 [0, 0.052]	0.03	1	1
Scalar	–	10	5.11	0 [0, 0.028]	0.03	1	1

In χ^2 test all $p > 0.05$.

multivariate invariance on the configural, metric, and scalar level (see **Table 3**). Although in urban children loading factor in OCS4 was slightly below the adopted criteria ($\beta = 0.35$), other loading factors were acceptable (>0.4, see **Table 2**). Finally, we tested measurement invariance across infection experience. The results indicated a very good model-fit-to-the-data for infected and non-infected children. It can be assumed that configural, metric, and scalar equivalence exists. Although we observed between configural and metric level ΔSRMR = 0.02, and according to assumptions, this change is slightly higher than criterion—should be <0.015—other criteria were fully met (see **Table 3**). In non-infected children we observed loading factor below 0.4 in OCS4 ($\beta = 0.35$), but others loading factors were acceptable (>0.4, see **Table 2**). Descriptive statistics for each group are presented in **Table 2**.

Then, we compared groups. The results indicated that girls significantly exceed boys in the level of COVID-19 obsession thoughts: $t_{(706)} = 2.35$, $p = 0.019$ and difference is small ($d = 0.18$). There was no differences in the OCS score between adolescents from rural and urban areas: $t_{(707)} = -0,80$, $p = 0.422$, $d = 0.06$ and groups of infected and non-infected: $U = 36832.5$, $p = 0.628$, $d = 0.09$. The results in all groups indicated right-skewed distribution, which means that most adolescents revealed a low level of obsession with COVID-19.

Summing up, results indicated that the OCS is a unidimensional scale that met the criteria for configural, metric, and full scalar invariance across gender (girls, boys), inhabitancy (urban, rural), and infection experience (infected, non-infected). Considering the full invariance of the OCS between groups, the descriptive statistics of the scale were calculated for the whole Iranian sample. The average level of OCS was weak ($M = 0.76$, $SD = 0.66$, $N = 709$, range 0–3), its distribution was right-skewed (skewness = 1.05, $W = 0.90$, $p < 0.001$) and close to mesokurtic (kurtosis = 0.69). The results in all groups indicated that most adolescents revealed a low level of obsession with COVID-19. Descriptive statistics for each group are presented in **Table 2**.

Finally, the reliability of the OCS was established for each group: Cronbach's α [95% *CI*] = 0.78 [0.74, 0.81] for girls, 0.75 [0.70, 0.79] for boys, 0.78 [0.74, 0.81] for rural children, 0.74 [0.69, 0.79] for urban children, 0.83 [0.81, 0.85] for infected with COVID-19, and 0.74 [0.66, 0.81] for those who were not infected. Composite reliability for the whole scale was 0.779.

DISCUSSION

The main objective of this study was to test the factor structure and reliability of the Obsession with COVID-19 Scale in an Iranian adolescents. The results confirmed unidimensionality of the OCS and its measurement invariance across gender, inhabitancy, and infections experience. Moreover, the Persian language version of OCS had a high internal consistency in entire sample and across various groups. The findings provided more evidence for a universality of the OCS structure presented by researchers from various countries (27–30). Thus, the Persian language version of the scale may contribute to further international research on the level of COVID-19 obsession.

Although the obsessive thoughts of COVID-19 disease is raised worldwide (42), the current study revealed relatively low level of obsessive thoughts about pandemic in Iranian adolescents. However, it doesn't mean that there are no adolescents who experience such obsessive thoughts. Students differ in the level of experienced COVID-19 thoughts, therefore OCS may be used as a screening tool that enables the observation of extremely high level of obsessive thoughts. There were no differences in the level of obsessive thought related to COVID-19 due inhabitancy and infection experience. It is likely that regardless of these factors, adolescents may count on appropriate help and access to medical care. However, girls reported more obsessive thoughts than boys. This result is consistent with previous findings that girls tend to report significantly higher depression and anxiety levels (43). Small differences between girls and boys may result from specific situation which is pandemic.

Our study has clear advantages and limitations. The OCS has only four items which facilitates its use in a short time. In the future, however, it can be consider modifying the scale and removing the last item. The fourth item had relatively lower psychometric properties compared to the other items, which is probably due to its separate content (related to dreams, not to daily thoughts). One of the limitations of our analysis is also that the infected/non-infected and rural/urban groups were unequal. Although measurement invariance in these groups is confirmed, it should be remembered that this group bias may influence the mean results of the tested population (especially the inhabitancy; infection is not something permanent).

Moreover, our sampling was not random and is limited to the group that we had access. We also did not controlled the language fluency and nationality of the participants. We tested adolescents who attended Iranian school and we assumed that all of them speak fluently in Persian language. This point is more than important because our study has all the disadvantages of self-report research (44). The results could be affected by temporary mood, level of mindfulness in reading items and instructions, the belief that participation in the study is important and makes sense, willingness to present themselves in a chosen way (45). The presented results should be treated as a starting point for further validation studies. The study was conducted only among adolescents which limits the possibility of generalizing the results to the whole Iranian population. Adults may experience more COVID-19 thoughts as they try to deal with own problems as well as resolve their children issues.

Moreover, this study was dedicated to establishing factor structure and reliability but convergent and divergent validity also should be tested. The future study should focus on relations between OCS to e.g. behaviors to avoid contamination or relations with obsessive-compulsive personality traits in adolescents and adults. Further studies should also check test-retest reliability to establish whether the responses are stable over time.

Diagnosis of pandemic related obsessive thoughts in adolescents is needed as the COVID-19 pandemic is still on going. As experts point out, it can be expected that the effects of the pandemic will be observed in the coming years (46). The period of adolescence is the time when young people establish relationships. During pandemic such developmental aim is difficult to meet. Pandemic as a global and extremely dynamic event has become a source of stress for billions of people around the world demanding unusual countermeasures (7). The lockdown led to the forced isolation of entire societies. A broadly defined lifestyle required change: the way we spend our free time, work and study (6). As this is the first time that modern generations have faced this kind of threat, it is important to test impact of pandemic on the young people mental health. As the pandemic is a global phenomenon, it is a special opportunity to check the impact of state policies on the mental health of citizens in different countries.

During crises, such as a global pandemic, seeking social support is often one of the most adaptable ways to deal with stress. Still, many government agencies have published guidelines on social distancing and hygiene. In other words, many of the recommendations to prevent the spread of COVID-19 include social distancing, which might prevent effective social support, which is required for well-being (47, 48). Many other strategies for dealing with stress, such as active coping with stress to alleviate problems, have also been reported to be effective during a crisis. Others, such as coping with substance use, have been found to be universally incompatible. Other strategies, such as distraction, might be context-dependent (49, 50). Prolonged restrictions of this type may have negative effects on mental health not only immediately but also in the long term. The use of a screening tool will help to prevent negative effects of pandemic on adolescents' future life.

CONCLUSIONS

Summing up, the COVID-19 pandemic triggered physical, psychological, social, and economic impacts that have resulted in intense anxiety, depression, obsession, compulsion, etc. Adolescents are particularly vulnerable to emotional difficulties, therefore, it is crucial to support such group. To do so, it is essential to have reliable tools to diagnose the thoughts related to pandemic. It is possible thanks to the Persian version of the OCS which is a unidimensional and reliable scale. It can be dependably used for psychological research and individual diagnosis across various groups, including boys, girls, infected, non-infected, rural, and urban adolescents. As this study should be treated as a starting point for further studies, more data should be collected in the future to establish validity of the OCS in Iranian population.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Counseling Department Review Board in University of Isfahan, Iran. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

FA, MS, and AA contributed to the concept of the study. FA organized and conducted the research. MS performed the statistical analysis. All authors wrote the manuscript and accepted its final version.

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COVID-19-Related Psychological Trauma and Psychological Distress Among Community-Dwelling Psychiatric Patients: People Struck by Depression and Sleep Disorders Endure the Greatest Burden

Amira M. Ali[1,2], *Abdulmajeed A. Alkhamees*[3]*, *Eman S. Abd Elhay*[4], *Samah M. Taha*[4] and *Amin O. Hendawy*[5,6]

[1] Department of Behavioral Medicine, National Institute of Mental Health, National Center of Neurology and Psychiatry, Tokyo, Japan, [2] Department of Psychiatric Nursing and Mental Health, Faculty of Nursing, Alexandria University, Alexandria, Egypt, [3] Department of Medicine, College of Medicine and Medical Sciences, Qassim University, Buraydah, Saudi Arabia, [4] Department of Psychiatric Nursing and Mental Health, Faculty of Nursing, Mansoura University, Mansoura, Egypt, [5] Department of Biological Production, Tokyo University of Agriculture and Technology, Tokyo, Japan, [6] Department of Animal and Poultry Production, Faculty of Agriculture, Damanhour University, Damanhour, Egypt

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Xenia Gonda,
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***Correspondence:**
Abdulmajeed A. Alkhamees
A.alkhamees@qu.edu.sa

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COVID-19 has created a general state of worry and distress, especially among vulnerable groups such as those with psychiatric diagnoses. Worldwide, psychiatric care provision has drastically suffered during the pandemic, with many patients unable to access proper care, which may have implications for increased mental health consequences in patients with psychiatric disorders (e.g., relapse and suicide). This cross-sectional study used structural equation modeling to investigate COVID-19-related trauma and distress among Arab psychiatric population during COVID-19 quarantine. Patients with pre-existing psychiatric disorders ($N = 168$) completed an online survey that comprised the Depression Anxiety Stress Scale 21 (DASS-21), the Impact of Event Scale-Revised (IES-R), and a questionnaire on COVID-19-related attitudes/perceptions, sources of information, used protective measures, and socio-demographic information. Respondents commonly reported feeling down-hearted/blue, trouble concentrating, along with symptoms of avoidance and rumination related to the pandemic. Patients with depression and sleep disorders expressed higher COVID-19-related trauma than patients with other disorders. Perceived physical health mediated the effect of co-morbid chronic physical disorders on COVID-19 trauma, psychological distress, perceived vulnerability to COVID-19, and perceived likelihood of recovery in case of contracting COVID-19. Perceived physical health and perceived vulnerability to COVID-19 were strong direct predictors of COVID-19-related trauma and psychological distress. Staying at home negatively predicted COVID-19 trauma and exerted an indirect negative effect on psychological distress via COVID-19 trauma. COVID-19 trauma, age, and marital status directly predicted psychological distress, with COVID-19 trauma being the strongest predictor. Educational level, income, having family members working in the medical field, keeping up to date with the news on deaths/infected cases or the development of

COVID-19 drugs or vaccines, satisfaction with available information on COVID-19, and using different protective measures were not associated with significant differences in COVID-19 trauma and psychological distress scores. Immuno-psychiatric interventions should be designed to target COVID-19-trauma and distress among younger single patients with perceived poor physical health, especially those diagnosed with depression and sleep disorders.

Keywords: coronavirus disease 2019/COVID-19, psychological trauma, psychological distress, psychiatric disorders/co-morbid physical disorders, stay-at-home, major depression disorder/sleep disorders, age/unemployment/single/marital status, Arabic/Arab/Saudi Arabia

INTRODUCTION

The ongoing coronavirus disease 2019 (COVID-19) pandemic has been associated with the flaring of numerous psychological symptoms such as fear, anxiety, depression, stress, worry, anger, traumatic emotional experiences, and hopelessness in the general public since it first erupted in 2019 until now (1). Among 140732 individuals across 103 studies conducted during the COVID-19 outbreak, the prevalence of anxiety was 27.3% (95% CI: 23.7 to 31.2%) in the general population and 39.6% (95% CI: 30.1 to 50.1%) in COVID-19 patients (2). The levels of distress and trauma symptoms develop at higher levels in individuals who have been in contact with COVID-19 patients (e.g., healthcare providers and family members of COVID-19 patients) due to the development of vicarious trauma (3, 4). However, the general public and vulnerable groups are not exempted from experiencing negative emotional reactions. This is because of numerous distressing features of the pandemic: (1) wide geographical expansion of the disease, (2) announcement of COVID-19 as a global pandemic by the World Health Organization (WHO) entailing confirmed information on human-to-human transmission of the disease, (3) aggressive nature of the disease and rising death rates, (4) lack of disease-specific treatments, (5) uncertainty concerning the protective effects of evolving vaccines, (6) economic consequences of the outbreak, and (7) terrorizing images and stories of the pandemic communicated by mass media and social media (1, 5–10).

In several instances, stories informed about COVID-19 involve propagated and dangerously inaccurate beliefs, which support the contagion of fear alongside the disease itself (11–15). In particular, fears frequently reported are relevant to the negative impact of the pandemic on household finances of individuals and their significant others, unavailability of health care, insufficient food supply, job loss/unavailability, and excessive fear of contracting the disease (1, 6, 16, 17). In fact, Arpaci and colleagues have developed a measure of COVID-19 phobia based on criteria described in disease classification systems such as DSM-IV (8). In accordance, several studies reported negative consequences of COVID-19 phobia in different parts of the world (6–8, 17). Death due to lack of presenting to the hospital because of fear of contracting COVID-19 is a documented example (17).

Social distancing, primarily being locked down at home has been adopted in most countries as the most protective strategy against COVID-19. However, this strategy may cause several negative physical and psychological problems such as obesity, depression and domestic violence (18–20). For large-size families, especially with children under the age of 18 years, prolonged exposure to human sounds within the context of home confinement may cause excessive sensory input, sense of crowding—especially in small-size households, and lack of privacy leading to detrimental effects on health and well-being (21, 22). Large-scale studies show that being in self-isolation during COVID-19 was associated with greater depression, health anxiety, generalized anxiety disorder (GAD), financial worry, insomnia, acute stress, and loneliness among adults in the United States (US) (23, 24). The number of days in isolation correlates with the intensity of COVID-19-related distress (25). Meanwhile COVID-19 fear, deficient coping, and vicarious trauma associated with frequent exposure to social media/news concerning COVID-19 are identified mechanisms for increased COVID-19 psychopathology during the lockdown, especially in psychiatric/neurological patients, women, young age, and students (26, 27).

Imposed isolation, along with false or misleading information about COVID-19, may tigger a sense of perceived loss of control and jeopardize people's existential need to feel safe. Fuelled by alarmist saturation publicity, conspiracy theories—illogical, erroneous, and unhelpful disease-related beliefs/arguments (e.g., the virus causing COVID-19 is man-made)—propagate (28–30). COVID-19 associated conspiracy beliefs spread in a manner analogous to a virus (15, 29). Conspiracy beliefs develop stronger in response to widespread and significant events, which are enclosed within contradiction, uncertainty, misinformation, or unsatisfactory mundane explanations. These beliefs are largely endorsed by distressed individuals to help them achieve a sense of comfort. They operate by promoting cognitive closure—lower attention to and misappraisals of anomalous/threatening stimuli, increasing the occurrence of perceptual abnormalities and persecutory ideation (11, 12, 28, 31). An investigation involving community-dwelling individuals in the UK early during the pandemic reports that COVID-19 news moderated the effect of low political trust and COVID-19 fear on psychotic-like experiences (e.g., paranoia, hallucinations, and compulsive buying), especially among employees and students (32). Meanwhile, hospitalized psychiatric patients expressed a belief that the hospital staff orchestrated the pandemic to restrict leave and delay discharge (28). Indeed, psychiatric patients demonstrate increased proneness to COVID-19 conspiracy beliefs (28, 33), which are evoked by several liability factors

including environmental conditions and psychological processes: low socioeconomic status (e.g., being unmarried and low level of education), powerlessness, perceptions of alienation from decision makers and breakdown in containment and social order, increased health-related concerns, adverse childhood experiences, maladaptive personality traits such as schizotypal and paranoia, psychiatric problems, as well as other non-psychotic psychological characteristics (e.g., social isolation, stress) (28, 31).

A longitudinal study evaluated the emotional impact of COVID-19 (posttraumatic stress as well as depression, anxiety, and stress symptomatology) in the general public in China twice over the course of 4 weeks. It reported reduction in the intensity of COVID-19-related traumatic stress over time. However, the intensity of trauma was significantly above the cut-off point at both instances. Meanwhile, the intensity of the symptoms of depression, anxiety, and stress was significantly high at both measurements (34). A meta-analysis of longitudinal studies reports a slight significant increase in mental symptomatology early during the pandemic. However, symptoms of anxiety and general mental dysfunction declined by mid-2020 while the levels of depression remained persistently high (35). Thus, adaptation to the prolonged pandemic may lessen the trauma but does not abolish it and associated symptoms of emotional negativity (34, 35). Likewise, the feeling of loneliness during strict lockdown is reported to decrease over time among the general public. However, some individuals (e.g., unemployed and unmarried) may still experience intense loneliness (36). Various social factors are reported to interfere with psychological responses and resilience during the pandemic (37). For example, psychological distress is higher among individuals with female gender, student status, young age, single social status, employment, increased number of people in the household (3–5 persons), change in daily routine, and loss of income (25, 26).

People vulnerable to stress, who usually have low social support, coping problems, and poor adaptation, may develop psychopathology and severely suffer under conditions of collective distress such as the current crisis of the global COVID-19 pandemic (19, 38–41). COVID-19 phobia is reported to increase depression, anxiety, phobic-anxiety, paranoia, obsession-compulsion symptoms, emotional coping, and dysfunctional behaviors in the general population (26, 32, 42). Meta-analytic data emphasize that pre-existing psychiatric illnesses represent a key risk factor for increased mental distress during COVID-19 (27). Available data show worsening in the levels of psychiatric symptoms such as anxiety, depression, stress, insomnia, suicidal ideation, impulsivity, posttraumatic stress symptoms, and dysfunctional eating in patients with pre-existing psychiatric disorders during the COVID-19 pandemic (41, 43, 44). Indeed, COVID-19 related fear/anxiety is reported to trigger relapse in a remitting patient with schizophrenia (38) as well as in two elders with depressive disorder (45). Apart from those case studies, an investigation during COVID-19 lockdown in India reports relapse in 30% of 132 patients with severe mental disorders who were stable before COVID-19. Stopping psychiatric medications was evident in one out of five patients, and it was associated with worsening of psychiatric symptoms (46).

Challenges regarding limiting COVID-19 transmission among psychiatric inpatients and caregivers have drastically affected the provision of psychiatric care across the world during the COVID-19 crisis. There is more dependence on telemedicine (telepsychiatry, even at the emergency department), restrictions on hospital admission, and enrolling patients into COVID-19 positive and negative units based on testing for COVID-19 status (47, 48). Although the use of telepsychiatry has increased in many Arab countries after COVID-19, several barriers (relevant to patients and systems) render this service less effective for counseling and treatment (49). In the meantime, some small- to medium-sized psychiatric hospitals also refuse to receive new inpatients because of poor medical conditions, which would possibly deteriorate distress symptoms for patients with mental illness (47).

In addition to being unable to access proper healthcare, the pandemic is associated with challenges for obtaining food, housing, income, and medication, which may lead to a rise in drug non-compliance and negative perceptions among sufferers of psychiatric disorders who are already a stigmatized group (50). In general, people with psychiatric disorders exhibit poor physical health, physical co-morbidities, nutritional deficiencies, and short life expectancy (51–53). All these factors increase vulnerability to COVID-19 (54, 55). In fact, the incidence of COVID-19 is high in patients with psychiatric disorders, especially those with depression and schizophrenia (56, 57). Additionally, having a prior psychiatric diagnosis is associated with high mortality among hospitalized COVID-19 patients (53, 57). On the other hand, cytokine storms in severe COVID-19 are reported to trigger damages in the central nervous system resulting in the development of psychiatric disorders (e.g., post-traumatic stress disorder (PTSD), depression, sleep disorder, etc.) in a considerable proportion of recovering COVID-19 patients (56, 58).

The emotional influence of COVID-19 on vulnerable groups such as people with psychiatric problems needs to be further explored (43), with less known about patients in the Arab world, which comprises 22 countries inhabited by 423 million people (59). To bridge the gap, the current study evaluated psychological distress and COVID-19-related psychological trauma in a sample of Arab patients with psychiatric disorders. We hypothesized that COVID-19-related psychological trauma would predict psychological distress. We also hypothesized that participants' perceptions of COVID-19 (as a worrisome condition, high perception of susceptibility to the disease and less likelihood of getting recovered) and prolonged staying at home would be associated with higher levels of psychological distress and psychological trauma. COVID-19 frequently strikes patients with chronic diseases (e.g., diabetes, hypertension, etc.) (55, 60), and COVID-19-related distress is reported to be high among people with chronic disorders (61). Accordingly, we expected that people with perceived poor physical health and those with co-morbid physical disorders would experience more distress and trauma symptoms. We also proposed that patients working or having a family member working in the healthcare field would experience more trauma and distress. General anxiety and COVID-19 conspiracy beliefs among psychiatric inpatients (major depression and substance abuse) in the

UK is significantly associated with COVID-19 countermeasure necessity and compliance such as social distancing and political restrictions (33). In parallel, frequent use of precautionary measures (e.g., handwashing with hydroalcoholic solution and mask wearing regardless of the presence or absence of symptoms) is associated with higher psychological distress in the general public in Spain (62). Therefore, we assumed that patients with higher levels of distress or trauma would use more protective measures than patients with lower levels of distress or trauma.

METHODS

Study Design, Participants, and Procedure

An online questionnaire administered via Google Forms was distributed through WhatsApp and Twitter groups to 1160 anonymous respondents from Saudi Arabia. All participants who reported an age of 18 years or above and signed a digital informed consent were directed to the questionnaire. Data were collected during the official confinement period in Saudi Arabia over the course of four days between April the second and April the fifth, 2020. For this cross-sectional study, 168 respondents reporting a pre-existing diagnosis of a psychiatric disorder, which is diagnosed by a psychiatrist were recruited. The study plan was approved by the Institutional Review Board of Al Qassim University (No. 19-08-01).

Study Instruments

The structured questionnaire used in this study consisted of several parts. Part 1 comprised sociodemographic and clinical data such as age, income, education, employment, marital status, family size, type of household, working or having a family member working in the medical field, having a chronic physical disorder, health changes in the past 14 days (experiencing symptoms of fever, nasal congestion, muscle ache, etc.), visiting doctor/hospital or being admitted to the hospital during the past 14 days, direct and indirect contact with suspected or confirmed COVID-19 patients, contact with surfaces/tools contaminated with the virus causing COVID-19, being screened for, quarantined, or diagnosed with COVID-19.

Part 2 comprised perceptions and attitudes toward COVID-19—perceived physical health was assessed by one question "rate your physical health status on a scale from 1 = very bad to 5 = very good"; perceived vulnerability to COVID-19 was assessed by one question "rate your perceived vulnerability to COVID-19 on a scale from 1 = very unvenerable to 5 = very vulnerable"; perceived possibility of recovery if they contract COVID-19 was assessed by one question "rate the possibility of your recovery from COVID-19 if you get infected on a scale from 1 = very low to 5 = very high"; confidence in COVID-19 diagnostic methods was assessed by one question "rate your confidence in the methods used to diagnose COVID-19 on a scale from 1 = very unconfident to 5 = very confident"; perception of COVID-19 as a worrisome condition was assessed by one question "rate your agreement with the statement "there is extreme unnecessary worry concerning COVID-19 on a scale from 1 = strongly disagree to 5 = strongly agree".

Part 3 inquired about protective measures used by the respondents against COVID-19 such as wearing mask, keeping a one-meter distance, avoiding sharing eating utensils at household, and hand washing, along with the duration of being in self-isolation/stay-at-home.

Part 4 inquired about patients' information on COVID-19-related death rates, and the development of drugs or vaccines for COVID-19, their sources of information, and their satisfaction with the available information "How satisfied are you with the information available on COVID-19?", 1 = very unsatisfied to 5 = very satisfied.

Part 5 comprised the Arabic version of the Depression Anxiety Stress 21 (DASS-21) (63). The scale comprises 21 items in three subscales, each comprising 7 items, which measure symptoms of depression, anxiety, and stress over the past seven days. Item responses are rated on a 4-point scale that ranges from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). The overall score of the scale reflects psychological distress. The Arabic DASS-21 has been validated previously (64–66), and its reliability in the current sample is excellent ($\alpha = 0.96$) (63). In our analysis, we used the total score of the DASS-21 not of the subscales. This is because psychometric evaluations of the Arabic DASS-21 indicate its usefulness as a unidimensional measure of distress rather than being a distinct measure of depression, anxiety, and stress (64, 65).

Part 6 comprised the validated Arabic version of the Impact of Event Scale-Revised (IES-R) (67). The IES-R comprises 22 items in three subscales, which describe major features (intrusion, avoidance, and hyperarousal) of PTSD relevant to a specific trauma (68): psychological trauma relevant to the COVID-19 outbreak in this study. In this regard, each item on the IES-R has been altered to make the experience it depicts relevant to the COVID-19 outbreak such as thought of COVID-19 when I didn't mean to (item 6), pictures of the COVID-19 pandemic popped into my mind (item 9), tried not to think about COVID-19 (item 11), had sudden waves of strong feelings about COVID-19 (item 16), reminders of COVID-19 induced physical reactions such as sweating and palpitation (item 19), and had dreams about COVID-19 (item 20). The extent of distress induced by traumatic symptoms relevant to COVID-19 are rated on a 5-point equal response intervals (from 0 to 4), with higher scores indicating higher levels of traumatization (69). Internal consistency of the IES-R in the current sample is excellent ($\alpha = 0.92$).

Statistical Analysis

Quantitative variables with non-normal distribution were described using the median and interquartile range (IQR: 25–75%). Categorical variables were described using number and percentage. Independent-sample *t*-test and one-way ANOVA were used to describe between group differences in the DASS-21 and IES-R scores. A series of Spearman correlations involving sociodemographic variables and risk factors for psychological distress and psychological trauma (e.g., having family members working in the medical field, perceived vulnerability to COVID-19, etc.) with the DASS-21 and the IES-R were conducted. A structural equation model (SEM) predicting psychological distress and COVID-19-related trauma included variables with

significant correlations. To improve model fit, most non-significant predictors/direct paths were trimmed/eliminated from the model, except for those relevant to key predictors (e.g., staying at home, co-morbid physical disorders, and age) because they are relevant to the addressed hypotheses and model fit was already good. Maximum likelihood with a bootstrap involving 2000 random samples was used to obtain 95% bias-corrected confidence interval for all effects (70). Model fit was considered good based on a non-significant chi-square (χ^2) index, along with comparative fit index (CFI) and Tucker-Lewis index (TLI) >0.95, in addition to root mean square error of approximation (RMSEA) and standardized root-mean-square residual (SRMR) <0.06 (71). The analyses were conducted in SPSS and Amos, and significance was considered at a probability of less than 0.05 in two-tailed tests.

RESULTS

This study recruited 168 anonymous patients with psychiatric disorders through a web survey in Saudi Arabia during the lockdown period. The sociodemographic characteristics of the participants are described in **Table 1**. The majority of respondents were females. Forty-five (26.8%) respondents reported having a chronic physical disease (e.g., diabetes, hypertension, etc.). None of the respondents worked in the medical field while 13.7% of the respondents had a family member working in the medical field. Regarding family size, 33.3% of the respondents came from families comprising 3–5 members while 56.5% came from families comprising more than six members; the rest came from families comprising two members or less. As for the type of household, 56.5% of the respondents lived in villas, 17.3% lived in floors on villas while 29.2% lived in apartments. Independent sample *t*-test and one-way ANOVA test (**Supplementary Materials**) revealed significant differences in psychological distress scores among groups of age, marital status, and employment ($p = 0.009$, 0.007, and 0.004) while psychological trauma scores were significantly different only among education groups ($p = 0.039$).

GAD and depressive disorder were the most commonly reported psychiatric diagnoses (**Table 2**). Co-morbidity was recorded. Sleep disorders, obsessive compulsive disorder (OCD), and eating disorders were the mostly noted co-morbid conditions among patients with GAD and depressive disorder. Independent *t*-test revealed that psychological distress scores did not vary between groups of physical disorders or among groups of different psychiatric diagnoses (all p values > 0.05, **Supplementary Materials**). However, patients with depressive and sleep disorders expressed significant differences in COVID-19-related psychological trauma $t(160.2) = -3.21$, $p = 0.002$ and $t(69.5) = 2.41$, $p = 0.019$, respectively.

Direct and indirect exposure to someone suspected to have COVID-19 as well as exposure to surfaces/tools infected with the virus were reported in 1.2% of the respondents while the rest reported that exposure did not happen or did not know if they were exposed or not. As for health changes in the past 14 days, 31.1, 19.8, 17.4, 15.6, and 15.0% of the respondents reported symptoms of headache, muscle ache, dizziness, sore throat, and nasal congestion while 47.3% of the respondents reported not experiencing any symptoms. Of all the respondents, 19.0% visited the hospital or contacted a doctor in the past 14 days, 0.6% were admitted to the hospital, 3.6% were tested for COVID-19, 1.2% were quarantined for COVID-19, and none were diagnosed with COVID-19. COVID-19-related psychological trauma scores were higher in patients experiencing dizziness $t(44.5) = -2.53$, $p = 0.015$ and lower in patients not experiencing symptoms in the last 14 days $t(165.3) = 2.32$, $p = 0.021$. Psychological distress scores were significantly higher among patients experiencing sore throat

TABLE 1 | Sociodemographic characteristics of the participants.

Sociodemographic characteristics	(*N* = 168) No (%)
Gender	
Females	119 (70.8)
Males	49 (29.2)
Age (years)	
18–30	87 (51.8)
>31	81 (48.2)
Marital status	
Single	80 (47.6)
Married	77 (45.8)
Divorced/widowed	11 (6.6)
Education	
School education	51 (30.4)
University degree	117 (69.6)
Employment	
Employed	49 (29.3)
Unemployed	139 (82.7)
Monthly income (Saudi Rial▲)	
<15000	94 (56.0)
>=15000	74 (44.0)

▲*: One Saudi Rial is equivalent to 0.27 US Dollar or 0.23 Euro.*

TABLE 2 | Descriptive statistics of the clinical characteristics of the participants.

Clinical characteristics	(*N* = 168)
Diagnosis	
Anxiety disorders	70 (41.7%)
Depression	68 (40.5%)
Sleep disorders	40 (23.8%)
OCD	26 (15.5%)
Eating disorders	15 (8.9%)
PTSD	12 (7.1%)
Other disorders▲	34 (20.3%)
Having chronic physical disorder	
Yes	123 (73.2%)
No	54 (26.8%)
IES-R MD (Q1-Q3)	30.0 (14.0–43.0)
DASS-21 MD (Q1-Q3)	21.0 (6.0–39.8)

▲*: Other disorders included personality disorders, bipolar disorder, and psychotic disorders, OCD, obsessive compulsive disorder; PTSD, post-traumatic stress disorders; DASS-21, Depression Anxiety Stress Scale-21; IES-R, Impact of Event Scale-Revised; MD, median; Q1, first quartile; Q3, third quartile.*

TABLE 3 | Participants' perceptions of their general health status, COVID-19 diagnostic methods, their vulnerability to COVID-19, the possibility of their recovery if they contract COVID-19, and COVID-19 as a worrisome condition.

Patients' perceptions	(*N* = 168)		
	<3 No (%)	3 No (%)	>3 No (%)
General physical health status	14 (8.3)	37 (22.0)	117 (69.7)
Confidence in COVID-19 diagnose methods	7 (4.2)	32 (19.0)	129 (76.8)
Perceived vulnerability to COVID-19	99 (58.9)	51 (30.4)	18 (10.7)
Perceived possibility of personal recovery if you contract COVID-19	18 (10.7)	37 (22.0)	113 (67.3)
There is unnecessary worry concerning COVID-19	116 (69.0)	23 (13.7)	29 (16.3)

TABLE 4 | Participants' sources of COVID-19-related information and their use of protective measures against COVID-19.

COVID-19-related information and protective measures	(*N* = 168) No (%)
Updated with the news on COVID-19 deaths/infected cases	
Yes	153 (91.1)
No	15 (8.9)
Updated with the news on drugs/vaccines for COVID-19	
Yes	117 (69.6)
No	51 (30.4)
Sources of information	
Social Media	69 (20.9)
Local mass Media	53 (16.1)
Ministry of health	137 (41.5)
World Health Organization	71 (21.5)
Satisfaction with the available information on COVID-19 mean (SD)	4.2 (1.0)
Protective measures	
Wearing mask	30 (18.0)
Washing hands	140 (83.8)
Avoiding handshake	105 (62.9)
Keeping distance for one meter	82 (49.1)
Avoiding sharing eating utensils	38 (22.8)
Doing nothing	16 (9.6)
Home stay less than 12 hours per day▲	107 (63.7)
Not going outside at all	61 (36.3)

▲*: One participant stayed at home for up to 18 hours per day.*

t(31.89) = −2.64, $p = 0.013$ and difficulty breathing t(19.46) = −3.18, $p = 0.031$.

Descriptive statistics of items of the DASS-21 (**Supplementary Material**) indicate that feeling down-hearted and blue was the most commonly experienced symptom; median (Q1-Q3) = 2.0 (1.0–3.0), followed by being unable to become enthusiastic about anything feeling rather touchy; median (Q1-Q3) = 1.0 (0.0–3.0), and feeling that life was meaningless; median (Q1-Q3) = 1.0 (0.0–2.8). Mouth dryness, breathing difficulty, and trembling (e.g., hand) were the least reported symptoms; median (Q1-Q3) = 0.0 (0.0–1.0) followed by felt close to panic; median (Q1-Q3) = 0.0 (0.0–2.0). The most commonly reported symptoms on the IES-R (**Supplementary Material**) were avoided letting myself get upset when I thought about it or was reminded of it, thought about it when I did not mean, stayed away from reminders, tried not to think about it, had trouble concentrating, felt watchful and on guard, and tried not to talk about it; median (Q1-Q3) = 2.0 (0.0–3.0).

Table 3 shows that the majority of the respondents perceived their health status as good. However, 58.9% perceived themselves as vulnerable to COVID-19. Most respondents (69%) perceived COVID-19 as a worrisome condition—the mean score of respondents' agreement to the statement "there is extra unnecessary worry about COVID-19" was 2.0 ± 1.4. Scores below 3 on this item indicate disagreement to the statement. A considerable proportion of the participants had high confidence in the available diagnostic measures of COVID-19, and they perceived their possibility of recovery would be high if they contract COVID-19.

Acknowledging the Saudi Ministry of Health as their main source of COVID-19-related information, most patients reported being updated with the latest news on COVID-19 deaths/and number of infected cases as well as the news on drug/and vaccine discovery. No statistically significant differences in trauma and distress scores were noted among those following the latest news on COVID-19-related deaths/infected cases or the development of COVID-19 drugs or vaccines or those using various sources of information on COVID-19 (**Supplementary Material**).

Only 9.6% of the participants did not use protective measures and wearing a mask was less common. Handwashing, avoiding hand shake, and keeping a one-meter distance were commonly used by most participants (**Table 4**). There were no significant differences in the scores of psychological trauma and psychological distress among those using different protective measures. Only those who avoided sharing eating utensils at household expressed a statistical significant difference in psychological trauma t(54.6) = −2.18, $p = 0.034$. The scores of psychological trauma and psychological distress significantly varied among those with partial and complete compliance with stay-at-home orders t(127.8) = 2.50, $p = 0.014$ and t(127.2) = 2.21, $p = 0.029$, respectively.

As shown in **Table 5**, psychological distress and psychological trauma were strongly correlated. While psychological distress significantly correlated with age, marital status, and employment; psychological trauma correlated only with education among all sociodemographic factors. Monthly income was not correlated with either distress or trauma ($p > 0.05$, **Supplementary Material**). Both psychological distress and psychological trauma positively correlated with perceived vulnerability to COVID-19 and negatively correlated with perceived health status and perceived possibility of personal recovery. Psychological trauma negatively correlated with home stay and confidence in diagnostic methods of COVID-19. Perceiving COVID-19 as a worrisome condition correlated with psychological trauma ($r = 0.155$, $p = 0.045$) but not with psychological distress (**Supplementary Material**). Satisfaction

TABLE 5 | Correlations among trauma, psychological distress, sociodemographic characteristics, and perception of vulnerability to COVID-19.

Variables	1	2	3	4	5	6	7	8	9	10	11
1. DASS-21	–										
2. IES-R	0.714**	–									
3. Age	−0.240**	−0.097	–								
4. Sex	−0.054	−0.079	0.122	–							
5. Marital status	0.248**	0.081	−0.615**	0.014	–						
6. Education	0.064	0.155*	−0.146	−0.176	0.077	–					
7. Employment	0.184*	0.144	−0.366**	−0.271**	0.180*	0.037	–				
8. Perceived health status	−0.400**	−0.348**	0.070	−0.061	−0.069	0.005	−0.058	–			
9. Perceived vulnerability to COVID-19	0.297**	0.236**	0.033	0.052	0.024	−0.143	−0.064	−0.200**	–		
10. Confidence in diagnostic methods of COVID-19	−0.150	−0.180*	0.070	0.025	−0.064	0.110	−0.100	0.298**	−0.163*	–	
11. Perceived possibility of personal recovery	−0.208**	−0.289**	−0.096	−0.037	0.073	−0.082	−0.013	0.396**	0.236**	−0.180*	–
12. Home stay	−0.151	−0.180*	0.231**	0.367**	−0.075	0.053	0.117	0.052	0.097	−0.75	0.097

*, **: *Correlation is significant at the level of 0.05 and 0.01, respectively.*

with the available information on COVID-19 was negatively correlated with psychological distress and COVID-19-related trauma ($r = -0.247$ and -0.255, p values $= 0.001$). Psychological trauma negatively correlated with lack of use of any protective measures ($r = -0.187$, $p = 0.015$) and positively correlated with not sharing eating utensils at household ($r = 0.180$, $p = 0.020$).

After trimming most non-significant variables and paths, the SEM path analysis model predicting psychological trauma and psychological distress (**Figure 1**) had excellent fit on all fit measures (χ^2 (16) = 13.1, p = 0.665, CFI = 1.00, TLI = 1.02, RMSEA = 0.00, SRMR = 0.04). The model accounted for 19.0 and 59.0% of the variances in psychological trauma and psychological distress, respectively. As shown in **Figure 1**, perceived health status and vulnerability to COVID-19 were strong predictors of COVID-19-related trauma and psychological distress. Age, marital status, and COVID-19-related trauma predicted psychological distress, with the later expressing the strongest effect. Stay-at-home had a significant direct negative effect on COVID-19-related trauma and a significant indirect negative effect on psychological distress mediated by COVID-19-related trauma (β = −0.107, 95% CI: −0.177 to −0.038, $p = 0.017$).

Perceived vulnerability to COVID-19 had a strong indirect effect on psychological distress via COVID-19-related trauma (β = 0.112, 95% CI: 0.039 to 0.184, p = 0.009); it also mediated the indirect effect of perceived health status on COVID-19-related trauma (β = −0.033, 95% CI: −0.078 to −0.007, p = 0.022). COVID-19-related trauma mediated the indirect effect of perceived health status on psychological distress (β = −0.240, 95% CI: −0.324 to −0.163, p = 0.001). Although age had no significant effect on perceived health status, it exerted significant indirect effects via perceived health status on perceived vulnerability to COVID-19 and perceived likelihood of recovery in case of contracting the disease (β = −0.024, 95% CI: −0.065 to −0.004, p = 0.047) and (β = 0.046, 95% CI: 0.008 to 0.106, p = 0.048), respectively. The indirect effects of age on psychological distress and psychological trauma were marginal ($p = 0.082$ and 0.074, respectively). Having a co-morbid chronic physical disease expressed significant indirect effects on perceived vulnerability to COVID-19, perceived likelihood of recovery in case of contracting the disease, COVID-19-related trauma, and psychological distress via perceived health status (β = 0.050, 95% CI: 0.014 to 0.108, $p = 0.016$), (β = −0.096, 95% CI: −0.172 to −0.049, $p = 0.000$), (β = 0.085, 95% CI: 0.027 to 0.151, $p = 0.010$) and (β = 0.086, 95% CI: 0.022 to 0.150, $p = 0.018$), respectively.

DISCUSSION

To our knowledge, this is the first study to examine COVID-19-related psychological trauma and psychological distress among Arab patients with psychiatric disorders. COVID-19-related psychological trauma was evident, especially among patients with depression and sleep disorders, and it was a strong predictor of distress. Feeling down-hearted and blue, a depressive symptom, was the most reported distress symptom. Psychological distress was common among patients who were young, unemployed, and single. Staying at home was protective against COVID-19-related psychological trauma and psychological distress. Most participants perceived COVID-19 as a worrisome condition, and those with high perceived poor health status, high perceived vulnerability to COVID-19, and low perceived chance of recovery in case they contract the disease were more likely to exhibit high psychological distress scores.

Although no statistically significant differences in trauma and distress scores were noted between genders (**Supplementary Materials**), age was a significant negative predictor of psychological distress in our sample, which is consistent with several studies reporting higher distress among youth during the pandemic (3, 9, 37, 72). Age is an important factor that is closely linked to several other interrelated variables (e.g., education, marital status, employment, health status, loneliness, etc.) (70). For example, age was negatively correlated with marital status and employment, which were both positively correlated with COVID-19-related trauma (**Table 5**). As noted above, age exerted an indirect negative effect on perceived vulnerability to COVID-19 and an indirect positive effect on

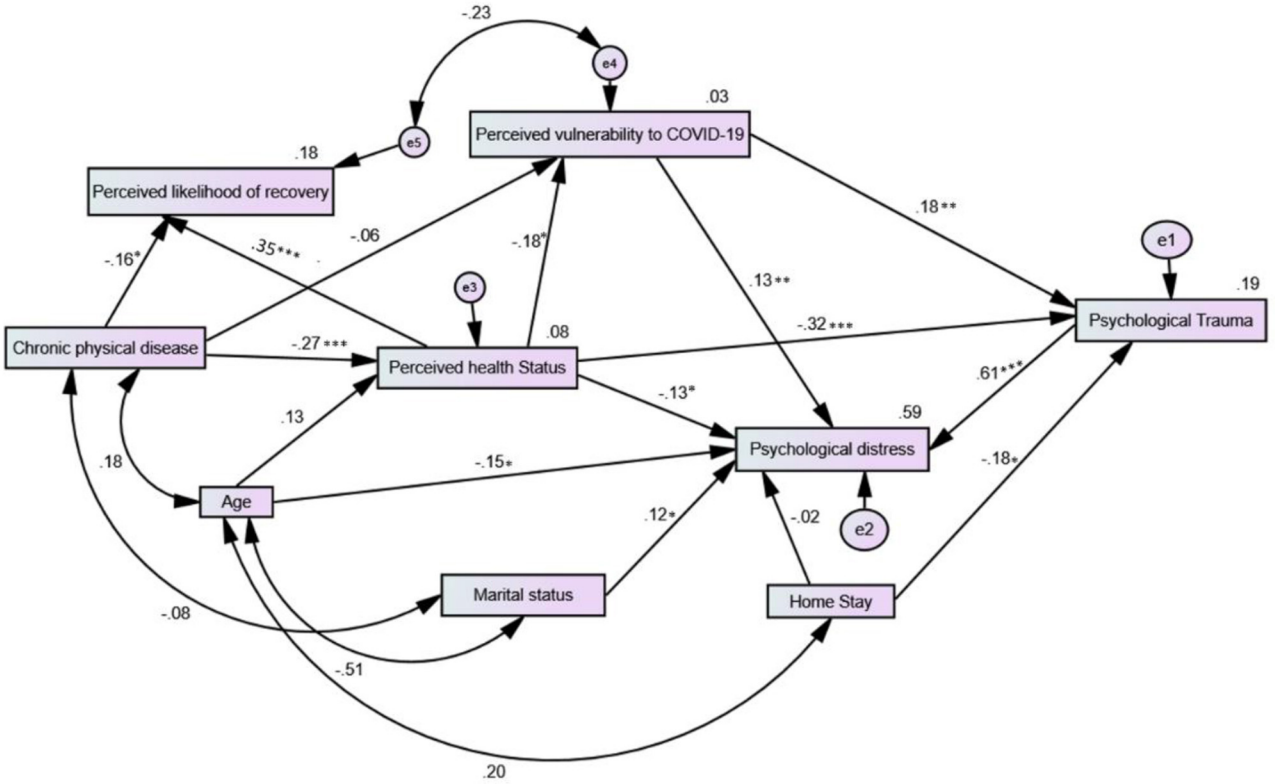

FIGURE 1 | Structural equation path model predicting COVID-19-related psychological trauma and psychological distress in Arab patients with psychiatric disorders.

perceived likelihood of recovery should the patients contract COVID-19. Age was also negatively associated with obtaining COVID-19-related information from the website of the WHO and the Ministry of Health (**Supplementary Material**). In fact, age along with marital status, educational level, and professional status are reported to affect resilience scores among the general public in several countries during COVID-19, with age expressing the strongest effect among all sociodemographic variables (37). Thus, interventions designed to mitigate COVID-19-related trauma may consider young age as a key effector, especially when it is associated with unemployment, low education, and single marital status.

Contrary to expectations and reports associating high COVID-19 related distress with chronic non-infectious diseases (61), having a chronic physical disorder was not directly associated with COVID-19-related distress or trauma. This may be attributed to the fact that many patients with chronic disorders may enjoy good health, especially when they stick to a healthy lifestyle (adequate exercise, diet, and sleep) (73). This logic may be true given that having a chronic physical disorder negatively predicted perceived health status and exerted indirect effects through that variable on psychological trauma and COVID-19-related distress as well as perceived vulnerability to COVID-19. In line, high levels of psychological distress are reported to prevail when physical disorders are associated with poor health status and low wellbeing such as during periods of active disease (52, 74). In addition to its mediating effect, perceived health status was also a direct predictor of both psychological distress and COVID-19-related trauma. Consistent with our findings, Chinese psychiatric patients with poor physical health expressed more depressive, anxiety, and stress symptoms (44). Likewise, a systematic review pinpoints perceived poor physical health as a predictor of distress among the general public, healthcare providers, and COVID-19 patients (43). Overall, patients with physical co-morbidities, especially those with perceived poor physical health, may be at high risk for COVID-19-related trauma and distress.

Among different psychiatric diagnoses, COVID-19-related trauma symptoms were significantly higher among patients diagnosed with depressive disorder and sleep disorders, which were also comorbid with one another. This finding is consistent with those of an Italian study reporting an association between low sleep quality and high distress in the general public exhibiting COVID-19-related PTSD (72). In fact, a meta-analysis involving cross-trait meta-analysis and Mendelian randomization analysis reports 29 loci shared between PTSD and major depressive disorder, along with a causal effect of genetically determined depressive phenotypes on PTSD. The authors concluded that PTSD, from a genetic point-of-view, is likely to be a subtype of depressive disorders (75). Taken together, depressed patients, particularly those with symptoms of dysfunctional sleep would require special immuno-psychiatric attention in order to prevent the development of COVID-19-related trauma.

Staying at home is reported to contribute to loneliness, decreased social support, and dysphoric mood (23, 24, 36). Contrary to our expectations, prolonged stay-at-home was protective against psychological trauma and distress. This could be related to alleviation of COVID-19 phobia secondary to reduction of direct contact with others (e.g., at work, supermarkets, etc.). In this context, young Italian people who worked outside their domicile during COVID-19 strict lockdown are reported to exhibit higher levels of anxiety and stress than the general public (3). It is also possible that trauma and distress symptoms were low in those with complete compliance with stay-at-home orders due to family interactions and social connectedness associated with large family size—predominantly, more than half the respondents came from families comprising more than 6 members. In support of this view, living with others or in a rural area, having greater social support and more close friends are documented protective factors against loneliness during COVID-19 in the UK (36). In line, perceived social support is reported to moderate the relationship between loneliness and anxiety during COVID-19 in China (76). Longitudinal data indicate that adolescents adhering to stay-at-home orders who feel socially connected are less prone to depression/anxiety, COVID-19 worries whereas those with online learning difficulties, increased conflict with parents, and COVID-19 worries experience an increase in mental health problems during the COVID-19 lockdown (16). On the other hand, data from Canada show that the presence of children under the age of 18 in the household is associated with increased alcohol use, suicidal ideation, parent conflicts with children, domestic violence, worsening of children's mental health as well as more frequent positive interactions with their children and feelings of closeness due to the pandemic (21).

Crowdedness during the confinement period may contribute to distress; however, the perception of human sounds is reported to be context-specific (22). In this study, family size was positively associated with the type of household ($r = 0.359$, $p < 0.01$), with the majority of the respondents living in villas or in a floor on a villa. Thus, the housing conditions would provide plenty of space and privacy. In line, compared with house dwellers, apartment dwellers experience more exposure to mechanical sounds, which is associated with lower self-reported health and lower restorative quality of the home (feeling away) during the lockdown (22).

Although none of the respondents worked in the medical field, some patients had a family member working in the medical field. However, those patients expressed no variation in COVID-19-related trauma or distress scores, which is contradictory to what is reported in the literature (3). This finding would be interpreted within the context of data collection, which took place during the beginning of the confinement period where the number of patients infected with COVID-19 in the entire Saudi Arabia was around 1000. Thus, it is possible that family members working in the medical field may had less contact with COVID-19 patients, entailing less vicarious trauma (4).

Strength, Implications, and Limitations

This study is the first to describe the psychological impact of COVID-19 and its correlates among Arab patients with psychiatric disorders. It examined psychological distress: non-specific negative emotions of combined feelings of anxiety and depression, which are closely associated with mental disorders (77). This is because the DASS-21 is not a diagnostic measure, and it primarily captures psychological distress rather than discrete symptoms of depression or anxiety (78). In line, a meta-analysis states that the reported incidence of depression and anxiety during the pandemic as assessed by various specific diagnostic measures (e.g., Generalized Anxiety Disorder, Hamilton Depression Scale, etc.) is highly heterogenous (79).

The findings identified some of the key risk factors of mental health consequences of COVID-19, which may inform immuno-psychiatric and resilience promoting efforts toward patients with psychiatric disorders, who represent one of the most vulnerable groups to COVID-19 and its adverse effects. The results highlight the importance of screening (e.g., online, on the phone) patients with psychiatric disorders for COVID-19-related trauma as well as symptoms of distress in order to mitigate mental health risks among those patients. Vulnerable individuals who may need special support are mainly those who are young, single, unmarried, with physical comorbidities, poor perceived physical health, and high perceived vulnerability to COVID-19. Patients diagnosed with major depression and sleep disorders are particularly vulnerable to COVID-19 trauma.

This study also has a number of limitations, which may limit the generalizability of the findings: cross-sectional design, selection bias (by recruiting only educated patients who use social media from a single Arab country), social desirability bias (self-reported data), and recall bias. Psychiatric diagnoses were self-reported, even though they were indicated to be performed by psychiatrists. Because of noted psychiatric comorbidities, it was not possible to investigate the contribution of the main psychiatric diagnosis to COVID-related distress and trauma in SEM. However, collecting data through an online survey was the only convenient way because face-to-face contacts were strictly forbidden during the confinement period. It is worth mentioning that data collection took place early during the pandemic while research signifies a temporary increase in mental symptomatology at the initial periods of the pandemic followed by a drop by mid-2020 to the levels reported before the pandemic (35). In addition, the pre-COVID-19 level of psychological distress in the current sample has not been assessed, which makes us unable to affirm that distress estimated is purely attributed to the pandemic. Therefore, the results must be interpreted with caution. Meanwhile, the pandemic is ongoing and the need to ensure prompt provision of adequate healthcare to acute psychiatric patients remains immense.

CONCLUSION

COVID-19-free patients with psychiatric disorders endorse COVID-19-psychological trauma, and subsequently experience psychological distress. Experiencing symptoms of dizziness, sore throat, and difficult breathing was associated with higher COVID-19-related trauma and distress. Patients

were up to date with the latest information about COVID-19 mortality and treatment, and the ministry of health was the main source of information in addition to the WHO and social media. Satisfaction with information available about COVID-19 did not correlate with distress or trauma. Patients largely complied with protective measures, and trauma symptoms were higher among those not sharing their eating utensils at household. Sociodemographic variables (age, marital status, and employment), perceived health status, and beliefs about risk of infection and chances of personal recovery significantly predicted distress and trauma. Staying at home was protective against COVID-19 trauma and emotional reactions.

To prevent mental health consequences, the findings suggest that more research attention should be directed toward fostering adaptive coping among young, unemployed, and single patients, especially those with depression and sleep disorders as well as those with physical disorders who perceive their physical health as poor or perceive themselves more vulnerable to COVID-19. Research is needed to investigate whether psychological distress in Arab psychiatric patients is associated with COVID-19-related conspiracy theories as well as burdensome consequences of the outbreak such as difficulties with access to healthcare services as well as availability of job/income, food, support system, etc. Longitudinal investigations are required to inform whether the emotional reaction of psychiatric patients changes over the course of the pandemic.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in Mendeley repository at: https://data.mendeley.com/datasets/8k3vmfxpd3/draft?a=67415321-61f7-4920-bd2a-749b365ff6fb (access on 27 September 2021).

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board of Al Qassim University (No. 19-08-01). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AMA, AAA, and AOH conceptualized the study and designed the methodology. AAA collected the data. ESAE and SMT cleaned the data. AMA and AOH analyzed and interpreted the data and edited and revised the final draft. AMA, ESAE, SMT, AAA, and AOH wrote the initial draft of the manuscript. All authors have critically revised and approved the final draft of the manuscript.

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SUPPLEMENTARYMATERIAL

The Supplementary Material containing relevant analyses that are not reported in this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.799812/full#supplementary-material

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The Role of Self-Care Activities (SASS-14) in Depression (PHQ-9): Evidence From Slovakia During the COVID-19 Pandemic

Beata Gavurova[1]*, *Boris Popesko*[2], *Viera Ivankova*[3] and *Martin Rigelsky*[4]

[1] Center for Applied Economic Research, Faculty of Management and Economics, Tomas Bata University in Zlín, Zlín, Czechia, [2] Department of Business Administration, Faculty of Management and Economics, Tomas Bata University in Zlín, Zlín, Czechia, [3] Institute of Earth Resources, Faculty of Mining, Ecology, Process Control and Geotechnologies, Technical University of Košice, Košice, Slovakia, [4] Department of Marketing and International Trade, Faculty of Management and Business, University of Prešov, Prešov, Slovakia

In the ongoing situation, when the world is dominated by coronavirus disease 2019 (COVID-19), the development of self-care programs appears to be insufficient, while their role in mental health may be crucial. The aim of the study was to evaluate the associations between self-care activities and depression in the general Slovak population, but also in its individual gender and age categories. This was achieved by validating the self-care screening instrument, assessing differences, and evaluating the associations using quantile regression analysis. The final research sample consisted of 806 participants [males: 314 (39%), females: 492 (61%)] and data were collected through an online questionnaire from February 12, 2021 to February 23, 2021. Patient Health Questionnaire (PHQ-9) for depression ($\alpha = 0.89$) and Self-Care Activities Screening Scale (SASS-14) [health consciousness (HC) ($\alpha = 0.82$), nutrition and physical activity (NPA) ($\alpha = 0.75$), sleep quality (SLP) ($\alpha = 0.82$), and interpersonal and intrapersonal coping strategies (IICS) ($\alpha = 0.58$)] were used as screening measures. Mild depressive symptoms were found in 229 participants (28.41%), moderate depressive symptoms in 154 participants (19.11%), moderately severe depressive symptoms in 60 participants (7.44%) and severe depressive symptoms in 43 participants (5.33%). The main findings revealed the fact that individual self-care activities were associated with depression. This supported the idea that well-practiced self-care activities should be an immediate part of an individual's life in order to reduce depressive symptoms. Sleep quality played an important role, while HC indicated the need for increased attention. Other dimensions of self-care also showed significant results that should not be overlooked. In terms of depression, females and younger individuals need targeted interventions. The supportive educational intervention developed based on the self-care theory can help manage and maintain mental health during a stressful period, such as the COVID-19 pandemic. Health policy leaders should focus on health-promoting preventive self-care interventions, as the demand for them increases even more during the pandemic.

Keywords: depression, mental health, health consciousness, nutrition and physical activity, sleep quality, coping strategies, COVID-19, self-care behavior

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***Correspondence:**
Beata Gavurova
gavurova@utb.cz

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INTRODUCTION

With the onset of coronavirus disease 2019 (COVID-19), people's daily lives changed within a few days as daily routines were interrupted and people were locked up at home. In this context, the ongoing COVID-19 pandemic represents a health burden not only in terms of the spread of a life-threatening infection, but also serious psychological consequences (1–4). The fear of infection as well as sudden changes in everyday life play a major role in this situation. Many countries have imposed strict measures and restrictions to successfully defeat COVID-19, with lockdown, quarantine, and isolation being the main strategies for victory (5). On the other hand, isolation and social distance are factors that increase the risk of poor mental health (6). Moreover, individuals had to face an unknown disease, worries about transmission, insecurity, but also new realities such as wearing a mask, home office, or home schooling (7, 8). In this way, evidence has shown that people are less able to control critical situations and manage stressful events related to severe acute respiratory syndrome compared to the stressful events of everyday life (9). Based on all these findings, the COVID-19 pandemic can be considered as a global trauma with consequences for mental health (6, 10).

From a mental health perspective, depression is a huge burden on health (11). In Slovakia, together with the COVID-19 pandemic, depressive symptoms also appeared across the population (12, 13), while depression is considered not only a health but also an economic burden in this country (14). In addition, it has been proven that Slovak family members of patients in intensive care units report a higher prevalence of depression (15), which can also be expected in COVID-19 disease. Young people, patients as well as females can be considered as risk and vulnerable groups in this country (16–20). On the other hand, there is little evidence among the general Slovak population, which was confirmed by the results of a new international study conducted by Zhang et al. (21). Although depression is a well-examined problem in Europe (22, 23), Slovakia is a European country that has long overlooked and neglected this serious health problem. There is an obvious insufficiency in the field of research, but also in the field of implementation of prevention and treatment strategies in practice (24). This is reflected in the lack of evidence-based interventions.

Following the above-mentioned facts, it should also be noted that the mental health of the population plays an important role in the success or failure of pandemic management, public policies and health measures to overcome the pandemic, but also in the success of communicating the importance of the measures, vaccination and COVID-19 risks (25). In this context, self-care behavior is considered to be one of the main strategies to eliminate not only the transmission of infection but also the psychological effects of the COVID-19 pandemic (26). Self-care covers a range of activities and approaches that an individual pursues to maintain physical and mental health, as well as to manage ill health (27). In these activities, individuals are encouraged by their self-care abilities, which represent the fundamental pillars of self-care, and by their self-efficacy, which facilitates the acquisition of the desired effects (28). According to Butler et al. (29), there are two objectives of self-care, namely to protect or manage stress and other negative situations, but also to maintain or enhance well-being and overall functioning. The authors also stated six life domains that need attention in terms of self-care activities: physical, professional, relational, emotional, psychological, and spiritual (29).

The lack of research efforts in Slovakia can be observed not only for depression, but also for self-care activities. In other words, this issue as a whole is not adequately researched in Slovakia. There is limited evidence on self-care behavior, while previous studies have focused mainly on professional helpers as a risk population group (30–32). The authors of these studies emphasized that increased and continuous attention is needed to promote the value of self-care behavior in this country. At the same time, they stated that health status plays an important role in self-care behavior (31, 32). The foreign evidence has shown that improvements in physical health, vitality, social functioning, emotions, and mental health can be expected if self-care interventions are involved in individuals' lives (33). Thus, the benefits of self-care activities are unquestionable (34) and their practice can be reflected in increased satisfaction (35). In this way, self-care is an important aspect of health promotion aimed at improving population health and well-being (33, 36). Self-care activities, as part of hygiene practices, are effective in coping with stress and preventing health problems, while the motivation to act and include self-care elements into daily routine plays an important role (37).

Bearing in mind the evidence presented above, it can be assumed that self-care activities are a core of mental health, especially in the stressful period of the COVID-19 pandemic. The main components of the self-care conceptual model take into account health literacy and self-awareness, health consciousness (HC), knowledge, mental well-being, healthy eating, physical activity, good hygiene, and risk avoidance (36, 38). Among these components, sleep quality (SLP) appears to be an important predictor of mental health and well-being, while physical and nutrition activity also plays a significant role (39). In terms of depression, several self-care activities, such as SLP, seemed to be inversely associated with this serious mental disorder (40). In this context, self-care behavior can be considered a predictor of depression (39).

In various countries, the presented issue has been examined mainly in terms of the role of depressive symptoms in self-care activities (41–44), but research area lacks knowledge about the role of self-care activities in depression (39, 40). Thus, this study contributes to addressing the limitations in the current literature by providing a better understanding of the problem. At the same time, international research has largely focused on patients rather than the general population, while the analyzes have covered only some of the activities that fall within the concept of self-care behavior. All these facts were the motivation for the authors of this study, which enriches scientific knowledge as such. It should also be noted that similar research has not yet been carried out in Slovakia. The presented study focuses on the associations between self-care and depression in a non-patient sample with respect to the whole concept of self-service activities. The resulting insights are of great importance for public health

in Slovakia, and the findings provide guidance to public health leaders in improving mental health and promoting self-care. This research is particularly needed during the COVID-19 pandemic, which left trauma in the lives of individuals.

METHODOLOGY

The aim of the presented study was to evaluate the associations between self-care activities and depression in the general Slovak population, but also in its individual gender and age categories.

Measures

The analytical procedures included a four-factor measure related to the concept of self-care, that is Self-Care Activities Screening Scale (SASS-14) (38). This instrument was developed to screen specific self-care activities during the COVID-19 pandemic with regard to HC and consists of the following dimensions (subscales): (i) health consciousness—HC ($\alpha = 0.82$), (ii) nutrition and physical activity—NPA ($\alpha = 0.75$), (iii) sleep quality—SLP ($\alpha = 0.82$), and (iv) interpersonal and intrapersonal coping strategies—IICS ($\alpha = 0.58$). The SASS-14 items offered possible responses using a 6-point Likert scale (numerical coding): (1) never, (2) very rarely, (3) rarely, (4) occasionally, (5) very frequently, (6) always. The higher the total and subscales scores, the higher the frequency of self-care activities performed by individuals.

The second measure was represented by the Patient Health Questionnaire (PHQ-9) for screening depression (45). This brief instrument in the form of a self-report questionnaire is able to diagnose not only depressive symptoms but also the severity of depression. The PHQ-9 instrument was selected based on its acceptance and common use in the professional and scientific community. The following responses were provided to PHQ-9 items (numerical coding): (1) not at all, (2) several days, (3) more than half the days, (4) nearly every day. The participants' responses recorded the period of the past 2 weeks before completing the questionnaire. The instrument provides a total score ranging from 9 to 36 with thresholds: 14–18 mild depressive symptoms, 19–24 moderate depressive symptoms, 25–29 moderately severe depressive symptoms, >29 severe depressive symptoms. Thus, the higher the total score, the more severe the depression. Cronbach's α was 0.89 (confidence interval—CI: 0.88–0.90).

Participants and Data Collection

A total of 958 responses were obtained, 152 of which were excluded due to non-compliance with criteria such as approved consent to participate in the survey, age over 18 years, but also due to system error, incomplete data, and irrelevant responses. Thus, 806 participants were included in the final research sample. In addition to screening measures presented above, the questionnaire also collected various socio-demographic information about participants. In terms of gender, there were 314 males and 492 females. Age was expressed using generational categories: participants born before 1980 (>41 years) = 176, between 1980 and 1989 (32–41 years) = 113, between 1990 and 1999 (22–31 years) = 427, in 2000, and later (<22 years) = 90. Females and young adults were slightly predominant in the research sample, but this limitation should not be considered as a bias that could significantly impair the results. In terms of social status, students slightly predominated (full-time student = 364, pensioner (old-age, disabled, etc.) = 26, maternity leave/guardianship = 18, unemployed = 31, entrepreneur = 50, employed = 317).

Data were collected through an online questionnaire from February 12, 2021 to February 23, 2021. Thus, the collection took 12 days, which can be considered a strength of research, as possible externalities during the pandemic with changing conditions were minimized. The subjects were the adult Slovak population. The data collection process was based on quota selection respecting gender, age and social status. The effort was to achieve a proportionally divided sample by gender. In terms of social status, a maximum of 30% of students, 50% of workers, and a maximum of 20% of other categories were expected. In terms of age, it was expected that 10% of participants were born in 2000 and later, while in the other three categories there was an effort to achieve approximately proportional representation. Some deviations from the country population could be observed, i.e., young people, females and students predominated. This can be considered a limitation of the study. On the other hand, the data collection was completed after 12 days as planned, because the risk of skewing results due to external social influences was more severe than the risk of some deficiencies in the sample. The time of collection was considered to be the most serious attribute of the negative effects on the sample during the pandemic.

The questionnaire was freely shared, but also promoted on the social network Facebook, while the target audience was controlled. Subsequently, the questionnaire was distributed to groups on the social network with a specific request for completion. Similar requests were sent by emails, which were obtained from publicly available databases.

Governance and Ethics

The study was conducted according to the guidelines of the Declaration of Helsinki (46). The research was approved by the Ethics Committee of the Clinical Trials Services, USP TECHNICOM, Technical University of Košice, Slovakia (Ref. 02/03/2021 IG Bioinformatics). At the beginning of the questionnaire, all participants received the same information about the research and they were provided with information about their rights and anonymity. All participants included in the research confirmed their informed consent. The participants did not receive any financial reward.

Statistical Analysis

The following statistical approach was selected to meet the main aim of this study. The characteristics of the central tendency (mean, median) were used for the statistical description. The level of reliability was verified by Cronbach's α. Non-parametric tests of differences (Wilcoxon signed-rank test, Kruskal Wallis test) were applied to evaluate possible differences in self-care activities and depression between individual population categories. The preference for non-parametric statistical methods was conditioned by the fact that several variables or groups of

TABLE 1 | Description of the data.

LV ID	MV ID	Questionnaire item	Mean	Median	Cr α (CI)
HC	HC 1	I am alert to changes in my health	4.84	5	0.82
	HC 2	I am usually aware of my health	5.25	5	(0.81–0.84)
	HC 3	I reflect about my health a lot	4.35	5	
	HC 4	I know my inner feelings about my health	4.95	5	
	HC 5	I am constantly examining my health	3.73	4	
NPA	NPA 1	I do physical activity (some sport, yoga, or dance) for at least 30 min a day	4.06	4	0.75
	NPA 2	I eat three servings of fruit and two of vegetables daily	4.36	5	(0.72–0.75)
	NPA 3	I think I am eating better than I used to (less sugar, salt, fried snacks, or precooked food)	4.06	4	
	NPA 4	I'm drinking an average of eight glasses of water a day	4.56	5	
SLP	SLP 1	I sleep 7–8 h a day	4.68	5	0.82
	SLP 2	I think that my rest is of quality	4.41	5	(0.79–0.84)
IICS	IICS 1	I am learning to do new things like: playing an instrument, sports, practicing a new language, cooking, painting, new apps, video games, etc.	3.80	4	0.58
	IICS 2	I actively participate in the initiatives of my community (e.g., clapping, singing, playing music, offering my support in what I could help, etc.)	2.53	2	(0.35–0.63)
	IICS 3	I am finding moments to be more connected to myself (I observe, write, or reflect on my thoughts, emotions, or behaviors)	4.25	4	
PHQ-9	PHQ-9 1	Little interest or pleasure in doing things	2.14	2	0.89
	PHQ-9 2	Feeling down, depressed, or hopeless	2.02	2	(0.88–0.90)
	PHQ-9 3	Trouble falling or staying asleep, or sleeping too much	1.92	2	
	PHQ-9 4	Feeling tired or having little energy	2.33	2	
	PHQ-9 5	Poor appetite or overeating	1.81	1	
	PHQ-9 6	Feeling bad about yourself—or that you are a failure or have let yourself or your family down	1.74	1	
	PHQ-9 7	Trouble concentrating on things, such as reading the newspaper or watching television	1.95	2	
	PHQ-9 8	Moving or speaking so slowly that other people could have noticed? Or the opposite —being so fidgety or restless that you have been moving around a lot more than usual	1.32	1	
	PHQ-9 9	Thoughts that you would be better off dead of or hurting yourself in some way	1.37	1	

LV, latent variable; MV, manifest variable, Cr α, Cronbach's α; CI, confidence interval; HC, health consciousness; NPA, nutrition and physical activity; SLP, sleep quality; IICS, interpersonal and intrapersonal coping strategies; PHQ-9, patient health questionnaire.

variables did not meet the conditions for the use of parametric tests (normality, homogeneity of variances). Correspondence analysis was performed using Pearson's χ^2-test. Finally, the associations between self-care activities and depression were verified using quantile regression (Percentile: $\lambda = 0.25, 0.50, 0.75$). Quantile regression analysis was preferred over other regression models, as this method is able to minimize the risk of skewing results due to identified deficiencies in the sample (deviations from the population).

The analytical calculations were performed using the programming language R v 4.1.1 (RStudio, Inc., Boston, MA, USA) and SPSS v 26 (Armonk, NY: IBM Corp.).

RESULTS

This section presents the main results and their interpretation. The results were obtained through several analytical procedures, including a statistical evaluation of the validity of the SASS-14 instrument, an assessment of the differences in the measured scores between gender and age categories, as well as a statistical examination of the associations between self-care activities and depression. At the beginning, a description analysis and a difference analysis were performed in order to provide a more detailed view of the analyzed data. Subsequently, a correspondence analysis focused on the links between gender-age characteristics, self-care activities in selected dimensions, and depression. At the end of this section, the main results of a quantile regression analysis were offered to determine the associations between self-care activities and depression.

Table 1 provides an overview of the latent variables (LV), which consist of manifest variables (MV) with the relevant identification number (ID), as well as their full wording. These LVs were included in the subsequent analyzes and were formed by the arithmetic mean of the individual MVs of the SASS-14 instrument and the sum of the PHQ-9 instrument. The measures of central tendency (mean, median) are offered for individual items of the questionnaire.

As stated in the methodology, the SASS-14 questionnaire items were scored in the interval 1 (never) to 6 (always), which means that the higher the number, the more frequent the specific self-care activity. In general, the mean and median values of the self-care activities ranged from 4 to 5 (**Table 1**). This finding revealed the fact that Slovak participants performed individual self-care activities occasionally or very frequently during the COVID-19 pandemic. The only exception was participation in

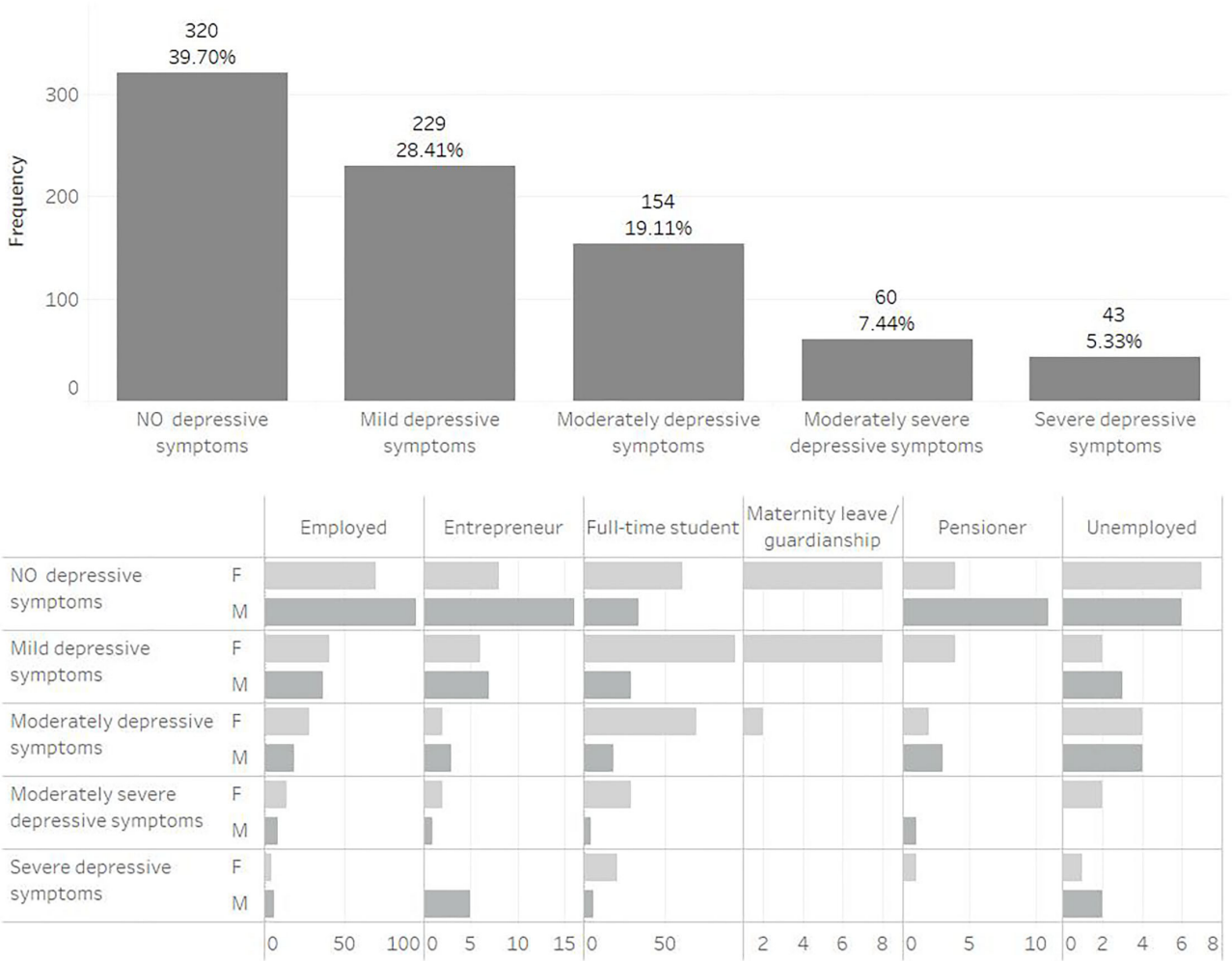

FIGURE 1 | Frequency of depressive symptoms among Slovak participants.

the initiatives of participants' community (IICS 2), which was very rare among participants (mean = 2.53; median = 2). On the other hand, health awareness was very frequent among participants (HC 2: mean = 5.25). Self-care behaviors such as alertness to changes in health (HC 1) or knowledge of inner feelings about health (HC 4) were also frequent. The PHQ-9 questionnaire items for depression were scored from 1 (not at all) to 4 (nearly every day). As can be seen, the mean values ranged from 1.32 to 2.33, indicating that Slovak participants reported individual depressive symptoms in several days during the past 2 weeks.

Based on the values of Cronbach's α, the reliability level could be considered acceptable in almost all cases analyzed. Only an item concerning IICS proved to be weaker in terms of reliability, and this could be considered as a certain limitation of the research.

Figure 1 provides more detailed information on depressive symptoms in Slovakia, while participants were assigned to one of five categories based on their depression score (PHQ-9). As can be seen, no depressive symptoms were found in 320 participants (39.70%). On the other hand, 229 participants (28.41%) reported mild depressive symptoms, 154 participants (19.11%) reported moderate depressive symptoms, 60 participants (7.44%) reported moderately severe depressive symptoms and 43 participants (5.33%) reported severe depressive symptoms. The results are also presented in terms of social status.

The following analyzes included the average scores of individual self-care activities (HC, NPA, SLP, and IICS) and the depression score (PHQ-9) as the sum of the values in the individual items. This approach was in line with the recommended procedure for adjusting selected scales.

Figure 2 shows self-care activities and depression in box plots, as well as the results of difference tests. This allows a closer look at the examined indicators. On this basis, significant differences between individual age categories and between gender categories were found in SLP, IICS, and depression (PHQ-9). This justifies the idea of examining the associations between self-care activities and depression in age and gender classifications. In terms of

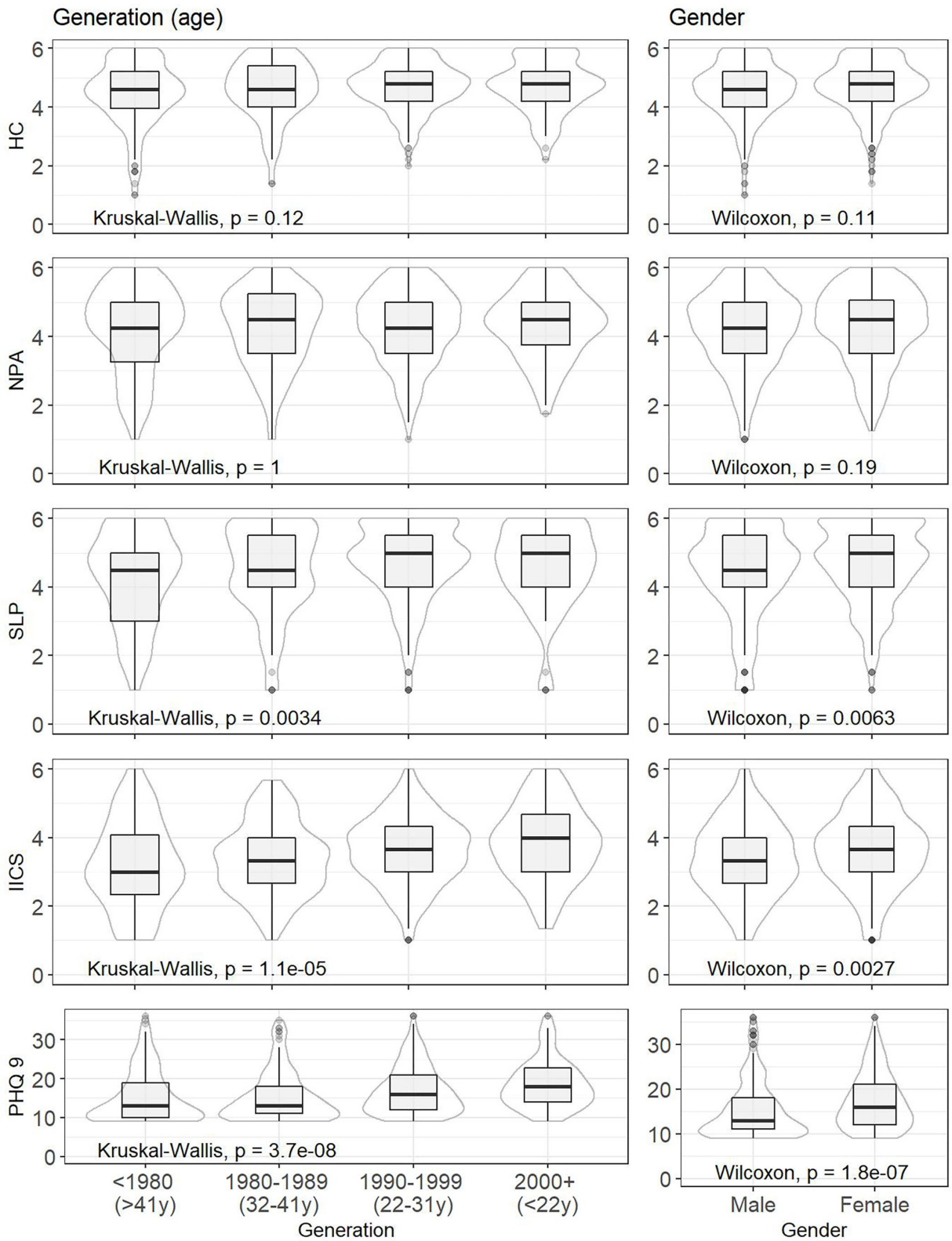

FIGURE 2 | Selected statistical characteristics of indicators and results of difference tests—classification by age and gender.

gender, females reported significantly higher levels of depression than males. Females also reported more self-care activities such as IICS and SLP. From an age perspective, younger participants were more prone to depression, and they reported more self-care activities such as IICS and SLP. Accordingly, significantly less IICS and SLP were observed among older participants aged 32 years and over (age categories: >41 years, 32–41 years).

Figure 2 also points to the median values of the indicators in individual population groups. The median value of 15 was found for all participants, which means mild depressive symptoms. Mild depressive symptoms were also common for females (median = 16), but not for males (median = 13). The youngest participants reported mild depressive symptoms, but their median score was on the verge of mild and moderate depression (median = 18). This was not the case for the oldest participants (median = 13).

The following correspondence analysis was used to assess the links between self-care activities, depression, and gender-age characteristics. The identification of the closest links can be important from a public health point of view, as it more precisely defines the population group to which increased attention should be paid. Self-care and depression indicators were transformed into percentiles (<25th perc., 25th−50th perc., 50th−75th perc., >75th perc.) and gender-age categories were merged (oldest males: M and >41 years, older males: M and 32–41 years,

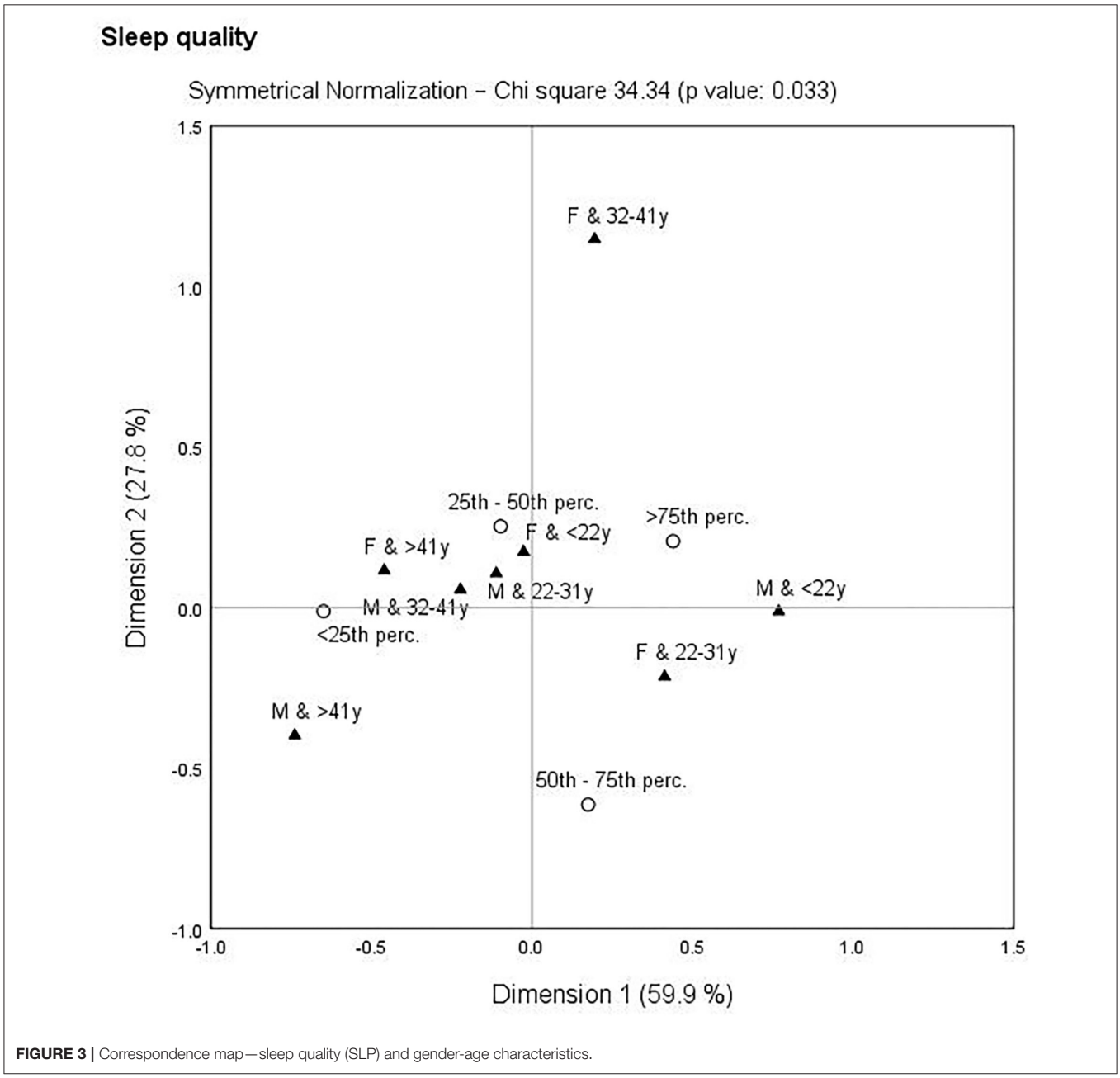

FIGURE 3 | Correspondence map—sleep quality (SLP) and gender-age characteristics.

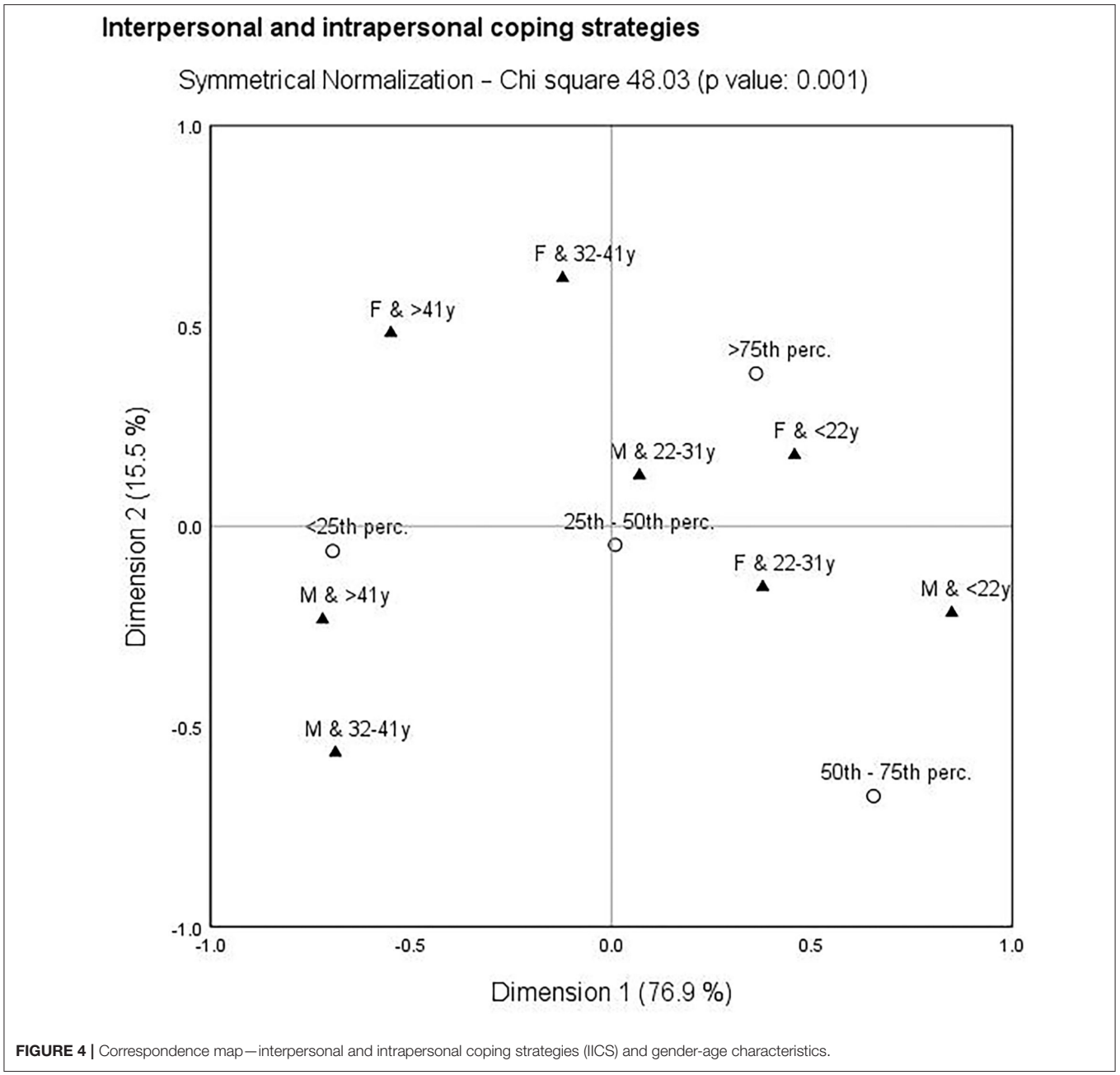

FIGURE 4 | Correspondence map—interpersonal and intrapersonal coping strategies (IICS) and gender-age characteristics.

younger males: M and 22–31 years, youngest males: M and <22 years, oldest females: F and >41 years, older females: F and 32–41 years, younger females: F and 22–31 years, youngest females: F and <22 years). Based on the results, there was no significant link in terms of HC ($\chi^2 = 23.89$, p-value = 0.298) and NPA ($\chi^2 = 15.41$, p-value = 0.802). In contrast, significant links with gender-age characteristic were identified for SLP ($\chi^2 = 34.34$, p-value = 0.033), IICS ($\chi^2 = 48.03$, p-value = 0.001), and depression (PHQ-9: $\chi^2 = 76.00$, p-value = <0.001). These links are shown in **Figures 3**–**5**.

With a focus on **Figure 3**, which is devoted to SLP and gender-age characteristics, several links could be observed. It is clear that younger participants showed higher SLP compared to older participants. In other words, younger participants were concentrated around the higher SLP. It is also evident that females aged 32–41 years appeared as a distant group.

Figure 4 deals with IICS and gender-age characteristics. It was possible to identify closer links than in the previous figure. The three closest links were found, namely the oldest males (>41 years) were concentrated around the lowest IICS (<25th perc.), younger males (22–31 years) were concentrated around the moderate IICS (25th—50th perc.), and the youngest females (<22 years) were concentrated around the highest IICS (>75th perc.).

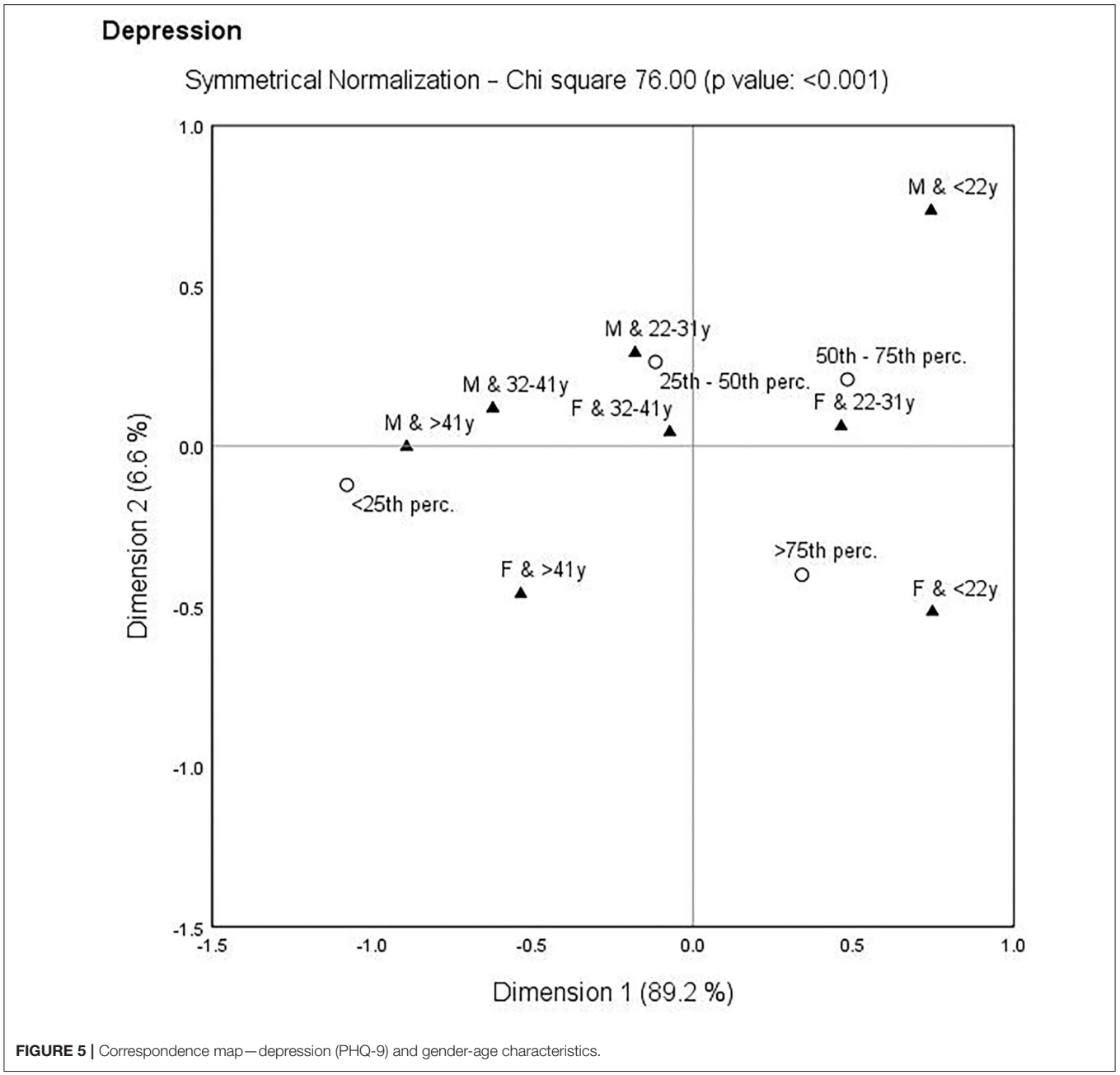

FIGURE 5 | Correspondence map—depression (PHQ-9) and gender-age characteristics.

Finally, the closest links were observed in **Figure 5**, which deals with depression (PHQ-9) and gender–age characteristics. It was possible to highlight the link of the oldest males (>41 years) with the lowest depression (<25th perc.), but also the link of the youngest females (<22 years) with the highest depression (>75th perc.).

The purpose of the following quantile regression analysis was to evaluate the associations between self-care activities and depression. In this analysis, depression, as a dependent variable, was divided into quartiles (25th percentile, 50th percentile, 75th percentile). Prior to the application of the analysis, the assumption of multicollinearity was evaluated, while the value of the variance inflation factor did not exceed the limit value of 10 in any of the analyzed cases.

Based on the results of the quantile regression analysis shown in **Table 2**, several significant associations could be confirmed. For all participants, IICS and HC were positively associated with the lowest depression ($\lambda = 0.25$). There were negative associations between SLP and the lowest depression in all participants, males and females. For females, it was also possible to observe that HC was positively associated with the lowest depression.

Consequently, SLP was negatively associated with moderate depression ($\lambda = 0.50$) in all participants, the oldest participants

TABLE 2 | Quantile regression analysis—associations between self-care activities and depression for all participants and their categories by age and gender.

Coef	All	<1980 (>41 years)	1980–1989 (32–41 years)	1990–1999 (22–31 years)	2000+ (<22 years)	Males	Females
$\lambda = 0.25$							
(Intercept)	**10.34† (1.36)**	**9.45† (2.72)**	**12.08** (4.74)**	**2.59** (4.88)**	**16.07*** (5.97)**	**10.8† (2.15)**	**11.61† (2.02)**
IICS	**0.57** (0.26)**	0.2 (0.63)	0.22 (0.75)	0.41 (1.18)	0.52 (1.02)	0.25 (0.41)	0.63* (0.36)
HC	**1*** (0.31)**	0.65 (0.74)	0.59 (0.83)	0.57 (1.07)	1.12 (1.36)	0.59 (0.47)	**1.48*** (0.48)**
NPA	−0.31 (0.26)	−0.13 (0.7)	0.2 (1.02)	0.39 (−0.3)	−0.88 (1.13)	−0.05 (0.42)	−0.21 (0.38)
SLP	**−0.86† (0.25)**	−0.53 (0.65)	−1.18 (0.76)	0.42 (−2.23)	−1.13 (0.8)	**−0.75** (0.37)**	**−1.53† (0.35)**
Pseudo R^2	0.038	0.035	0.052	0.021	0.058	0.033	0.055
$\lambda = 0.5$							
(Intercept)	**15.59† (1.89)**	**9.65*** (3.31)**	**17.34*** (6.36)**	**3.15*** (5.62)**	**16.35** (7.01)**	**11.84† (2.64)**	**15.24† (2.5)**
IICS	0.58* (0.3)	−0.13 (0.72)	0.73 (0.99)	0.45 (1.48)	0.52 (1.21)	0.36 (0.47)	0.83* (0.43)
HC	**1.49† (0.39)**	1.62* (0.89)	0.92 (1.07)	0.62 (1.99)	1.46 (1.54)	0.9 (0.58)	**1.78*** (0.54)**
NPA	−0.57* (0.33)	0.55 (0.81)	−1 (1.25)	0.45 (−0.59)	−0.94 (1.39)	−0.28 (0.51)	−0.58 (0.42)
SLP	**−1.5† (0.28)**	**−1.37** (0.67)**	−1.31 (0.87)	0.42 (−4.39)	−0.78 (0.97)	−0.67 (0.43)	**−1.69† (0.36)**
Pseudo R^2	0.042	0.039	0.092	0.046	0.071	0.028	0.069
$\lambda = 0.75$							
(Intercept)	**21.22† (2.47)**	**16.71† (3.73)**	**33.26† (5.73)**	**3.49† (7.49)**	**16.26** (6.77)**	**21.52† (4.02)**	**19.2† (2.94)**
IICS	0.56 (0.42)	0.93 (0.87)	0.77 (0.94)	0.55 (0.1)	−0.23 (1.2)	0.31 (0.58)	0.61 (0.56)
HC	**1.63† (0.49)**	1.61 (1.02)	0.74 (1.07)	0.66 (1.44)	**3.08** (1.48)**	1.13 (0.73)	**2.29† (0.6)**
NPA	−0.69* (0.41)	0.19 (0.94)	**−3.95† (1.14)**	**0.54† (0.07)**	−0.56 (1.45)	−0.6 (0.8)	−0.33 (0.48)
SLP	**−1.74† (0.33)**	**−2.1** (0.84)**	−0.76 (0.82)	0.43 (−5.36)	−1.07 (1.01)	**−1.56*** (0.58)**	**−2.15† (0.42)**
Pseudo R^2	0.057	0.054	0.186	0.062	0.069	0.057	0.066

*HC, health consciousness; NPA, nutrition and physical activity; SLP, sleep quality; IICS, interpersonal and intrapersonal coping strategies; PHQ-9: patient health questionnaire. Significant results are highlighted in bold. *p-value < 0.1. **p-value < 0.05. ***p-Value < 0.01. † p-value < 0.001.*

(>41 years) and females. Also, a significant positive association between HC and moderate depression was observed in all participants and females.

In terms of the highest depression rates ($\lambda = 0.75$), a significant association was confirmed in each category of participants. For all participants, the youngest participants (<22 years) and females, HC was positively associated with the highest depression. A significant negative association between SLP and the highest depression was identified for all participants, the oldest participants (>41 years), males and females. Interestingly, NPA was negatively associated with the highest depression in participants aged 32–41 years, while a positive association was observed in participants aged 22–31 years.

The above-mentioned associations could be summarized and interpreted as follows. More IICS were associated with more depression in all participants with the lowest depression score. Higher HC was associated with more depression, especially in all participants and females. More NPA was associated with less depression in people aged 32–41 years, but with more depression in people aged 22–31 years. Higher SLP was associated with less depression, especially for all participants and females.

DISCUSSION

This study contributes to the issue of self-care and mental health, which has an important position in social and professional discussions, especially during the COVID-19 pandemic. Based on the results, it can be concluded that Slovak participants performed self-care activities occasionally or very frequently during the COVID-19 pandemic. This can be considered a positive aspect during the COVID-19 pandemic, as self-care behavior is very beneficial in the lives of individuals (29, 34). From a public health perspective, it is important that individuals take care of themselves, especially during a difficult pandemic period. Among Slovak participants, health awareness appeared to be a very frequent self-care behavior. Overall, HC was the area of self-care that showed the highest scores. The key message of this finding is that individuals were heavily focused on their health during the health crisis. This can be further supported by public health interventions in such a way that it becomes an integral part of their lives, not only in a crisis situation. On the other hand, participation in community initiatives was very rare. This means that Slovaks did not engage in activities such as clapping, singing, playing music from home, which were popular in other countries during the pandemic.

This indicated the diversity of cultures that should be taken into account when creating targeted health-promoting self-care programs. The youngest participants and females reported significantly more self-care activities, especially in terms of IICS and SLP. Focusing on depression, Slovak participants reported individual depressive symptoms for several days during the past 2 weeks. In other words, all participants reported mild depressive symptoms. For public health professionals, this means the need for increased attention and constant monitoring of mental health. Females and young people were the most vulnerable group in terms of depression, and these population groups need increased attention from policy makers when developing successful mental health strategies. These findings support an interesting fact that females and young people were at higher risk of depression despite their higher levels of SLP and IICS. On the other hand, vulnerability of females and young people to psychological symptoms (including depression) during the COVID-19 pandemic was also demonstrated in many other studies (26, 47–50). Xiong et al. (10) also confirmed that common risk factors for mental discomfort during the pandemic were female gender, younger age (under 40 years), but also chronic or psychiatric disease and frequent exposure to social media and news concerning COVID-19. Using correspondence analysis, this study supported that participants' gender-age characteristics were linked with IICS, SLP, and depression. Therefore, gender and age should be taken into account when developing targeted public health strategies. The results agreed with the above-mentioned findings, thus more depression and self-care activities were observed in younger people, while lower scores were found in older people.

This study revealed the fact that several self-care activities were significantly associated with depression. Di Benedetto et al. (40) also emphasized that individuals with the healthiest self-care behaviors were also characterized by the lowest levels of depression. Daniali et al. (44) also revealed a significant association between depression and self-care behavior among Iranian patients with chronic diseases. The opposite perspective was examined among patients with diabetes in a study conducted by Chan et al. (41), who revealed that depression was associated with self-care activities, such as lower rates of reduced or stopped smoking and drinking, less exercise, less regular lifestyle, but also more use of health care and higher rates of foot care. Similar results were confirmed by Chen et al. (42), who found that self-care behaviors affected life satisfaction, while depression affected self-care behaviors and life satisfaction. This evidence confirmed the fact that depression is indirectly and directly associated with self-care (42, 43). The study supports the idea that self-care plays an important role in mental health. This is the key idea that public health professionals should focus on in order to improve the mental health of the population.

Specifically, higher HC was associated with higher depression in all participants (without classification) and females, regardless of depression score, but also in the youngest people (<22 years) with the highest depression score. This can be explained by the fact that those who paid more attention to their health during the COVID-19 pandemic also reported more depressive symptoms. It is well-known that emotional attention is positively related to perceived mental discomfort (51). In other words, individuals with greater concerns about their health may be sensitive to depression during a serious situation such as the COVID-19 pandemic (52, 53). The intensity of worried thoughts and health concerns about COVID-19 were found to be positively correlated with anxiety and depression, and negatively with SLP (54). In terms of the findings revealed in this study, Lee (55) also found that HC is positively related to fear and anxiety and not related to information seeking. According to the authors, health-conscious individuals were more likely to experience mental discomfort than those with low HC. In the context of this study, it is necessary to consider the effect of the pandemic on individuals and what information individuals had or what sources of information they sought. If this information caused health concerns during the pandemic, a higher rate of depression is understandable. Public health efforts should focus on eliminating disruptive information that could adversely affect HC. At this point, health literacy among the population should be underlined (43, 56). According to Wang et al. (57), health literacy has a multiple mediating effect on the relationship between depression and self-care behavior. Therefore, it is important to know what information individuals have and how this information shapes their behavior, mental state and frailty, especially during the COVID-19 pandemic. Health literacy and access to health information are known to improve quality of life (58), but the right information should be provided and communicated in an appropriate way.

It was also found that more NPA was associated with less depression in people aged 32–41 years, but with more depression in people aged 22–31 years. This discrepancy needs to be examined, as evidence from many studies has shown that physical activity and healthier eating habits predict better well-being (59, 60) and lower rates of depression (61–63). In this context, a reduction in exercise duration was considered a risk factor for depression, while an increase in exercise frequency was found to be a protective factor against depressed mood (64). Thus, the promotion of health activities is welcome (65, 66). Some inconsistencies could be observed in healthy eating, as some studies have supported the significant relationship between healthy nutrition and depression (67), while others have not (44). This indicates that NPA is a complex component of self-care and that further deeper investigation is needed to address these discrepancies. The type of questionnaire should also be considered.

Again, interestingly, this study showed that more IICS were associated with more depression in individuals with the lowest depression score. The opposite view was presented by Lara et al. (68), whose results indicated that active coping strategies may be helpful in the management of negative mental states during the COVID-19 pandemic. Miklowitz (69) also stated that cognitive and interpersonal coping strategies are effective for depressive symptoms. Thus, the findings in this study showed some inconsistency with previous findings, which encourages further investigation.

Regarding the quality of sleep, the findings were in line with well-known facts. Accordingly, higher SLP was associated with more depression, especially for all participants (without

classification) and females regardless of depression score, for males with the lowest and highest depression score, and for people aged 41 years and over with the highest and moderate depression score. This finding indicated that less depression could be expected with higher SLP, and the opposite view suggested that lower SLP may lead to more depression. In this context, it was possible to support the idea that good SLP is inversely associated with higher levels of depression (40). In contrast, poor SLP can be considered one of the most significant risk factors for mood disorders during the COVID-19 pandemic (70). Lee et al. (71) also emphasized that individuals with poor SLP are more likely to have some or severe problems not only with depression or anxiety, but also with physical activity, self-control and daily activity, and this may be reflected in an impaired quality of life. Thus, it can be concluded that SLP significantly predicts the severity of depressive symptoms (39, 72), and the presented study enriches this knowledge.

In conclusion, the internal consistency of the SASS-14 measure was good with acceptable to high (0.58–0.82) reliability in its subscales, which is in line with the results of the authors of this screening measure (38). The applied tools for measuring depression and self-care activities proved to be reliable for their use in the Slovak population by researchers and experts working in public health.

Public Health Implications

The findings revealed in this study emphasize the importance of a proactive approach to self-care and the integration of self-care behavior into mental health programs that respect gender and age differences. It is recommended to develop and implement programs to improve self-care behavior across the entire Slovak population, not just patients. The supportive educational intervention developed based on the self-care theory can help manage and maintain mental health not only during a stressful period, such as the COVID-19 pandemic. These programs should focus on increasing and maintaining motivation to practice and include self-care activities in daily routines. This effort would be positively reflected in public health outcomes, as higher levels of self-care knowledge, motivation and skills are expected (73). Gender and age should also be taken into account when developing public health programs aimed at self-care behavior and mental health. In terms of poor mental health, females and younger individuals need targeted interventions. Above all, self-care requires a commitment to an individual's own well-being as a priority (29). In this context, efforts to improve self-care behavior may be more effective if depression is also effectively managed (74).

As the study revealed a positive association between HC and depression, increased attention during the COVID-19 pandemic should be focused on information that shapes HC. One possible explanation for this result could be the high exposure to information about COVID-19, which grows into constant exposure to overwhelming news headlines and misinformation (26, 75). Therefore, in an effort to improve self-service behavior and mental health, emphasis should be placed on the reliability and clarity of information, accessibility, careful communication, and relevant resources. Given the links between health literacy and self-care, health literacy also has a justified place in this problem. A higher health literacy is significantly correlated with greater self-care behavior (76, 77). In addition, health literacy is considered a mediating variable between depression and self-care (57). Therefore, public health leaders should take steps to increase health literacy.

Health-promoting preventive self-care interventions are promising to increase the well-being of healthy individuals (78), and the demand for them increases even more during the pandemic. In the current situation, when the world is dominated by COVID-19, the development of self-care programs in Slovakia appears to be insufficient, but their role in the mental health of the population may be crucial. Despite the importance of this issue, it is still a poorly examined problem. Also, at the level of Slovak public policies, not enough attention is paid to this issue. Expanding the knowledge base would help speed up the process of efforts to implement successful evidence-based strategies. It is therefore appropriate to encourage international cooperation in order to create a valuable information platform, which should then be applied at policy level (79).

Strengths and Limitations

The study enriches the knowledge base about self-care behavior and its relation to mental health. Thus, this study clarifies the associations between self-care activities and depression in the Slovak population, while respecting gender and age characteristics. As previous literature has focused on the role of depression in individual self-care activities, the results of this study provide novelty in terms of the role of self-care activities in depression. In addition, the research covered the whole concept of self-care and respected gender and age differentiation. The fact that the study is focused on a non-patient sample can also be considered a strength. The findings are of great importance for public health and offer guidance to Slovak public health leaders in terms of improving mental health. Last but not least, this study is an important appeal for the development of health-promoting preventive self-care programs, which are lacking in Slovakia.

Despite the many strengths of this study, it is necessary to point out its limitations, which could be addressed in future research. In particular, the disproportionate nature of the sample could be included in the limitations of this study. Thus, there was a higher proportion of females and the social status of students (younger participants). However, this limitation need not be considered disruptive to the results and value of knowledge. The analysis was performed in the decomposition of identifiers, thus the problem of disproportionality of the sample was dispersed. Also, it must be emphasized that self-care is not the only factor in depression. Thus, the results should not be considered the only right pathway. Future research should address these limitations. Another limitation could be the fact that the SASS-14 measure is a new instrument and the factor of IICS showed relatively lower reliability values, which were accepted by the authors of the instrument. Therefore, future research should focus on this factor in order to find out whether it would show relatively low reliability also in other population groups. Regarding the limitations of the used models, it should be noted that causality

was not examined in this study. For this reason, the findings cannot be interpreted as causal. All the results can only be understood in terms of associations, while a consideration of causal relationships can be misleading.

CONCLUSION

The aim of the presented study was to evaluate the associations between self-care activities and depression in the general Slovak population, but also in its individual gender and age categories. The study answered the question how self-care activities are associated with depression. This provided a deeper insight into the issue, and the main findings support the general idea that well-practiced self-care activities should be an immediate part of an individual's life in order to improve mental health, especially to reduce depressive symptoms. In this context, SLP plays an important role, while HC indicates the need for increased attention during the pandemic. Public health efforts should focus on improving SLP and alleviating disturbing information that could adversely affect HC, and these efforts could be reflected in reducing depression. In this way, health literacy should be improved in Slovakia. Other dimensions of self-care have also shown significant results that should be taken into account. In terms of poor mental health, females and younger individuals need targeted interventions in this country. The findings call for immediate support for self-care behavior and the development of successful strategies aimed at the non-patient population. Slovak health policy leaders should focus on health-promoting preventive self-care interventions, as the demand for them increases even more during the pandemic. Gender and age characteristics should also be taken into account in this effort.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The study was conducted according to the guidelines of the Declaration of Helsinki. The research was approved by the Ethics Committee of the Clinical Trials Services, USP TECHNICOM, Technical University of Košice, Slovakia (Ref. 02/03/2021 IG Bioinformatics). All participants included in the research confirmed their informed consent. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

BG: conceptualization, investigation, resources, writing—original draft preparation, visualization, writing—review and editing, supervision, project administration, and funding acquisition. BP: conceptualization, visualization, writing—review and editing, supervision, project administration, and funding acquisition. VI: conceptualization, investigation, resources, writing—original draft preparation, visualization, writing—review and editing, and supervision. MR: conceptualization, methodology, formal analysis, investigation, data curation, writing—original draft preparation, and writing—review and editing. All authors contributed to manuscript revision, read, and approved the submitted version.

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SYSTEMATIC REVIEW
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COVID-19 Pandemic and Overall Mental Health of Healthcare Professionals Globally: A Meta-Review of Systematic Reviews

Muhammad Chutiyami[1], Allen M. Y. Cheong[2,3]*, Dauda Salihu[4], Umar Muhammad Bello[3,5], Dorothy Ndwiga[1], Reshin Maharaj[1], Kogi Naidoo[6], Mustapha Adam Kolo[7], Philomina Jacob[8], Navjot Chhina[6], Tan Kan Ku[6], Liza Devar[1], Pratitha Pratitha[1] and Priya Kannan[9]*

[1] School of Nursing, Institute of Health and Management, Sydney, NSW, Australia, [2] School of Optometry, The Hong Kong Polytechnic University, Kowloon, Hong Kong SAR, China, [3] Centre for Eye and Vision Research, Hong Kong, Hong Kong SAR, China, [4] School of Nursing, The Hong Kong Polytechnic University, Kowloon, Hong Kong SAR, China, [5] Department of Physiotherapy, Yobe State University Teaching Hospital (YSUTH), Damaturu, Nigeria, [6] Institute of Health and Management, Melbourne, VIC, Australia, [7] Department of Geography, University of Maiduguri, Maiduguri, Nigeria, [8] Health Careers International Pty Ltd., Kochi, India, [9] Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Kowloon, Hong Kong SAR, China

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Xenia Gonda,
Semmelweis University, Hungary

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Andrea Fiorillo,
University of Campania Luigi Vanvitelli, Italy

***Correspondence:**
Muhammad Chutiyami
muhammad.c@ihm.edu.au
Allen M. Y. Cheong
allen.my.cheong@polyu.edu.hk

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Objective: This meta-review aimed to provide a comprehensive overview of overall mental health of healthcare professionals during the COVID-19 pandemic.

Method: We conducted a comprehensive literature search on Academic Search Premier, CINAHL, Cochrane Library, and MEDLINE. A predefined eligibility criterion was used to screen the articles. The methodology quality of eligible studies was assessed using Joanna Briggs Institute checklist for systematic reviews. The data were narratively synthesised in line with the meta-review aim.

Result: Forty systematic reviews (represented as $K = 40$), which reported data from 1,828 primary studies (N) and 3,245,768 participants, met the inclusion criteria. The findings from a pooled prevalence indicate that anxiety (16–41%, $K = 30$, $N = 701$), depression (14–37%, $K = 28$, $N = 584$), and stress/post-traumatic stress disorder (18.6–56.5%, $K = 24$, $N = 327$) were the most prevailing COVID-19 pandemic-related mental health conditions affecting healthcare workers. Other reported concerns included insomnia, burnout, fear, obsessive-compulsive disorder, somatization symptoms, phobia, substance abuse, and suicidal thoughts. Considering regions/countries, the highest anxiety was reported in the United-Kingdom [22.3, 95% Confidence Interval (CI):7–38, $N = 4$] compared to other countries, while the highest depression was in the Middle-East, (41, 95% CI:16–60, $N = 5$) and stress in the Eastern Mediterranean region (61.6, 95% CI:56.4–66.8, $N = 2$) compared to other regions. The most significant risk factors include female gender, younger age, being a nurse, and frontline professional. The most-reported coping strategies include individual/group psychological support, family/relative support, training/orientation, and the adequacy of personal protective equipment.

Conclusion: It was concluded that healthcare professionals (nurses, doctors, allied health) have experienced various mental health issues during COVID-19 pandemic.

The meta-review, therefore, recommends targeted interventions and health policies that address specific mental health issues to support health professionals worldwide during the duration of the COVID-19 pandemic and similar future health crises.

Systematic Review Registration: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD4202126200, identifier: CRD42021262001.

Keywords: COVID-19, health professional, mental health, review–systematic, coping strategies

INTRODUCTION

Coronavirus pandemic (COVID-19) has caused an unprecedented concern across the globe since the current outbreak began in 2019 in Wuhan, China (1). The outbreak was declared a pandemic by the World Health Organisation (WHO) in March 2020 (2). As of 4 September 2021, over 200 million cases and 4.5 million deaths have been reported across more than 200 countries/territories worldwide (2). The number of cases and mortalities continue to increase across different countries despite efforts to control and manage the threat. Recent mutations in the virus represent a constant concern, with new strains, such as the Bengal variant identified in India (3), leading to second and third waves of the disease transmission in multiple countries (2).

The COVID-19 pandemic has resulted in significant impacts not only among the general population and affected patients but also among the health professionals (interchangeably referred to as healthcare workers (HCWs) who care for infected patients. Although the pandemic has affected various aspects of health and well-being, mental health is among the most reported concerns (4–6). Countries that have experienced high caseloads, such as Italy (7) and Spain (8), have reported a higher prevalence of mental health issues among healthcare workers (HCWs) relative to less-affected regions. During the early stages of the outbreak, the highest prevalence of mental health concerns was reported in China, where the outbreak originated (4). Similar to the current COVID-19 outbreak, previous pandemics, including those associated with Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS), were characterised as mental health disturbances in both the general population and among health professionals (9–11). The current COVID-19 pandemic has several aspects of psychiatric interest and relevance considering the uncertainties and hopelessness among the general population, of which efforts have not been successful in overcoming the outbreak (12). Marazziti and Stahl (12) added that psychiatrists could play a significant role in supporting nurses, doctors and other frontline professionals as well as managing the long-term consequences of the pandemic. Ghebreyesus (13) further necessitates the need for preparedness and getting services ready, particularly in resource-poor countries before another outbreak through supporting the countries in establishing community-based mental health services for everyone. Therefore, addressing the mental health needs of the general population at large and health professionals, in particular, is of paramount importance.

Many primary studies have been conducted to examine various mental health aspects among health professionals or the general population in different countries, including African (14), American (15), Asian (16–18), and the European (19–22) countries. Similarly, several systematic reviews have been conducted to summarise these mental health concerns among health professionals (23–26). Most systematic reviews have been conducted to explore specific aspects of mental health among health professionals, such as anxiety and depression (26–28), insomnia (29), and post-traumatic stress disorder (PTSD) (30, 31). Other systematic reviews have been conducted in specific categories of HCWs, such as nurses (32), dental professionals (33), or surgeons (10). Systematic reviews have also been limited to certain regions/countries, such as China (34). These systematic reviews have been conducted at different stages of the outbreak, focusing on different factors; the consolidation of these findings is of paramount importance to provide comprehensive evidence regarding the prevalence and risk factors associated with mental health issues among HCWs to guide policymakers and other stakeholders in the allocation of resources and interventions. This review attempted to summarise existing systematic reviews examining the impacts of the ongoing COVID-19 pandemic on various aspects of mental health among health professionals. The primary aim of the current systematic review of systematic reviews (termed a meta-review) was to provide a comprehensive overview of the overall mental health of healthcare professionals during the COVID-19 pandemic. Our secondary aim was to report coping strategies reported alongside the mental health problems to open windows for further studies. For the purposes of this article, the term COVID-19 is used interchangeably to refer to both COVID-19 and SARS-CoV-2 pandemic.

METHODS

A systematic review of systematic reviews (referred to as a meta-review) was adopted for this study. The reporting of this meta-review was guided by the standards established by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) extension statement (35). The review question was formulated using a PICO (Participants, Intervention, Comparator, Outcome) framework. The participants comprised HCWs, including nurses, medical doctors, and allied health professionals such as physiotherapists. For this review, the intervention was considered to be exposure to COVID-19, and the comparator group included members of the general population or non-health professionals. The assessed outcomes were the prevalence and risk factors of various mental health issues. The review was registered with

the international prospective register of systematic reviews (PROSPERO: CRD42021262001).

Eligibility Criteria

Studies were included if they were systematic reviews with or without meta-analyses; were published in the English language; could be obtained in full-text format; and assessed the impacts of COVID-19 among health professionals (medical doctors, nurses, allied health professionals). Scoping reviews and rapid reviews were included if they employed key systematic approaches to the review process, including a predefined search strategy, screening, data extraction, and synthesis. Systematic reviews that included the general population but performed a separate analysis of HCWs were included. Additionally, systematic reviews that synthesised data including previous pandemics but reported separate COVID-19-related findings were also included. Exclusion criteria included traditional literature reviews, narrative reviews (non-systematic), primary studies, non-COVID-19-related studies, and reviews assessing the COVID-19 impacts on non-health professionals.

Information Sources

Four electronic databases, including Academic Search Database, CINAHL Complete, Cochrane Database of Systematic Reviews, and MEDLINE Complete, were searched for eligible studies examining the mental health impacts of COVID-19 pandemic among HCWs. The search was supplemented with a Google Scholar search (first 10 pages), and a "snowballing" approach was used to identify additional resources from reference lists and citations cheques. The search was not restricted by a publication start date, and all databases were searched until June 2021.

Searches

A comprehensive search of each database was conducted using keywords/medical subheading (MeSH) terms to identify relevant systematic reviews. Boolean operators and truncations were also used. EBSCOHost was used to search Academic Search Database, CINAHL Complete, and MEDLINE Complete using the same search terms: (COVID-19 OR Coronavirus OR SARS-COV2) AND ("mental health" OR psychological OR depression OR post-trauma* OR anxiety OR stress* OR burnout OR insomnia OR suicide*) AND ("healthcare worker*" OR "medical staff" OR "health professional*" OR nurse* OR physician* OR "medical doctor") AND ("systematic review" OR "rapid review" OR "scoping review"). Cochrane Database of Systematic Reviews was searched using the terms; (COVID-19 OR Coronavirus OR SARS-COV2) AND ("healthcare worker*" OR "medical staff" OR "health professional*" OR nurse* OR physician* OR "medical doctor"). The search of Google Scholar was conducted using the term "covid-19 healthcare worker mental health." The search was limited to articles published in the English language.

Selection of Evidence

The predefined eligibility criteria were applied to the selection process, which involved the sequential screening of the titles, abstracts, and full texts of the systematic reviews identified by the electronic database search. Three reviewers (MC, UMB, and PJ) screened and selected articles using the predefined inclusion and exclusion criteria. Two of the reviewers (MC and PJ) screened the studies independently and resolved discrepancies by discussion, while the third reviewer (UMB) was involved if an agreement was not reached. The selected studies were systematic reviews examining any aspect of mental health among health professionals during the COVID-19 pandemic.

Data Extraction

Data extraction was performed using a Microsoft Excel package specifically designed to meet the aim of the review. The extraction form was designed by three reviewers (DS, UMB and MAK) and included author's details, the aims of the review/research question(s), types of primary studies included in the review, location of primary studies included in the review, type of health professionals (e.g., nurses) assessed in the review, specific mental health domains assessed, measures/instruments used for assessments, detailed results, and author's conclusions. Two reviewers (LD and PP) extracted the data from the included studies. Differences were resolved through discussion between the two authors. A third reviewer (MC) cross-checked all extracted data for accuracy and completeness.

Critical Appraisal of the Included Studies

Quality appraisals of the included studies were performed using the Joanna Briggs Institute (JBI) checklist for systematic reviews (36). The instrument consists of 11 items that assess different aspects of a systematic review, each of which can be answered using the options "Yes," "No," "Unclear," or "Not Applicable" (36). An appraisal of each included systematic review was conducted independently by two reviewers (PJ and NC). The outcomes of the two reviewers were cross-checked by a third reviewer (MC), and all discrepancies were resolved by the third reviewer through re-examining the article. For this review, the number of items receiving a "yes" answer for each study was counted and used to determine the quality of the review. Although the JBI checklist for systematic reviews does not provide a classification guideline for determining the study quality, we considered studies that satisfied at least 70% of the criteria (8 out of 11 items) to be of good quality.

Synthesis of Results

A meta-analysis was deemed inappropriate for this meta-review, as some of the included studies were already meta-analysed. Conducting a meta-analysis on a review that includes a meta-analysis risks inflating the statistical significance of the results (37). Therefore, an in-depth narrative synthesis was conducted by four of the reviewers (MC, AMYC, DS, UMB).

The narrative synthesis involved a detailed examination of the narrative and numeric summary findings and the reported conclusions regarding the impacts of the COVID-19 pandemic on any aspect of mental health among health professionals, including the prevalence of mental health issues and associated risk factors among medical doctors, nurses, and allied health professionals. The impact of COVID-19 on the overall prevalence of mental health issues was reported for those studies that did not include a comparison with non-health professionals. For

studies that reported a comparison against a non-healthcare population, the impact was reported as either significant or non-significant. Where available and possible, the effect sizes, study designs included in the systematic reviews (narrative synthesis or meta-analysis), and the quality of the systematic review was considered when drawing conclusions.

RESULTS

Selection of Included Studies

The study selection steps are reported in **Figure 1**. The initial search from the four databases (Academic Search Premier, CINAHL, MEDLINE, and Cochrane) resulted in the identification of 503 articles, and the supplemental search performed on Google Scholar resulted in 19 relevant articles, resulting in a total of 522 articles. Duplicate articles were removed, and an English language limitation was applied to the database search, which resulted in the identification of 143 articles. These 143 articles were screened according to titles and abstracts against the eligibility criteria, resulting in the identification of 96 articles that potentially met the inclusion criteria. One study without available full text was removed, and the full texts of the remaining 95 studies were retrieved and screened for eligibility. Finally, 40 studies were identified as fully meeting the eligibility criteria. The reference lists of these 40 studies were reviewed, which did not result in the identification of any additional studies. Therefore, 40 studies were included in the final review.

Characteristics of the Included Studies

The 40 systematic reviews (represented as K) included in this meta-review were published between 2020 and 2021 (**Supplementary Table 1**). The total number of primary studies (represented as N) included in the systematic reviews was 1,828; however, three reviews ($K = 3$, 7.5%) included studies beyond COVID-19, such as those examining the impacts of SARS or MERS. A total of 3,245,768 subjects (represented as n) were included, although the majority of the systematic reviews did not report either genders or ages ($K = 22$, 55%); eight reported one but not the other ($K = 8$, 20%), and only ten reviews reported both ($K = 10$, 25%). Eleven studies reported genders, with women ($n = 468{,}851$, 53.8%) constituting high proportion. Twelve studies reported an age range between 18 and 75 years. Ten studies reported on a mixture of health professionals and the general population ($n = 2{,}204{,}914$, 67.9%), whereas 30 studies included only health professionals with ($n = 1{,}040{,}854$, 32.1%). The most commonly used search databases among the included systematic reviews were PubMed ($K = 29$, 72.5%), MEDLINE ($K = 20$, 50%), Embase ($K = 20$, 50%), Web of Science ($K = 14$, 35%), PsycINFO ($K = 12$, 30%), Google Scholar ($K = 10$, 25%), Scopus ($K = 10$, 25%), and CINAHL ($K = 8$, 20%). The most commonly reported study design was cross-sectional ($K = 32$, 80%). The General Anxiety Disorder 7 (GAD-7, $K = 28$, 70%), Patient Health Questionnaire (PHQ, $K = 26$, 65%), Depression Anxiety Stress Scale (DASS, $K = 21$, 52.5%), Zung Self-Rating Depression Scale (SDS, $K = 17$, 42.5%), Zung Self-Rating Anxiety Scale (SAS, $K = 17$, 42.5%), Insomnia Severity Index (ISI, $K = 16$, 40%), Pittsburgh Sleep Quality Index (PSQI, $K = 16$, 40%) were the most commonly reported instruments used for the assessment of mental health and associated factors.

Critical Appraisal of the Included Studies

The included systematic reviews were evaluated using quality assessment criteria, with scores ranging from 3/11 to 11/11 based on the JBI checklist (**Table 1**). The majority of the studies (31/40) were considered of good quality, which we defined as meeting at least 70% of the (8/11) assessment criteria. All included studies satisfied the first criterion of stating a clear and explicit research question or aim, whereas half (20/40) of the studies failed to meet the criterion of assessing publication bias. All studies were included in the synthesis of findings, regardless of their quality assessment score.

Study Findings

Overall Mental Health

Seven reviews, which synthesised data from 51 primary studies ($N = 51$), reported the overall mental health impacts of COVID-19 on HCWs (**Table 2**). Of these, the prevalence rate was assessed in four reviews, two of which reported pooled prevalence values calculated from meta-analyses, ranging from 11.6% [95% confidence interval (CI): 9.2–14.6%, $N = 3$] (64) to 34% (95% CI: 24–44%, $N = 28$) (23). One review (40) reported a positive correlation between COVID-19 and the incidence of psychiatric disorders ($N = 8$).

Overall mental health risk factors include being a woman (58, 61) and being divorced (61). Compared with non-HCWs, health professionals reported a higher rate of mental health problems (23, 24, 39). Among health professionals, nurses (24, 58, 61) and doctors (40) were associated with the highest risk of developing any mental health problem. Additionally, longer working hours (61), fewer years of working experience (61), a lack of access to personal protective equipment (PPE) (61) and close contact with infected patients (41, 61) were associated with a higher incidence of mental health problems.

Anxiety

Anxiety or anxiety symptoms were assessed in 30 reviews, which synthesised data from 701 primary studies (**Table 2**). Of these, the prevalence rate was reported in 26 reviews, including 20 reviews that reported pooled prevalence values calculated from meta-analyses, ranging from 16% (95% CI: 12–20%, $N = 23$) (27) to 41.42% (95% CI: 36–47%, $N = 75$) (28). Among reviews without meta-analysis, the prevalence rate was estimated to be as high as 65.2% in Italy (25). The most-reported anxiety assessment tool was the GAD-7, which was reported in 15 reviews (**Table 2**).

The sociodemographic risk factors associated with the incidence of anxiety or anxiety-like symptoms included female gender (24, 29, 42, 45, 50, 58, 62), living in a rural area (24), being married (62), having a child (62), and younger age ($\leq$40 years) (24, 39, 42, 50, 52, 62). Additionally, pre-existing illness (24), having physical COVID-19 symptoms (62), exposure to a COVID-19 patient (38, 48, 54, 62), working in a COVID-19 unit or hospital (62), working in an intensive care unit (ICU) (50), a lack of social support (54, 62), a lack of access to adequate

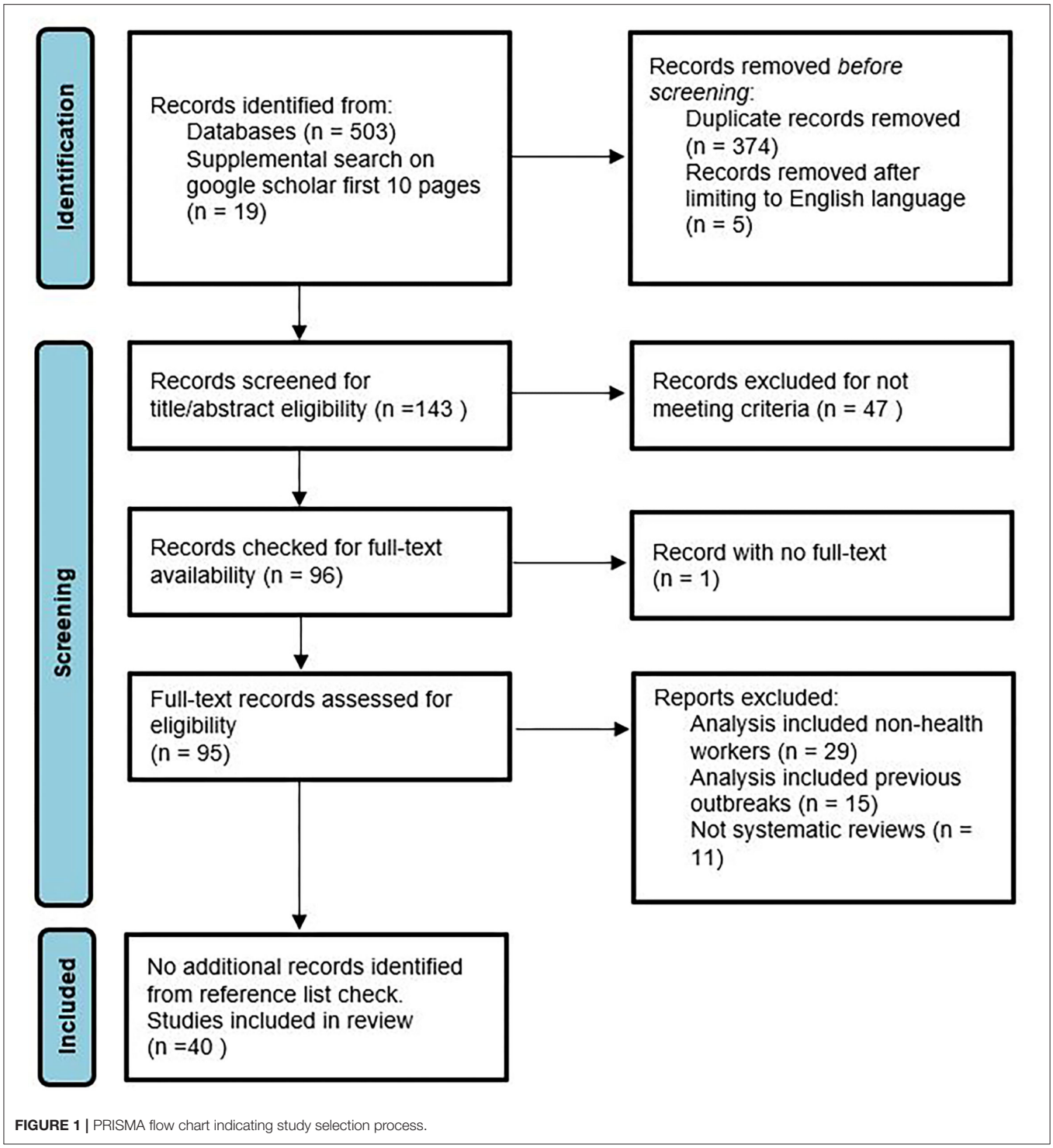

FIGURE 1 | PRISMA flow chart indicating study selection process.

PPE (54, 62), and insufficient knowledge regarding COVID-19 (54) were also associated with increased anxiety and anxiety-like symptoms.

The risk of developing anxiety was higher among nurses (29, 34, 42, 45, 50, 53, 55, 58, 65), and frontline professionals (24, 34, 42, 45, 50, 63, 65). The prevalence of anxiety among frontline nurses (39%, 95% CI: 32–46%, $N = 24$) was higher than among other nurses (32%, 95% CI: 27–38%, $N = 42$) (32) and overall health professionals (29.0%, 95% CI: 23.4–34.7%, $N = 22$) (34). Compared with the pre–COVID-19 prevalence, anxiety significantly increased during the COVID-19 pandemic (50). Health professionals with pre-existing insomnia were significantly more prone to developing anxiety symptoms [odds ratio (OR): 13.6, 95% CI: 10.5–17.5] (39).

TABLE 1 | Outcome of the critical appraisal of the included studies.

S/ no	Study references	Criteria assessed based on JBI checklist											Total criteria met
		1	2	3	4	5	6	7	8	9	10	11	
1	Al Maqbali et al. (32)	1	1	1	1	1	-	-	1	1	1	1	9
2	Arora et al. (23)	1	1	1	1	1	1	1	1	1	1	0	10
3	Cenat et al. (27)	1	1	1	1	1	1	1	1	1	1	1	11
4	De Brier et al. (38)	1	1	1	1	1	1	1	1	0	1	1	10
5	da silva Neto et al. (39)	1	1	1	1	1	1	1	1	1	0	0	9
6	da silva and Neto (40)	1	1	1	1	-	-	1	1	1	-	1	8
7	da silva and Neto (41)	1	1	1	1	1	1	-	-	-	1	1	8
8	Danet (42)	1	1	1	1	1	-	-	1	-	1	1	8
9	De Kock et al. (24)	1	1	1	1	1	1	1	1	-	1	1	10
10	De Pablo et al. (43)	1	1	1	1	1	-	1	1	0	1	0	8
11	D'Ettorre et al. (30)	1	1	1	0	1	-	1	1	0	1	0	7
12	Dong et al. (34)	1	1	1	1	1	1	1	1	1	1	1	11
13	Falasi et al. (31)	1	1	-	1	1	-	1	1	0	1	1	8
14	Galanis et al. (44)	1	1	1	1	1	0	0	1	1	1	0	8
15	Gohil et al. (33)	1	1	1	1	-	-	1	1	0	1	0	7
16	Hao et al. (45)	1	1	1	1	1	-	1	1	1	-	1	9
17	Krishnamoorthy et al. (46)	1	1	1	1	1	1	-	1	1	1	0	9
18	Kunz et al. (25)	1	1	-	0	1	1	0	1	0	1	0	6
19	Kunzler et al. (47)	1	1	1	1	1	1	1	1	-	1	1	10
20	Li et al. (48)	1	1	1	1	1	0	1	1	1	1	1	10
21	Luo et al. (49)	1	1	1	1	1	-	-	1	0	1	1	8
22	Mahmud et al. (28)	1	1	1	1	1	1	1	1	1	1	1	11
23	Marvaldi et al. (26)	1	1	1	1	1	-	1	1	1	1	1	10
24	Moitra et al. (50)	1	1	1	1	-	-	1	1	0	1	-	7
25	Muller et al. (51)	1	1	1	1	1	1	1	1	0	1	1	10
26	Pappa et al. (29)	1	1	1	1	1	1	1	1	0	1	1	10
27	Phiri et al. (52)	1	1	1	1	1	1	1	1	1	1	-	10
28	Salari et al. (53)	1	1	-	1	1	0	0	1	1	1	0	7
29	Sanghera et al. (54)	1	1	1	1	-	-	-	1	-	1	1	7
30	Santabarbara et al. (55)	1	1	1	1	1	1	-	1	1	1	-	9
31	Saragih et al. (56)	1	1	1	1	1	1	1	1	1	1	1	11
32	Sharifi et al. (57)	1	1	1	1	1	1	-	1	-	1	1	9
33	Shaukat et al. (58)	1	1	1	0	-	-	-	1	0	1	0	5
34	Sheraton et al. (59)	1	1	-	1	1	1	1	1	1	1	1	10
35	Sriharan et al. (60)	1	1	1	1	1	1	1	1	0	1	1	10
36	Thatrimontrichai et al. (61)	1	-	1	0	0	-	1	-	0	0	1	4
37	Varghese et al. (62)	1	1	1	1	1	1	1	1	1	1	1	11
38	Vindegaard and Benros (63)	1	1	0	0	-	0	0	-	0	0	1	3
39	Wu et al. (11)	1	1	1	1	1	-	1	1	1	1	-	9
40	Zhao et al. (64)	1	1	1	1	1	1	1	1	1	1	0	10

Criteria 1 to 11- 1, clarity of review question; 2, appropriateness of inclusion criteria; 3, appropriateness of search strategy; 4, adequacy of search sources; 5, appropriateness for criteria in appraising included studies; 6, appraisal conducted by 2 or more reviewers independently; 7, methods to minimise errors in data extraction; 8, appropriate methods to combine studies; 9, assessment of publication bias; 10, recommendation for policy/practise based on reported data; 11, appropriateness of directives for new research. Key, 1, meet criteria; 0, Not meet criteria;, -, Unclear.

Study location appears to contribute to the levels of anxiety reported among HCWs. In China, the prevalence of anxiety in Hubei Province, where the outbreak originated, was 37.9% (95% CI: 28.7–47.1%), which was higher than in other regions of China (30.8%, 95% CI: 25.1–36.5%) (34). Three reviews (48, 52, 62) conducted sensitivity analyses according to country or region. Phiri et al. (52) indicated that a higher incidence of anxiety was reported in the United Kingdom (UK: 22.3%, 95% CI: 7–38%, $N = 4$) compared with the United States of America (USA: 19.99%, 95% CI: 17%−23%, $N = 4$), China (18.98%, 95% CI: 16–22%, N

TABLE 2 | Mental health impacts of COVID-19 on health professionals.

Outcomes	Measure	References	Impact of COVID-19 on outcome			Effect size/comment
			Impact classified/ compared between groups		Overall impact (no comparison)	
			Significant	Not significant		
Overall mental health/ psychological problems	BAI, CES-D, CPDI, DASS-21, GAD-7, GHQ-12; HADS-A, HAMA, HAMD, IES-R, ISI, ITQ, PHQ-9: PTSD-SS, PSQI, SAS, SASR, SDS, SOS, SRQ, STAI, WHO-5	Arora et al. (23)			✓	34% (95%CI: 24–44) $N = 28$
	NA	De Brier et al. (38)	✓			β: 5.347, (95%CI:3.831;8.184) $N = 1$. Contact with infected patients
	GAD-7, GHQ, PHQ-4, PHQ-9, SCL-90,	da Silva and Neto (40)	✓			Meta-correlation between covid and psychiatric disorder = 0.72% (95%CI: 0.66–0.78) $N = 8$
	NA	Luo et al. (49)			✓	Range = 14 to 72%, $N = 5$
	NA	Shaukat et al. (58)			✓	23% $N = 1$
	NA	Sheraton et al. (59)		✓		OR = 1.39 (95%CI: 0.99–1.96), Z = 1.89 $N =$ 5. compared to non-HCW
	NA	Zhao et al. (64)			✓	11.6% (95% CI: 9.2–14.6) $N = 3$, $n = 3{,}327$
Anxiety/ Anxiety symptoms	#GAD-7, SAS	Al Maqbali et al. (32)			✓	37% (95% CI 32–41), $N = 73$. Nurses only
	NA	De Brier et al. (38)	✓			AOR: range from 1.57 to 2.06, $N = 2$ Contact with infected patients
	BAI, DASS-21, GAD-7, GAD-2, HAMA, SAS,	Cenat et al. (27)		✓		16% (95%CI:12–20) $N = 23$, > 15% (95%CI:11–20) $N = 31$
	AS, DAS, GAD-7, HAMA, SAS, SCL-90, SF-36	da Silva Neto et al. (39)	✓			13%, OR = 1.62 (95%CI:1.33–1.96) $N = 7$, higher than non-HCW, 5%
	DASS-21, GAD-7, SF-36, STAI	Danet (42)			✓	Range = 20–72%, $N = 7$
	DASS-21, GAD-7	De Kock et al. (24)			✓	Range = 14.5–44.6%, $N = 2$
	NA	de Pablo et al. (43)	✓			22.2% (95%CI: 13–36) $N = 4$, $n = 7{,}716$
	DASS-21, GAD-7, SAS	Dong et al. (34)			✓	34.4% (95%CI: 30–39) N = 22. China
	DASS-21, GAD-7, HAMA, SAS, SLC-90	Hao et al. (45)			✓	28.6% (95%CI: 22–36) $N = 16$
	NA	Krishnamoorthy et al. (46)			✓	24% (95%CI: 16–32) $N = 16$
	NA	Kunz et al. (25)			✓	65.2% N = 1. Only highest prevalence reported (Italy)
	NA	Kunzler et al. (47)		✓		SMD = −0.08 (95%CI: −0.66–0.49) $N = 13$, n = 5,508. compared to before covid
	NA	Luo et al. (49)			✓	26% (95%CI: 18–34) $N = 12$
	# BAI, DASS-21, HAMA, HADS, GAD, SAS	Mahmud et al. (20)			✓	41.42% (95% CI: 36–47) $N = 75$, $n = 147{,}435$
	NA	Marvaldi et al. (26)			✓	30% (95 %CI, 24.2–37.05) $N = 22$, $n = 51{,}942$
	NA	Moitra et al. (50)			✓	Not quantified. $N = 10$
	NA	Muller et al. (51)			✓	24% (95%CI: 9–90) $N = 22$, $n = 47{,}630$
	BAI, DASS-21, HAMA, GAD-7, SAS	Pappa et al. (29)			✓	23.2% (95%CI: 18–29) $N = 12$

(Continued)

TABLE 2 | Continued

Outcomes	Measure	References	Impact of COVID-19 on outcome			Effect size/comment
			Impact classified/ compared between groups		Overall impact (no comparison)	
			Significant	Not significant		
	DASS-21, GAD-7, HADS	Phiri et al. (52)			✓	21.9% (95%CI: 19-25) N= 69
	DASS-21, GAD-7, SARS, SAS	Salari et al. (53)			✓	25.8% (95% CI 20.5–31.9%) *N* = 23
	DASS-21, GAD-7, HAMA, SAS	Sanghera et al. (54)			✓	Range = 12.3–35.6% *N* = 33
	BAI, DASS-21, GAD-7, HADS, STAI-S, SAS	Santabarbara et al. (55)			✓	25% (95% CI: 21–29%) *N* = 71
	NA	Saragih et al. (56)			✓	40% (95% CI: 29–52%) *N* = 40
	DASS-21, GAD-2/7, HADS, HAMA, PHQ-4, SAS	Li et al. (48)			✓	22.1% (95% CI, 18.2–26.3%) *N* = 57
	GAD-7, SAS	Shaukat et al. (58)			✓	Range = 23–44% *N* = 2
	NA	Thatrimontrichai et al. (61)			✓	25.9%, *N* = 18, *n* = 6,305/24,297. Asia
	NA	Varghese et al. (62)			✓	32% (95%CI: 21–44%) *N* = 21, *n* = 13 641. Nurses
	NA	Vindegaard and Benros (63)			✓	Not quantified. *N* = 8.
	NA	Wu et al. (65)			✓	29% (95%CI 23.6–34.7) *N* = 23, *n* = 50,143 Nurses/doctors; 19.9% (12.4–28.6) *N* = 7, n = 2,521 other professionals
	NA	Zhao et al. (64)			✓	23.2% (95% CI: 17–31) *N* = 14, *n* = 13,020
Burnout	MBI	Danet (42)			✓	Range = 12–36% (emotional exhaustion and depersonalisation) *N* = 2
	NA	de Pablo et al. (43)	✓			25% (95%CI: 13–43) *N* = 1, *n* = 32
	NA	Galanis et al. (44)			✓	emotional exhaustion 34.1%, depersonalisation 12.6%, lack of personal accomplishment 15.2%; *N* = 6. Nurses
	NA	Kunz et al. (25)			✓	45.6%, *N* = 1. Only highest prevalence reported (Belgium)
	NA	Moitra et al. (50)			✓	Not quantified. *N* = 2
	MBI	Sanghera et al. (54)			✓	Range = 3.1–43.0%, *N* = 5
	MBI, questionnaire, Pfi	Sharifi et al. (57)			✓	Not quantified. *N* = 12
	MBI, questionnaire	Sriharan et al. (60)			✓	Range = 13–39%, *N* = 2. Nurses
Depression/ depressive symptoms	#PHQ-9, SDS	Al Maqbali et al. (32)			✓	35% (95%CI: 31–39) *N* = 62, nurses
	NA	De Brier et al. (38)	✓			AOR: range from 1.52 to 2.97, *N* = 2. Contact with infected patients.
	BDI, DASS-21, HAMD, PHQ-2, PHQ-9, SDS	Cenat et al. (27)		✓		14% (95%CI:11–17) *N* = 18, < general population 17% (95%CI:13–22) *N* = 28
	DS, HAMD, PHQ-4, PHQ-9, SDS	da Silva Neto et al. (39)	✓			12.2%, OR = 1.3246; 95%CI 1.0930 to 1.6053) *N* = 7, > other professionals 9.5%
	DASS-21, IPQ, PHQ-9, SDS	Danet (42)			✓	Range = 25–65%, *N* = 10

(Continued)

TABLE 2 | Continued

Outcomes	Measure	References	Impact of COVID-19 on outcome			Effect size/comment
			Impact classified/ compared between groups		Overall impact (no comparison)	
			Significant	Not significant		
	DASS-21, PHQ-9	De Kock et al. (24)			✓	Range = 8.9–50.4% *N* = 2
	Estimate	de Pablo et al. (43)	✓			17.9% (95%CI: 7–40) *N* = 4, *n* = 7,716
	DASS-21, PHQ-9, SDS	Dong et al. (34)			✓	31.1% (95 CI: 25–38) *N* = 18. China
	DASS-21, HAMD, PHQ-2, PHQ-9, SCL-90, SDS	Hao et al. (45)			✓	24.1% (95% CI: 16–32) *N* = 14
	NA	Krishnamoorthy et al. (46)			✓	25% (95%CI:19–32) *N* = 16
	NA	Kunz et al. (25)			✓	57.9%, *N* = 1. Only highest prevalence reported (Italy)
	NA	Kunzler et al. (47)		✓		SMD =-0.16 (95%CI:−0.59–0.26) *N* = 7, *n* = 2,226. compared to before covid
	#SDS, CES-D, DASS-21, HADS	Mahmud et al. (20)			✓	37.12% (95% CI:32–42) *N* = 69, *n* = 144,649
	NA	Marvaldi et al. (26)			✓	31% (95 %CI, 26–37) *N* = 25, *n* = 68,030
	NA	Moitra et al. (50)			✓	Not quantified. *N* = 18
	NA	Muller et al. (51)			✓	28% (95%CI: 5–51) *N* = 19, *n* = 35,219
	BDI-II, DASS-21, CES-D, PHQ-2, SDS	Pappa et al. (29)			✓	22.8% (95%CI: 15–32) *N* = 10
	DASS-21, HADS, PHQ-9	Phiri et al. (52)			✓	23.4% (95%CI: 21–26) *N* = 66
	DASS-21, SDS, BDI-II, HAD	Salari et al. (53)			✓	24.3% (95%CI: 18–32%) *N* = 21
	DASS-21, PHQ-9, PHQ-4, SDS, HAMD	Sanghera et al. (54)			✓	Range = 13.5–44.7%, *N* = 32
	NA	Saragih et al. (56)			✓	37% (95% CI: 29–45%) *N* = 30
	CES-D, DASS-21, HADS, PHQ-2, PHQ-4, PHQ-9	Li et al. (48)			✓	21.7% (95% CI:18–25) *N* = 55
	NA	Shaukat et al. (58)			✓	50.4%, *N* = 1
	NA	Thatrimontrichai et al. (61)			✓	27.2%, *N* = 14, *n* = 10,617/39,014. Asia
	NA	Varghese et al. (62)			✓	32% (95% CI: 21–44) *N* = 17, *n* = 12 294
	NA	Vindegaard and Benros (63)			✓	Not quantified. *N* = 6
	#GHQ-9, SDS, WHO-5	Wu et al. (65)			✓	31% (95%CI:25–38) *N* = 23, *n* = 41,889 Nurses/doctors; 14.1% (7.4–22.4) *N* = 6, *n* = 2,471 other professionals
	NA	Zhao et al. (64)			✓	23.9% (95% CI: 15–36) *N* = 11, *n* = 11,922
Fear	NA	De Brier et al. (38)	✓			AOR: 1.41, (95%CI:1.03;1.93), *N* = 1. Contact with infected patients.
	Self-questionnaire	De Kock et al. (24)			✓	87%, *N* = 1. Dentist. Fear of infection from patient or co-worker
	NA	Gohil et al. (33)			✓	Range = 60–96.6%, *N* = 12; Dental. Fear of contagion
	NA	Thatrimontrichai et al. (61)			✓	77.1%, *N* = 4, *n* = 2,743/3,558. Asia

(Continued)

TABLE 2 | Continued

Outcomes	Measure	References	Impact of COVID-19 on outcome			Effect size/comment
			Impact classified/ compared between groups		Overall impact (no comparison)	
			Significant	Not significant		
Insomnia	AIS, ISI, PSQI	Cenat et al. (27)	✓			37% (95%CI:33–40) *N* = 6, HCW, higher than general population 16% (95%CI:8–30) *N* = 8
	ISI	da Silva Neto et al. (39)			✓	Range = 34–38.4%, *N* = 3
	ISI	De Kock et al. (24)			✓	34%, *N* = 1.
	NA	de Pablo et al. (43)			✓	44.5% (95%CI: 38–51) *N* = 3, *n* = 3,490
	ISI-7, PSQI	Hao et al. (45)			✓	44.1% (95% CI:31.3–57.0%) *N* = 5
	NA	Krishnamoorthy et al. (46)			✓	37% (95%CI:32–42) *N* = 4
	AIS, ISI, PSQI	Mahmud et al. (20)			✓	43.76% (95% CI: 36–52) *N* = 21, *n* = 33,370
	NA	Moitra et al. (50)			✓	Not quantified. *N* = 10
	AIS, ISI	Pappa et al. (29)			✓	38.9% (95%CI: 27–42) *N* = 5
	NA	Phiri et al. (52)			✓	23.98% (95%CI: 16–32) *N* = 4
	AIS, ISI, PSQI	Sanghera et al. (54)			✓	Range = 33.8–36.1%, *N* = 12
	ISS, PSQI	Shaukat et al. (58)			✓	34%, *N* = 1
	NA	Sheraton et al. (59)	✓			OR = 2.19 (95%CI: 1.33–3.62), Z = 3.08 *N* = 2. compared to non-HCW
	NA	Thatrimontrichai et al. (61)			✓	35%, *N* = 3, *n* = 2,072/5,919. Asia
	NA	Varghese et al. (62)			✓	38.3%, (95% CI = 5.8%−78.6) *N* = 2, *n* = 261
	NA	Wu et al. (65)			✓	47.3% (95%CI:39–56) *N* = 7, *n* = 13,375 Nurses/doctors; 31.8 (27.2–36.5) *N* = 2, *n* = 1,380 other professionals
Obsessive compulsive symptoms	NA	Hao et al. (45)			✓	16.2% (95%CI: 3.0–30) *N* = 4
	NA	Vindegaard and Benros (63)			✓	Not quantified. *N* = 1
Phobia	SLC-90, SCL	Hao et al. (45)			✓	35.0% (95% CI: 8.6–61) *N* = 4
PTSD/ emotional stress/ distress	NA	De Brier et al. (38)	✓			AOR: 1.60, (95%CI:1.25;2.04), *N* = 1. PTSD. Contact with infected patients.
	IES-R, K-6, SCL-90, SRQ-20	Cenat et al. (27)		✓		21% (95%CI:5–57) *N* = 4, HCW PTSD < general population 22% (95%CI:8–50) *N* = 9; 17% (95%CI:13–22) *N* = 9, HCW distress > general population 10% (95%CI:5–21) *N* = 10
	ASDI, IES-R; PSS	Al Maqbali et al. (32)			✓	43% (95% CI: 37–49), *N* = 40, nurses. Emotional stress
	NA	da silva and Neto (41)			✓	Not quantified, *N* = 31. HCW stress in ICU
	DASS-21, DSM-5, ASAISTSS	Danet (42)			✓	Range = 37–78% *N* = 10. stress
	NA	de Pablo et al. (43)			✓	29.9% (95%CI: 9–65) *N* = 3, *n* = 6,789. Distress; 7.7% (95%CI: 6–11) *N* = 22, *n* = 470 PTSD
	DASS-21, IES-R, IES-6, PCL-C, PTSD-SS	Dong et al. (34)			✓	29.1% (95%CI: 24–34) *N* = 9. Stress & PTSD, China

(Continued)

TABLE 2 | Continued

Outcomes	Measure	References	Impact of COVID-19 on outcome			Effect size/comment
			Impact classified/ compared between groups		Overall impact (no comparison)	
			Significant	Not significant		
	CBI, GPS, IES-R, PCL-6, PCL-C	d'Ettorre et al. (22)			✓	Range = 6.6%-58.6%. *N* = 16, PTSD
	NA	Falasi et al. (31)			✓	Range = 3.4% (India) to 71.5% (China) *N* = 5. Acute PTSD
	IES-R, PTSD-SS, PCL-C, PSS-10	Hao et al. (45)			✓	25.6% (95% CI: 12–39) *N* = 5. PTSS
	NA	Krishnamoorthy et al. (46)			✓	41% (95% CI:19–65) *N* = 4 distress; 13% (11–16%) *N* = 2. PTSS
	NA	Kunz et al. (25)			✓	73.6% *N* = 1. Only highest prevalence reported (Spain). PTSD
	NA	Kunzler et al. (47)		✓		SMD = 0.49 (95% CI:−0.60–1.57) *N* = 3, *n* = 1,570. compared to before covid. Stress
	IES, DASS-21, PSS, PTSD	Mahmud et al. (20)			✓	44.86% (95% CI: 36.98–52.74) *N* = 41, *n* = 82,783. Stress
	NA	Marvaldi et al. (26)			✓	20.2% (95 %CI:9.9–33) *N* = 6 PTSD; 56.5% (95 %CI:31–81), *N* = 3 Acute stress
	NA	Muller et al. (51)			✓	37% (95%CI: 7–97) *N* = 13, *n* = 20,391
	IES-R, PCL-5	Phiri et al. (52)			✓	25% (95%CI: 19–31) *N* = 19. PTSD
	CES-D, IES-R, PSS-10, PSS	Sanghera et al. (54)			✓	Range = 5.2–32.9% *N* = 11 acute stress; 7.4–37.4% *N* = 13. PTSD
	NA	Saragih et al. (56)			✓	49% (95% CI: 22–75) *N* = 7 PTSD; 37% (95% CI: 25–50) *N* = 15 Distress
	NA	Li et al. (48)			✓	21.5% (95% CI, 1–35%) *N* = 9
	IES, PTSD-SS	Shaukat et al. (58)			✓	Range = 23.4–71%, *N* = 2. Stress disorder
	NA	Varghese et al. (62)			✓	18.6% PTSD (95% CI = 4.8%−38) *N* = 3, *n* = 638; 40.6% stress (95% CI = 25.4–56.8%,) *N* = 10, *n* = 4,204. Nurses
	#GHQ-12, IES, K6, PSS-10	Wu et al. (65)			✓	41.2 (19.8–64.5) *N* = 5, *n* = 10,165. Distress
	NA	Zhao et al. (64)			✓	28% (95% CI: 9.5–59) *N* = 5, *n* = 4,327. PTSS
Somatization symptoms	NA	Hao et al. (45)			✓	10.7% (95% CI: 1.9–19.6%) *N* = 5
	NA	Kunz et al. (25)			✓	Not quantified. *N* = 1. Reported as higher among nurses than doctors (Italy)
Substance abuse	NA	Kunz et al. (25)			✓	6.2% *N* = 1. Only highest prevalence reported in nurses and doctors (Spain)
Suicidal thought/ self-harm	NA	Phiri et al. (52)			✓	5.8% (95%CI: 5–7) *N* = 4

 # other measures not specified; N, number of studies; n, number of participants; AOR, Adjusted Odds Ratio; ASDI, Acute Stress Disorder Inventory; BAI, Becks Anxiety Inventory; BDI, Beck Depression Inventory; CES-D, Centre for Epidemiology Scale for Depression; CPDI, COVID-19 Peritraumatic Distress Index; DASS-21, Depression, Anxiety Stress Scale; DSM-5, PTSD Symptoms Severity Scale; GAD-7, Generalised Anxiety Disorder; GHQ, General Health Questionnaire; HADS-A, Hospital Anxiety Depression Scale–Anxiety; HAMA, Hamilton Anxiety Scale; HAMD, Hamilton Depression Scale; HCW, Healthcare Workers; IES-R, Impact of Event Scale-Revised; ISI, Insomnia Severity Scale; IPQ, Illness Perception Questionnaire; ITQ, International Trauma Questionnaire; K-6, Kessler-6 Item Psychological Distress Scale; MBI, Maslach Burnout Inventory; OR, Odds Ratio; PHQ, Patient Health Questionnaire; Pfi, Stanford Professional Fulfilment Index; PTSD-SS, Post Traumatic Stress Disorder-Short Scale; PTSS, Posttraumatic Stress Symptoms; PSQI, Pittsburgh Sleep Quality Index; PCL-C, PTSD Checklist Civilian; PTSD-SS, Posttraumatic Stress SAS, Self-rating Anxiety Scale; SASR, Stanford Acute Stress Reaction; SCL, Symptoms Checklist; SDS, Self-rating Depression Scale; SF, Health Questionnaire; SMD, Standardised Mean Difference; SOS, Stress Overload Scale; STAI, State-Trait Anxiety Inventory; SRQ, Stress Response Questionnaire; SRQ-20, Self Reporting Questionnaire-20; STSS, Secondary Traumatic Stress Scale; WHO-5, World Health Organization-5.

= 24), and Italy (13.44%, 95% CI: 6–20%, $N = 6$). Li et al. (48) by contrast, reported that the Middle-East presented with the highest pooled estimated prevalence of anxiety (28.9%, 95% CI: 21.6–36.8%, $N = 7$), whereas, the lowest incidence was reported for North America (14.8%, 95% CI: 13.9–15.7%, $N = 2$). In Asia, China yielded a pooled prevalence of 19.1% (95% CI: 15.5–23.0%, $N = 37$), which was slightly lower than the pooled prevalence reported for all other studies from East Asia (20.5%, 95% CI: 15.7–25.8, $N = 40$). Other regions examined included Europe (23.9%, 95% CI: 19.6–28.4%, $N = 4$) and South Asia (21.0%, 95% CI: 11.7–31.4%, $N = 3$). Varghese et al. (62) examined the pooled prevalence among nurses across various regions and reported the highest pooled prevalence for the Eastern Mediterranean region (41.9%, 95% CI: 10.7–77.3%, $N = 3$, $n = 907$) compared with the Western Pacific/Southeast region (30.9%, 95% CI: 17.2–46.5%, $N = 10$, $n = 10{,}579$) and the European region (30.5%, 95% CI: 16.7–46.3%, $N = 7$, $n = 2{,}067$) (62).

Depression

Depression and depressive symptoms were assessed in 28 reviews, which synthesised data from 584 primary studies (**Table 2**). The prevalence rate was reported in 24 reviews, including 17 that reported the pooled prevalence values calculated from meta-analyses, which ranged from 14% (95% CI: 11–17%, $N = 18$) (27) to 37.12% (95% CI: 32–42%, $N = 69$) (28). Among reviews without meta-analyses, the prevalence rate was estimated to be as high as 65% (42). The most-reported depression assessment tools were the PHQ, versions 2 and 9, which were reported in 10 reviews (**Table 2**).

Exploring sociodemographic risk factors associated with depression revealed that female gender (24, 29, 42, 45, 50, 62), being single or not married (42), and younger age (≤40 years) (24, 39, 50, 52, 62) were associated with a higher incidence of depressive symptoms. Additionally, spending too much time reading COVID-19-related information (50), less work experience (42), a lack of social support (48), and pre-existing organic illnesses were associated with higher levels of depression (24). The risk of developing depression or depressive symptoms was higher among nurses (29, 42, 50, 65), frontline professionals (24, 42, 50, 63, 65), professionals working in surgical units (24), COVID-19 units and hospitals (62), and professionals with direct patient contact (38, 48, 54, 58). Depression was significantly associated with poor sleep quality and insomnia (39, 50). Health professionals with insomnia had a 13-fold higher risk of developing depressive symptoms than those without insomnia (OR: 13.5517, 95% CI: 10.4771–17.5285, $p < 0.0001$) (39).

Compared with the pre-COVID-19 prevalence, depressive symptoms significantly increased during the COVID-19 pandemic (50). The prevalence of depression among frontline nurses (33%, 95% CI: 24–43%, $N = 19$) was higher than that among other nurses (33%, 95% CI: 29–37%, $N = 36$) (32) and that among overall health professionals (29.2%, 95% CI: 21.7–36.7%) (34). Similarly, the prevalence of moderate to severe depression among frontline HCWs (14.6%, 95% CI: 6.3–23.0%) was higher than that among second-line HCWs (8.7%, 95% CI: 3.9–13.4%) (45).

Three reviews (48, 52, 62) conducted sensitivity analyses according to country or region. Phiri et al. (52) indicated that the highest depression prevalence was reported for the Middle East (41%, 95% CI: 16–60%, $N = 5$) compared with those reported for China (22.13%, 95% CI: 18%−27%, N = 24), Italy (20.39%, 95% CI: 10–31%, $N = 5$), and the UK (19.29%, 95% CI: 7%−32%, N = 5). Li et al. (48) also reported higher depression prevalence in the Middle East (34.6%, 95% CI: 25.1–44.9%, $N = 5$) compared with those in South Asia (28.8%, 95% CI: 18.1–40.8%, $N = 3$) and Europe (22.0%, 95% CI: 18.9–25.3%, $N = 4$). The pooled estimates were lowest for North America (18.7%, 95% CI: 17.8–9.7%, $N = 2$) and East Asia (19.1%, 95% CI: 15.2–23.4%, $N = 39$). Varghese et al. (62) examined the pooled prevalence of depression among nurses across various regions. The highest prevalence of depression was found in the Eastern Mediterranean region (61.2%, 95% CI: 16.9–96.2%, $N = 2$, $n = 592$) compared with the Western Pacific/Southeast region (27.4%, 95% CI: 13–44.7%, $N = 9$, $n = 11{,}181$) and European region (30.9%, 95% CI: 20.4–42.5%, $N = 5$, $n = 433$) (62).

PTSD/Stress/Distress

Emotional stress, distress, and PTSD were assessed from 24 reviews, which synthesised data from 327 primary studies (**Table 2**). Of these, the prevalence rate was reported by 21 reviews, including 15 that reported pooled prevalence values calculated from meta-analyses, ranging from 18.6% (95% CI: 4.8–38%, $N = 3$) (62) to 56.5% (95% CI: 31–81%, $N = 3$) (62). Among reviews without meta-analysis, the prevalence rate was estimated to be as high as 78% (42). The most-reported distress and PTSD assessment tool was the Impact of Event Scale (IES), which was reported in 10 reviews (**Table 2**).

The risk of developing PTSD, stress, or distress was generally higher among women (30, 31, 42, 50, 62), younger professionals (30, 42, 50, 52, 62), professionals with limited experience (30, 42), and those living with family members (31). Similarly, the risk of experiencing psychological stress or distress was higher among nurses (31, 42, 49, 50, 54, 65) and frontline professionals than among other HCWs (24, 31, 49). Prevalence of stress and distress was higher among frontline nurses (46%, 95% CI: 39–54%, $N = 17$) than among nurses working on the second line (42%, 95% CI: 31–53%, $N = 20$) (32). Similarly, frontline health professionals experience higher levels of distress (mean = 2.66 ± 0.93) than other health professionals (mean = 2.46 ± 0.83) (42). The disproportionate need for technological supplies in ICU settings, combined with the scarcity of these supplies, promotes high rates of psychological stress among HCWs who work in ICU settings (41). Similarly, a lack of adequate PPE (24), direct exposure to patients (54, 58, 62), working in ICU or emergency settings (42), working in a perceived unsafe environment (30), working in COVID-19 hospitals (62), and working in regions with high caseloads (49) were associated with an increased risk of developing stress or distress. Emotional stress was also associated with a lack of training and social support (30) and a history of mental illness or chronic disease (24, 42).

Varghese et al. (62) examined the pooled prevalence among nurses across various regions. The highest prevalence was reported for the Eastern Mediterranean region (61.6%, 95% CI:

56.4–66.8%, $N = 2$, $n = 763$) compared with the Western Pacific/Southeast region (47.2%, 95% CI: 14.7–81%, $N = 4$, $n = 3{,}165$) and the European region (34.2%, 95% CI: 21.2–48.6%, $N = 3$, $n = 232$) (62).

Insomnia

Insomnia was assessed by 16 reviews, which synthesised data from 91 primary studies (**Table 2**). The prevalence rate was reported in all 16 reviews, including 9 that reported pooled prevalence values calculated from meta-analyses, ranging from 23.98% (95% CI: 16–32%, $N = 4$) (52) to 47.3% (95% CI: 39–56%, $N = 7$) (65). The most-reported insomnia assessment tool was the ISI, which was reported in 7 reviews (**Table 2**).

Insomnia risk factors include female gender (24, 50), occupation as a nurse (50, 65), being a frontline professional (24, 42, 50), existing organic illness (24), and younger age (≤30 years) (52). Additionally, direct exposure to a COVID-19 patient (54), fear for self-infection (54, 58), working in an isolation unit (54), living in a rural area (24), and a lack of faith in psychological support (54) were associated with the increased incidence of insomnia.

Burnout

Burnout was assessed from 8 reviews, which synthesised data from 62 primary studies (**Table 2**). Of these, the prevalence rate was reported in 6 reviews, and only 1 study reported the pooled prevalence from a meta-analysis (43), which indicated an overall pooled prevalence for burnout of 25% (95% CI: 13–43%, $N = 3$) (43). Other reviews reported estimated prevalence values ranging from 12% (42) to 45.6% (25). The prevalence of burnout domains was reported in one review (44), which indicated that emotional exhaustion (34.1%), depersonalisation (12.6%), and lack of personal accomplishment (15.2%) were common reasons cited for burnout among nurses ($N = 6$). The most-reported burnout assessment tool was the Maslach Burnout Inventory (MBI), which was reported in 4 reviews (**Table 2**).

Burnout prevalence was higher among women (42, 50, 60) and younger professionals (44, 54). Decreased social support (44), fewer years of experience (<5 years) (60), more time spent working in quarantine areas (44), working in high-risk environments (44), working with insufficient resources (44), increased workload (44), and lower levels of specialised training (44) were significant risk factors for burnout. Among various health professionals, nurses (42, 54, 60) and frontline HCWs (42) were more at risk of developing burnout than other health professionals.

Other Mental Health Impacts

Other reported mental health impacts associated with the COVID-19 pandemic included fear of infection (4 reviews, $N = 26$), obsessive-compulsive disorder (2 reviews, $N = 5$), phobia (1 review, $N = 4$), somatisation symptoms (2 reviews, $N = 6$), substance abuse (1 review, $N = 1$), and suicidal ideations or self-harm (1 review, $N = 4$) (**Table 2**).

The fear of infection ranged from 60 to 96.6% ($N = 12$) among dental professionals (33). Additionally, a prevalence of 77.1% ($N = 4$, $n = 3{,}558$) for fear of infection was reported in Asia (61). One review (45) reported pooled prevalence values for obsessive-compulsive disorder (16.2%, 95% CI: 3–30%, $N = 4$), phobias (35%, 95% CI: 8.6–61, $N = 4$) and somatisation symptoms (10.7%, 95% CI: 1.9–19.6%, $N = 5$), and another review (52) reported a pooled prevalence for suicidal ideation (5.8%, 95% CI: 5–7%, $N = 4$). The prevalence of substance abuse was reported to be 6.2% among nurses and doctors in Spain (25).

Interventions/Coping Strategies Reported Alongside the COVID-19-Related Mental Health Issues

Strategies for overcoming mental health problems encountered during the COVID-19 pandemic included identifying people at risk (61), seeking individual or group-level professional psychological support (42, 51), attending counselling (51), practising mindfulness exercises (61), pursuing religious or spiritual channels (42), obtaining online information (51), refocusing and performing positive appraisal (42), ensuring family safety (24), seeking support from families or relatives (51, 61), asking for support from nurse leaders (60), practising resilience (24, 61), being in a committed relationship (24, 61), attending training or orientation for infectious disease unit (24, 60, 61), verifying access to adequate PPE (24, 51, 60, 61), reducing workloads (57), and reducing job-related stressors (57). One review reported participants, who prefer to overcome their psychological distress alone without any intervention (51).

DISCUSSION

To our knowledge, this is the first meta-review to investigate the impacts of COVID-19 pandemic on the overall mental health and well-being of HCWs (allied health professionals, doctors, and nurses). One strength of this meta-review is the large sample size included, which was drawn from 1,828 individual studies performed worldwide to evaluate the psychological impacts of COVID-19 on health professionals.

The most prevalent mental health problems identified in this review included anxiety, depression, and stress/PTSD. Other prevailing mental health problems include burnout, insomnia, fear of infection, obsessive-compulsive disorder, phobia, somatisation symptoms, substance abuse, and suicidal ideation/self-harm. Significant risk factors associated with the incidence of mental health issues include female gender, young age, low educational level, being a nurse, being a frontline health professional, experience, and country of residence. This meta-review reports the most comprehensive evidence to date regarding the mental health prevalence and risk factors among global HCWs associated with the COVID-19 pandemic. Mental health is among the commonly reported concerns associated with COVID-19 (4–6), particularly among individuals in the general population who have limited knowledge regarding the pandemic and tend to experience a high prevalence of adverse mental health conditions (4). Although the healthcare professions have stronger knowledge and experience in managing the pandemic condition, their mental health concerns are no different, or even higher than the general population. Accordingly, the overall pooled prevalence of mental health issues was reported to be higher among HCWs, compared to the general population (27, 39) but

lower than that among COVID-19 patients (46). Additionally, hard-affected countries, such as Italy (25), were associated with a higher prevalence of mental health issues relative to other regions. During the early stages of the outbreak, the highest prevalence of mental health issues was reported in Hubei Province, China, where the outbreak originated (4). Similar to the COVID-19 outbreak, previous pandemics, including SARS and MERS, were also characterised by mental health disturbances among health professionals (10, 11).

The findings of this meta-review further indicated that female HCWs are at a greater risk of mental health concerns than their male counterparts, which was identified for anxiety, depression, stress, insomnia, and burnout. Although none of the studies included in this review examined the nature of this association, the additional domestic burden among women has reportedly increased during COVID-19, including childcare, which likely contributed to worse mental health (66). Bahrami et al. (67) were of the opinion that metacognitive belief in uncontrollability, advantages, and the avoidance of worry may have contributed to the higher prevalence of anxiety in women than in men. Similar patterns of increased psychological disturbances were observed among females in the general population (6, 68) and among other professionals, such as teachers (69) during the COVID-19 pandemic. Additionally, the study reported by Hou et al. (68) examining differences during the COVID-19 pandemic indicated that men showed more resilience to stress, whereas women experienced more stress and anxiety symptoms.

Anxiety was the most prevalent mental health problem reported among HCWs during the COVID-19 pandemic, according to the findings of this review. The highest reported anxiety prevalence was 65.2% (25). The prevalence of anxiety varies across professions, with nurses reporting higher levels of anxiety than other professionals, which might be attributable to nurses having more frequent contact with the patients relative to other health professionals. Various studies have reported severe or dysfunctional anxiety levels among nurses due to the nature of various nursing roles (24, 65, 70). A similar prevalence of anxiety has been reported among teachers during the COVID-19 pandemic (69). The review by de Oliveira Silva et al. (69) reported an anxiety prevalence between 10 and 49.4% among teachers, which was associated with workload and the demand for online teaching. Higher anxiety was also found among pregnant women during the third trimester of pregnancy, associated with poor social support and increased demand on them to use COVID-19 protective measures (71). The causes of increased anxiety are likely multifaceted and are further complicated by the impacts of the pandemic.

The findings of this meta-review further indicated that the highest prevalence of depression was reported at 65% (42). Unsurprisingly, the rate of depression was higher among professionals in contact with COVID-19-positive patients and those working in COVID-19 units (24, 42, 50, 63, 65), which is likely to be associated with increased interaction with dying or suffering patients. Additionally, professionals with insomnia were 13 times more likely to develop depressive symptoms than those without insomnia (39). Increased depression incidence may be associated with a fear of contracting the infection or infecting family members, as has been reported in some studies (33, 51). A recent review study examining frontline professionals also indicated an association between depressive symptoms and the direct diagnosis or treatment of COVID-19 patients (5). High rates of depression or depressive symptoms have also been reported among the general population (4, 6), which has been associated with increased alcohol use (4) and suicidal ideation (6).

Stress-related symptoms were identified as common psychological concerns among HCWs. The findings of this meta-review indicated various emotional stress conditions associated with COVID-19, including acute stress, distress, and PTSD symptoms. The prevalence was reported as high as 78% for distress and 71.5% for PTSD. Stress, including PTSD in particular, may be associated with the exposure of HCWs exposure to adverse conditions, coupled with the increased demand for work. Previous studies conducted during pandemics also reported that HCWs in emergency units were exposed to traumatic stressors, such as the burden of rapid decision-making, demands to manage patient and family expectations, unexpected daily caseloads, and high fatality rates (9, 72). The pattern of stress identified among HCWs in the current review is similar to that described by teachers (69). Similar to anxiety and depression, being a nurse or frontline professional was identified as a significant risk factor for stress associated with COVID-19. In line with previous studies, the burden of stress among HCWs may be influenced by poor social support, coupled with fear of getting infected or infecting family members (9, 70, 71).

The findings of the current review further indicate differences in the mental health concerns of health professionals across regions. For instance, in China, HCWs in various provinces were reported to experience less anxiety than those working in Hubei Province, where the outbreak originated (30.8 vs. 37.9%). The current review further identified that the three most commonly occurring psychological concerns (anxiety, depression, and stress) were experienced at higher rates in some countries than in others. The highest prevalence of anxiety was reported in the UK (22%), whereas the highest prevalence of depression was reported in the Middle East (41%), and the highest stress level was observed in the Eastern Mediterranean region (61.6%). By contrast, the lowest prevalence of anxiety was reported in Italy (13.44%), the lowest prevalence of depression was reported in the UK (19.29%), and the European region experienced the least stress (34.2%). Previous studies indicate that higher levels of mental health concerns observed in particular regions or countries may be associated with large caseloads or poorly functioning healthcare systems (4, 73).

Other mental health concerns identified in this meta-review include burnout, fear of infection, phobia, somatisation symptoms and substance abuse, each affecting more than one-quoter of the professionals except somatization symptoms. Of these, fear of infection is the most prevalent, with a prevalence rate of as high as 96.6% among dental professionals while somatization symptoms were the least reported mental health concern among the professionals, accounting for about 10%. Fear of covid-19 was reported to spread faster than the virus (13) and is strongly associated with the uncertainties about the outbreak, of which many countries, including high-income countries, are

struggling to contain the outbreak (12, 13). On this note, Pakpoup and Griffiths (74) opined the need for understanding the different factors underpinning the fear associated with the virus to determine the needed education and prevention programs, and which groups of people to target. These programs could be instrumental towards overcoming the fear of COVID-19 and affected individuals to engage in preventative behaviours (74). Burnout on the other hand, may be associated with increased rates of hospitalisation coupled with longer working hours, particularly among frontline professionals. During the initial stages of the outbreak, burnout was highest among nurses, especially the depersonalisation sub-scale (75). This is largely associated with longer working hours, of which those with younger age were most affected compared to experienced and/or older professionals (75).

Review Limitations

Although this meta-review provides comprehensive evidence regarding the overall mental health impacts of the COVID-19 pandemic among health professionals, various limitations must also be considered when interpreting these findings. First, many of the included systematic reviews were associated with the potential for bias, as assessed by the JBI systematic review checklist (36) (**Table 1**). However, this could be associated with the rapid nature of the pandemic evolution, coupled with the need to quickly fill research gaps. Second, systematic reviews both with and without meta-analyses were included in this meta-review; therefore, no additional meta-analyses were conducted. Instead, the findings were narratively synthesised, and the only effect sizes available are those that were reported by the included studies. Third, it is unclear from the included systematic reviews if the HCWs had underlying conditions prior to the COVID-19 pandemic, which may have exacerbated the development of the various mental health issues identified in this review. Finally, the current review only reported coping strategies identified alongside the prevalence and risk factors associated with the various mental health conditions. Additional studies remain necessary to specifically investigate interventional techniques capable of supporting the mental health of health professionals during pandemics such as COVID-19.

Conclusions

Based on the findings of this meta-review, health professionals (nurses, doctors, and allied health professionals) experience various forms of COVID-19-related mental health issues. The most prevalent mental health issue is anxiety, followed by depression and stress/PTSD. Other significant mental health problems include insomnia, burnout, fear of infection, obsessive-compulsive disorder, somatisation symptoms, and suicidal ideation/self-harm. Female gender and younger age were the most significant sociodemographic risk factors associated with COVID-19-related mental health impacts. Other risk factors included being a nurse and being a frontline professional. The findings of this meta-review have implications for both practise and policies, therefore, we recommend targeted interventions and health programs that address specific mental health issues to support health professionals worldwide during pandemics such as COVID-19. This is in line with the position paper of the World Psychiatric Association (76), which recommended continued psychiatric support including telepsychiatry, promoting adherence to physical health measures such as social distancing, as well as respecting the human rights of individual with mental disorders. McDaid (77) added the need for strategies to support overall mental health recovery beyond the pandemic, which could be tailored to individual country context.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding authors.

AUTHOR CONTRIBUTIONS

MC, DS, and UB: conceptualisation and study protocol. PJ and MK: articles search. MC and PJ: article screening and selection. DS, LD, and PP: data extraction. NC, PJ, and TK: quality assessment. MC, AC, DS, and UB: data analysis. RM, KN, and PK: supervision and review for intellectual content. MC, DS, and DN: writing first draft of manuscript. All authors: final approval of manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.804525/full#supplementary-material

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Problematic Mobile Phone Use and Life Satisfaction Among University Students During the COVID-19 Pandemic in Shanghai, China

Wenning Jiang[1], *Jin Luo*[2,3], *Hannan Guan*[4,5], *Feng Jiang*[2,3]* *and Yi-Lang Tang*[6,7]

[1] Antai College of Economics and Management, Shanghai Jiao Tong University, Shanghai, China, [2] School of International and Public Affairs, Shanghai Jiao Tong University, Shanghai, China, [3] Institute of Healthy Yangtze River Delta, Shanghai Jiao Tong University, Shanghai, China, [4] School of Education, Shanghai Jiao Tong University, Shanghai, China, [5] Department of Education Information Technology, East China Normal University, Shanghai, China, [6] Department of Psychiatry and Behavioral Sciences, Emory University, Atlanta, GA, United States, [7] Atlanta Veterans Affairs Medical Center, Decatur, GA, United States

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Edited by:
Wulf Rössler,
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Guangyu Hu,
Chinese Academy of Medical Sciences and Peking Union Medical College, China
Xin Li,
East China University of Science and Technology, China

***Correspondence:**
Feng Jiang
fengjiang@sjtu.edu.cn

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Objective: This study examined problematic mobile phone use (PMPU) and its relationship with life satisfaction in Chinese university students during the pandemic.

Methods: An anonymous online survey was conducted in a university in China. The Mobile Phone Addiction Index (MPAI) and the Satisfaction with Life Scale (SWLS) were used to assess the severity of problematic mobile phone use and life satisfaction, respectively. Data on demographic and health-related factors were also collected.

Results: A total of 1,491 undergraduate students (73.3% were male) completed the survey. On average, students in the survey reported spending 7.4 ± 4.3 h/day on phone use. Their MPAI score was 38.1 ± 13.3 and SWLS score was 24.9 ± 6.8, respectively. After controlling for confounding factors, the MPAI score was significantly associated with lower life satisfaction. Multiple linear regression revealed that higher monthly allowances, frequent insomnia, longer phone use duration were significantly associated with PMPU.

Conclusion: University students in China spend nearly half of their waking hours on mobile phone use, significantly longer than before the COVID-19 pandemic. PMPU is associated with insomnia, lower life satisfaction and higher allowances. If the trend continues after the pandemic, interventions may be needed. Increase in-person interactions, limiting online social and gaming time, awareness campaign may be effective in reducing the impact of PMPU and improve life satisfaction.

Keywords: mobile phone use, life satisfaction, association, university students, China

INTRODUCTION

Smartphones have become a necessity and the most important communication tool because of their convenience and accessibility (1–3), and this is especially true for young people. Due to the technological advances, smartphones have been used in academic, professional, social and recreational activities, including those tasks that were previously only possible on computers. In the meantime, excessive smartphone use could lead to a series negative health outcomes, including depression, anxiety, sleep deprivation and insomnia (4–7), and low life satisfaction. Furthermore,

excessive smartphone use may increase the risk of problematic mobile phone use (PMPU), and even lead to smartphone addiction (8).

Of note, neither smartphone addiction nor internet addiction is officially listed as a diagnosis in any major diagnostic systems and it is controversial to consider it as a diagnostic entity. However, a few other terms have been used to describe this phenomenon: problematic mobile phone use, mobile phone addiction, excessive mobile phone use, and compensatory mobile phone use (9). PMPU is characterized by excessive attention and uncontrolled dedication to one's cell phone use (10).

In China, young people are the largest growing group of smartphone users, especially university students (11). University students tend to routinely use smartphones in their study and other daily activities (12). In 2018, a survey demonstrated that Chinese university students spend over 5 h/day on mobile phones, and ∼4/5 (79%) use smartphones in class (2).

The COVID-19 has dramatically changed people's lives in numerous ways. In the early stages of the pandemic, a range of emergency public health measures were adopted, such as universal masking, social distancing, locking down, school closure, and public transportation suspension. One adaptive behavioral change during the extraordinary times is increased use of the internet and smartphone for either professional use or personal use. One survey found that, during the COVID-19 pandemic, adolescents spent more time on the internet to study, play games, and chat with friends (13). This large-scale social isolation and overexposure to the mobile devices may contribute to a few mental health issues, including the potential to have PMPU.

As an important element in happiness, life satisfaction is the gap between what people have and what they want (14), which correlates positively with academic performance and productivity (15). It is believed that life satisfaction is affected by conditions such as health, socioeconomic status, and activities (16).

To date, although a few studies have examined internet use and smartphone use in adolescents, middle and high school students (17–22), few studies examined the smartphone use pattern and PMPU among university students in China during the COVID-19 pandemic. Furthermore, no studies have examined the association between PMPU and life satisfaction using standard structured instruments. Therefore, we designed this study and collected data among university students during the COVID-19 pandemic. We firstly surveyed the average time spent on smartphones, then examined the factors associated with PMPU, with focus on the relationship between PMPU and life satisfaction.

MATERIALS AND METHODS

Study Design and Participants

This cross-sectional study was conducted in a comprehensive university from July 7 to 17 in 2021. Before the start of the survey, we calculated the minimum sample size using the following formula:

$$n = \frac{N}{1 + \frac{4d^2(N-1)}{z_\alpha^2}}$$

where n is the minimum sample size, N the size of the students in Shanghai Jiao Tong University, d the maximum error of estimate, and z_α the critical value of normal distribution at the assumed confidence level.

Three schools (Antai College of Economics & Management; School of International and Public Affairs; School of Electronic, Information and Electrical Engineering) were selected as convenience samples, while all full-time undergraduates in the selected schools were invited to participate. The weblink of the study was posted via WeChat, a popular social app in mainland China.

The Ethics Committee in Shanghai Jiao Tong University approved the study protocol (approval number: H2021158I). Each participant provided written informed consent before they responded to the questionnaire.

Measures

Socio-Demographic Characteristics

We collected socio-demographic data of the participants, including gender, age, grade, place of hometown, ethnicity, major, monthly allowances, and relationship status. We also collected information on alcohol use, cigarette use, and insomnia based on literature review (2).

PMPU

PMPU was assessed using the Mobile Phone Addiction Index (MPAI), which has been widely used in various studies (23, 24). MAPI was developed by Leung to rate the comprehensive level of mobile phone addiction and related symptoms, including the inability to control craving, feel anxious and lost, withdrawal or escape, and productivity loss (25). All 17 items were rated on a 5-point Likert-type scale, ranging from 1 (Never) to 5 (Always), while higher total scores indicate higher levels of mobile phone addiction (23). The Cronbach's α of MPAI was 0.93 in the present study.

Life Satisfaction

Participants' overall life satisfaction was assessed using the Satisfaction with Life Scale (SWLS) (14), which has been widely used around the world with good reliability and validity (26, 27). The scale assesses an individual's satisfaction with life as a whole. It has 5 items, such as "The conditions of my life are excellent." Participants rated the items on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), with higher scores indicative of better-perceived life satisfaction. The Cronbach's α of SWLS in our samples was 0.94.

Data Analysis

One-sample K-S test was used to examine the normality of the data. Descriptive analyses for the sample's socio-demographic, PMPU, life satisfaction, and other related factors were conducted.

The associations between PMPU, life satisfaction, and other factors were examined with independent samples *t*-test, analysis of variance (ANOVA), chi-square test, and Pearson correlation analysis, as appropriate. The independent associations between PMPU and life satisfaction were determined with a stepwise multiple linear regression after controlling for significant correlates as identified in the univariate analyses. The independent factors associated with PMPU were identified through a stepwise method of multiple linear regression; MPAI score was entered as the dependent variable, while its significant correlates in univariate analyses were involved as the independent variables. Data analyses were carried out with the STATA software version 16.0 (Stata Corporation, College Station, TX, USA), with the significance level at the *p*-value of 0.05 (two-tailed).

RESULTS

In total, 4,561 undergraduates were invited to participate and 1,534 students responded (response rate of 33.63%). The relatively low response rate might be attributable to the busy schedules at the end of the Spring semester. Therefore, 1,491 undergraduates completed the survey without logical errors and were included in the statistical analysis.

Their mean age was 20.8 ± 2.9 years, and 73.3% were male. They spent 7.4 ± 4.3 h/day on smartphones, with the MPAI score of 38.1 ± 13.3. Their SWLS score was 24.9 ± 6.8. **Table 1** shows the detailed information of their social-demographic and related characteristics.

Table 2 displays the results of univariate analyses, showing the factors associated with PMPU and life satisfaction.

Table 3 shows the Pearson correlation coefficients of PMPU and life satisfaction with age and smartphone use time. Phone use time was significantly associated with MPAI score ($r = 0.135$, $p < 0.05$).

After controlling for other related factors, MPAI score was significantly associated with lower life satisfaction ($\beta = -0.10$, $p < 0.001$) (**Table 4**).

We also found that PMPU was significantly associated with higher monthly allowances, frequent insomnia, longer phone use time (**Table 5**).

DISCUSSION

Based on a large (>1,000), relatively homogenous sample of undergraduate students from a university, we found that students spent 7.4 ± 4.3 h/day on phone use. Their MPAI score was 38.12 ± 13.33 and SWLS score was 24.987 ± 6.81, respectively. We also found the MPAI score was significantly associated with lower life satisfaction. Multiple linear regression revealed that PMPU was significantly associated with higher monthly allowances, frequent insomnia, and longer phone use duration in this sample.

To our best knowledge, this survey was one of the first that examined the relationship between PMPU and life satisfaction among Chinese university students during the COVID-19 pandemic. This study found a negative association between

TABLE 1 | Characteristics of 1,491 participants.

Characteristic	*N*	%
Gender		
Male	1,093	73.31
Female	398	26.69
Grade		
Freshman	401	26.89
Sophomore	404	27.10
Junior	457	30.65
Senior	229	15.36
Hometown setting		
Urban	979	65.66
Rural	512	34.34
Ethnicity		
Han Chinese	1,376	92.29
Minority nationality	115	7.71
Major		
Engineering	494	33.13
Science	464	31.12
Economy	108	7.24
Others	425	28.50
Monthly allowances (RMB)		
<1,000	184	12.34
1,000–1,499	509	34.14
1,500–1,999	391	26.22
2,000–2,499	228	15.29
2,500–2,999	65	4.36
≥3,000	114	7.65
Relationship status		
Not dating nor married	864	57.95
Dating but unmarried	534	35.81
Married	54	3.62
Others	39	2.62
Insomnia		
No	623	41.78
Seldom (≤3 times/month)	450	30.18
Sometimes (1–2 times/week)	275	18.44
Often (3–5 times/week)	109	7.31
Daily (>5 times/week)	34	2.28
Cigarette use		
No	1,177	78.94
Ex-smoker	185	12.41
Current smoker	129	8.65
Alcohol use		
Never	862	57.81
Rare (≤2 times/month)	410	27.50
Sometimes (≤4 times/month)	145	9.73
Often (≤12 times/month)	47	3.15
Always (>12 times/month)	27	1.81
	Mean	**SD**
Age (years)	20.83	2.89
MAPI	38.12	13.33
SWLS	24.87	6.81
Phone use duration (hours)	7.39	4.32

MAPI, mobile phone addiction index; SWLS, the satisfaction with life scale.

TABLE 2 | Univariate analyses of factors associated with PMPU and SWLS.

Variable	MPAI score			SWLS		
	Mean ± SD	*t*/F	*P*	Mean ± SD	*t*/F	*P*
Gender		−0.60	0.549		3.29	**0.001**
Male	38.00 ± 13.41			25.22 ± 6.84		
Female	38.46 ± 13.13			23.91 ± 6.67		
Grade		1.49	0.214		1.23	0.297
Freshman	37.14 ± 13.53			24.37 ± 7.04		
Sophomore	37.89 ± 13.54			24.86 ± 6.97		
Junior	38.65 ± 12.92			25.11 ± 6.42		
Senior	39.18 ± 13.38			25.31 ± 6.89		
Place of hometown		0.01	0.916		0.79	0.430
Urban	38.09 ± 13.52			24.97 ± 6.86		
Rural	38.17 ± 12.98			24.68 ± 6.74		
Ethnic groups		−2.28	**0.022**		0.73	0.465
Han	37.89 ± 13.29			24.91 ± 6.81		
Minority nationality	40.84 ± 13.65			24.43 ± 6.89		
Specialty		4.65	**0.003**		7.08	**<0.001**
Engineering	37.87 ± 12.49			24.10 ± 6.32		
Science	36.74 ± 14.21			25.87 ± 7.22		
Economy	37.72 ± 12.26			23.48 ± 6.32		
Others	40.02 ± 13.38			25.04 ± 6.89		
Monthly allowances (RMB)		6.19	**<0.001**		1.57	0.166
<1,000	34.34 ± 14.55			24.90 ± 8.56		
1,000–1,499	37.56 ± 12.70			24.45 ± 6.26		
1,500–1,999	38.06 ± 12.60			24.67 ± 6.46		
2,000–2,499	41.05 ± 13.63			25.54 ± 6.71		
2,500–2,999	40.37 ± 11.71			24.92 ± 6.58		
≥3,000	39.82 ± 15.17			26.04 ± 7.44		
Relationship status		8.12	**<0.001**		6.40	**<0.001**
Not dating nor married	36.78 ± 13.39			24.34 ± 6.75		
Dating but unmarried	39.58 ± 12.53			25.31 ± 6.68		
Married	42.48 ± 16.25			27.31 ± 7.71		
Others	41.87 ± 14.62			27.21 ± 7.49		
Insomnia		37.96	**<0.001**		11.47	**<0.001**
No	33.90 ± 13.17			26.17 ± 6.85		
Seldom (≤3 times/month)	39.22 ± 12.03			24.37 ± 6.39		
Sometimes (1–2 times/week)	41.80 ± 12.26			23.85 ± 6.10		
Often (3–5 times/week)	45.19 ± 12.74			22.78 ± 7.51		
Daily (>5 times/week)	48.59 ± 16.36			22.76 ± 10.02		
Cigarette use		17.86	**<0.001**		1.11	0.331
No	37.11 ± 13.16			24.83 ± 6.71		
Ex-smoker	42.99 ± 12.15			25.48 ± 6.87		
Current smoker	40.33 ± 14.72			24.37 ± 7.67		
Alcohol use		10.63	**<0.001**		4.18	**0.002**
Never	36.34 ± 13.51			25.42 ± 6.86		
Rare (≤2 times/month)	39.89 ± 12.47			23.81 ± 6.41		
Sometimes (≤4 times/month)	42.34 ± 11.92			25.01 ± 6.54		
Often (≤12 times/month)	42.19 ± 13.50			23.83 ± 7.61		
Always (>12 times/month)	38.48 ± 17.32			24.63 ± 9.37		

Bold value for $p < 0.05$.

TABLE 3 | Pearson correlation analysis for PMPU and SWLS.

Variable	MPAI	SWLS
Age (years)	0.015	0.015
Phone use duration	0.135*	−0.015

*$p < 0.05$.

TABLE 4 | Association of PMPU and SWLS.

Variable	β	95% CI (Lower)	95% CI (Upper)	P
MAPI	−0.10	−0.13	−0.07	**<0.001**
Female	−1.15	−1.90	−0.40	**0.003**
Marriage				
Dating but unmarried	1.43	0.72	2.13	**<0.001**
Married	4.21	2.38	6.04	**<0.001**
Others	3.64	1.54	5.75	**0.001**
Insomnia				
Seldom	−1.28	−2.09	−0.48	**0.002**
Sometimes	−1.87	−2.82	−0.92	**<0.001**
Often	−2.85	−4.22	−1.48	**<0.001**
Daily	−2.67	−4.96	−0.37	**0.023**

Bold value for $p < 0.05$.

TABLE 5 | Independent correlates of PMPU.

Variable	β	95% CI (Lower)	95% CI (Upper)	P
Monthly allowances (RMB)				
1,000–1,499	3.52	1.39	5.66	**0.001**
1,500–1,999	3.24	1.02	5.46	**0.004**
2,000–2,499	5.85	3.38	8.31	**<0.001**
2,500–2,999	5.00	1.98	8.03	**0.006**
≥3,000	5.02	1.45	8.59	**0.002**
Insomnia				
Seldom (≤3 times/month)	5.00	3.47	6.54	**<0.001**
Sometimes (1–2 times/week)	7.47	5.67	9.27	**<0.001**
Often (3–5 times/week)	10.28	7.68	12.87	**<0.001**
Daily	14.01	9.61	18.42	**<0.001**
Phone use duration	0.28	0.12	0.43	**<0.001**

Bold value for $p < 0.05$.

excessive mobile phone use and life satisfaction, suggesting a link between PMPU and lower life satisfaction. While the mechanism and causality are unclear, some studies reported significant association between excessive mobile phone use and poor sleep quality, insomnia (28–30), depression and anxiety (6, 31), all of which may be linked to poor life satisfaction or quality of life (QOL) (32–34). Similar findings between PMPU and life satisfaction have been reported by other studies. Reports from the United States and Lebanon also found that PMPU was negatively associated with life satisfaction, mediated by academic performance and stress (35, 36). Another study of Chinese university students demonstrated that the severity of mobile phone addiction was significantly associated with lower scores on all domains of QOL measures (2).

In the current study, we found the average duration of mobile phone use was 7.39 h, which was much longer than previous studies, especially those prior to the COVID-19 pandemic. A study conducted in December 2018 in Shenzhen, a city in south China, showed that youth (18–24 years old) people used mobile phones for 3.78 ± 2.51 h per day before the pandemic (37). Xie et al. showed that male university students in pre-pandemic Macau used mobile phones 2.7 ± 2.4 h per day, while female students 3.0 ± 2.5 h (38). Another study in Turkey Inonu University before the COVID-19 pandemic found that 21.6% of students used cell phones for 3 h or less, 31.7% between 4 and 5 h, 18.5% between 6 and 7 h, and 28.2% longer than 8 h (39). The survey of Mobile phone usage in 2018 found university students in China on average spent over 5 h/day on mobile phones, which is much closer to our findings (2). The significant difference in mobile phone use among different studies may be due to different samples, time of survey and how the questions were asked. During the COVID-19 period, university students needed to use smartphones for academic activities, including online class and learning, which may explain the longer phone use (40), although our data did not differentiate between personal use and professional use.

An interesting finding of our study is that the MAPI score was lower than in several previous studies. For example, Liu et al. found that the MPAI score in male medical college students in Shanghai was 44.94 ± 12.08, female 45.25 ± 11.87 (41). A study of high school students in Sichuan and Chongqing showed a little higher MPAI score with a mean of 41.65 than our study (24). Again the sampling methods, samples' demographic features may explain some of the difference. It is also possible that although our sample reported longer time on smartphone, they had used it more academic activities instead of smartphone gaming, therefore less distress and impairments were experienced, as other types of smartphone activities such as internet gaming were associated with psychological distress (42, 43).

In the regression model, we found that PMPU was significantly associated with students' monthly allowances, which often reflect their family socioeconomic status. This finding is in line with findings of a study among Iranian medical university students, which demonstrated that family economic status was a significant predictor of mobile phone dependency (44). The exact mechanism between socioeconomic status and PMPU warrants further investigations.

Several limitations about this study need to be noted. First, due to the nature of a cross-sectional survey, a causal relationship between PMPU and other variables could not be examined. Second, some important information related to PMPU and life satisfaction, such as personality and academic performance, were not recorded. Third, we did not specify whether the time spent on smartphone was for academic activity, social communication or gaming, which may provide more helpful information regarding

intervention. Fourth, as the instruments were self-reported, the recall bias and response bias cannot be ruled out in the study. Finally, as the participating schools were selected by convenience, this could lead to sampling bias, therefore the generalizability of the conclusions may be limited.

CONCLUSIONS

In conclusion, we found university undergraduate students in China spend nearly half of their waking hours on mobile phone use, significantly longer than before the COVID-19 pandemic. PMPU is associated with insomnia, lower life satisfaction and higher allowances. Awareness campaign is needed. If this trend continues, interventions may be indicated, including facilitating in person interactions, limiting online social and gaming time. These changes may be effective in reducing the impact of PMPU and improve life satisfaction among students.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee in Shanghai Jiao Tong University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

FJ and Y-LT made substantial contributions to the study design. JL, WJ, and HG collected data. FJ analyzed the data. JL and FJ interpreted the results of analysis and completed the manuscripts. Y-LT critically revised the manuscript. All authors contributed to the article and approved the submitted version.

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Depression During COVID-19 Quarantine in South Korea: A Propensity Score-Matched Analysis

Yongjoo Kim[1], *Hye-Young Kwon*[2]*, *Seungyoung Lee*[3] and *Chang-Bo Kim*[4]

[1] College of Korean Medicine, Sangji University, Wonju, South Korea, [2] Division of Biology and Public Health, Mokwon University, Daejeon, South Korea, [3] College of Nursing, Kyunghee University, Seoul, South Korea, [4] Seoul Health Foundation, Seoul, South Korea

Background: Quarantine, a public health measure used to control the coronavirus disease 2019 (COVID-19) pandemic, has been linked to an increased risk of developing adverse psychological sequelae. This study sought to investigate whether quarantining during the COVID-19 pandemic was associated with depression among Koreans.

Methods: Data were obtained from the Seoul COVID-19 Study of Quarantine (SCS-Q) and the 2019 Korea Community Health Survey (KCHS). Using propensity scores estimated based on sociodemographic and health conditions, 919 individuals undergoing quarantine in the SCS-Q were matched with 919 individuals who did not experience quarantine in the 2019 KCHS. Depressive symptoms were measured using the Korean version of the Patient Health Questionnaire-9 (PHQ-9), where major depression is defined as a PHQ-9 score $\geq$ 10. Logistic regression models were adjusted for sociodemographic and health-related factors.

Results: Depression prevalence was higher in quarantined individuals than in the control group (7.8 vs. 3.8%, $p < 0.001$). Logistic regression analyses revealed that quarantining was associated with higher likelihoods of having major depression [odds ratio (OR) = 2.28, 95% confidence interval (CI): 1.49, 3.51] after adjusting for relevant covariates.

Limitations: Due to the online nature of the SCS-Q, this study included a limited number of elderly participants, limiting the generalizability of the findings to the general Korean population.

Conclusions: The findings suggest that Koreans undergoing COVID-19 quarantine are at higher risk of depression. While further investigation is warranted, public health measures to control infectious disease outbreaks, such as quarantine, would benefit from incorporating strategies to address unintended adverse psychological effects, such as depression.

Keywords: COVID-19, quarantine, mental health, psychological impacts, depression, depressive symptoms, depressive disorder, South Korea

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Edited by:
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Tamkang University, Taiwan
Aleksandra Maria Rogowska,
University of Opole, Poland

***Correspondence:**
Hye-Young Kwon
haeyoungkwon0111@gmail.com

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INTRODUCTION

The novel coronavirus disease 2019 (COVID-19) pandemic is an urgent global public health issue. Quarantine is one of the most commonly used public health measures to address the spread of infectious disease outbreaks, limiting the movement of people who are at high risk of exposure to an etiological agent, even in the absence of clinical symptoms or laboratory results (1). However, due to the unpleasant nature of quarantine stemming from separation and restriction, adverse psychological sequelae are pervasive among individuals who undergo quarantine (2–4).

A growing body of literature has documented that quarantining is associated with elevated levels of psychological distress, including depression, anxiety, and suicidality (4–7). A recent review reported that quarantining due to infectious disease outbreaks can be followed by psychological and environmental stressors such as fears/concerns of infection, loss of social relationships and physical activities, and insufficient supplies and information, which in turn can lead to mental disorders, including depression, anxiety, and post-traumatic stress symptoms (4). In relation to COVID-19 quarantine, generally higher levels of psychological distress symptoms have been reported among individuals undergoing quarantine in China (3, 5), Ireland (8), and Italy (9). Moreover, a Canadian study found that, compared to individuals who did not undergo quarantine, those who experienced quarantine tended to have increased suicidality, self-harm intentions, and other unfavorable mental health outcomes (7). These previous studies necessitate further research to inform effective intervention strategies to address adverse psychological consequences during the implementation of quarantine.

In South Korea, after the first laboratory-confirmed case of COVID-19 was detected in January 2020, the spread of COVID-19 has been relatively successfully controlled to the extent that it does not require a nationwide lockdown (10). Based on the "3T" strategy (Testing-Tracing-Treating), mandatory quarantine has been widely implemented among high-risk populations. That is, individuals who had close contact with those who received positive laboratory test results, even in the absence of clinical symptoms, or individuals who traveled abroad were required to have a 14-day self-quarantine at home or dedicated facilities (10). Previous Korean studies have generally focused on the levels of psychological distress among the general public during the COVID-19 pandemic or individuals infected with COVID-19 (11–13). For instance, Kim and colleagues found higher levels of sleep disturbance and perceived stress among the general public residing where COVID-19 was prevalent (11). However, despite the accumulated number of individuals who experienced or were undergoing quarantine in South Korea and the increasing body of evidence showing the negative psychological impacts of quarantine among other populations, to date, there has been limited evidence to understand whether COVID-19 quarantine leads to an elevated risk of mental disorders among Koreans. Therefore, in this study, we sought to investigate the association between quarantining during the COVID-19 pandemic and depression among Koreans. Based on previous research, we hypothesized that individuals undergoing COVID-19 quarantine would have an elevated risk of depression and higher levels of depressive symptoms than those who did not experience quarantine.

METHODS

Sample and Data Source

In South Korea, all individuals who enter the country from abroad or make close contact with those affected by COVID-19 are recommended to undergo screening tests at local screening posts. Of those, individuals who receive negative test results are required to conduct self-quarantine in a dedicated facility or at home for 14 days, whereas those who receive a positive test result are transferred to designated hospitals or residential centers for surveillance. In Seoul Metropolitan City, local district governments and public health centers are in charge of the self-quarantine process, including managing screening posts, providing quarantine guidelines and necessary supplies, and monitoring and communicating with those who are quarantined.

The Seoul COVID-19 Study of Quarantine (SCS-Q) was conducted by the Seoul Health Foundation (SHF) in collaboration with the local district public health centers. The SHF is a public institute established by the Seoul Metropolitan City in order to develop and evaluate public health policies and interventions. In collaboration with local public health centers in Seoul, investigators at SHF developed and administered an online survey. All individuals aged 19 years or above who were undergoing self-quarantine at some point from October to November 2020 in Seoul were sampled and invited to participate in the survey. During the survey period, 5,175 individuals underwent self-quarantine. Of those, 1,139 individuals (overall response rate: 22.0%) agreed to participate in the survey and responded accordingly.

The survey questionnaire was composed of three parts: (a) sociodemographic information including age, sex, socioeconomic status, living arrangement, and residing area; (b) evaluation of quarantine-related processes and experiences; and (c) health-related factors such as depression, anxiety, health-related quality of life, self-rated health, and other medical histories.

The Institutional Review Board of Seoul Metropolitan City approved our study (IRB No. 2020-10-0001). We obtained online informed consent from all survey respondents prior to survey participation.

To select a control group, we used data from the Korea Community Health Survey (KCHS), which is a nationally representative study of Korean community-dwelling individuals aged 19 years or older, measuring information on sociodemographic, behavioral, and medical conditions, administered by the Korea Centers for Disease Control and Prevention (14). The KCHS measures information on sociodemographic, behavioral, and medical conditions. Of the individuals included in the 2019 KCHS, we focused on samples from Seoul, including 3,649 individuals.

Based on the information from the two samples ($N = 1{,}139$ from the SCS-Q and $N = 3{,}649$ from the 2019 KCHS), we used a propensity score matching method to match individuals

from the SCS-Q with individuals from the 2019 KCHS. First, we built logistic regression models to estimate the propensity to be quarantined with respect to age, sex, district of residence, education, employment status, income level, and chronic conditions such as hypertension, which were determined using a stepwise model selection process. Based on the propensity score estimated by the function of the aforementioned independent variables, the samples from the SCS-Q ($N = 919$) were matched to samples from the 2019 KCHS ($N = 919$), including a total of 1,838 individuals, as the final analytic sample of this study.

Measures

We used the Korean version of the Patient Health Questionnaire-9 (PHQ-9) to assess depressive symptoms. The PHQ-9 is a commonly used validated measure for depression and comprises nine items capturing symptoms of depression, including anhedonia, depressed mood, trouble sleeping, feeling tired, change in appetite, guilt/self-blame, trouble concentrating, feeling restless/slowed down, and suicidal thoughts, over the past 2 weeks (15). Per each item, response options represent the perceived frequency of the depressive symptom specified in each item during the past 2 weeks, including "never (0)," "several days (1)," "more than half of the days (2)," and "almost every day (3)," resulting in a total score ranging from 0 to 27 (15). Previous studies have reported excellent level of internal consistency reliability of PHQ-9 with Cronbach's alpha values ranging from 0.81 to 0.95 among US and Korean samples (16–19). A consistent result was found in our sample with a Cronbach's alpha value of 0.87. A meta-analysis reported that a cut-off of ≥10 is one of the most commonly used thresholds to identify major depressive disorder with a sensitivity of 0.85, and specificity of 0.89, when compared with a structured psychiatric interview (20). The validity and reliability of the Korean translated version of the PHQ-9 have been reported in previous studies (16, 18, 19). The Korean version of the PHQ-9 was administered to the 2019 KCHS cohort. In the SCS-Q, to assess depressive symptoms during quarantine, the timeframe of each item was modified from "over the past 2 weeks" to "during quarantine."

Statistical Analysis

For descriptive analyses, we examined means (standard deviations) for continuous variables and frequencies (proportions) for binary/categorical variables among individuals quarantined during the COVID-19 pandemic (from the SCS-Q) and the control group (from the 2019 KCHS study) before and after matching, respectively. We also examined and compared the distribution of PHQ-9 scores, major depression (PHQ-9 score $\geq$ 10), and mild depression (PHQ-9 score $\geq$ 5) in quarantined individuals and the control group after matching. We further examined and compared the distribution of major depression according to relevant covariates, including age (19–39, 40–64, 65+), sex, district of residence, education (high school graduate or less vs. some college education or more), employment status (wage worker, employer/self-employed, economically inactive, others), income level (lowest in quartiles vs. higher than lowest), marital status (single, married, divorced/widowed), living arrangement (living alone vs. others), comorbid conditions such as hypertension and diabetes, and self-rated health (good/very good vs. moderate or worse), among quarantined individuals and the control group after matching.

To investigate whether quarantine during the COVID-19 pandemic was associated with an increased likelihood of major depression, we used a logistic regression modeling approach linking major depression with respect to quarantine status and other relevant independent variables based on the matched data. For all statistical analyses, SAS 9.4 (SAS Institute, Inc. Cary, NC, USA) was used.

RESULTS

Descriptive Statistics

Table 1 shows the characteristics of the samples before and after matching. Before matching, significant differences were found in the distribution of relevant sociodemographic and health-related factors between those under quarantine during the COVID-19 pandemic ($N = 1,139$ individuals from the SCS-Q) and control groups ($N = 3,649$ individuals residing in the four local districts in Seoul from the 2019 KCHS). However, after the matching procedure based on the aforementioned propensity score method, those under quarantine during the COVID-19 pandemics (N=919 individuals from the SCS-Q) showed nearly identical characteristics, in terms of the relevant sociodemographic and health-related factors, with the control group ($N = 919$ individuals residing in Seoul from the 2019 KCHS).

Table 2 presents the differences in the distribution of depression measures in those under quarantine during the COVID-19 pandemic ($N = 919$) and in the control group ($N = 919$). Overall, individuals undergoing self-quarantine during the COVID-19 pandemic had higher levels of depressive symptoms (mean score 3.38 vs. 2.29, $p < 0.001$) and a higher prevalence of major (7.8 vs. 3.8%, $p < 0.001$) and mild depression (28.1 vs. 16.8%, $p < 0.001$) than those in the control group. Moreover, major depression was more prevalent among women than among men (10.4 vs. 5.3%), the younger age group (10.2% of those aged 19–39 vs. 5.6% of those aged 40+), economically inactive group than wage workers (11.6 vs. 6.3%), and those living alone than those not living alone (14.0 vs. 6.7%).

Quarantining and Depression

Table 3 demonstrates the findings from the logistic regression models linking quarantine during the COVID-19 pandemic with major depression (defined as a PHQ-9 score of 10 or above, representing moderate to severe level of depressive symptoms) among the study participants ($N = 3,649$). Overall, individuals undergoing quarantine during the COVID-19 pandemic were more likely to have major depression (OR = 2.28, 95% CI: 1.49, 3.51) than those in the control group, after accounting for relevant sociodemographic and health-related factors. We found a similar association (OR = 2.03, 95% CI: 1.61, 2.56) when using more relaxed criteria to define the outcome (mild/major depression, defined as a PHQ-9 score of 5 or above, representing mild, moderate, or severe level of depressive symptoms).

TABLE 1 | Sociodemographic and health-related characteristics of the SCS-Q sample and control group before and after matching.

Variables		Before matching						After matching					
		Quarantinees during COVID 19 pandemic		Control group		χ^2 or *t*-valtest statisticsue[a]	*P*-value	Quarantinees during COVID 19 pandemic		Control group		χ^2 or *t*-value[a]	*P*-value
		(*N* = 1,139)		(*N* = 3,649)				(*N* = 919)		(*N* = 919)			
Male, *N*(%)		565	(49.6%)	1,528	(41.9%)	21.08	<0.0001	468	(50.9%)	468	(50.9%)	0.00	NS
Age, Mean(SD)		39.01	(12.54)	52.35	(17.60)	28.27	<0.0001	39.82	(12.16)	40.10	(13.14)	0.49	NS
Age group													
	19-39	608	(53.4%)	941	(25.8%)	472.22	<0.0001	472	(51.4%)	466	(50.7%)	0.08	NS
	40-64	508	(44.6%)	1,690	(46.3%)			427	(46.5%)	433	(47.1%)		
	65 and over	23	(2.0%)	1,018	(27.9%)			20	(2.2%)	20	(2.2%)		
Dwelling district						31.42	<0.0001						
	Nowon-gu	330	(29.0%)	912	(25.0%)			256	(27.9%)	258	(28.1%)	0.06	NS
	Sungbuk-gu	341	(29.9%)	917	(25.1%)			276	(30.0%)	276	(30.0%)		
	Eunpyung-gu	261	(22.9%)	910	(24.9%)			208	(22.6%)	204	(22.2%)		
	Yangcheon-gu	207	(18.2%)	910	(24.9%)			179	(19.5%)	181	(19.7%)		
Income						102.44	<0.0001					0.17	NS
	Lowest	138	(12.1%)	146	(4.0%)			26	(2.8%)	29	(3.2%)		
Employment status						268.85	<0.0001					0.07	NS
	Wage worker	625	(54.9%)	1,620	(44.4%)			576	(62.7%)	554	(60.3%)		
	Employer/Self-employed	98	(8.6%)	407	(11.2%)			86	(9.4%)	115	(12.5%)		
	Economically inactive	312	(27.4%)	1,588	(43.5%)			241	(26.2%)	238	(25.9%)		
	Others	104	(9.1%)	34	(0.9%)			13	(1.4%)	12	(1.3%)		
Education						284.19	<0.0001					0.06	NS
	High school or less	254	(22.3%)	1,850	(50.7%)			155	(16.9%)	151	(16.4%)		
	Tertiary education	885	(77.7%)	1,799	(49.3%)			764	(83.1%)	768	(83.6%)		
Predisposing chronic diseases												0.16	NS
	Hypertension	96	(8.4%)	1,017	(27.9%)	183.90	<0.0001	83	(9.0%)	88	(9.6%)		
Propensity scores		0.38	(0.21)	0.19	(0.15)	28.45	<0.0001	0.32	(0.13)	0.32	(0.13)	0.00	NS

[a] *Test statistics were driven from t tests for continuous variables, McNemar's test for binary variables, and Chi-squared test for categorical variables.*

TABLE 2 | Distribution of depression-related measures among quarantined individuals during the COVID-19 pandemic and the control group.

	Quarantinees during COVID 19 pandemic (*N* = 919)		Control group (*N* = 919)		χ^2 or *t*-value	*P*-value
PHQ score		(4.30)	2.29	(3.257)	6.15	<0.0001
	3.38					
Major Depression[a], *N* (%)	72	(7.8%)	35	(3.8%)	747.56	<0.0001
Mild/Major Depression[b], *N* (%)	258	(28.1%)	154	(16.8%)	315.40	<0.0001
By sex					0.35	NS
Male	25	(5.3%)	14	(3.0%)		
Female	47	(10.4%)	21	(4.7%)		
By age					14.78	0.0001
19-40	48	(10.2%)	18	(3.9%)		
40-65	24	(5.6%)	17	(3.9%)		
65 and over	0	(0.0%)	0	(0.0%)		
By district					6.97	NS
Nowon-gu	23	(9.0%)	7	(2.7%)		
Sungbuk-gu	13	(4.7%)	12	(4.3%)		
Eunpyung-gu	13	(6.3%)	10	(4.9%)		
Yangcheon-gu	23	(12.8%)	6	(3.3%)		
By income level					45.00	<0.0001
Lowest	2	(7.7%)	10	(34.5%)		
Others	70	(7.8%)	25	(2.8%)		
By employment					6.27	NS
Wage worker	36	(6.3%)	9	(1.6%)		
Employer/Self-employed	5	(5.8%)	4	(3.5%)		
Economically inactive	28	(11.6%)	21	(8.8%)		
Others	3	(23.1%)	1	(8.3%)		
By education					21.28	<0.0001
High School	12	(7.7%)	19	(12.6%)		
Tertiary Education	60	(7.9%)	16	(2.1%)		
By marital status					15.68	<0.0001
Married	33	(6.3%)	11	(2.1%)		
Single	37	(10.2%)	14	(4.1%)		
Divorced/widowed	2	(5.6%)	10	(17.5%)		
By type of household					30.31	<0.0001
living alone	20	(14.0%)	9	(7.4%)		
others	52	(6.7%)	26	(3.3%)		
By Predisposing diseases						
Hypertension	3	(3.6%)	5	(5.7%)	55.35	<0.0001
Diabetes	2	(4.4%)	3	(7.9%)	61.49	<0.0001
By self-rated health					37.10	<0.0001
Good/very good	32	(7.6%)	1	(0.2%)		
Moderate/bad/very bad	40	(8.0%)	34	(6.7%)		

[a]*Major depression was defined as PHQ-9 score of 10 or above, representing moderate or severe levels of depressive symptoms.*
[b]*Mild/Major depression was defined as PHQ-9 score of 5 or above, representing mild, moderate, or severe levels of depressive symptoms.*

We also found other factors associated with depression, including sex, income, employment status, marital status, and self-rated health. For instance, women were more likely to have mild/major depression, defined as a PHQ-9 score of 5 or above, than men (OR = 1.37, 95% CI: 1.08, 1.75) after accounting for all other factors. Individuals in the lowest quartile of income were more likely to have mild/major depression (OR = 2.43, 95% CI: 1.33, 4.43) than those with higher incomes. Similarly, individuals with an economically inactive status were associated with a higher likelihood of having major depression, defined as a PHQ-9 score of 10 or above, than salaried workers (OR = 2.28, 95% CI: 1.42, 3.64). In addition, divorced/widowed individuals were more likely to have mild/major depression (OR = 1.79, 95% CI: 1.06, 3.01) than married individuals and those with

TABLE 3 | Association between quarantine during the COVID-19 pandemic and depression among the matched sample ($N = 1,838$).

Factors		Major depression[a]			Mild/major depression[b]		
		Odds ratio	95% confidence limits		Odds ratio	95% confidence limits	
Quarantine during pandemic	(Ref = Pre-pandemic)	2.28	1.49	3.51	2.03	1.61	2.56
Sex	(Ref = Male)	1.33	0.86	2.06	1.37	1.08	1.75
Age		0.99	0.97	1.01	0.98	0.97	0.99
Dwelling district	Nowon	1.29	0.73	2.28	0.86	0.63	1.16
(Ref = Seongbuk)	Eunpyeong	1.18	0.64	2.20	0.86	0.62	1.19
	Yangcheon	2.09	1.17	3.73	0.91	0.65	1.27
Income	(Ref = Middle or High)	2.38	1.07	5.28	2.43	1.33	4.43
Education level	(Ref = Tertiary)	1.61	0.98	2.65	1.34	0.98	1.81
Employment status	Employer/self-employed	1.32	0.62	2.82	1.15	0.78	1.71
(Ref = Salaried workers)	Economically inactive	2.28	1.42	3.64	1.18	0.89	1.55
	Others	4.16	1.29	13.40	1.85	0.78	4.38
Marital status	Single	1.18	0.66	2.12	0.98	0.71	1.35
(Ref = Married)	Divorced/widowed	1.92	0.85	4.31	1.79	1.06	3.01
Hypertension	Yes (Ref = No)	0.88	0.37	2.08	1.10	0.70	1.73
Diabetes	Yes (Ref = No)	1.10	0.39	3.11	1.10	0.62	1.96
Self-rated Health State	Moderate/bad/very bad (Ref = good/very good)	1.87	1.21	2.90	1.79	1.41	2.27
Family size		0.83	0.69	0.99	0.94	0.85	1.04

[a] *Major depression was defined as PHQ-9 score of 10 or above, representing moderate or severe levels of depressive symptoms.*
[b] *Mild/Major depression was defined as PHQ-9 score of 5 or above, representing mild, moderate, or severe levels of depressive symptoms.*

moderate or worse self-rated health were more likely to have major depression (OR = 1.87, 95% CI: 1.21, 2.90) than those with good or better self-rated health.

In terms of model fit, our primary model with major depression as a dependent variable, compared to our secondary model with mild/major depression as a dependent variable, generally showed more preferable range of Akaike information criterion (AIC, 818.18 for primary model vs. 1864.07 for secondary) and negative log-likelihoods values (−2*LogL, 83.52 for primary vs. 130.00 for secondary).

DISCUSSION

In the present study, we investigated whether self-quarantine during the COVID-19 pandemic was associated with an increased risk of depression among Korean adults. We used a propensity score matching method and found that individuals undergoing quarantine during the COVID-19 pandemic were more likely to have major and mild depression, as well as higher levels of depressive symptoms than those in the control group after accounting for relevant sociodemographic and health-related factors. To the best of our knowledge, this is the first study to document such associations among the Korean population.

Previous studies have demonstrated generally elevated levels of psychological distress in relation to the COVID-19 pandemic across the general population (2, 21–24) and among multiple subgroups, including individuals undergoing quarantine (3, 5), those infected with coronavirus (25, 26), and front-line healthcare workers (2, 24, 27), with some mixed findings (28, 29).

In terms of psychological distress during quarantine, a review study examining the mental health impacts of quarantine from previous infectious disease outbreaks (e.g., severe acute respiratory syndrome, Middle East respiratory syndrome-related coronavirus, Ebola virus, and H1N1) documented that quarantine has detrimental psychological impacts across multiple populations (4). In relation to the COVID-19 outbreak, Daly and colleagues used a nationwide study of Canadian adults conducted in March 2020, approximately 4 weeks after the early phase of the COVID-19 outbreak in Canada, and found that individuals who went through quarantine for any reason were more likely to have suicidal thoughts and intentional self-harm, as well as more unfavorable mental health status overall, than those who did not (7). The findings were more prominent among those quarantined due to the presence of COVID-19 symptoms or contact with someone who had COVID-19 symptoms, whereas the findings were less noticeable for those quarantined due to recent travel (7). Similarly, high levels of psychological distress (e.g., depressive/anxiety symptoms) have been reported among quarantined populations in China (3, 5), Ireland (8), and Italy (9).

More broadly, in terms of psychological distress among the general population, Ettman and colleagues examined the prevalence of depression measured using the PHQ-9 before and during the COVID-19 pandemic by using nationally representative samples of US adults and found that the prevalence was higher during the COVID-19 pandemic (March-April 2020) than before (2017–2018) for all categories of depression (mild/moderate/moderately severe/severe) (22). Similar findings have been reported for anxiety in the US

population (23). Pierce et al. revealed that the prevalence of clinically significant psychological distress symptoms, measured using the 12-item General Health Questionnaire (GHQ-12) was higher during the COVID-19 outbreak (April 2020) than before (2018–2019) among the UK general population, which was confirmed by the significant within-individual increase in GHQ-12 scores based on a nationally representative cohort study (30). Peng et al. demonstrated that, among 2,726 individuals aged 18–70 years who underwent 14 days of quarantine during the COVID-19 pandemic in Shenzhen City, China, the prevalence of depression was 6.2%; the association was more apparent among those who were younger, unmarried, and with lower levels of education (3). Studies have reported that the elevated psychological distress symptoms during the COVID-19 pandemics were more pronounced among women (vs. men), younger age groups (e.g., ≤40 vs. 40+ years), those with predisposing chronic physical/psychiatric conditions, those unemployed (vs. employed), and those who have greater exposure to media sources and social media (31, 32).

Moreover, Ma et al. found that, among 770 clinically stable patients with COVID-19 in China, more than 40% exhibited clinically relevant depression symptoms defined as having a PHQ-9 score ≥ 5, whereby the pattern was more pronounced among women (vs. men), those with family member(s) infected with COVID-19 (vs. those without), and those with severe COVID-19 infection (vs. mild/moderate infection) (26).

The findings of our study replicate and extend the prior literature linking quarantining and elevated psychological distress in the Korean population. Our findings are generally consistent with previous evidence showing more unfavorable mental health outcomes, including depression and anxiety, among individuals in North America (7), Asia (3, 5), and European countries (8, 9) quarantined due to the COVID-19 pandemic. More broadly, our findings align with previous literature documenting negative mental health outcomes during the COVID-19 pandemic among the general population (2, 21–24) and other subgroups, including individuals with suspected or laboratory-confirmed COVID-19 (25, 26) and healthcare workers (2, 24, 27). Consistent with previous studies, we also found that depression was more prevalent in women (vs. men), younger individuals (19–39 years vs. 40+), and those living alone (vs. not) during the COVID-19 quarantine.

Potential mechanisms linking COVID-19 quarantine and depression may include elevated levels of negative emotions, such as fear, concerns, frustration, and loneliness. Quarantining due to close contact with an infected individual may cause fear and concerns of infection (4, 7). Moreover, quarantining can lead to limited social relationships, physical activities, and elevated social isolation and loneliness. Insufficient provision of basic supplies and necessary information can also lead to increased psychological burden during quarantine (4, 7). Further prospective investigations are warranted to understand the mechanisms through which quarantine leads to negative psychological consequences.

Strengths and Limitations

The findings of our study should be interpreted in consideration of the following limitations. First, our study is susceptible to potential selection bias due to the online survey procedure, whereby elderly individuals under quarantine were less likely to participate in the SCS-Q, generally as a result of limited access to the online survey. Together with the fact that our survey was conducted in Seoul Metropolitan City, our findings may not be generalizable to the general Korean population. The control group was selected from participants of the 2019 KCHS before the COVID-19 pandemic. Therefore, the observed association between quarantine during the COVID-19 pandemic and depression may reflect the potentially negative psychological impacts of the COVID-19 pandemic, as well as the impacts of quarantine. However, we were not able to decompose such impacts, warranting further investigation.

Nevertheless, our study has several strengths. Despite the increasing number of individuals who experienced quarantine during the COVID-19 pandemic, to the best of our knowledge, there has been limited evidence regarding the impacts of quarantine on mental health among Koreans. We used a propensity score matching method, through which individuals undergoing quarantine were compared to those who did not experience quarantine but had similar characteristics in terms of sociodemographics and health conditions.

CONCLUSIONS

The findings of our study replicate and extend the findings of previous studies linking quarantine and depression in Korean populations. Our findings suggest that Korean adults who underwent self-quarantine during the COVID-19 pandemic may be at higher risk of developing depression regardless of age, sex, socioeconomic status, living arrangements, and health conditions. Our findings indicate that effective strategies should be developed to prevent and address the psychiatric burden among individuals undergoing quarantine. Specifically, recent studies have emphasized the urgent needs to develop and implement sufficient training and supportive resources to address negative psychological outcomes among quarantine hotel workers during the pandemic (33–35). Similarly, effective quarantine strategies for the general population would benefit from developing and disseminating an innovative virtual platform through which educational programs, coping and counseling sessions, and peer-group support communities can be provided to those undergoing quarantine during the pandemic.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Institutional Review Board of Seoul Metropolitan City approved our study (IRB No. 2020-10-0001). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HYK formulated the research question, designed the study, conducted the analysis, and interpreted the results. YK drafted the manuscript. HYK, SL, and CBK reviewed and revised the manuscript. All authors contributed to the acquisition of data, approved the final version of the manuscript, and consented to its publication.

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Associations of Depressive Symptoms, COVID-19-Related Stressors, and Coping Strategies. A Comparison Between Cities and Towns in Germany

Caroline Meyer[1*†], *Rayan El-Haj-Mohamad*[1,2†], *Nadine Stammel*[1,2], *Annett Lotzin*[3], *Ingo Schäfer*[3], *Christine Knaevelsrud*[1] *and Maria Böttche*[1,2]

[1] Department of Clinical Psychological Intervention, Freie Universität Berlin, Berlin, Germany, [2] Research Department, Center ÜBERLEBEN, Berlin, Germany, [3] Department of Psychiatry and Psychotherapy, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

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***Correspondence:**
Caroline Meyer
caroline.meyer@fu-berlin.de

[†]These authors have contributed equally to this work and share first authorship

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Background: The COVID-19 pandemic has led to a wide range of stressors related to depressive symptoms. Prevention measures like physical distancing have burdened the general population, especially in highly urbanized areas. However, little is known about the associations between pandemic-related stressors, coping strategies, and depressive symptoms in highly urbanized vs. less urbanized environments.

Methods: Participants were recruited in a cross-sectional online survey in Germany. Propensity score matching yielded a matched sample of city ($n = 453$) and town ($n = 453$) inhabitants. Depressive symptoms, COVID-19-related stressors, and coping strategies were compared between cities and towns. Multiple regression analysis was performed to determine associations between pandemic-related stressors and depressive symptoms for the two groups separately.

Results: City inhabitants showed significantly higher depression scores than town inhabitants ($t = 2.11$, df $= 897.95$, $p = 0.035$). Seven coping strategies were more often used by the city sample. Depressive symptoms were associated with "restricted physical social contact" and "difficult housing conditions" (adjusted $R^2 = 0.19$, $F_{[9,443]} = 12.52$, $p < 0.001$) in city inhabitants, and with "fear of infection" and "difficult housing conditions" (adjusted $R^2 = 0.20$, $F_{[9,443]} = 13.50$, $p < 0.001$) in town inhabitants.

Limitations: The data were collected at the end of the first wave and represent a snapshot without causal inferences. Pandemic-related stressors were measured with a newly developed scale.

Conclusion: Depressive symptoms, perceived stressors, and approach/avoidance coping strategies differed between city vs. town inhabitants. These differences should be considered in policy-making and mental health care.

Keywords: coronavirus, depression, restrictions, level of urbanization, pandemic stressors, mental health

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has affected the lives of hundreds of millions of people worldwide, changing their ways of living, working, and interacting with others. According to the latest figures provided by the World Health Organization (1), over 218 million people across the world have been infected and over 4.5 million people have died (1). To contain the spread of COVID-19, governments around the world have taken various non-pharmaceutical measures, including those that restrict physical social contact and movement. During the first wave of COVID-19 in Germany (02/2020 to 05/2020), these measures included contact restrictions (e.g., restricted personal contact), work-related restrictions (e.g., closure of shops and restaurants, working from home), restrictions in daily activity (e.g., reduced leisure activities), closure of educational institutions (e.g., schools, universities, and kindergartens), and border closures (2). These preventive measures have resulted in massive disruptions in economic systems and in people's personal lives, leading, among other problems, to job loss or reduced income (3). As a result of the variety of stressors caused by the pandemic and by preventive measures to contain the spread of infection, people have been confronted with a wide range of known risk factors for mental health problems, thus amplifying major mental health problems, and specifically depressive symptoms, worldwide (4–7). An increase in depressive and anxiety symptoms, as well as distress due to the pandemic, has also been reported in Germany (8, 9). As the virus spreads primarily through direct contact or airborne via droplets and aerosols, it spreads more easily in urbanized areas with a high population density (10). In general, people living in highly urbanized areas of high-income countries are more vulnerable to mental health problems than those living in less urbanized areas (11). Accordingly, the pandemic's impact on mental health has been found to be greater in highly urbanized and thus densely populated areas (12, 13). In a representative sample in Germany, a higher degree of urbanization was strongly associated with higher rates of mood disorders (14, 15). Moreover, studies have found that high population density, noise pollution, and light pollution in areas with a high degree of urbanization are responsible for higher levels of stress and consequently higher levels of affective disorders (16, 17). However, recent research has identified social stress, and specifically social isolation, as the most important risk factor for inhabitants of highly urbanized areas (18). During the pandemic, the long-term reduction of physical social contact, i.e., the social isolation, seems to have been associated with feelings of loneliness and disconnect from daily routine, leading to an increase in depressive and anxiety symptoms (19, 20). On the other hand, living in highly urbanized areas is not only a risk factor for inhabitant's mental health but also offers several advantages that can mitigate stressors due to the higher degree of urbanization. For instance, cities can provide better educational and professional opportunities, infrastructure, cultural opportunities, and health care (17, 21). However, many of these advantages and protective factors are no longer applicable due to the COVID-19 restrictions. In particular, measures to counteract social isolation were strongly restricted during lockdown, including cultural activities, social meeting points, public spaces and parks, restaurants or cafés, and other areas that enable and encourage social encounters (21).

Since many of the protective factors of life in cities are not present during the ongoing pandemic, it is additionally important to assess situational coping strategies that might buffer the pandemic-related stressors and might have an impact in terms of exacerbating or mitigating mental health problems [e.g. association between coping strategies and depression in older adults, (22)]. The most widely used measure to assess situational coping strategies is the Brief COPE (23, 24). According to a recent review (25), the most frequently used two-factor model classifies coping strategies into approach-related coping strategies, in which the individual actively approaches the stressor (e.g., active coping, acceptance), and avoidance-related coping strategies, in which the individual attempts to ignore the stressor or avoid its impacts (e.g., self-distraction, self-blame). Several studies have demonstrated an association between coping strategies and depressive symptoms during the pandemic. For instance, it was shown that approach-related coping strategies like positive reframing or active coping tend to be associated with lower levels of depressive symptoms (26–28). By contrast, avoidance-related coping strategies, such as self-distraction, behavioral disengagement, and self-blame, seem to be significantly associated with a higher degree of depressive symptoms (26–28). During the pandemic, the most frequently employed coping strategy is that of "acceptance" (27–29). Overall, the non-pharmaceutical measures that were implemented to control the number of infections during the first wave in Germany amplified the risk factors for depressive symptoms that are especially relevant in highly urbanized populations, such as social isolation, while simultaneously limiting the utilization of protective factors. Given the higher psychological burden in more urbanized areas and the restricted protective factors during the pandemic, a better understanding of pandemic-related stressors and protective factors such as coping strategies is needed. To develop adequate mental health response plans, it is crucial to understand the psychological consequences in areas with different population density and respective beneficial coping strategies. Therefore, the aim of this study was to compare the association of COVID-19-related stressors with depressive symptoms and coping mechanisms in relation to the level of urbanization in a German sample. In Germany, the majority of people (85%) live in urbanized areas such as towns (more than 5,000 inhabitants) or cities (more than 100,000 inhabitants). Due to Germany's high overall level of urbanization, living and working conditions in rural and suburban areas are strongly dependent on the infrastructure of the surrounding towns or cities, and the actual level of urbanization is therefore difficult to determine in suburbs and in rural areas. To minimize this heterogeneity, the present study focuses only on urban populations, with a town's population representing a moderate level of urbanization and population density and a city's population representing a high level of urbanization and population density.

In accordance with previous findings in the literature, the hypotheses of the study were threefold. First, we expected to find

higher levels of depressive symptoms in the highly urbanized areas (city sample) compared to the moderately urbanized areas (town sample) during the COVID-19 pandemic. Second, we expected pandemic-related stressors (e.g., restricted physical social contact, problems with childcare, restricted access to resources) to show a differential association with depressive symptoms between the two samples. Third, we expected coping strategies to differ between the city and the town sample as a possible result of different levels of depressive symptoms.

METHODS

Design and Sample

The cross-sectional study was part of a pan-European longitudinal study on psychopathology, pandemic-related stressors, and coping during the COVID-19 pandemic [30, study registry: https://doi.org/10.17605/OSF.IO/8XHYG]. An online survey was used to collect data from the general population in Germany between June and September 2020. Ethical approval was obtained from the Local Psychological Ethics Committee at the Center for Psychosocial Medicine (LPEK) at the University Medical Center Hamburg-Eppendorf (LPEK-0149).

Eligibility criteria included (1) minimum age of 18 years and (2) ability to understand and write in German. Prior to participation, all participants were informed about the aim of the study and provided informed consent. The link for the survey was sent via various networks to increase variability of the sample (e.g., social media, professional organizations, leisure and sports clubs). Participants received no compensation.

Measures

In addition to the primary and secondary outcome measures, sociodemographic variables were assessed, including propensity characteristics (i.e., age, gender, COVID-19 infection, migration background, refugee background, general health status, partnership, number of children, household income, education) as well as the main variable for matching, i.e., self-reported residential area (city, suburb, town, rural area).

Depressive Symptoms

The Brief Patient Health Questionnaire (PHQ-9) assesses depressive symptoms during the last two weeks with nine items (30) rated on a 4-point Likert scale (0 = "not at all" to 3 = "nearly every day"). The overall score ranges from 0 to 27, with higher scores indicating more depressive symptoms. The measure has been validated in several populations (31, 32) and has shown excellent reliability ($\alpha = 0.86$ to 0.91). The German version of the PHQ-9 is likewise well validated (32).

Pandemic Stressor Scale

The Pandemic Stressor Scale (33) assesses the perceived burden of COVID-19-related stressors during the last month with 30 items. Each item is rated on a 4-point Likert scale (0 = not at all burdened to 3 = strongly burdened), with an additional category "does not apply to me."

The items are based on recently published research examining the burden of the COVID-19 pandemic. An exploratory factor analysis of a German sample yielded a nine-factor solution, which was cross-validated by a confirmatory factor analysis using the data of an Austrian sample of the ADJUST study (33).

Overall, nine COVID-19-related stressors, each containing up to five items, were identified: "Restricted physical social contact," "Problems with childcare," "Work-related problems," "Fear of infection," "Burden of infection," "Restricted activity," "Crisis management and communication," "Restricted access to resources," and "Difficult housing conditions." Subscale scores were computed by calculating the average of the scores of the respective items. Before calculating the subscores, the category "Does not apply to me" was recoded into 0 ("Not at all burdened"). For details, see **Appendix A**.

Coping

The Brief COPE Inventory (23) is the short version of the COPE scale (34) and measures coping strategies on 14 two-item scales, with items rated on a 4-point Likert scale (1 = I haven't been doing this at all to 4 = I've been doing this a lot). The Brief COPE assesses situational coping responses to a specific stressor. In the current study, the COVID-19 pandemic was named as the specific stressor. According to Solberg et al. (25), the subscales of the Brief COPE are mostly categorized into two types of coping: approach coping styles (Use of emotional support, Use of instrumental support, Positive reframing, Acceptance, Active coping, Planning) and avoidance coping styles (Self-distraction, Denial, Substance use, Behavioral disengagement, Venting, Self-blame). The subscales humor and religion are not integrated in this dichotomy.

Statistical Analyses

First, propensity score matching was performed to reduce the risk of selection bias due to different group sizes, but mainly to control for various confounding variables arising from the convenience sampling (i.e., non-randomized assignment of the two groups). The potential confounding variables used in the propensity score matching included age, gender, previous COVID-19 infection, migration status (own or parental migration), refugee status, subjective physical health status, partnership, having children, household income, and level of education. For propensity score matching on the groups of towns and cities, we used 1:1 matching on propensity scores with nearest neighbor matching without replacement, which is the most common form of matching (35, 36). To evaluate the balance of covariates, standardized mean differences (SMD) and level of significance were assessed before and after matching using t-tests for metric variables and X^2 or Fisher's exact tests for categorical variables. An SMD of 0.1 or less indicates a negligible difference between two groups (37). A t-test was used to examine whether the groups differed with respect to the primary outcome of depressive symptoms.

Multiple regression analysis was performed separately for the city sample and the town sample to determine associations between pandemic-related stressors and depressive symptoms in each group. Finally, t-test analyses were conducted to determine whether the groups used different coping strategies.

Complete case analysis was used, as recommended for propensity score matching when data is missing at random (38).

This method excludes all cases with missing data in the primary outcome or at least one of the covariates. All statistical analyses were performed using R4.0.2.

RESULTS

Baseline Characteristics Before and After Matching

In total, $N = 2{,}782$ participants from all 16 Federal states of Germany participated in the cross-sectional online survey. We excluded participants who were not living in Germany at the time of the study ($n = 30$) or did not complete the Patient Health Questionnaire-9 (PHQ-9, $n = 502$), as this was the main outcome for the study. Given the aim of the present study, we excluded an additional n = 452 participants who lived in suburbs ($n = 263$) or rural areas ($n = 189$). The final sample before propensity score matching consisted of $N = 1{,}798$ participants, 1,319 of whom lived in a city (73.4%). Baseline characteristics before and after matching are shown in **Table 1**. Before matching, there were significant differences between city and town participants in terms of age (participants in towns were older), being in a partnership (more people in towns were living in a partnership), having children (more people in towns reported having children), and educational level (higher educational level in cities). The standardized mean difference of potential covariates ranged from−0.201 to 0.385.

To evaluate the quality of our matched sample, we used both the *p*-value and the standardized mean difference as criteria. After propensity score matching, city and town samples did not differ substantially in all reported covariates (all $p > 0.05$, **Table 1**), and the standardized mean difference was within 0.1 (**Figure 1**). The matching process resulted in a total sample of $n = 906$ participants, with $n = 453$ in each group. In the matched sample, the age ranged from 18 to 78 years ($M = 41.6$, SD = 12.4) and the majority of participants were female ($n = 627$, 69.2%).

Depressive Symptoms and COVID-19-Related Stressors in Cities and Towns

For all subsequent analyses, only the matched sample was considered. The city sample reported significantly higher levels of depressive symptoms compared to the town sample ($t = 2.11$, df = 897.95, $p = 0.03$, **Table 2**).

Overall, people from cities and towns perceived similar COVID-19-related stressors. In total, the perceived stressors exerted low or moderate levels of burden in both samples (lowest

TABLE 1 | Covariates before and after propensity score matching.

	Before propensity score matching			After propensity score matching		
	City ***n* = 1319**	**Town** ***n* = 479**	***p***	**City** ***n* = 453**	**Town** ***n* = 453**	***p***
Age [M(SD)]	39.9 (12.4)	41.7 (12.5)	0.006**	41.5 (12.4)	41.73 (12.4)	0.750
Female (%)	930 (70.8)	342 (71.5)	0.795	305 (67.3)	322 (71.1)	0.250
COVID-19 infection (yes, %)	9 (0.7)	2 (0.4)	0.738	3 (0.7)	2 (0.4)	1
Migration (yes, %)	193 (14.6)	74 (15.4)	0.690	75 (16.6)	70 (15.5)	0.717
Refugee (yes, %)	7 (0.5)	1 (0.2)	0.613	0 (0.0)	0 (0.0)	-
Health status (%)			0.128			0.391
Very good	474 (35.9)	151 (31.5)		153 (33.8)	142 (31.3)	
Good	570 (43.2)	240 (50.1)		203 (44.8)	231 (51.0)	
Satisfactory	219 (16.6)	73 (15.2)		79 (17.4)	65 (14.3)	
Poor	50 (3.8)	14 (2.9)		16 (3.5)	14 (3.1)	
Very poor	6 (0.5)	1 (0.2)		2 (0.4)	1 (0.2)	
Partnership (yes, %)	903 (68.5)	367 (76.6)	<0.001***	343 (75.7)	350 (77.3)	0.638
Children (yes, %)	482 (36.5)	264 (55.1)	<0.001***	248 (54.7)	252 (55.6)	0.841
Household income (%)			0.110			0.964
Very low income	49 (3.8)	22 (4.8)		19 (4.2)	22 (4.9)	
Low income	96 (7.5)	22 (4.8)		25 (5.5)	22 (4.9)	
Medium income	543 (42.6)	180 (39.6)		186 (41.1)	180 (39.7)	
High income	375 (29.4)	139 (30.6)		135 (29.8)	138 (30.5)	
Very high income	211 (16.6)	91 (20.0)		88 (19.4)	91 (20.1)	
Education (%)			<0.001***			0.738
<10 years schooling	4 (0.3)	0 (0.0)		0 (0.0)	0 (0.0)	
≥10 years schooling	166 (12.6)	65 (13.6)		68 (15.0)	60 (13.2)	
Vocational studies	382 (29.0)	202 (42.2)		188 (41.5)	189 (41.7)	
Completed studies	767 (58.2)	212 (44.3)		197 (43.5)	204 (45.0)	

*Fisher's exact test was performed for the variables COVID-19 infection, refugee, health status, and education. Pearson's χ^2 test was performed for gender, migration, partnership, children, and income. T-test was performed for age. **p < 0.01, ***p < 0.001.*

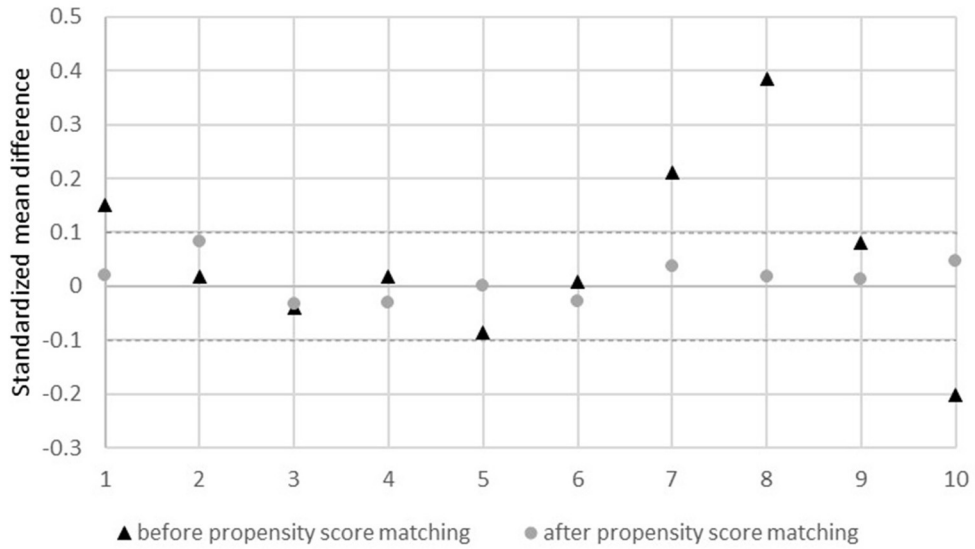

FIGURE 1 | Standardized mean difference before and after propensity score matching. 1, age; 2, sex; 3, infection yes/no; 4, migration yes/no; 5, refugee yes/no; 6, health status; 7, partner yes/no; 8, children yes/no; 9, income; 10, educational level.

TABLE 2 | Depressive symptoms measured by the PHQ-9 and stressors measured by the Pandemic Stressor Scale after propensity score matching.

	City		Town		*p*	Cronbach's α
	n	M (SD)	*n*	M (SD)		
Depressive symptoms						
PHQ-9	453	6.68 (5.13)	453	5.99 (4.72)	0.035*	0.86
Pandemic Stressor Scale						
Fear of infection	453	1.59 (0.73)	453	1.60 (0.73)	0.724	0.73
Restricted activities	453	1.56 (0.80)	453	1.46 (0.84)	0.063	0.72
Restricted physical social contact	453	1.51 (0.87)	453	1.43 (0.84)	0.163	0.85
Crisis management and communication	453	0.99 (0.75)	453	1.12 (0.79)	0.013*	0.71
Difficult housing conditions	453	0.65 (0.77)	453	0.52 (0.70)	0.005**	0.75
Work-related problems	453	0.64 (0.85)	453	0.77 (0.85)	0.024*	0.86
Problems with childcare	453	0.61 (1.08)	453	0.56 (1.00)	0.416	0.92
Restricted access to resources	453	0.60 (0.68)	453	0.60 (0.60)	0.849	0.62
Burden of infection	453	0.59 (0.79)	453	0.67 (0.84)	0.162	0.76

*PHQ-9, Patient Health Questionnaire-9. Differences in mean values between the subsamples were tested by t-test. *$p < 0.05$, **$p < 0.01$.*

burden $M = 0.59$, "burden of infection" in cities; highest burden $M = 1.60$, "fear of infection" in towns; range from 0 to 3). The following stressors were perceived to be the most stressful in both samples: problems with fear of infection ($M = 1.59$ in cities, $M = 1.60$ in towns), restricted activities ($M = 1.56$ in cities, $M = 1.46$ in towns), and restricted physical contact ($M = 1.51$ in cities, $M = 1.43$ in towns). Nevertheless, there were three significant differences between the town and city inhabitants: Participants in towns were more stressed because of work-related problems and "crisis management and communication" compared to those in cities. At the same time, participants living in cities were significantly more stressed due to the "difficult housing conditions" (**Table 2**).

Associations Between COVID-19-Related Stressors and Depressive Symptoms in Cities and Towns

We conducted correlation analysis (**Appendices B,C**) and multiple regression analyses (**Table 3**) to examine the relationship between depressive symptoms and the pandemic stressor subscales for each sample separately. Correlates of depressive symptoms differed between the city and town samples (**Table 3**).

For the city sample, depressive symptoms were associated with "restricted physical social contact" and "difficult housing conditions" (adjusted $R^2 = 0.19$, $F_{[9,443]} = 12.52$, $p < 0.001$). For the town sample, depressive symptoms were associated with "fear

TABLE 3 | Regression analysis of stressor subscales on depressive symptoms for city sample and town sample after propensity score matching.

	City ($n = 453$)				Town ($n = 453$)			
	b	***β***	**SE**	***p***	***b***	***β***	**SE**	***p*-value**
Intercept	3.01		0.64	<0.001***	1.02		0.63	0.106
Restricted physical social contact	1.31	0.22	0.32	<0.001***	0.25	0.04	0.30	0.404
Problems with childcare	−0.43	−0.09	0.24	0.072	0.18	0.04	0.23	0.425
Work-related problems	0.20	0.03	0.27	0.463	0.13	0.02	0.25	0.583
Fear of infection	0.51	0.07	0.36	0.156	1.66	0.26	0.33	<0.001***
Burden of infection	−0.21	−0.03	0.30	0.490	−0.26	−0.05	0.27	0.325
Restricted activities	−0.59	−0.09	0.34	0.081	0.40	0.07	0.29	0.166
Crisis management and communication	0.59	0.09	0.33	0.073	0.41	0.07	0.30	0.167
Restricted access to resources	0.17	0.02	0.37	0.642	−0.05	−0.01	0.37	0.892
Difficult housing conditions	2.10	0.31	0.36	<0.001***	1.76	0.26	0.34	<0.001***
Adjusted R^2	0.19				0.20			

****p < 0.001.*

TABLE 4 | Coping strategies by subsamples after propensity score matching and results of group comparison between city sample and town sample.

	City $n = 453$ [M (SD)]	Town $n = 453$ [M (SD)]	*p*	Cronbach's α
Approach coping strategies				
Acceptance	**3.69 (1.69)**	**3.44 (1.71)**	**0.028***	**0.66**
Positive Reframing	**3.20 (1.88)**	**3.02 (1.81)**	**0.144**	**0.74**
Planning	3.17 (1.66)	3.03 (1.63)	0.218	0.53
Active Coping	2.92 (1.62)	2.55 (1.60)	<0.001***	0.60
Emotional Support	2.70 (1.72)	2.26 (1.68)	<0.001***	0.74
Instrumental Support	1.83 (1.59)	1.54 (1.56)	0.005**	0.82
Avoidance coping strategies				
Self-Distraction	**3.29 (1.63)**	**3.09 (1.59)**	**0.061**	**0.55**
Venting	1.95 (1.48)	1.74 (1.45)	0.028*	0.58
Behavioral Disengagement	1.03 (1.21)	0.91 (1.10)	0.115	0.32
Substance Use	0.81 (1.39)	0.51 (1.13)	<0.001***	0.92
Self-Blame	0.67 (1.24)	0.64 (1.22)	0.666	0.69
Denial	0.55 (1.09)	0.60 (1.07)	0.406	0.51
Humor	2.41 (1.72)	2.05 (1.60)	<0.001***	0.69
Religion	0.62 (1.29)	0.75 (1.43)	0.151	0.82

*Differences in mean values between the subsamples were tested by t-test; the three most frequently used coping strategies are printed in bold. *p < 0.05, **p < 0.01, ***p < 0.001.*

of infection" and "difficult housing conditions" (adjusted $R^2 = 0.20$, $F_{[9,443]} = 13.50$, $p < 0.001$).

Coping Strategies in Cities and Towns

When comparing coping strategies between the two samples, the city inhabitants reported a higher use of seven out of fourteen coping strategies compared to those from towns. Participants living in cities reported significantly higher values on approach coping strategies (active coping, instrumental support, acceptance, emotional support) but also on avoidance coping strategies (venting, substance use) as well as the strategy "humor." The most frequently used coping strategies in both samples were acceptance, self-distraction, and positive reframing (**Table 4**).

DISCUSSION

The current study examined differences and similarities in depressive symptoms, COVID-19-related stressors, and coping strategies in city and town inhabitants in Germany. Through the use of propensity score matching, we were able to control for systematic differences between the two groups that may have resulted from convenience sampling. This allowed us to estimate, for the first time, a more precise representation of city and town inhabitants regarding the above-mentioned variables and shows the importance of the matched factors, as they varied significantly before matching. We found higher levels depressive symptoms in the city sample compared to the town sample in the matched

samples, confirming previous results while controlling for several confounding factors. The relationship between pandemic related stressors and depressive symptoms differed between city and town inhabitants. Furthermore, city inhabitants reported a more frequent use of several coping strategies.

We found significantly higher levels of depressive symptoms in participants from cities compared to those from towns. Our results are in line with previous studies describing generally higher depressive symptoms in urban areas (11, 14). Moreover, they also correspond to recent studies that investigated populations in high-income countries during the pandemic and found a link between higher levels of urbanization and higher levels of mental distress (39, 40). This seems to reflect the effect of the non-pharmaceutical lockdown measures that were implemented to control the number of infections during the first wave of COVID-19 in Germany, which focused on contact restrictions and especially restricted time spent in public places both outdoors and indoors (2). These measures therefore amplified social isolation, being one of the main risk factors for depressive symptoms in city inhabitants (18). In accordance with this, the stressor "restricted physical social contact" was perceived as one of the most burdensome pandemic-related stressors by the city inhabitants. It was also strongly associated with depressive symptoms in the city sample but not in the town sample, indicating a potentially stronger impact of contact restrictions on depressive symptoms in more densely populated areas, though our cross-sectional design does not allow for causal inferences. At the same time, most of the benefits of living in cities (e.g., cultural activities, social meeting points) were eliminated due to the pandemic-specific restrictions. In contrast, access to outdoor spaces and a view of nature were found to be protective factors during the pandemic and are related to reduced levels of depressive and anxiety symptoms, especially under strict lockdown conditions (41). Both of these natural "buffers" are less available in cities.

Our study also aimed at a more differentiated understanding of possible factors influencing depressive symptoms in both cities and towns. Concerning stressors and coping strategies, we found both similarities and substantial differences. The findings on pandemic-specific stressors illustrate the extent to which the inhabitants of cities and towns felt stressed in various areas of everyday life and leisure during the pandemic. In the present study, only three significant differences emerged ("work-related problems" and "crisis management and communication" were higher in towns, "difficulties in housing conditions" were higher in cities), while the majority of pandemic-related stressors were perceived as equally burdensome in cities and towns. For both groups, the stressors perceived as the most burdensome were "fear of infection," "restricted activities," and "restricted physical social contact." Studies have shown that infection-related stressors, i.e., fear of infecting others and loved ones, are perceived as highly stressful during the pandemic (42) due to the fact that the virus is life-threatening for people in high-risk groups [e.g., elderly, people with lung or heart diseases, (43)]. Furthermore, fear can also be explained by a lack of knowledge and by the unfamiliar and unpredictable new reality (44). The higher perceived stress with regard to restrictions of activities and physical social contacts appears to be self-evident due to the overall reported benefits of physical activity and social contacts (45).

"Work-related problems" as well as "crisis management and communication" were perceived as significantly more burdensome in towns. It is possible that people in cities can adapt more easily to crises due to a better infrastructure. This might, for example, include digitalization, better job opportunities in the case of job loss, better health care, and more services that offer support (46). These infrastructure advantages in cities could therefore mitigate the association between the aforementioned stressors and depressive symptoms. Previous research has already indicated an impact of media coverage on fears relating to COVID-19 (42). Garfin et al. (47) recommend using trustworthy and informative media and avoiding repetitive exposure to media with little new information. Especially in times of lack of knowledge, this is of high importance and could buffer the stressor "crisis management and communication." In cities, "difficult housing conditions" were perceived as significantly more stressful. One explanation could be that the limited options in cities (e.g., small apartments, fewer social alternatives to seeing friends or family members, limited public spaces) were perceived as more burdensome.

The relationship between pandemic-related stressors and the severity of depressive symptoms illustrates that "difficult housing conditions" are associated with depressive symptoms in both samples. This is in line with previous findings suggesting that poor housing conditions, and especially limited space, are related to higher levels of depressive symptoms (48). In cities, the "restricted physical social contacts" were also significantly related to depressive symptoms. COVID-19 measures resulted in limited to no social contact over several months. As mentioned above, it can be assumed that these measures, especially in cities, aggravated a trend that has been found in previous studies. As previous findings show, people have begun to feel lonely during the pandemic, which is strongly correlated with depressive symptoms (19, 20). In towns, "fear of infection" was significantly related to severity of depressive symptoms. Due to a lesser social anonymity in towns, a potential fear of stigmatization as a result of an infection could explain this additional significant finding (49).

With regard to coping strategies, it was found that city inhabitants use seven of the examined 14 coping strategies significantly more often compared to town inhabitants (approach-related strategies i.e., active coping, acceptance, emotional and instrumental support; avoidance-related coping strategies, i.e., venting, substance use as well as the coping strategy "humor"). There were no significant differences in the other seven strategies. Recent studies have shown that "active coping," "venting," and "substance use" in particular are associated with depressive symptoms due to the pandemic (27). One explanation for why city inhabitants, on average, use more often strategies to cope with the pandemic could lie in the fact that depressive symptoms are higher in cities than in the towns, meaning that there is a greater need to use these strategies. However, research has shown that more frequent use of positive coping strategies might not be predictive of better positive adjustment over time (50). At this point, it is also important to mention that the rank order of the frequency of coping

strategies used is the same in cities and towns. In both samples, "acceptance," "positive reframing," and "self-distraction" are used most frequently. This is in line with previous studies that also found "acceptance" and "self-distraction" to be among the most frequently used strategies during the pandemic (27–29). In a recent study, the coping strategy of "positive reframing" was the most beneficial in coping with depressive symptoms (27).

In our study, we found significant relationships between situational stressors and depressive symptoms even at an early stage of the pandemic. Presumably, these effects have intensified further over the course of the pandemic. The ongoing dilemma of lockdown and reopening has several implications, and the present findings emphasize that the level of urbanization has an impact on depressive symptoms as well as perceived COVID-19-related stressors.

LIMITATIONS

The study findings should be interpreted in the light of several limitations. First, the data were collected in the period of June 2020 to September 2020. This period was at the end of the first wave of the pandemic, when infection rates were low and relatively few restrictions were in place in Germany. Second, as the data were cross-sectional, they represent a momentary snapshot of the situation without providing any information about the time course. Also, no statements can be made about representativeness as the sample was circumstantial and purposeful and the rate of return is unknown. However, different recruitment strategies were applied to increase the variability of the sample (e.g., social media, interest groups, companies). Third, pandemic-specific restrictions were measured using a newly developed instrument (33). Fourth, some of the subscales of the Brief COPE showed questionable or poor reliability scores in our study (Cronbach's Alpha: 0.53–0.92). This has also been reported in other studies (51, 52) and seems to be a general problem of the questionnaire, which is also reflected in the inconsistent factor structure of the Brief COPE (53). Fifth, although the propensity score matching has several advantages for examining the hypotheses and ensured comparability of our samples, the current dataset does not contain all participants and the representativeness of the two subsamples may have been altered especially in the city sample.

CONCLUSION

Characteristics regarding depressive symptoms and coping strategies as well as the impact of pandemic-related stressors in cities and towns should be considered when addressing psychosocial support for vulnerable groups during and after the pandemic. Policy makers need to be aware of the special risks and needs in urban populations and should carefully evaluate the COVID-19-related measures taken in view of mental health costs and benefits. It seems to be important to investigate implications for different life circumstances and also to detect specific characteristics due to the level of urbanization. Future studies should therefore apply standardized measures of urbanization, e.g., by including population figures or other objective measures. Specifically, it becomes clear that restricted activities and physical social contact as well as housing conditions seem to be most burdensome in urban inhabitants. These stressors should receive special attention, both to better identify vulnerable people and to make future restrictions less stressful.

Long-term effects of the restrictions on mental health must be closely monitored, and mental health care offers need to be adapted to increased needs as early as possible.

This could be addressed in an easy and cost-effective manner by implementing low-threshold (online) interventions with instructions for self-help and self-care. In addition, longitudinal studies will be needed to differentiate between functional and dysfunctional coping strategies during and after the pandemic and to determine their effect on depressive symptoms. It is important to learn from this exceptional situation, to be able to give advice to vulnerable populations for the current situation and for potentially similar situations in the future.

DATA AVAILABILITY STATEMENT

The detailed sociodemographic information of the dataset does not fully protect the anonymity of the respondents. For this reason, the entire dataset cannot be made publicly available. However, excerpts of the data on a higher aggregation level can be provided upon justified request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Center for Psychosocial Medicine (LPEK) at the University Medical Center Hamburg-Eppendorf (LPEK-0149). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AL designed the study in cooperation with the project steering committee formed by the representatives of the ESTSS countries [see (54)]. AL, MB, and RE-H-M were responsible for the data collection in Germany. CM, RE-H-M, and MB carried out the statistical analyses and drafted the manuscript. AL, IS, NS, and CK carefully revised the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.791312/full#supplementary-material

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Impact of Long-Term Home Quarantine on Mental Health and Physical Activity of People in Shanghai During the COVID-19 Pandemic

Wentong Zhu[1†], *Doudou Xu*[2†], *Hui Li*[3†], *Gang Xu*[4], *Jingyan Tian*[5,6], *Luheng Lyu*[7], *Naifu Wan*[1], *Lijiang Wei*[1], *Wuwei Rong*[1], *Chenchen Liu*[1], *Beiwen Wu*[2*], *Xiaolan Bian*[3*] and *Ankang Lyu*[1*]

[1] Department of Cardiovascular Medicine, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [2] Department of Nursing, School of Medicine, Ruijin Hospital, Shanghai Jiao Tong University, Shanghai, China, [3] Department of Pharmacy, School of Medicine, Ruijin Hospital, Shanghai Jiaotong University, Shanghai, China, [4] School of Public Health, School of Medicine, Shanghai Jiao Tong University, Shanghai, China, [5] Department of Endocrine and Metabolic Diseases, Shanghai Institute of Endocrine and Metabolic Diseases, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [6] Shanghai National Clinical Research Center for Metabolic Diseases, Key Laboratory for Endocrine and Metabolic Diseases of the National Health Commission of the PR China, Shanghai Key Laboratory for Endocrine Tumor, State Key Laboratory of Medical Genomics, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [7] Department of Biochemistry and Molecular Biology, Miller School of Medicine, University of Miami, Miami, FL, United States

This study aimed to investigate the effects of long-term home quarantine on the mental health of people during the COVID-19 epidemic in Shanghai. We conducted an online questionnaire survey on March 26 2020 and collected data on demographics, level of physical activity (PA), and mental health status of the participants. We assessed the mental health status using the Patient Health Questionnaire (PHQ-9) and Generalized Anxiety Disorder Scale (GAD-7), whereas PA was assessed using International Physical Activity Questionnaire Short Form (IPAQ-SF). Of all 2,409 valid samples, participants reported performing a total of 2015.20 metabolic equivalent of task (MET)-minutes/week of total PA before the outbreak period and 1720.29 MET-minutes/week of total PA during the outbreak period ($p < 0.001$). Participants who spent a longer time at home reported to have a better performance on the PHQ-9 ($p = 0.087$) and GAD-7 ($p < 0.001$). A high level of PA was considered an protective factor against depression (OR = 0.755, 95% CI 0.603–0.944, $p < 0.001$). Additionally, a high level of PA had a preventative effect on anxiety (OR = 0.741, 95% CI 0.568–0.967, $p < 0.001$), and a longer working period during the outbreak was shown to be a risk factor for anxiety (11–29 days, OR 1.455, 95% CI 1.110–1.909; 30–60 days OR 1.619, 95% CI 1.227–2.316). Home confinement during the pandemic might not have a negative effect on mental health provided that people engage in more PA indoors. This study encourages interventions for mental health problems through physical exercise.

Keywords: COVID-19, home quarantine, mental health, physical activity, well-being

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Xenia Gonda,
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Paroma Mitra,
New York University, United States

****Correspondence:***
Ankang Lyu
lvankangrj@163.com
Xiaolan Bian
bxl40338@rjh.com.cn
Beiwen Wu
Gaoan2005new@163.com

[†]These authors have contributed equally to this work and share first authorship

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INTRODUCTION

The Coronavirus Disease 2019 (COVID-19) outbreak started in Wuhan, China in late 2019 and rapidly spread worldwide, resulting in over 140 million infections and 3 million deaths (1) as of April 20, 2021. Mandatory restriction of movement is commonly used to restrain the transmission of infectious diseases, especially respiratory diseases such as the 2003 SARS, MERS, and H1N1 (2). About a year ago, most of China, including Shanghai, adopted strict quarantine measures to control the pandemic. For example, Shanghai launched a Level 1 public health emergency response (3) on January 25, 2020. Facemasks were mandatory in public places, while mandatory temperature screenings were introduced at public places such as hospitals, tourist sites, and commercial centers. Any event that could possibly attract large crowds was banned or delayed. And a large proportion of the population switched to working from home.

China was the first country to bear the brunt of the COVID-19 pandemic, and also one of the first to resume social tranquility. Several studies have focused on psychological health among different groups of people in China. A Chinese survey showed that during the beginning stage of the pandemic, about a third of respondents from the general population suffered from moderate to severe anxiety (4). The burden of psychological stressors on healthcare workers during the epidemic was also a concern (5, 6). Wang et al. conducted a study on the prevalence and associated factors of psychological disorders of the COVID-19 epidemic in China (7, 8). Studies in other countries have also investigated the psychological impact of the COVID-19 pandemic on the general population (9–11) and students (12–16). The results of these studies confirmed that the pandemic had a severe psychological impact on people.

The current study mainly aims to investigate how a change in lifestyle affected mental health during the outbreak period. In this study, we define the 60-day Level 1 public health emergency response declared by Shanghai between January 24 and March 24 as the outbreak period. During the outbreak period, people spent most of their time being quarantined at home, which may increase mental health issues. Mental stressors may include changes in employment, reduced levels of physical activity (PA), a change in working environment, being unable to leave the house and interacting with the outside world, economic adversity due to loss of income, and fear of the COVID-19 pandemic.

The efficacy of exercise as a treatment approach for depression has been demonstrated in several studies. Previous studies have clarified dysregulated pathways as major factors in depression, which include neurotransmitter imbalances, dysregulated inflammatory pathways, HPA disturbances, neuroprogression, increased oxidative stress, and mitochondrial disturbances (17–23). Physical exercise can relieve depression by affecting the pathways mentioned above (24). Moreover, PA has been mentioned as a potential treatment for anxiety (25, 26). In the current study, we focused on how home confinement affects the mental health of workers and its relationship with PA.

As of November 12th 2021, a total of more than 7.1 billion vaccine doses have been administered globally, meanwhile, over 3 million newly confirmed cases were reported in the last 7 days (27). The data revealed vaccination alone is not almighty to beat COVID-19. Other prevention measurements including wearing face masks, keeping social distance and isolation are as crucial. Nie et al. (28). identified long-term home quarantine as one of major factors affecting mental health of Chinese residents and physical exercise was associated with improvement of mental health burden. Faulkner et al. (29). demonstrated that a negative change in exercise behavior during the COVID-19 restrictions was associated with poorer mental health of adults in the UK, Ireland, New Zealand and Australia. The strength of this study is that we provide a novel perspective for people under quarantine, that indoor and outdoor physical exercise is recommended and necessary to improve mental health status. In our study, time duration of home confinement is a key element. During the 60-day outbreak period, working from home became common. On the basis of days at work during the outbreak, we divided the participants into three groups (**Table 1**). We assumed people who spent different time on home confinement would perform differently on mental health and PA status.

TABLE 1 | Demographic characteristics of the participant population, $n = 2{,}409$ (n, %).

Age (y)	**37.7 ± 9.1**	**Gender**	
≤30	599 (24.9)	Male	955 (39.6)
31–40	933 (38.7)	Female	1,454 (60.4)
>40	877 (36.4)	**Education**	
Days at work during the outbreak Period (d)	20.5 ± 16.8	High school	214 (8.9)
≤10	853 (35.4)	Vocational	320 (13.3)
11–29	715 (29.7)	Undergraduate	1,579 (65.5)
30–60	841(34.9)	Graduate	296 (12.3)
Weight change	0.8 ± 2.0	**History of chronic diseases**	
N/A	365 (15.2)	Yes	346 (14.4)
weight unchanged	1,479 (61.4)	No	2,063 (85.6)
weight gained	795 (33)		
weight lost	135 (5.6)		

METHODS

Study Population

Employed individuals who underwent routine health checkups at Ruijin Hospital were recruited to complete an online questionnaire. A total of 2,580 participants completed the questionnaire, which yielded 2409 samples after data validation.

Data Collection

A standard questionnaire was designed to obtain participants' demographic information, the number of days they were working during the COVID-19 pandemic (in Shanghai), change in body weight, physical activity intensity, chronic disease history (hypertension, diabetes, coronary artery disease, thrombosis disease, chronic respiratory disease, pulmonary hypertension, liver cirrhosis, chronic kidney disease, chronic gastritis, tumor,

TABLE 2 | IPAQ-SF responses before and during the outbreak.

		During the outbreak	Before the outbreak	Δ(%)	*p* Value
All PA	MET values	1,720.29 ± 1,813.79	2,015.20 ± 2,100.60	294.91(17.1)	<0.001
Vigorous–intensity activities	Days/week	1.09 ± 1.80	1.26 ± 1.86	0.17 (15.6)	<0.001
	min/week	20.70 ± 32.20	24.30 ± 24.64	3.60 (17.4)	<0.001
	MET values	463.93 ± 1,016.53	543.85 ± 1,020.04	79.92 (17.2)	0.006
Moderate–intensity activities	Days/week	2.74 ± 2.64	2.77 ± 2.61	0.03 (1.1)	0.629
	min/week	45.43 ± 47.29	44.90 ± 45.15	0.53 (1.2)	0.692
	MET values	750.93 ± 1,098.53	714.50 ± 1,005.96	36.43 (5.1)	0.230
Walking	Days/week	2.87 ± 2.57	3.96 ± 2.59	1.09 (38.0)	<0.001
	min/week	38.85 ± 39.05	47.96 ± 41.80	9.11 (23.4)	<0.001
	MET values	505.43 ± 684.32	756.84 ± 816.94	251.41 (49.7)	<0.001
Sitting	Hours/day	6.13 ± 3.20	5.66 ± 3.15	0.47 (8.2)	<0.001

etc.), and the state of their mental health (depression and anxiety index).

Survey Questionnaires

With regard to data privacy and consent for participation, a consent file was obtained prior to completing the questionnaire. Before completing the survey, participants were made aware of their participation in this study. The survey was not anonymous. However, all data collected would only be used for research purposes.

Our team designed an online survey to assess changes in health during the COVID-19 outbreak. In our final survey, we included two questionnaires that evaluate mental health and one that evaluated PA—Patient Health Questionnaire (PHQ-9) (30), Generalized Anxiety Disorder Scale (GAD-7) (31) and International Physical Activity Questionnaire Short Form (IPAQ-SF) (32). Specifically, the participants were told to provide the answers to their IPAQ-SF before and during the outbreak. The entire questionnaire was in Chinese and was available online on March 26, 2020.

PHQ-9

The PHQ-9 is a self-reporting diagnostic tool for depression that contains nine items associated with depression-related symptoms (30). Each item is rated as 0 (not at all), 1 (for several days), 2 (at least half of the time), and 3 (nearly every day). A total score of 0–4 points indicates no depressive symptoms, a total score of 5–9 points indicates mild depression, a total score of 10–14 points indicates moderate depression, a total score of 15–19 points indicates severe depression, and a total score of 20–27 points indicates extremely severe depression. The PHQ-9 has been extensively validated and has satisfactory reliability (sensitivity, 0.77; specificity, 0.94) (33). This scale has also been widely used with Chinese populations and has demonstrated excellent psychometric properties (34).

GAD-7

The GAD-7 is a seven-item self-reporting scale used to measure generalized anxiety disorder (31). Each item is rated from 0 to 3, similar to PHQ-9 (as described above). Participants who scored $\geq$5 were considered to be suffering from anxiety. The validity and reliability of the GAD-7 scale in the general population has been confirmed in previous studies (35), and has been widely used in China. Good reliability and validity of the Chinese version of GAD-7 has been confirmed (36).

IPAQ-SF

Time data measured by min/week collected from the IPAQ-SF were categorized into different levels of exercise (vigorous, moderate, and walking). METs were matched with each level according to the official IPAQ guidelines: vigorous PA = 8.0 METs, moderate PA = 4.0 METs, and walking = 3.3 METs. According to the IPAQ scoring guide (available at www.ipaq.ki.se), we divided our participants into high, moderate, and low levels of PA. The Chinese version of IPAQ-SF was proved reliable (37).

Statistics

The results in **Table 2** were presented as mean ± SEM. Comparisons between the two groups were made using the Student *t* test. The positive rates of IPAQ-SF, PHQ-9, and GAD-7 among different working-day groups during the outbreak were compared through χ^2 tests. A *P* value lower than 0.05 was considered a statistically significant difference. Binary logistic regression models were used to evaluate the association between different factors with PHQ-9 and GAD-7. Statistical analyses were performed with GraphPad Prism 8 for macOS (Graph Pad Prism Software Inc., San Diego, CA, U.S.) and SPSS 25 (SPSS, Inc, Chicago, IL, U.S.).

RESULTS

Participant Characteristics

A total of 2,580 participants completed the online survey between March 26 and May 9, 2020, which yielded 2,409 valid samples. The mean age of respondents was 37.7 years (range: 20–88). 39.6% of the participants were male, and 77.8% possessed a high level of education (undergraduate and above). 14.4% of the participants had a history of chronic disease, 33% gained weight during the outbreak period, and 5.6% reported losing weight. We

TABLE 3 | Comparison on the positive rates of IPAQ-SF, PHQ-9, and GAD-7 among different working-day groups during the outbreak.

Surveys	30–60d	11–29d	0–10d	χ^2	*p*-value
PA level (High/Total)	199/841	155/715	266/853	21.298	<0.001
GAD-7 ≥5/Total	149/841	138/715	107/853	14.732	<0.001
PHQ-9 ≥5/Total	217/841	187/715	187/853	4.886	0.087

divided the entire data sample by the number of days worked at home during the outbreak period. Out of the 2,409 participants, 853 (35.4%) worked for <10 days, 715 (29.7%) worked between 11 and 29 days, and 841 people worked for more than 30 days.

Physical Activity Before and During the Outbreak Period

As shown in **Table 1**, the average weight change was positive, with 33% of the participants reporting weight gain during the outbreak. We compared the responses to the PA questionnaire (IPAQ-SF) recorded before and during the outbreak period, and the results are presented in **Table 2**.

Participants reported performing a total of 2015.20 MET-minutes/week of total PA before the outbreak period, and 1720.29 MET-minutes/week of total PA during the outbreak period ($p < 0.001$). The number of days/week and minutes/day of vigorous intensity PA during the outbreak decreased by 15.6% ($p < 0.001$) and 17.4% ($p < 0.001$), respectively. In addition, the MET values of vigorous-intensity PA were 17.2% lower than those before the outbreak period ($p = 0.006$). The number of days per week of moderate intensity PA decreased by 1.1% during the outbreak period ($p = 0.629$), whereas the amount of minutes/day of moderate intensity PA increased by 1.2% during the same period ($p = 0.692$). Additionally, the MET values of moderate intensity PA were 5.1% higher during the outbreak period ($p = 0.230$). The number of days/week of walking reduced by 38% during the outbreak period ($p < 0.001$). Likewise, the amount of minutes/day of walking reduced by 23.4% during the outbreak period ($p < 0.001$). Additionally, MET values of walking were also revealed to be 49.7% lower during the outbreak period ($p < 0.001$). Statistical analysis also revealed that the amount of hours/day of sitting increased by 8.2% during the outbreak period ($p < 0.001$).

PA Intensity, Depression, and Anxiety Proportions in Different Lengths of Home Confinement

We used the Chi-square test to further investigate the relationship between the length of time spent working during the outbreak period, PA levels, and mental health status (**Table 3**). We found PA levels ($p < 0.001$), GAD-7 score ($p < 0.001$), and PHQ-9 score ($p = 0.087$) to be associated with different working times during the outbreak period.

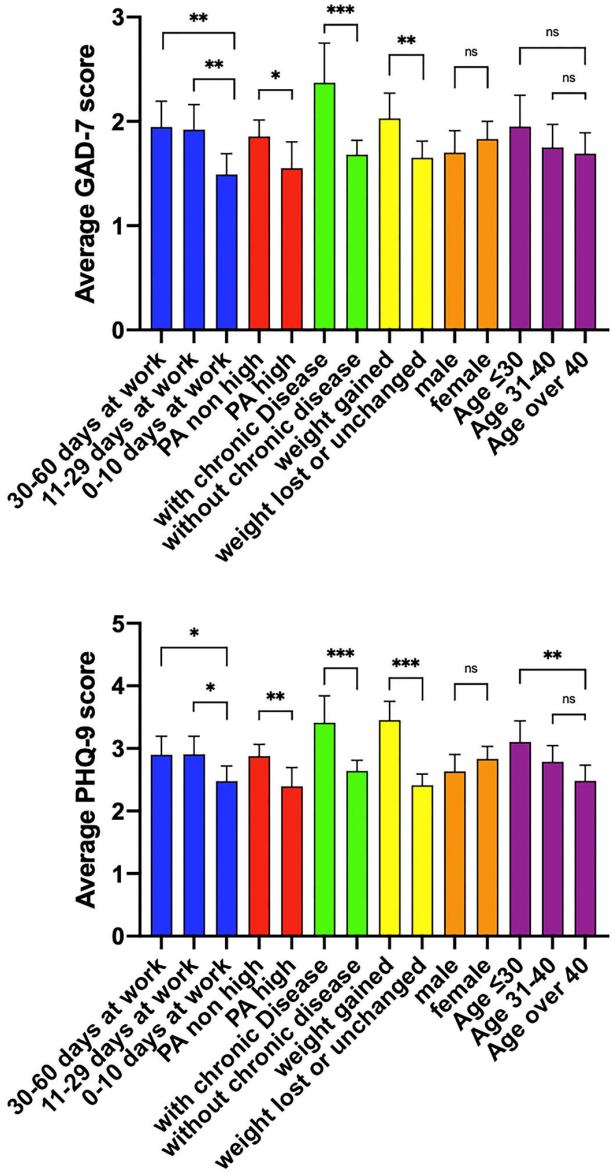

FIGURE 1 | Average GAD-7/PHQ-9 scores in different characteristic groups of participants. PA high: participants who had high level of physical activity. PA non-high: participants who had medium or low level of physical activity. According to the IPAQ scoring guide listed previously, Physical activity status of the participants were graded high, medium and low. In this article, medium and low levels of physical activity were combined as PA non-high. The other characteristic groups were described in **Table 1**. **p*<0.05, ***p*<0.01, ****p*<0.001, ns, not significant.

Average PHQ-9/GAD-7 Scores in Different Characteristic Groups of Participants

As shown in **Figure 1**, people who worked 30–60 days and 11–29 days during the outbreak period reported significantly higher average GAD-7 scores than those who worked for <10 days ($p < 0.01$). People who maintained a high level of PA intensity scored significantly lower than those who reported moderate and low

levels of PA intensity ($p < 0.05$). Participants with a history of chronic diseases scored notably higher than those without ($p < 0.001$). People who gained weight during the outbreak period also reported significantly higher scores than those who did not gain weight ($p < 0.01$). However, gender and age groups did not show any statistical significance on their performance on the GAD-7 scale.

In the case of PHQ-9 scores, people who went to work for 30–60 days and 11–29 days during the outbreak period reported significantly higher average GAD-7 scores than those who went to work for <10 days ($p < 0.05$). People who maintained a high level of PA intensity scored significantly lower than those who reported moderate or low levels of PA intensity ($p < 0.01$). Participants with a history of chronic diseases scored notably higher than those who did not ($p < 0.001$). People who gained weight during the outbreak period showed significantly higher scores than those who did not gain weight ($p < 0.001$). Similar to the GAD-7 results, gender differences in PHQ-9 performance were also minor. For the age groups, individuals younger than 30 years scored significantly higher than those aged >40 years ($p < 0.01$).

Binary Logistic Regression Analysis of PHQ-9 and GAD-7 Scores

Binary Regression Model for PHQ-9

As shown in **Table 4**, the relatively older participants tended to perform better in the PHQ-9 survey than the younger ones (OR 0.978, 95% CI 0.967–0.988), suggesting that age could be a protective factor. A higher PA level was also seen to be a protective factor (OR 0.755, 95% CI 0.603–0.944). Gaining weight during the outbreak (OR 1.754, 95% CI 1.466–2.217) and a history of chronic diseases (OR 1.711, 95% CI 1.312–2.233) were risk factors for depression.

Binary Regression Model for GAD-7

Similarly, gaining weight during the outbreak (OR 1.324, 95% CI 1.057–1.659) and a history of chronic diseases (OR 1.752, 95% CI 1.329–2.311) were risk factors for anxiety. Higher PA level was also seen to be a protective factor (OR 0.741, 95% CI, 0.568–0.967). Compared to participants who worked less than 10 days during the outbreak, participants who spent 11-29 days (OR 1.455, 95% CI 1.110–1.909) and more than 30 days at work (OR 1.619, 95% CI 1.227–2.316) were more likely to score over 5 in the GAD-7 survey, which indicates that going to work was a huge risk factor during the outbreak (**Table 4**).

DISCUSSION

Home confinement due to the current COVID-19 pandemic has dramatically impacted lifestyle activities globally, especially in terms of PA (38, 39). Overall, we found that differences in the length of home confinement during COVID-19 can have different levels of influence on mental health. Before the survey data was analyzed, we presumed that a longer time spent in quarantine might have had an adverse impact on mental health, and that not being able to socialize could be a significant source of psychological stress (40). Our presumption is supported by a study focusing on psychological distress during the SARS epidemic reported that symptoms of PTSD and depression increased by 28.9 and 31.2%, respectively. A longer duration of quarantine was associated with the increased prevalence of PTSD symptoms (41).

Interestingly, inconsistent with the previous studies mentioned above, our study showed that individuals who spent a longer time at home were more likely to have higher levels of PA and performed better in the PHQ-9 and GAD-7 surveys. The reasons behind this may include the following: going outdoors meant being exposed to more risk of contact with the virus than staying at home, and staying indoors would give people more time to spend on PA.

In this study, we found that the intensity of PA during the outbreak period was significantly lower than that before ($p < 0.001$, **Table 2**), and this finding was supported by a previous international study (42). The most significant change was in walking, which decreased by nearly 50% in MET value during the outbreak period. A 17.2% reduction in MET values of vigorous activity and 8.2% increase in hours of sitting were also notable. However, the intensity of moderate PA during and before the outbreak period were similar. According to the results of this study, the walking capacity was significantly reduced due to confinement. Hence, we encourage diversified indoor sports activities as an alternative. We also noted that regular PA may play an important role in relieving the symptoms of anxiety and depression. Although there is no evidence that PA can prevent the onset of depression, exercise can reduce the possibility of aggravating the symptoms in patients with mild depression (43) given that depression is commonly associated with low levels of PA. One study on data from over 4,000 adults showed that people with depression spent significantly less time doing light and moderate PA (44). In addition to depression, the protective effect of PA on generalized anxiety disorder has also been proven in another study. The odds of developing GAD was reduced by approximately 57% among older adults who met WHO PA guidelines (45). A cross-sectional study of 1.2 million people reported that regular PA has a positive effect on mental health (46).

According to previous studies, the 1-month prevalence of a major depressive disorder was 5.2% in a sample representing the general population (47). Accordingly, the cut-off PHQ-9 score was set at five in the current study. Based on our cut-off score, 591 participants out of 2,409 (24.5%) were considered to have mild depression or above. If we adjust the cut-off score to 10 points, 138 participants (5.7%) would be considered to have moderate or high levels of depression, consistent with the prevalence from the study mentioned above. Generalized anxiety disorder has an estimated prevalence in the general population of 1.6% to 6.2% (48–51). Among the 2,409 participants in the current study, 394 (16.4%) scored more than five points, and 81 (3.4%) scored more than 10 points in the GAD-7 survey. Previous studies showed that GAD-7 mean scores of the sample representing the general population ranged from 2.0 points (52) to 8.0 points (53). In our study, the mean scores of our samples was 1.8%.

Since the beginning of the 21st century, humankind have suffered subsequently from the SARS in 2003, H1N1 in 2009, MERS in 2012, Ebola virus disease (EVD) in 2014, and the new COVID-19 in 2019, five public health emergencies caused by

TABLE 4 | Regression results for the PHQ-9 and GAD-7 scores.

						95% Confidence interval for exp (B)	
	B	SE	Wald	Sig	Exp (B)	Lower bound	Upper bound
PHQ-9							
Age	−0.23	0.006	16.19	<0.001	0.978	0.967	0.988
Gaining weight	0.562	0.098	32.574	<0.001	1.754	1.446	2.127
History of chronic diseases	0.537	0.136	15.678	<0.001	1.711	1.312	2.233
High-level PA during outbreak	−0.282	0.114	6.071	0.014	0.755	0.603	0.944
GAD-7							
Gaining weight	0.281	0.115	5.955	0.015	1.324	1.057	1.659
History of chronic diseases	0.561	0.141	15.8	<0.001	1.752	1.329	2.311
High-level PA during outbreak	−0.300	0.136	4.868	0.027	0.741	0.568	0.967
Days at work							
0–10 days*			12.951	0.002			
11–29 days	0.375	0.138	7.359	0.007	1.455	1.11	1.909
30–60 days	0.482	0.141	11.587	0.001	1.619	1.227	2.136

*Parameter estimates for predictors in each logistic regression model. *means reference.*

infectious disease. Problem of mental health crisis has gained increasing attention. There's no doubt that eliminating the existence of the disease is the best way to avoid public mental health crisis (54). Sports was considered to be effective to promote mental health (55). Previous researchers have suggested various mechanisms of positive effect of physical activity on mental health (56, 57). What kind of types of physical activities are more accessible and practical for people especially under confinement? Future studies are needed to explain how to maintain physical activity during a global health crisis. To explore effectiveness and efficiency of physical activity to intervene impaired mental health, cross-sectional, multicenter studies of large sample sizes should be encouraged.

This study also showed that individuals who spent longer time at home during the outbreak period were more likely to have higher levels of PA, and they performed better in the PHQ-9 and GAD-7 surveys. A reasonable explanation for this interesting result could be as follows: At the initial stage of the COVID-19 epidemic, outdoor activity carried a higher risk of exposure to the virus. More people started working from home for a longer period of time, which gave them more time to exercise freely.

CONCLUSION

To our knowledge, our study is the first to focus on a unique demographic of people undergoing health checkups, a demographic that is characterized by a stable income and a relatively high level of education. This study provided valuable information to people suffering from home confinement. We found that home confinement during a pandemic is not detrimental to mental health provided that people engage in more PA indoors. Therefore, we encourage people who are being quarantined to spend more time doing physical exercise to reduce the risk of developing depression, generalized anxiety disorder, or any other potential mental health issues.

The present study has several limitations. First, the data collected were based on an online survey, which required the participants to assess their levels of PA prior to the pandemic. It was unrealistic to design a prospective study in response to the current pandemic. Second, the time frame for the current study was only 60 days. As the pandemic develops further, the relationships between the measures and various factors in the study might change. Future research should include larger population samples to further confirm the current findings.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ruijin Hospital Ethics Committee, Shanghai Jiao Tong University School of Medicine. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AL, JT, BW, GX, and XB: designed the study. AL, JT, BW, WZ, NW, and LL: designed the questionnaire. WZ, LW, WR, and CL: recruited participants and collected data. WZ, DX, HL, and GX: performed the statistical analysis. WZ: wrote the first draft. All authors revised, read, and approved the final manuscript.

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The Prevalence and Associated Factors of Depressive Symptoms Among Medical Students in Bangladesh During the COVID-19 Pandemic: A Cross-Sectional Pilot Study

Md. Abdullah Al Jubayer Biswas[1], M. Tasdik Hasan[2,3,4], Nora Samir[5], Sayma Islam Alin[6], Nusrat Homaira[5], Md. Zakiul Hassan[7], Mst Rabeya Khatun[8], Afifa Anjum[6,7], Sahadat Hossain[2,6], Kamrun Nahar Koly[7], Farhana Safa[9], Syeda Fatema Alam[10], Md. Abdur Rafi[11], Md. Abdullah al Osman Biswas[12], Farida Yasmin[13], Vivek Podder[13], Tonima Islam Trisa[7], Dewan Tasnia Azad[14], Rhedeya Nury Nodi[2], Fatema Ashraf[2,10], S. M. Quamrul Akther[10] and Helal Uddin Ahmed[15]*

[1] Department of Statistics, University of Dhaka, Dhaka, Bangladesh, [2] Public Health Foundation, Bangladesh (PHF, BD), Dhaka, Bangladesh, [3] Department of Public Health, State University of Bangladesh (SUB), Dhaka, Bangladesh, [4] Department of Primary Care and Mental Health, University of Liverpool, Liverpool, United Kingdom, [5] Discipline of Paediatrics, School of Women's and Children's Health, The University of New South Wales, Sydney, NSW, Australia, [6] Department of Public Health and Informatics, Jahangirnagar University, Dhaka, Bangladesh, [7] International Centre for Diarrheal Diseases Research, Bangladesh (icddr, b), Dhaka, Bangladesh, [8] Department of Biotechnology and Genetic Engineering, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh, [9] Department of Public Health, Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada, [10] Shaheed Suhrawardy Medical College Hospital, Dhaka, Bangladesh, [11] Rajshahi Medical College, Rajshahi, Bangladesh, [12] Sheikh Sayera Khatun Medical College, Gopalgonj, Bangladesh, [13] Tairunnessa Memorial Medical College and Hospital, Gazipur, Bangladesh, [14] Jashore Medical College, Jashore, Bangladesh, [15] National Institute of Mental Health, Dhaka, Bangladesh

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***Correspondence:**
Md. Abdullah Al Jubayer Biswas
jubayerbiswas@gmail.com

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Background: Whilst very limited studies have demonstrated a correlation between the COVID-19 pandemic and depressive symptoms amongst Bangladeshi medical students, the prevalence and associated factors of depressive symptoms as measured by the Patient Health Questionnaire (PHQ-9) remains widely unknown.

Objective: The study aimed to investigate the prevalence and factors associated with depression symptoms among Bangladeshi medical students during the COVID-19 pandemic lockdown period.

Method: In this web-based cross-sectional pilot study, medical students' data was collected using the Google Forms web survey platform after obtaining electronic informed consent. A total of 425 medical students were selected using a systematic sampling technique to accumulate depression symptoms and demographic and pandemic-related information. Depression was measured by a self-administered, validated English version of the Patient Health Questionnaire (PHQ-9) tool. The descriptive analysis utilized frequency and percentages, while the stepwise binary logistic regression analysis was performed to investigate the factors associated with depressive symptoms.

Result: Among 425 medical students, 62.3% were female, 97.4% unmarried. Almost 80.2% of medical students had mild to severe levels of depressive symptoms as characterized by PHQ-9. A significantly higher probability of depression was found amongst female students (adjusted OR = 1.8), those who struggled to stay away from social media (adjusted OR = 1.8), those who tried to be optimistic for maintaining better psychology (adjusted OR = 11.1), and those who always had a sleeping difficulty in the last 4 weeks (adjusted OR = 8.9).

Conclusion: A very high prevalence of depression symptoms among Bangladeshi medical students was found across the majority of socio-demographic variables. The alarming prevalence and associated factors of depression suggests the need for follow-intensity psychosocial interventions designed for medical students during the COVID-19 pandemic

Keywords: medical students, depressive symptoms, patient health questionnaire-(PHQ-9), COVID-19, Bangladesh

INTRODUCTION

As of December 23, 2021 the COVID-19 crisis has overwhelmed healthcare systems worldwide and resulted in over 5.3 million deaths and 273 million infections (1). The mental health and well-being of health care workers have been particularly impacted during the COVID-19 outbreak, with an increased prevalence of anxiety, fear, depression, and insomnia reported. Reasons for higher anxiety and depressive symptoms reported by health care workers during the pandemic include extended work shifts, higher risk of infection, lack of adequate personal protective equipment (PPE) and prolonged separation and isolation from families and friends (2). Medical students, in particular, are at risk of developing adverse mental health outcomes due to changes in teaching techniques, interruptions in academic curricula and clinical rotations, increased workload, and viral exposure during the COVID-19 epidemic (3–5). A meta-analysis found that the COVID-19 pandemic had a substantial adverse effect on the mental well-being of medical students (6). In addition, psychological reactions and depressive symptoms have been intensified in various other contexts due to COVID-19 pandemics (7, 8). During the COVID-19 pandemic in Brazil, 64.4% of medical students reported depressed symptoms using the Patient Health Questionnaire (PHQ-9), whereas, in India, it was 44.89% using the DASS-21 (5, 9).

Like the general population, medical students in Bangladesh have been demonstrated to suffer detrimental psychological impacts due to the COVID-19 epidemic (10, 11). A cross-sectional study during the COVID-19 pandemic reported that 49.9% of 425 Bangladeshi medical students had depressive symptoms measured by the Hospital Anxiety & Depression Scale (HADS) (10). However, there are limited data on prevalence and the associated factors of depressive symptoms using PHQ-9 during the COVID- 19 pandemic medical students. Additionally, it's unknown how the social isolation during lockdown periods in Bangladesh impacted the prevalence of depressive symptoms amongst Bangladeshi medical students. Also, in light of the long-term psychological effects of COVID-19, Bangladeshi medical students' depression status needs to be assessed so that an appropriate mitigation strategy may be devised in the future. Therefore, our study aimed to assess the prevalence and factors associated with depressive symptoms among medical students using PHQ tools during the COVID-19 pandemic lockdown period in Bangladesh. We also hypothesized that the prevalence of depression among Bangladeshi medical students would be the same regardless of their demographics or any other information about the epidemic. The findings of this study may help educational stakeholders understand medical students' mental status during health crises and plan targeted interventions to address such issues in the present pandemic and for future public health crises.

METHODOLOGY

Study Setting and Population

An online cross-sectional pilot survey was conducted between April 21, 2020, and May 10, 2020, to explore prevalence and factors associated with depressive symptoms among Bangladeshi medical students, coinciding with the 1st wave of the COVID-19 pandemic. All medical students who were Bangladeshi citizens, aged $\geq$18 years, currently enrolled in undergraduate medical program (MBBS) in any Bangladeshi medical college, residing in Bangladesh during the pandemic, had access to the social media platforms including Facebook, WhatsApp, Twitter or an e-mail account, and could read and understand English were eligible to participate.

Data Collection

We designed an online survey data collection tool with the declaration of anonymity and confidentiality using the Google Forms web survey platform to minimize human contact and adhere to the strict COVID-19 protocols. Initially, we recruited five volunteer medical students conveniently from five different medical colleges situated in different locations in Bangladesh, including Chittagong, Dhaka, Sylhet, Barisal, Rajshahi. The five volunteers developed a primary contact list of medical

students using their social media platforms, such as Facebook, WhatsApp, and Twitter. After finalizing the primary contact list, the study team selected medical students from the list and sent an invitation message with a link for the survey using given e-mails or social media profiles. The invitation letter explained the rationale, objectives, and nature of the project. Medical students who accepted the invitation provided their responses by browsing the link; otherwise, they were counted as non-response.

Depressive Symptoms Measure

A self-administered version of the Patient Health Questionnaire (PHQ-9), the PRIME-MD diagnostic instrument for measuring depression, was utilized to assess depression symptoms (12). An English version of nine items PHQ-9 depression module whose reliability and validity have been reported by multiple studies was designed on the Google Form platform (13). A four-point Likert scale layout was followed to create an online PHQ-9 section where each item of the PHQ-9 scale was scored from zero implied not problematic at all to three indicated extremely difficult. The global summation of the nine issues delineated the level of the severity of depression. Recommended cut off PHQ-9 scores for level of depression severity (12): minimal (score 0–4), mild (score 5–9), moderate (score 10–14), moderately severe (score 15–19), severe (score 20–27). Patient Health Questionnaires had good internal consistency (Cronbach's Alpha = 0.77), adequate split-half reliability ($r = 0.80$) in our data.

Demographic and Pandemic Related Information

The self-reported and structured demographic and pandemic related questionnaire had five sections: socio-demographic, tension related to COVID-19 infection, adherence with media, the strategy taken to maintain psychological health and difficulty in sleeping. Participants filled a brief section after the informed consent segment on demographic characteristics including age in year, gender, marital status, profession, monthly income, ever searching remedy for mental health. In the next susceptible to COVID-19 section, participants invited the questions related to tension about himself/herself and family members getting infected by COVID 19, hard to step ways from media. Also, to evaluate respondents' recreational activities, they were asked questions regarding leisure activities, time to spend on leisure activities, and struggling to stay away from media. Furthermore, the difficulty in sleeping cycles was assessed using questions related to sleeping disturbance faced in the last 4 weeks and the average sleep time during the previous 4 weeks.

Sample Size and Sampling Technique

We calculated sample size using a single population proportion formula and considering 74.4% mild to severe depression assessed by the Patient Health Questionnaire (PHQ-9) among medical students of Banaras Hindi University, Varanasi, Uttar Pradesh, India (14, 15). Considering a 95% confidence interval (CI), 5% absolute precision, 5% non-response rates, and a 1.27 design effect, a minimum sample of 390 was calculated. A systematic sampling technique was used where every third eligible medical student was selected and approached to participate in the study. The final contact list was used as a list-based sampling frame (16, 17). The detailed sampling strategy is shown in **Figure 1**.

Statistical Analysis

We conducted descriptive analyses using frequency, percentage, mean, and standard deviation (SD) depending on the variables' type. Depressive symptoms of the study participants were categorized using established cutoff and summarized using frequency and percentage (12). Cross-tabulation with Pearson's Chi-square was used to test the association of demographic and pandemic related variables with participants' severity of the depressive symptom. We executed a binary logistic regression analysis to explore the bivariable relationship between the respondent's depression symptoms and explanatory variables. We reported bivariable analysis output as the unadjusted odds ratio (UOR) with a 95% confidence interval. We utilized stepwise logistics regression with removal algorithm to identify the factors associated with depression and described as adjusted odds ratio (AOR) with 95 % confidence interval (14, 15) for multivariable analysis. We included variables in the final multivariable model, which were significant at the 5% significance level. Statistical significance of the association was considered for p-values <0.05. The analysis was performed using Stata software (Stata Corp. 2017. Stata Statistical Software: Release 13. College Station, TX: Stata Corp LP).

Ethical Consideration

The study received ethical approval from the Ethical Review Committee, Shaheed Suhrawardy Medical College, and Dhaka, Bangladesh (ShSMC/Ethical/2020/12). A concise outline of the study and information regarding ethics were provided on the google form's preliminary page. Confidentiality of the participants was strictly maintained by avoiding identifiable personal questions, and data was collected anonymously. The respondents were also informed about their voluntary participation and ending the survey at any time just by closing the web browser. Likewise, the consent field was kept as a mandatory field for starting the study. The study was carried out under the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) guideline (18). Furthermore, the study investigators monitored all procedures relevant to the study to ensure the proper ethical standards of the concerned national and institutional committees on human experimentation and the Helsinki Declaration of 1975, as revised in 2008.

RESULTS

The final contact list had 1,368 medical student contact information, and among them, 456 medical students were identified and sent the invitation. After excluding 31 responses due to duplicate response, lack of complete records, the data set of 425 responses were finalized for analysis. This study had a response rate of around 93.2%.

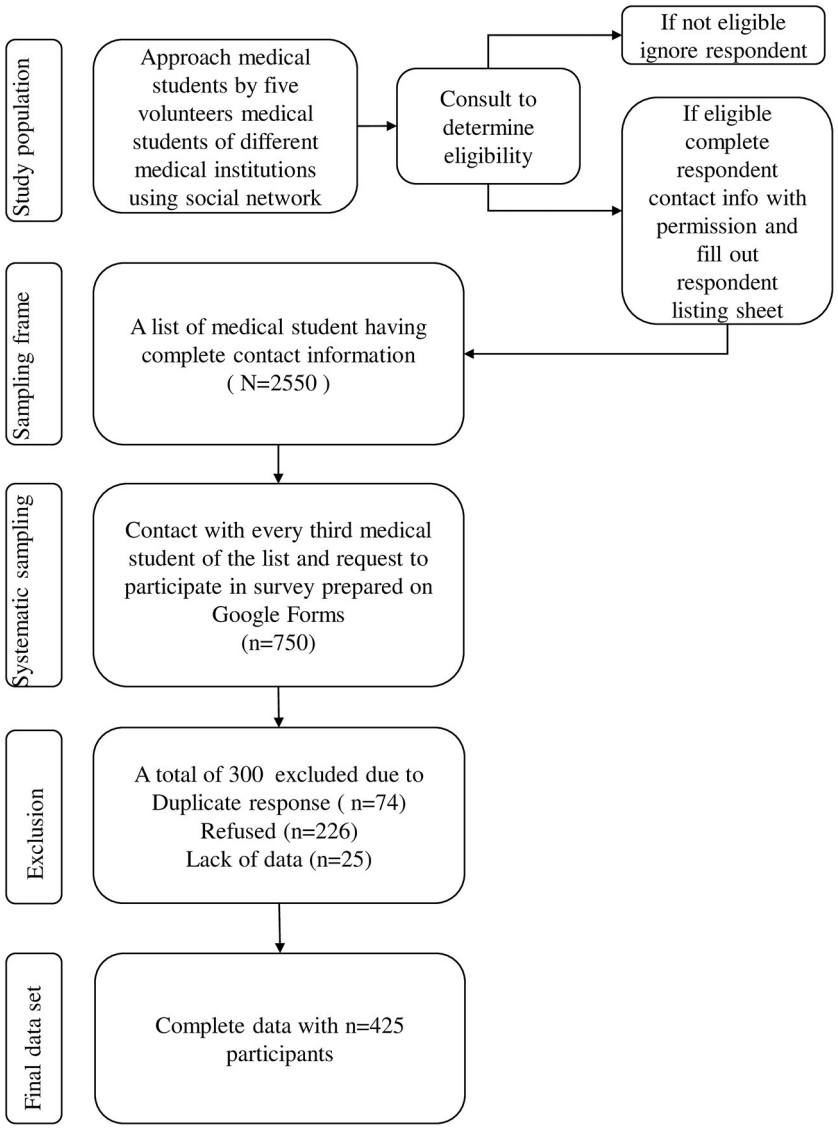

FIGURE 1 | Flow chart of sampling strategy.

Demographic and Pandemic Related Information

Among 425 medical students, 62.3% were female, and the mean age was 22 years with a standard deviation of 1.8 years. Almost all the students were fully engaged with the study (87.5%) and never sought treatment for their mental health issue (93.2%) (**Table 1**).

Prevalence of Depressive Symptoms Among Medical Student

Among all study participants, the average PHQ-9 score was 9.5 with a standard deviation of 5.4 and a range between zero to 26 (**Figure 2**). The prevalence of mild to severe depressive symptoms was 80.2% where it was high among females (83.8%) and among married students (90.9%). Likewise, the prevalence was decreased significantly with decreasing tension about the family member getting infected by COVID-19, ranging from 66.0 to 84.3%. Moreover, the significant highest prevalence was observed for the medical student who struggled to get away from social media (83.1%), always faced sleeping disturbances in the last 4 weeks (93.5%), then counters category (**Table 1**).

Associated Factors of Depressive Symptoms Among Medical Students

Table 2 shows the outcome of the bivariable and multivariable analyses. After controlling for other factors, the multivariable analysis found a higher probability of depression symptoms among female medical students (AOR = 1.8). Additionally, depressive symptoms remained almost similar among four successive categories of the respondents who had a sleeping disturbance in the last 4 weeks (Always vs. Never AOR = 8.9,

TABLE 1 | Prevalence of mild to severe depressive symptom among medical students, measured by PHQ-9, during COVID-19 pandemic following their demographic and pandemic related characteristics, 2020 Bangladesh.

Variables		Prevalence of depression		
	% (*n*)	% (row)	95% CI	*P*-value
Among all participants	100.0 (425)	80.2	(76.1, 83.9)	
Age in year	22.0 ± 1.8			
≤20	25.4 (108)	72.2	(63.0, 79.9)	
21–24	68.5 (291)	83.5	(78.8, 87.4)	0.038
≥25	6.1 (26)	76.9	(56.7, 89.4)	
Gender				
Male	37.7 (160)	74.4	(67.0, 80.6)	
Female	62.3 (265)	83.8	(78.8, 87.8)	0.018
Marital status				
Married	2.6 (11)	90.9	(53.5, 98.8)	0.368
Unmarried	97.4 (414)	79.9	(75.8, 83.5)	
Profession				
Part-time job	12.5 (53)	90.6	(79.1, 96.1)	0.044
Solely study	87.5 (372)	78.8	(74.3, 82.6)	
Ever seeking treatment for mental health issues				
Yes	6.8 (29)	89.7	(71.9, 96.7)	0.187
No	93.2 (396)	79.5	(75.3, 83.2)	
The tenseness of getting infected by COVID-19 about				
Himself/herself				
Severe	36.9 (157)	84.1	(77.4, 89.0)	
Moderate	43.5 (185)	79.5	(73.0, 85.0)	0.209
No/minimal	19.5 (83)	74.7	(64.2, 83.0)	
Family members				
Severe	64.2 (273)	84.3	(79.4, 77.8)	
Moderate	24.0 (102)	76.5	(67.2, 83.7)	0.006
No/minimal	11.8 (50)	66.0	(51.8, 77.8)	
Source of news				
Television news	68.5 (291)	80.8	(75.8, 84.9)	
Social media	18.8 (80)	86.3	(76.7, 92.3)	0.038
Newspaper	12.7 (54)	68.5	(54.9, 79.6)	
Struggling to get away from social media				
Yes	71.1 (302)	83.1	(78.4, 87.0)	0.020
No	28.9 (123)	73.2	(64.6, 80.3)	
The strategy took to maintain healthy psychology				
Yes	44.2 (188)	80.8	(74.6, 85.9)	
No	55.8 (237)	79.7	(74.0, 84.3)	0.760
Type of strategic strategy taken to maintain healthy psychology (Multiple responses)				
Involving leisure activities	55.3 (104)	80.8	(72.0, 87.4)	0.832
Spending quality of time with friends and family	29.3 (55)	87.3	(75.4, 93.9)	0.160
Maintaining COVID-19 instructions	21.8 (41)	73.2	(57.5, 84.6)	0.232
Practicing religion norms	21.3 (40)	80.0	(64.6, 89.7)	0.969
Optimistic thinking/positive outlook	17.6 (33)	96.9	(80.1, 99.5)	0.012
Maintaining physical activity	17.0 (32)	90.6	(74.2, 97.0)	0.125
Staying at home	7.5 (14)	71.4	(42.8, 89.3)	0.400
Avoiding COVID-9 new broadcast	2.1 (4)	80.0	(25.5, 97.9)	0.989
Difficulty in sleeping				
Having sleeping disorder in last 4 weeks				
Always	10.8 (46)	93.5	(81.4, 97.8)	
Often	14.8 (63)	92.1	(82.1, 96.6)	
Sometimes	24.5 (104)	87.5	(79.6, 92.6)	<0.001
Occasionally	22.8 (970)	86.6	(78.2, 92.1)	
Never	27.1 (115)	56.5	(47.3, 65.3)	

(Continued)

TABLE 1 | Continued

Variables		Prevalence of depression		
	% (*n*)	% (row)	95% CI	*P*-value
Average time of sleep in last 4 weeks				
<6 h	19.8 (84)	83.3	(73.7, 89.9)	
6–8 h	36.0 (153)	75.8	(68.4, 81.9)	0.226
More than 8 h	44.2 (188)	82.4	(76.3, 87.3)	

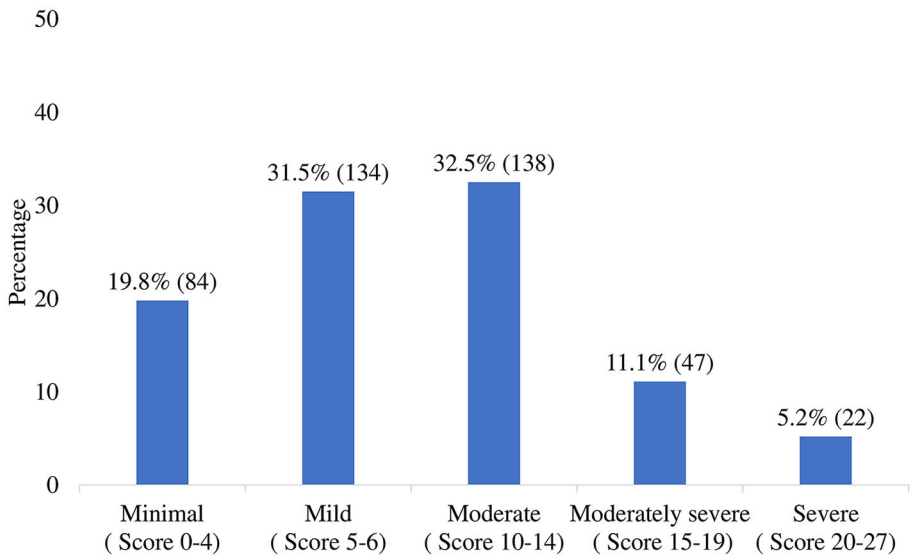

FIGURE 2 | Level of depression severity among medical students obtained by categorizing PHQ-9 score. The total PHQ-9 score was 4,038, with an average 9.5 ± 5.4 and a median 9.0.

95% CI: 2.6–31.4; Often vs. Never AOR = 7.9, 95% CI: 2.8–21.7; Sometimes vs. Never AOR = 5.6, 95% CI: 2.7–11.5; Occasionally vs. Never AOR = 5.0, 95% CI: 2.3–9.7). Also, students who maintained a positive outlook for keeping psychological health fit had a higher probability of being depressed during the COVID-19 pandemic (AOR = 11.1).

DISCUSSION

Our study aimed to determine the prevalence and factors associated with depressive symptoms among Bangladeshi medical students during the COVID-19 pandemic. The study findings revealed that the prevalence of mild to severe depressive symptoms was high in medical students, and factors such as gender, struggling to get away from social media, and having sleep disturbances in the preceding 4 weeks were significantly associated with depressive symptoms.

In our study, 80.2% of medical students had mild to severe levels of depressive symptoms, which was comparable to findings from Bangladesh (49.1%), India (74.6%) and Brazil (64.41%) but higher than those reported from Nepal (5.5%) and Iran (25.6%) (3, 3, 5, 10, 19, 20). The disparity in prevalence could be due to the usage of multiple measurement scales and countries contexts. Additionally, the tension associated with the possibility of infecting a family member with COVID-19, gender, adverse effects of COVID-19 and its perceived long-term health outcomes, discrimination against the frontline physicians and a tendency to get irritated more quickly than normal could all contribute to the high prevalence (10, 21). The study by Tasdik et al. reported depression symptoms in 38.9% of medical students, with 3.6, 14.5, and 20.8% being severe, moderate, and mild depression, respectively pre-COVID-19 era, which used PHQ-9 as the assessment tool. This highlights the overwhelming mental health burden experienced by the medical students during the pandemic (22).

Our study found that female medical students reported experiencing significantly more depressive symptoms than male students, comparable with earlier epidemiological studies (10, 23). Research on the disparity between women and men during the COVID-19 pandemic revealed that female students had higher COVID-19 pandemic risk perceptions than male students (23, 24). That research also estimated higher conscientiousness, neuroticism, tolerance to experiences, and tension to be higher in female university students (23). However, in comparison to results from a similar COVID-19 pandemic survey, it was found that gender did not significantly affect the medical students'

TABLE 2 | Logistic regression analysis of medical student who had depression for mild to severe level during COVID-19 pandemic, 2020 Bangladesh.

	Depression (mild to severe level)			
	Unadjusted OR (95% CI)	***P*-value**	**Adjusted OR (95% CI)**	***P*-value**
Age in year				
21–24	1.9 (1.2–3.3)	0.012	–	
≥25	1.3 (0.5–3.5)	0.628	–	
≤20	Reference			
Gender				
Female	1.8 (1.1–2.9)	0.019	1.8 (1.1–3.1)	0.032
Male	Reference		Reference	
Profession				
Parttime job	2.6 (1.0–6.7)	0.051	–	
Solely study	Reference			
The tenseness of getting infected by COVID-19 about family members				
Severe	2.8 (1.4–5.4)	0.003	–	–
Moderate	1.7 (0.8–3.5)	0.174	–	–
No/minimal	Reference			
Adherence with media				
Source of news				
Television news	2.9 (1.2–6.8)	0.016	–	–
Social media	1.9 (1.0–3.7)	0.046	–	–
Newspaper	Reference			
Struggling to get away from social media				
Yes	1.8 (1.1–3.0)	0.021	1.8 (1.0–3.1)	0.041
No	Reference		Reference	
Strategy took to maintain psychological health				
Type of strategic capture				
Optimistic thinking/positive outlook				
Yes	8.6 (1.2–63.8)	0.035	11.1 (1.3–93.5)	0.034
No	Reference		Reference	
Difficulty in sleeping				
Having a sleeping disorder in the last 4 weeks				
Always	11.0 (3.2–37.6)	<0.001	8.9 (2.5–31.4)	0.001
Often	8.9 (3.3–23.9)	<0.001	7.9 (2.8–21.7)	<0.001
Sometimes	5.4 (2.7–10.7)	<0.001	5.6 (2.7–11.5)	<0.001
Occasionally	5.0 (2.5–9.9)	<0.001	4.9 (2.3–9.8)	<0.001
Never	Reference		Reference	
Average time of sleep in the last 4 weeks				
6–8 h	0.6 (0.3–1.2)	0.180	–	
More than 8 h	0.9 (0.5–1.9)	0.858	–	
<6 h	Reference			

mental health (25). In light of our study, further investigation into understanding the kinds of social support that can help mitigate gender-specific mental health well-being issues among Bangladeshi medical students is essential.

Additionally, we also found that medical students who fail to disengage from social media during the COVID-19 pandemic tend to experience more frequent depressive symptoms. At the height of the COVID 19 pandemic, students were unable to leave their homes for fear of being infected or breaking government-imposed lock-down laws (26). Online platforms were initially used to learn about the virus and spread information, which resulted in a spike in mobile social media use (26). Maintaining social media use for an extended period may cause social, family, and/or occupational impairments, cyberchondria as well as mental health and well-being problems (26–28). A recent survey of 100 first-year medical students in India showed that time spent on social media for over 4 hours during lock-down rose from 1.1 to 47.72% (29). It was also found that social network use of >4 h is significantly correlated with mood variations, including feeling frustrated among medical students (29). Based

on our findings, we believe institutions and clinicians must work together to find ways to combat social media addiction among medical students and encourage healthy use of social media during the pandemic. In order to get a clearer understanding of how medical students should utilize social networking channels as helpful learning resources, further research is needed.

We also found that medical students who had a sleeping disorder in the last 4 weeks were more likely to have depressive symptoms, similar to a previous prospective longitudinal study conducted in India on 217 medical students (30). In that study, researchers found that medical students who had increased depression during the COVID-19 pandemic were 1.11 times more likely to have poor sleep quality (30). Because of travel limitations and lock-down precautions, medical students were dealing with reduced physical activity, changing living circumstances, and greater employment pressure (30). Sleep was adversely affected by these combinations, one of the key symptoms of seeking depression (30, 31). In addition, it may highlight the need for the medical community to provide further support to medical trainees at times of health crises such as the COVID-19 pandemic in order to prevent sleep disorders, burnout and associated downs-stream psychological effects.

Strength and Limitation

It was one of the first few studies to examine the prevalence and associated factors of depressive symptoms among medical students under lock-down scenarios, using a validated method for detecting depressive symptoms. To avoid sampling bias, we constructed a contact list of medical students based on the eligibility criteria, which also ensured representation of the population we wanted to study. However, our study has several limitations. Firstly, as we prepared a primary contact list based on five volunteer medical studnets social media networks, there might have been some selection bias in the list. Secondly, students without internet or social media accounts were excluded due to the online approach of the survey platform. As a result, our results were not generalisable to all Bangladeshi medical students. Thirdly, depressive symptoms were assessed only by self-report, which may not be consistent with professional mental health diagnoses. However, the questionnaire used has been validated for use in self-reported depressive symptoms (12). Fourthly, findings from this research do not give a comprehensive picture of COVID-19's long-term impact on depression symptoms, preventative measures, and coping techniques. Furthermore, future longitudinal studies are required to examine the ramifications of COVID-19 on the medical student's psychological well-being.

CONCLUSION

We conclude that during the worldwide pandemic of COVID-19, the prevalence of depressive symptoms was alarmingly high among Bangladeshi medical students, which indicates medical students were at high risk of developing depressive symptoms during the ongoing pandemic. Given that medical students are prone to developing depression during the COVID-19 pandemic, adequate mental health services focusing on depression for students might be considered by medical colleges. Besides, in times of infectious disease outbreaks like COVID-19, when mental health issues like depression symptoms impacts academic performance, physical health, psychological well-being, interventions targeted to improve mental health conditions in medical students are crucial.

DATA AVAILABILITY STATEMENT

The study's original contributions are provided in the article/supplementary material. Any further questions should be addressed to the corresponding author.

ETHICS STATEMENT

The study received ethical approval from the Ethical Review Committee, Shaheed Suhrawardy Medical College, and Dhaka, Bangladesh (ShSMC/Ethical/2020/12). A concise outline of the study and information regarding ethics were provided on the google form's preliminary page. Confidentiality of the participants was strictly maintained by avoiding identifiable personal questions, and data was collected anonymously. The respondents were also informed about their voluntary participation and ending the survey at any time just by closing the web browser. Likewise, the consent field was kept as a mandatory field for starting the study. The study was carried out under the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) guideline (Eysenbach, 2004). Furthermore, the study investigators monitored all procedures relevant to the study to ensure the proper ethical standards of the concerned national and institutional committees on human experimentation and the Helsinki Declaration of 1975, as revised in 2008. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MTH, SFA, MAR, VP, SMQA, and FA: conceptualization. MAAJB and MRK: data analysis. MTH, SFA, MAR, VP, DA, and RNN: investigation. MAAJB, MTH, and SH: methodology. MTH, FS, SFA, and SH: resources. SMQA and FA: supervision. MAAJB, SIA, MTH, and MRK: writing –original draft. MAAJB, MTH, NS, SIA, NH, MZH, SH, FY, MAaOB, FS, KNK, SFA, MAR, VP, TIT, RNN, DA, MRK, FA, SMQA, and HUA: writing –review and editing. All authors contributed to the article and approved the submitted version.

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The Prevalence of Psychological Distress and Its Relationship to Sleep Quality in Saudi Arabia's General Population During the COVID-19 Pandemic

Maha M. AlRasheed[1,2], Sinaa Al-Aqeel[1], Afnan M. Alkadir[1], Khulood Bin Shuqiran[1], Fowad Khurshid[1], Noura M. AlRasheed[3], Roua M. Al-kufeidy[4], Omar A. Alhaj[5], Haitham Jahrami[6,7] and Ahmed S. BaHammam[8,9]*

[1] Department of Clinical Pharmacy, College of Pharmacy, King Saud University, Riyadh, Saudi Arabia, [2] Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia, [3] General Administration of School Health, Ministry of Health, Riyadh, Saudi Arabia, [4] Department of Botany and Microbiology, Molecular Immunology, College of Science, King Saud University, Riyadh, Saudi Arabia, [5] Department of Nutrition, Faculty of Pharmacy and Medical Sciences, University of Petra, Amman, Jordan, [6] Ministry of Health, Manama, Bahrain, [7] College of Medicine and Medical Sciences, Arabian Gulf University, Manama, Bahrain, [8] Department of Medicine, College of Medicine, University Sleep Disorders Centre, King Saud University, Riyadh, Saudi Arabia, [9] The Strategic Technologies Program of the National Plan for Sciences and Technology and Innovation in the Kingdom of Saudi Arabia, Riyadh, Saudi Arabia

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***Correspondence:**
Maha M. AlRasheed
mahalrasheed@ksu.edu.sa

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Background: We aimed to examine the effect of the COVID-19 pandemic and associated mitigation measures on sleep quality and psychological distress in Saudi Arabia.

Methods: Subjective sleep quality over the preceding 30 days was measured using the Pittsburgh Sleep Quality Index (PSQI). In addition, Kessler Psychological Distress Scale (K10) was used to assess the psychological distress.

Results: The study included 836 participants. The median age was 28 years, 624 (74.64%) were females, and 158 (18.90%) were healthcare workers. Factors associated with poor sleep were recent changes in the sleep habits $p = 0.004$), anxiety or fear because of coronavirus news on social media $p = 0.02$), fear because there was no approved drug to treat COVID-19 $p = 0.03$), and unaware of the presence of chronic diseases $p = 0.03$). Female gender $p = 0.02$), fear or anxiety because of coronavirus news on social media $p = 0.04$), recent change in sleep habits (OR: 1.97 (1.15–3.39); $p = 0.01$), fear because there is no approved drug to treat COVID-19 $p = 0.001$), monthly income < 1000 SR $p = 0.01$), and isolation $p = 0.01$) were associated with distress. PSQI and K10 scores were significantly correlated $p < 0.001$).

Conclusion: Poor sleep and psychological distress are common during the COVID-19 outbreak in Saudi Arabia. Identifying factors associated with poor sleep and psychological distress would help develop specific intervention programs that enhance mental health and sleep quality during pandemics.

Keywords: PSQI score, K10 score, COVID-19, psychological distress, sleep quality

INTRODUCTION

The World Health Organization declaration (1) on March 11, 2020, classifying the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) disease as a global pandemic mandated governments worldwide to implement measures to mitigate virus spread. These procedures included lockdowns, quarantine, social distancing, and travel restrictions, all of which may reduce physical activity and exposure to daylight, adversely affecting the pace of time flow (2) and disrupting nighttime sleep (3, 4). These measures increase the risk of mental health problems. A rise in the prevalence of generalized anxiety disorders, post-traumatic distress, depression, and worsening of psychiatric symptoms has been reported in published systematic reviews (5–9) because of the pandemic. In addition, female gender, younger age, unemployment, educational level, insufficient knowledge of the disease, frequency of exposure to social media/disease-related news, and chronic/psychiatric illnesses have been implicated as risk factors for these disorders. A meta-analysis of studies up to July 5, 2020, identified 44 publications involving 54,231 participants from 13 countries, demonstrating a pooled global rate of 35.7% for sleep problems among the studied populations. Patients infected with SRS-CoV-2, commonly known as COVID-19, exhibited a higher rate of sleep problems of 74.8% compared to 36.0% in healthcare workers and 32.3% in the general population (10). Examples of reported sleep problems linked to the COVID-19 pandemic involve increased sleep duration and latency (11), worsening of sleep quality (11–16), decrease in the amount and regularity of sleep, and insomnia symptoms (13).

Gender has been demonstrated to play a major effect in the experience of sleep disruptions in previous research (17). A study of research, for example, discovered that females have a greater risk of insomnia than males. Matud and Garca (18) found that women had a greater frequency of mental health concerns than males. Furthermore, sleep loss leads women to be more anxious than males (19). During the COVID-19 epidemic, females experienced more psychological anguish than males (20). However, whether gender influences the association between sleep problems and mental health during the COVID-19 pandemic is unknown and warrants more investigation. As a result, we expected that gender would have an influence on the connection between sleep disruptions and mental health.

Saudi Arabia has implemented several mitigation measures such as curfew, self-quarantine for infected or symptomatic individuals and travelers arriving in Saudi Arabia, mandatory face masks, and restrictions on national and international journeys since the identification of the first case in March 2020 (21). Full and partial curfews were imposed from March 24 until June 20, 2020. Lockdown included schools, universities, and shops not selling basic stuff. While the published research on mental health and sleep quality and its association with COVID-19 might apply to Saudi Arabia, many country-specific social and economic variables could influence the rates of mental and sleep problems. Hence, local decision-makers need local data to plan preventive public health interventions during potential subsequent pandemics. Additionally, there is a need to identify risk factors associated with mental and sleep problems to prioritize preventive and treatment strategies targeting vulnerable groups (22).

During the COVID-19 epidemic, the current study looked at the incidence of sleep disruptions in different demographic categories of Saudi Arabians. Furthermore, the association between sleep disruptions and mental health status, as well as the factors that influence it, was investigated. The current study's findings will give vital information to medical personnel and the government regarding who would benefit the most from initiatives aimed at minimizing sleep disruptions and promoting mental health during the COVID-19 crisis.

METHODOLOGY

Study Design and Participants

A cross-sectional questionnaire-based study was conducted between May 8 and June 29, 2020. The study was conducted during the lockdown period in Saudi Arabia. The eligible study population included participants aged 18 years and older, capable of reading and understanding the questionnaire that was availed to participants in Arabic and English to select their preferred language and those living in Saudi Arabia during the study period. We excluded participants on sleep or psychiatric medications ($n = 76$). A convenience sampling technique was employed to recruit the participant according to availability and accessibility. The required sample size for the study was calculated using the Raosoft sample size calculator, employing a type I error margin of 5% and a confidence interval of 95%, power was set at 80% (23) and the population of Saudi Arabia estimated at 34,813,871 according to the United Nations database (24). An estimated sample size of 385 individuals was determined as adequate for the study. However, to increase power, the ultimately recruited population was 836.

This study was approved by the Institutional Review Board (IRB) of King Saud University Medical City (E-20-4869) and the IRB of the Ministry of Health (20-331E).

Survey Instruments

The principal investigator constructed a dedicated account for the online questionnaire using a Google Form. It collected information on (**Supplementary Table 1**):

a. Socio-demographic characteristics of the participants, including age, gender, marital status, work sector, family status, income, education, employment status, and region of residence.
b. The social interaction involved attitude and response to social events, measured with the desire to attend such events, attendance frequency, and involvement in the activities.
c. COVID-19 and associated disease data aimed to evaluate participants' personal experience with COVID-19 infection. The questions used to cover this item involved "the frequency of going out before the coronavirus pandemic, information about coronavirus and its ways of spreading, concerns about lack of approved drug to treat COVID-19, the effect of COVID-19-related news on social media on anxiety, and fear,

TABLE 1 | Socio-demographic of participants.

Variable	All participants ($n = 836$)
Age (Years)	28 (22–38)
Female	624 (74.64)%
Marital status	
Single	464 (55.5%)
Married	336 (40.19%)
Divorced/widow/separated	36 (4.31%)
Do you work in the healthcare sector? (Yes)	158 (18.9%)
Do you have children?	322 (38.52%)
How many members of your family live with you at home (including you)?	
One to two persons	103 (12.32%)
Three to five persons	270 (32.30%)
More than five persons	463 (55.38%)
Nationality	
Saudi	775 (92.7%)
Non-Saudi	61 (7.3%)
Educational level	
Middle school or lower, High school or Diploma	196 (23.44%)
Bachelor's degree or higher	640 (76.56%)
Job-status	
I do not work	159 (19.02%)
Employee	341 (40.79%)
Self-employed	22 (2.63%)
Student	314 (37.56%)
Monthly income	
I don't want to answer	315 (37.68%)
<1000 SR	136 (16.27%)
1000–2999 SR	81 (9.69%)
3000–5999 SR	44 (5.26%)
6000–9999 SR	57 (6.82%)
10000–30000 SR	171 (20.45%)
>30000	32 (3.83%)
Region of residence (Riyadh)	536 (64.11%)
Social interaction	
Loves and waits for social events	301 (36%)
Gets bored of social events and does not go there	162 (19.38%)
Hates social events and does not go there	54 (6.46%)
Neutral	319 (38.16%)
How often do you go out weekly before the coronavirus pandemic outside working hours?	
None	75 (8.97%)
Once a week	178 (21.29%)
Two to three times a week	325 (38.88%)
Four times or more	258 (30.86%)
I have good information about coronavirus and its ways of spreading	
Highly agree	733 (87.68%)
Agree	20 (2.39%)
Neutral	68 (8.13%)
Disagree	12 (1.44%)
Highly disagree	3 (0.36%)
I feel very afraid because there is no approved drug to treat COVID-19	
Highly agree	152 (18.18%)
Agree	296 (35.41%)
Neutral	200 (23.92%)
Disagree	148 (17.7%)
Highly disagree	40 (4.78%)
Coronavirus news on social media increases my anxiety and fear	
Highly agree	169 (20.22%)
Agree	271 (32.42%)
Neutral	176 (21.05%)
Disagree	173 (20.69%)
Highly disagree	47 (5.62%)
Isolated	84 (10.05%)
Do you have COVID-19?	
Yes	24 (2.87%)
No	745 (89.11%)
In the past	67 (8.01%)
Curfew hours during the past month	
Partial curfew 6 a.m.−3 p.m.	424 (50.72%)
Partial curfew 6 a.m.−8 p.m. Penalties for not wearing a face mask	409 (48.92%)
No curfew, Penalties for not wearing a face mask, refuse to be checked for temperature	3 (0.36%)
Pregnancy	19 (2.27%)
Are your sleep habits affected by special occasions as Ramadan or vacations? (Yes)	768 (91.87%)
Do you suffer from a chronic disease?	
No	671 (80.26%)
Yes	105 (12.56%)
I don't know	60 (7.18%)

Continuous data were expressed as median (25th−75th percentiles) and categorical data as numbers and percentages.

TABLE 2 | PSQI score component and K-10 score.

Variable	All participants ($n = 836$)
Subjective sleep quality	2 (2–3)
Sleep latency	1 (1–2)
Sleep duration	0 (0–1)
Habitual sleep efficiency	1 (0–3)
Sleep disturbance	1 (1–2)
Use of sleeping medication	0 (0–0)
Day time dysfunction	1 (0–2)
PSQI score	7 (6–10)
K-10 score	24 (18–31)

Continuous data were expressed as median and 25th−75th percentiles.

whether infected by COVID-19, suffering from a chronic disease, pregnant or how one's sleeping habits were affected by

special occasions such as the month of Ramadan or vacations." A recent meta-analysis showed that Ramadan and related behaviors influence sleep duration and daytime drowsiness. The average total sleep time for the entire population was 7.2 h at the start of the study, which fell by around 1 h throughout Ramadan. Ramadan fasting might affect daytime drowsiness, although the effect is minimal, as reflected by a recent meta-analysis that showed nearly a 1 point increase in the ESS score (25).

d. Over the preceding 30 days, subjective sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI) (26). The tool looks at seven areas: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, the use of sleep-promoting medication, and daytime dysfunction (26). Each component is scored on a four-point scale from 0 (no difficulty) to 3 (severe difficulty). The global score is calculated by adding each component's score, ranging from 0 to 21, with higher scores indicating lower sleep quality. It presents a cut-off point of PSQI ≤ 5 as good and PSQI >5 as poor sleep quality (26). We used the Arabic version of the PSQI got from MAPI Research Trust. The validity and reliability of the Arabic version have been demonstrated (27). The PSQI has a sensitivity of 89.6% and specificity of 86.5% for distinguishing good and poor sleepers, using a cut-off score of 5.
e. Kessler Psychological Distress Scale (K10) measures psychological distress based on ten questions assessing emotional states (28). It uses a 5-point scale ranging from "None of the time," which is assigned a score of 1, to "All of the time," assigned a score of 5. The maximum total score is 50, while the minimum is 10. A total score of <20 was considered not to represent stress of any level, while 20–24 represented mild stress, 25–29 moderate stress, and 30–50 represented severe stress (28). We used the Arabic version of K10 obtained from the Health Translation online library (29). The validity and reliability of the Arabic version have been demonstrated (30).

Procedure

The principal investigator posted an invitation on Twitter, WhatsApp, and Facebook. We reached isolated participants by sending invitations to special governmental facilities to be shared with them. Participants responded to the survey by scanning the Quick Response code (Q.R. code) on the questionnaire address or clicking on the appropriate link. Before taking part in the study, the participants gave their informed consent. There were no monetary or non-monetary incentives for time or responses; participation was voluntary.

Statistical Analysis

Data visualization and Shapiro-Wilk normality test was employed to evaluate the distribution of the continuous variables. Non-normally distributed continuous data were expressed as median (25th−75th percentiles) and compared using the Mann-Whitney U test. Categorical data were presented as numbers and percentages and compared by the Chi-square test or Fisher's exact test if the expected frequency was less than five.

The correlation between the K10 and PSQI scores was tested using the Spearman correlation test. Multivariable logistic regression analysis was used to identify risk factors associated with poor sleep and distress. Univariable logistic regression was performed for the individual variables, whereby those displaying a *P*-value <0.2 were included in a stepwise logistic regression analysis with a forward selection. A stay *P*-value of <0.05 was required to be included in the final regression model. Collinearity was tested using variance inflation factor (VIF), model calibration with the Hosmer-Lemeshow test, and discrimination with the area under the receiver operator curve. Negative binomial regression was used to identify factors associated with PSQI and K10 scores. We followed the same route for model selection as described for logistic regression analysis. Odds ratios (OR) and incidence rate ratios (IRR) were reported for the logistic and negative binomial regression models, respectively. Marginal analysis was performed after negative binomial regression to identify the K10 scores predicting PSQI scores. A generalized structural equation modeling was used to test the relationship between poor sleep and distress in the presence of other variables that could affect sleep. All statistical analyses were performed using STATA 16.1 (Stata Corp- College Station- TX- USA). A *P*-value of ≤ 0.05 was considered statistically significant.

RESULTS

Participants

One thousand three hundred fifty-four participants opened the survey; 913 completed it, and 441 did not. After excluding the participants on sleep or psychiatric medications, 836 were included. There were no differences in age ($p = 0.67$), gender ($p = 0.63$), marital status ($p = 0.70$), area of residence ($p = 0.56$), job-status ($p = 0.47$), education ($p = 0.92$) and nationality ($p = 0.15$) between respondents and non-respondents. However, non-respondents were more among healthcare professionals and had higher income ($p < 0.001$).

Socio-Demographics

We included 836 participants in our analysis. The median age was 28 years (25th−75th percentiles: 22–38), and 624 (74.6%) were females. Healthcare workers represented 18.9% of our participants ($n = 158$) and the majority were Saudis nationals ($n = 775$, 92.7%) and live in Riyadh ($n = 536$, 64.1%) (**Table 1**).

The socio-demographic data and the questionnaire responses were compared between participants with poor vs. good sleep and participants who had distress vs. those without distress in **Supplementary Table 1**.

PSQI and K10 Scores

The median PSQI score was 7 (6–10), and the median K10 score was 24 (18–31) (**Table 2**). The box plots of PSQI components in participants with good vs. poor sleep are presented in **Figure 1**. There was a significant difference in PSQI score between participants with poor vs. good sleep [8(6–10) vs. 4(3–4); $p <$

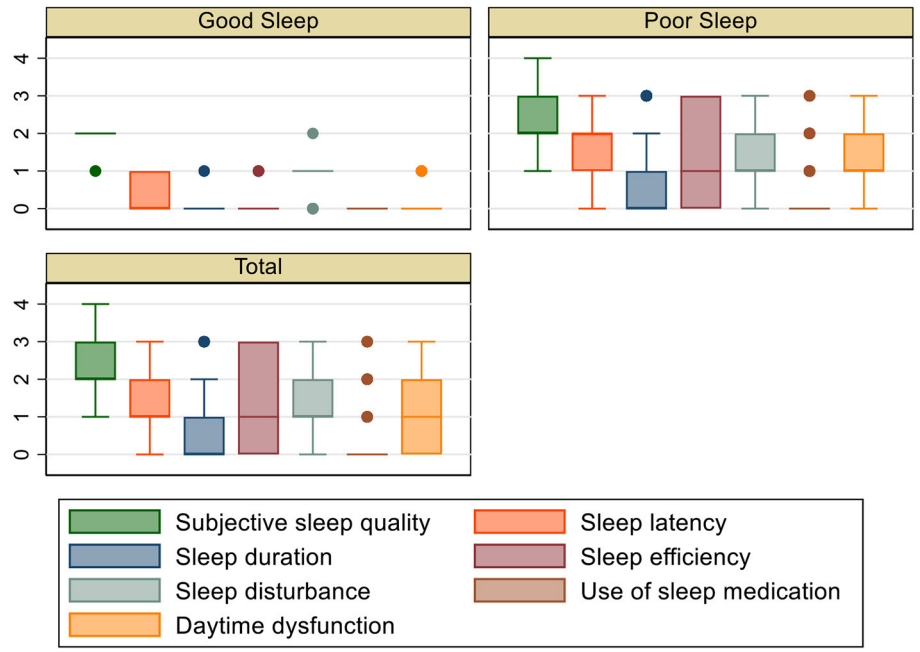

FIGURE 1 | Box plot of PSQI components in participants with good and poor sleep.

0.001] and between participants with distress vs. no distress [8(6–11) vs. 6(5–8); $p < 0.001$]. Participants with poor sleep had a higher K10 score compared to participants who had a good sleep [25(19–31) vs. 17(13–23); $p < 0.001$].

Factors Associated With Poor Sleep

Poor sleep was reported in 733 (87.7%) participants. Factors associated with poor sleep were recent changes in sleep habits due to special occasions such as Ramadan or vacations [(OR: 2.49(1.33–4.66); $p = 0.004$)], anxiety or fear because of coronavirus news on social media [2.13(1.10–4.11); $p = 0.02$], fear because there was no approved drug to treat COVID-19 [1.72(1.07–2.78); $p = 0.03$] and unawareness of the presence of chronic disease [9.15 (1.25–67.21); $p = 0.03$] (C-statistics: 0.65, Hosmer-Lemeshow $p = 0.97$). Recent changes in sleep habits, anxiety, fear because of coronavirus news on social media, chronic disease status, and hating social events were significantly associated with increased PSQI scores, while students had significantly lower PSQI scores (**Table 3**). Variables included in the multivariable logistic and negative binomial regressions are given in **Supplementary Table 2**.

Factors Associated With Distress

Distress was reported in 568 participants (67.9%). Female gender [OR: 1.54 (1.06–2.24); $p = 0.02$], living outside Riyadh (the capital) [OR: 1.74(1.23–2.48); $p = 0.002$], fear or anxiety because of coronavirus news on social media [OR: 1.64(1.02–2.65); $p = 0.04$], recent changes in sleep habits because of Ramadan or vacation [OR:1.97(1.15–3.39); $p = 0.01$], fear because there is no approved drug to treat coronavirus COVID-19 [OR:2.24(1.36–3.69); $p = 0.001$], monthly income of <SR 1000 [OR:2.07(1.22–3.5); $p = 0.01$], isolation [OR:2.08 (1.16–3.71); $p = 0.01$] and unaware of the presence of chronic disease [OR:2.53(1.19–5.4); $p = 0.02$] were associated with distress (C-statistics: 0.73, Hosmer-Lemeshow $p = 0.17$). Young age, students, and employees had lower K10 scores while getting bored or hating social events, fear of no available COVID-19 treatment, isolation, and feeling anxious or afraid of COVID-19 news on social media increased K10 score (**Table 4**). Variables included in the multivariable logistic and negative binomial regressions as given in **Supplementary Table 3**.

Relationship Between Sleep and Distress

PSQI and K10 scores had a significant positive correlation (Spearman rho = 0.41; $p < 0.001$) (**Figures 2A,B**). A K10 score of 21 points predicted poor sleep with a sensitivity of 64%, specificity of 72%, area under the curve of 0.73 (**Figure 3A**). The predicted PSQI scores according to the measured K10 score are shown in **Figure 3B**.

Distress was included in a generalized structural equation model to evaluate its relationship with poor sleep in the presence of other variables. Distress was significantly associated with poor sleep [coefficient: 0.15(0.10–0.20); $p < 0.001$]. Additionally, recent changes in sleep habits increased poor sleep by 8.4% ($p = 0.04$), while students had lower chances of experiencing poor sleep ($p = 0.01$). All distress categories affected sleep significantly moderate [coefficient: 0.12 (0.05–0.17); $p < 0.001$], high [0.16 (0.1–0.23); $p < 0.001$], very high [0.18(0.12–0.24); $p < 0.001$. Other factors presented in **Figure 4** were not significantly associated with poor sleep when distress was included in the model.

TABLE 3 | Factors associated with poor sleep and PSQI score.

	Factors associated with poor sleep		Factors associated with PSQI score	
	OR (95% CI)	***P***	**IRR (95% CI)**	***P***
Sleep habits affected by special occasions as Ramadan or vacations	2.49 (1.33–4.66)	0.004	1.19 (1.07–1.33)	0.001
Coronavirus news on social media increases my anxiety and fear (Highly agree)	2.13 (1.10–4.11)	0.02	1.05 (1.03–1.08)	<0.001
I have a chronic disease (I don't know)	9.15 (1.25–67.21)	0.03	1.05 (1.01–1.1)	0.02
I feel very afraid because there is no approved drug to treat COVID19 (Agree)	1.72 (1.07–2.78)	0.03	–	–
Hates social events and does not go there	–	–	1.17 (1.04–1.04)	0.01
Student	–	–	0.91 (0.84–0.98)	0.01

CI, confidence interval; IRR, incidence rate ratio; OR, odds ratio.

TABLE 4 | Factors associated with distress and K-10 score.

	Factors associated with distress		Factors associated with K-10 score	
	OR (95% CI)	***P***	**IRR (95% CI)**	***P***
Age	0.97 (0.96–0.99)	0.003	0.99 (0.98–0.99)	<0.001
Female	1.54 (1.06–2.24)	0.02	–	–
Student	0.63 (0.4–0.99)	0.047	0.88 (0.82–0.95)	0.001
Employee	–	–	0.9 (0.84–0.96)	0.001
I feel very afraid because there is no approved drug to treat COVID19 (Highly agree)	2.24 (1.36–3.69)	0.001	1.05 (1.02–1.07)	<0.001
Coronavirus news on social media increases my anxiety and fear	0.65 (0.45–0.95)	0.03		
Disagree		–	–	
Agree	1.64 (1.02–2.65)	–	1.13 (1.01–1.27)	0.04
Highly agree		0.04	1.26 (1.11–1.43)	<0.001
Sleep habits affected by special occasions as Ramadan or vacations	1.97 (1.15–3.39)	0.01	–	–
Living outside Riyadh	1.74 (1.23–2.48)	0.002	–	–
Monthly income <1000 SR	2.07 (1.22–3.5)	0.01	–	–
I have a chronic disease (I don't know)	2.53 (1.19–5.4)	0.02	–	–
Gets bored of social events and does not go there	–	–	1.12 (1.04–1.18)	0.002
Hates social events and does not go there	2.85 (1.27–6.4)	0.01	1.23 (1.12–1.35)	<0.001
Isolation	2.08 (1.16–3.71)	0.01	1.12 (1.04–1.21)	0.004

CI, confidence interval; IRR, incidence rate ratio; OR, odds ratio.

DISCUSSION

The current study found a high rate of sleep disturbances in the Saudi Arabia population during the COVID-19 lockdown, and that sleep disturbances increased the risk of mental health problems, particularly in front-line epidemic workers, people who were quarantined or isolated, young people. The findings emphasize the significance of interventions aimed at persons with sleep disorders in order to decrease mental health problems during a public health crisis. Vulnerable populations, in particular, should be continuously watched. The current findings can be used to establish mental health intervention policies during epidemic/pandemic situations.

An epidemic or pandemic such as the COVID-19 affects societies' physical and mental health (6, 7). During the COVID-19 outbreak, stress, anxiety, and depression increased, while sleep was similarly affected, as evidenced by various studies in different populations (4, 5, 8, 9, 11, 15, 16). Another study found that current or previous COVID-19 infection was associated with psychiatric disorders and loneliness (31). As a result, the objective of this study was to evaluate the factors that affected sleep quality and psychological distress in the Saudi population during the COVID-19 pandemic. Our study revealed that the prevalence of poor sleep was associated with recent changes in sleep habits, fear, and anxiety due to lack of approved drugs for treating the disease as well as an overflowing amount of COVID-19-related information on social media. Before COVID-19, medical residents in Saudi Arabia have a significant rate of poor sleep quality. The most mentioned sleep distractors were increased sleep latency and short sleep duration. Sleep deprivation was linked to on-call schedules and shift jobs. The 80-h weekly maximum for training programs should be adhered to, and wellness programs should be included in the curriculum (32). A similar trend was also reported in local studies that underlined deterioration in sleep quality and a high prevalence of sleep disorders during the spreading of the pandemic among physicians, quarantined

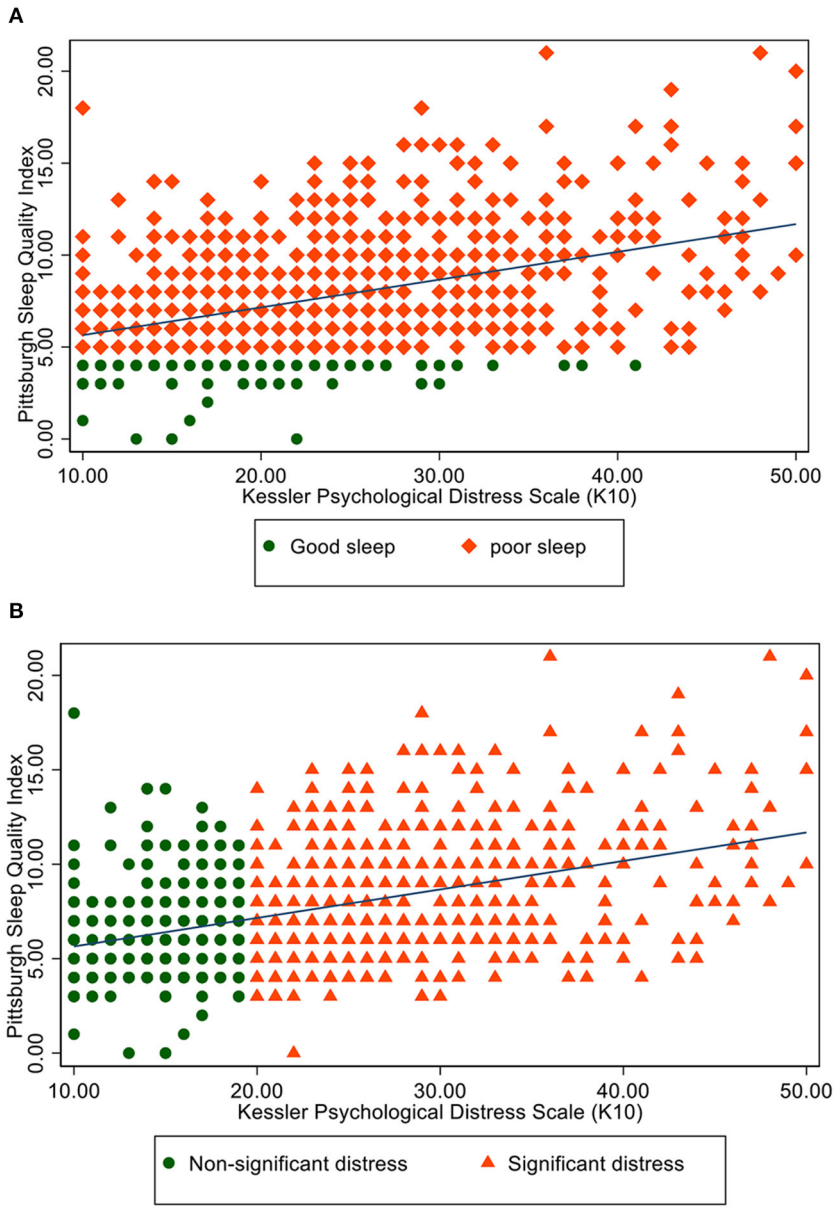

FIGURE 2 | (A) Scatter plot of PSQI and K-10 scores in patients with poor vs. good sleep. **(B)** Scatter plot of PSQI and K-10 scores between participants with significant and non-significant distress.

individuals, and the public (33–36). Other studies from different countries have highlighted the increased prevalence of sleep problems. For example, Casagrande et al. (37) reported a 57.1% prevalence of poor sleep quality among the Italian population during the pandemic (37). Similarly, in a web-based cross-sectional survey of 7,236 Chinese individuals, Huang and Zhao (38) indicated that about 18% of the participants reported symptoms of poor sleep quality during the disease outbreak (38). An Italian cross-sectional study observed a significant increase in the PSQI score during COVID-19 lockdown (39).

The overwhelming COVID-19 social media news and information created fear and confusion among the public (40). Another study of 521 Bangladeshi individuals found that fear of the COVID-19 disease significantly impacted sleep quality, with significantly higher COVID-19 dread, perceived stress, and subjective sleep quality (41). In addition, poor sleep quality has a detrimental impact on life satisfaction, health, and social and emotional domains (42).

Our study found psychological distress among 67.9% of our sample, with a median K10 score of 24 (18–31). This finding

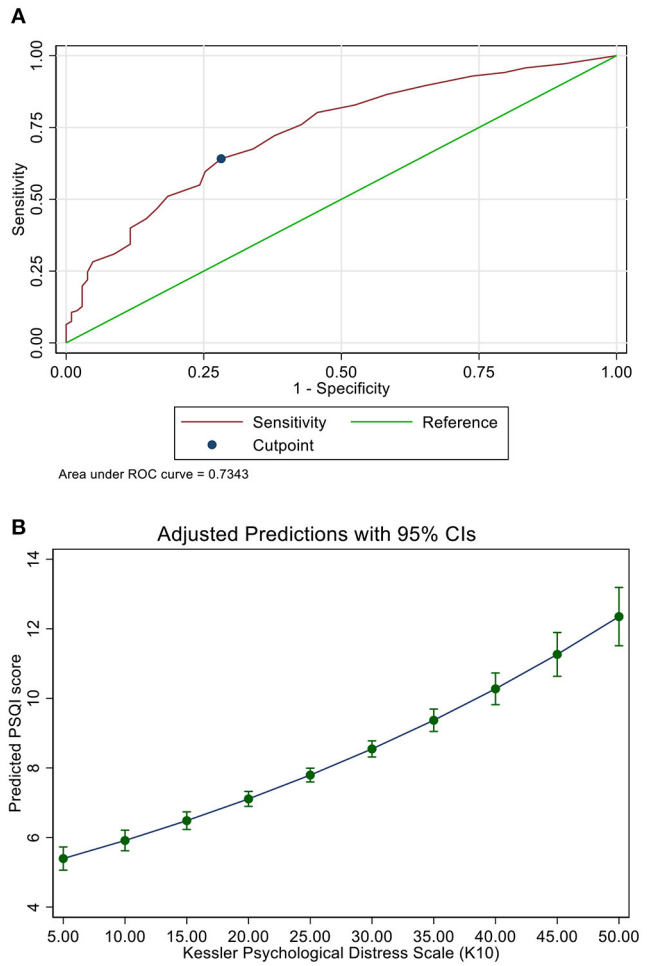

FIGURE 3 | (A) The receiver operator curve (ROC) for the cut-off point of K-10 score predicting poor sleep. **(B)** The predicted PSQI score according to the K-10 score.

is consistent with other studies that reported the increased prevalence of psychological distress during the pandemic (43–45). In some studies, the psychological distress related to pandemics has been associated with gender, whereby these trends among females appear to have remained constant or even become exasperated (46). Our study has also revealed a significant association of psychological distress with the female gender. These findings are comparable to the studies of Al-Hanawi et al. (45) and Alkhamees et al. (44), reporting similarly higher rates of distress among females during the pandemic (44, 45). The explanation for this might be that older individuals are better at managing their stress than younger ones because they better understand the epidemic. Another theory is that COVID-19 causes the most emotional anguish among younger individuals due to their high exposure to social media, which disseminates a significant quantity of information about the epidemic, some of which are important and some unsettling. Previous data from KSA supports this conclusion, demonstrating that internet addiction causes significant suffering among the young, particularly those at undergraduate college levels (45). In contrast, however, higher stress levels were linked to the disease in men than in women in some other studies, possibly pointing to ethnic or societal variations in such demographic-related analyses (47–49).

The COVID-19 epidemic expanded the use of electronic devices, particularly smartphones, as a method of reducing the negative consequences of social isolation and communicating with the rest of the world, all while preserving the necessity for social separation. As a result, the number of research documenting the negative impacts of excessive mobile device use on mental and physical health is continuously growing (50–54).

This study also revealed the sleep quality and psychological distress among healthcare workers during this outbreak of COVID-19. Previous national studies showed that healthcare workers are a vulnerable group susceptible to psychological distress (55, 56). Our results showed that almost 18% (n = 132) of the studied participants experienced poor sleep quality, and 16.9% reported psychological distress. Our findings concur with the recent data published from other countries. A recent analysis reported a 45.1% (95% CI: 37.2–53.1%) sleep disturbance and a higher total PSQI score of (9.83) in the Chinese healthcare workers during the pandemic (57).

Our study also observed a change in the prevalence of sleep quality and mental health among students. Findings indicate that 36.6% of students had poor sleep quality, while 40.5% experienced psychological distress. Comparable with our results, a recent study in Bangladesh reported that University students were mentally distressed and experiencing poor subjective sleep quality during the pandemic (58). Similar results were also revealed by Martinez-Lezaun et al. (59), who reported 70.7% of the University students showed worse sleep quality during the lockdown.

The recent COVID-19 pandemic has also triggered various economic crises that have resulted in psychological suffering among different groups of people in society. Accordingly, our study has shown significantly higher psychological distress among low-income categories. At the same time, a longitudinal study in the general Japanese population also reported severe psychological distress among those in the lower-income bracket compared to those in the higher category (60). A cross-national analysis from 62 countries found social isolation and loneliness adversely impact psychological wellbeing and its prediction of poor mental health of society (61) similar to our findings. A significant relationship was found in our study between sleep quality and psychological distress, as demonstrated by the significant positive correlation between PSQI scores and K10 scores. Similar findings were reported in different populations and risk groups (62, 63). Accordingly, it can be speculated that information linking sleep quality with psychological distress provides some important clues about the potential role of the

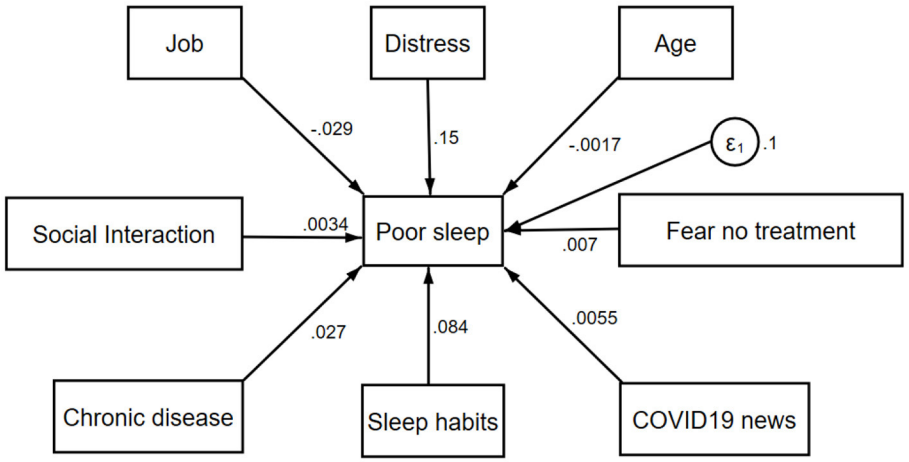

FIGURE 4 | Relationship between poor sleep and factors associated with it (Numbers on arrows indicate the effect magnitude of each variable on sleep, ε is the calculated error).

former in predicting the onset of psychological problems and depressive disorders.

There were limitations to the current study that must be noted. First, the data and results were derived from a cross-sectional design; hence it is difficult to make causal inferences. Also, since this is a cross-sectional survey that was done during the early stages of the COVID-19 epidemic in Saudi Arabia, long-term effects are not known. The data particularly captures the mental health state at that moment. Second, using a web-based survey procedure to conduct a study such as ours within the period of social distancing limits the generalizability of the results. Most of our participants were relatively young, which could be due to the distribution of the survey through social media. This observation could lead to an underestimation of the psychological effect of the pandemic. Third, reporting bias is possible due to the self-reported nature of the survey. Fourth, since the median PSQI score is relatively low, this could be a particular kind of selection bias. Those who have voluntarily responded could be more interested in the topic since being sleep-disturbed. The survey did not include data related to contact with COVID-19 patients, which could be the source of stress. Several other factors could have affected sleep and were not included in the survey. Longitudinal follow-up studies are advised to investigate the dynamic dynamics of people's mental health state during the pandemic. Finally, no specialist sleep assessment instruments were utilized, which resulted in the omission of data such as the severity of sleep disorders, limiting our knowledge of the observed sleep abnormalities.

CONCLUSION

Our survey results reveal a sizeable percentage of the Saudi population experienced poor sleep and psychological distress during the COVID-19 outbreak. Poor sleep was strongly associated with recent changes in sleep patterns, worry, or anxiety because of the lack of an authorized medication to treat coronavirus and the overabundance of information about COVID-19 on social media. In addition, distress was significantly correlated with female gender, low monthly income, and isolation, while sleep quality and psychological distress were interrelated.

DATA AVAILABILITY STATEMENT

Data are available upon reasonable requests to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board (IRB) of King Saud University Medical City (E-20-4869) and the IRB of the Ministry of Health (20-331E). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MA, SA-A, HJ, and AB: conceptualization, investigation, and methodology. MA: formal analysis. MA, AA, KB, and NA: data curation. MA, SA-A, HJ, AB, NA, and FK: writing—original draft preparation, writing—review, and editing. All authors read and agreed to the published version of the manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.809040/full#supplementary-material

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ORIGINAL RESEARCH
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Does Mental Health Affect the Decision to Vaccinate Against SARS-CoV-2? A Cross-Sectional Nationwide Study Before the Vaccine Campaign

Julian Maciaszek[1], Marta Lenart-Bugla[1], Dorota Szcześniak[1], Paweł Gawłowski[2], Wojciech Borowicz[3], Błażej Misiak[1] and Joanna Rymaszewska[1]*

[1] Department of Psychiatry, Wroclaw Medical University, Wroclaw, Poland, [2] Department of Emergency Medical Service, Wroclaw Medical University, Wroclaw, Poland, [3] Department of Pediatric Infectious Diseases, Wroclaw Medical University, Wroclaw, Poland

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***Correspondence:**
Julian Maciaszek
julian.maciaszek@umed.wroc.pl

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The COVID-19 pandemic generated a sense of threat in the society, leading to social isolation and mental health deterioration. A great deal of hope for the development of herd immunity was placed in preventive vaccinations. The survey, performed before vaccine campaign between September 26-October 27, 2020, during the second wave of the SARS-CoV-2 pandemic in Poland with the Computer Assisted Web Interviews method. The study was partly community based and partly open to the public. Participants were invited to complete the survey using Google forms *via* social media (Facebook, WhatsApp). The survey was also distributed 54 times at the request of interested persons *via* e-mail. Total 1,043 questionnaires were assessed for eligibility and 41 were excluded (13 because of the age under 18, and 28 due to refusal to participate: non-response after sending questionnaire *via* e-mail). Finally 1,001 questionnaires were included to the study and statistical analysis was performed on the basis of the 1,001 responses. The questionnaire consisted of three parts: a sociodemographic survey, a questionnaire assessing the knowledge of the SARS-CoV-2 and the General Health Questionnaire-28. Participants also determined their attitude toward being vaccinated against SARS-CoV-2. The questionnaire was completed by a total of 1,001 participants: 243 people declared that they will not get vaccinated against SARS-CoV-2. Majority of people declaring the willingness to vaccinate were representatives of medical professions, suffering from chronic diseases, with higher values on the total GHQ-28 scale and the subscales: anxiety and insomnia, social dysfunction and somatic dysfunction. Loss of income, difficult access to health care, recognizing the restrictions as excessive and knowledge about COVID-19 were found as significant positive determinants of the reluctance to vaccinate. Greater readiness to vaccinate can be associated with greater certainty about its effectiveness and a hypothetical collectivist attitude. Experiencing anxiety and psychopathological symptoms

are risk factors for infection, but can also be conducive to reliance on information about vaccination presented in the media. Reluctance to vaccinate may result from greater awareness of the complexity of the disease, and thus less faith in the effectiveness of vaccines.

Keywords: COVID-19, SARS-CoV-2, anxiety, mental deterioration, vaccine decision-making

INTRODUCTION

Analyzes prepared by the WHO Collaborating Center for Infectious Disease Modeling predicted the effects of the SARS-CoV-2 pandemic at the level of the 1,918 influenza pandemic, killing 50 million people (1). The average mortality rate of SARS-CoV-2 is 2.2%, the Infection Fatality Rate (IFR) ranges from 0.3 to 0.6% (2, 3). To date, over 5 million people have died from COVID-19 worldwide (4). Due to reorganization of the health care system, a reduction in the total number of hospitalizations and planned procedures (5, 6), hospitalizations due to acute coronary syndromes (7, 8) and oncological operations (9) was observed. As a result of these changes, many countries have seen an increase in the number of deaths compared to previous years, also after taking into account those caused by COVID-19 (10). The introduced lockdowns also contributed to the severe economic crisis and an increase in the unemployment in most countries (11).

The COVID-19 pandemic generated a sense of threat in the society, modified lifestyles, leading to social isolation, and thus contributing to a reduction in the quality of life (12). In the course of the pandemic in the general public, symptoms of post-traumatic stress disorder and depression, as well as increased and anger were observed (13–15). In the previous study, analogous to the current one, conducted during the first wave of SARS-CoV-2 in Poland, over 50% of respondents showed at least mild psychopathological symptoms (16). A study by Babicki et al. (17) in the Polish population indicated an equally high prevalence of psychopathological symptoms also during the second wave of the pandemic. The impact of the pandemic on anxiety seems to be particularly important, as confirmed by the study conducted by Greenhawt et al. (18), based on approximately 5,000 respondents whose mean state anxiety score (S-anxiety) was significantly higher than mean trait anxiety score (T-anxiety), with both scores being significantly higher than the previously published standards. The meta-analysis by Bueno-Notivol et al. (19) indicates that the pooled prevalence of depressive symptoms in society during the COVID-19 pandemic is estimated at 25%—approximately seven times greater compared to the average prevalence of pre-pandemic depression, estimated at 3.44%. A study comparing the first and second waves of COVID-19 also confirmed the persistent negative impact of the pandemic on the quality and duration of sleep (20).

A great deal of hope for the development of herd immunity was placed in preventive vaccinations. So far, on November 4, 2021, 39% of the world's population was fully vaccinated against SARS-CoV-2. Individual countries differ significantly depending on the number of complete vaccinations, e.g., USA 57%, Israel 65%, Germany 66%, Poland 53% and Russia 33% (21).

So far, only individual studies examining the factors influencing the decision to vaccinate have been published. Due to the importance of the topic, this original survey is aimed to identify the relationship between the decision to vaccinate and demographic factors, mental health measured with the standardized GHQ-28 questionnaire and pandemic-related factors. We hypothesize that the presence of psychopathological symptoms, as well as the level of knowledge on SARS-CoV-2 determine the willingness to be vaccinated.

MATERIALS AND METHODS

The survey was performed from September 26, 2020 to October 27, 2020, during the second wave of the SARS-CoV-2 pandemic in Poland. At that time, there was a sharp increase in the number of reported positive test results and, due to the epidemiological situation, additional restrictions were introduced, such as the obligation to cover the mouth and nose in public spaces (22).

At the time of data collection, no SARS-CoV-2 vaccines were available and no reports of their efficacy were published. The questionnaires were obtained using the Computer Assisted Web Interviews (CAWI) method, which is currently one of the most popular and fastest growing survey methods. Thanks to the feeling of anonymity and the opportunity to participate in the survey at a time convenient for the respondent, it allows to collect more reliable data. The manuscript was formulated based on STROBE Statement—cross-sectional reporting checklist (23) and the protocol was described in the STROBE flow chart (**Figure 1**). A priori analysis performed using G* Power software (24) revealed that to detect a correlation with $r = 0.01$ and power of 0.95, the calculated sample size was 595. Due to the potential non-response, questionnaires were sent to more participants. The study was partly community based and partly open to the public. Participants were invited to complete the survey using Google forms *via* social media (Facebook, WhatsApp) and information about the survey was also posted on the website of the Department of Psychiatry of the Wroclaw Medical University. In the case of people willing to complete the survey who do not use social media, the survey was also distributed 54 times at the request of interested persons *via* e-mail. The questionnaire was fully anonymous, aimed at people aged 18 and over, and only fully completed questionnaires were analyzed. Total 1,043 questionnaires were assessed for eligibility and 41 were excluded (13 because of the age under 18, and 28 due to refusal to participate: non-response after sending questionnaire *via* e-mail). Finally 1,001 questionnaires were included to the study and statistical analysis was performed on the basis of the 1,001 responses.

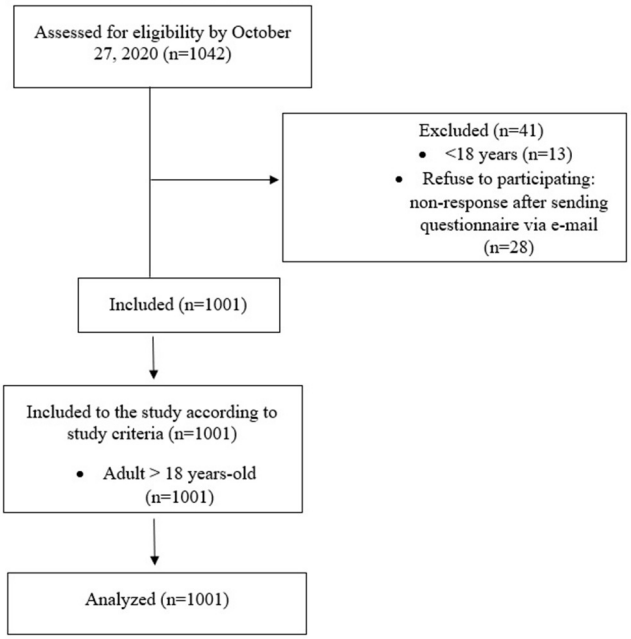

FIGURE 1 | STROBE flow chart.STROBE.

All participants gave their informed consent to participate in the survey. The study procedure was approved by the Ethics Committee of the Medical University of Wroclaw (Poland, no 188/2020) and performed in accordance with the principles of the Helsinki Declaration.

The study consisted of three parts: a sociodemographic survey, a questionnaire assessing the knowledge of the SARS-CoV-2 pandemic and the General Health Questionnaire-28 (GHQ-28). Participants also determined their attitude toward being vaccinated against SARS-CoV-2, choosing from the following responses: (a) "I will definitely not get vaccinated against SARS-CoV-2"; (b) "I would make a decision based on the ratio of vaccine efficacy to the observed side effects"; (c) "I will definitely get vaccinated against SARS-CoV-2".

The sociodemographic survey included questions about sex, age, place of residence, education, the presence of chronic diseases and the use of psychological or psychiatric care. This section also included questions about the impact of lockdown on income, access to medical care, frequency of tracking the epidemiological situation, main sources of knowledge about the SARS-CoV-2 pandemic, and assessment of the extent of the lockdown. The full sociodemographic survey is available in the **Supplementary Table S1**.

The original questionnaire of knowledge about COVID-19 included 10 questions, for each correct answer, participants could get one point. Question number 1 regarded the current definition of a pandemic, questions 2,3,4,6 concerned the virulence and course of SARS-CoV-2 infection, questions 5,7,8 concerned the measurable effects of the pandemic, and questions 9 and 10 regarded knowledge of personal protective equipment. The detailed questionnaire of knowledge about COVID-19 is available in the **Supplementary Table S2**.

The number of correct answers was included as the measure of knowledge (**Supplementary Table S2**). The Cronbach's alpha in the total sample was 0.716, indicating acceptable internal consistency. In our previous study, we presented the relationship between mental health and knowledge of SARS-CoV-2 (25).

The GHQ-28 is a questionnaire that assesses the prevalence of psychopathological symptoms in the general population. It consists of 28 questions divided into four categories of symptoms: severe depression (items 6, 19, 20, 21, 22, 23, 24), anxiety and insomnia (items 2, 7, 9, 13, 15, 17, 18), disorders of social functions (items 5, 10, 11, 25, 26, 27, 28) and somatic symptoms (items 1, 3, 4, 8, 12, 14, 16) (26, 27). The points range from 0 to 84 points, with a higher score indicates greater psychopathology in the mental picture. The cut-off point for clinical significance was set at 24 points, as described by Makowska and Merecz (27).

Only fully completed questionnaires were used for statistical analysis. The following procedure was used: anonymous responses received *via* Google Forms were identified by code numbers, checked for completeness and submitted for further analysis.

The Mann-Whitney U test or *t*-test, respectively, were used to compare participants for continuous values. The Shapiro-Wilk test was used to evaluate the normal distribution. The chi-square test was used to assess the differences between the groups in terms of categorical variables. Additionally, a binary logistic regression was performed. Reluctance to vaccinate against SARS-CoV-2 was defined as the dependent variable. The independent variables were the factors that significantly differentiated the anti-vaccination and pro-vaccination groups with respect to the bivariate comparison. Three models differing from the independent variables were created to determine the model with the highest value of Negelkere's R2 that most fully described the effect on the dependent variable. The higher Negelkere's R2 value, the greater the proportion of variance 'explained' by the regression model makes it a useful measure of the success of predicting a dependent variable from independent variables.

In the first step, we took into account the psychopathology described in the GHQ-28 subscales. Next, we added sociodemographic factors. Finally, we extended the previous models to include factors related to the pandemic, considering the level and source of knowledge about COVID-19, as well as the impact of lockdown and attitudes to the introduced restrictions.

The results were considered significant if the *p*-value was <0.05. All analyzes were performed in SPSS (IBM SPSS Statistics for Windows).

RESULTS

General Characteristics

In the current study, 1,001 responses were collected. Among the respondents, 243 people (24%) declared "I will definitely not get vaccinated against SARS-CoV-2", 574 people (57%) declared "I would make a decision based on the ratio of vaccine effectiveness to the observed side effects", and 184 people (18%) declared "I will definitely get vaccinated against SARS-CoV-2". **Table 1** presents the characteristics of the study group taking into account gender. Almost 75% of the respondents were women, the average age was 38 years (standard deviation [SD]: 14.6, range 18–83), 90%

TABLE 1 | General characteristics of total sample. *n* (%) or mean ± standard deviation.

	Total $n = 1001$	Women $n = 750$ (74.85%)	Men $n = 251$ (25.15%)	*p*-value
Age, years	38.36 ± 14.62	38.17 ± 14.19	38.91 ± 15.82	0.867
Place of residence (urban)	901 (90.01%)	675 (90%)	226 (90.04%)	0.971
Education level (higher education)	759 (75.82%)	576 (76.80%)	183 (72.91%)	0.276
Occupation (medical profession)	479 (47.85%)	382 (50.93%)	97 (38.65%)	**0.031**
Chronic diseases (yes)	210 (20.98%)	167 (22.27%)	43 (17.13%)	0.225
Psychiatric or psychological care	172 (17.18%)	138 (18.40%)	34 (13.55%)	0.179
GHQ-28 positive scoring	394 (39.36%)	318 (42.40%)	76 (30.28%)	<0.000
GHQ-28—Total score	22.86 ± 12.9	23.72 ± 13.34	20.29 ± 11.04	0.692
GHQ-28—somatic symptoms	5.66 ± 3.8	6.01 ± 3.89	4.65 ± 3.28	**0.000**
GHQ-28—anxiety and insomnia	6.58 ± 4.7	6.95 ± 4.76	5.46 ± 4.18	0.105
GHQ-28—social dysfunction	7.66 ± 2.9	7.72 ± 3.01	7.46 ± 2.50	**0.019**
GHQ-28—severe depression	2.96 ± 3.8	3.04 ± 3.80	2.72 ± 3.57	0.168
Vaccination (anti-vaccination)	243 (24.28%)	182 (24.27%)	61 (24.30%)	0.645
Loss of income	277 (27.67%)	206 (27.47%)	71 (28.29%)	0.979
Difficulty in accessing heathcare	457 (45.65%)	357 (47.60%)	100 (39.84%)	**0.029**
Daily tracking of the epidemiological situation	424 (42.36%)	320 (42.67%)	104 (41.43%)	**0.000**
Opinion: the applied lockdown was excessive	348 (34.77%)	238 (31.73%)	110 (43.82%)	**0.020**
Mass media as main source of information	382 (38.16%)	345 (46.00%)	37 (14.74%)	**0.037**
Knowledge about SARS-CoV-2: number of correct answers	6.0 ± 2.1	5.85 ± 2.12	6.48 ± 2.12	**0.000**

Data expressed as n (%) or mean (SD). Significant effects ($p < 0.05$) are marked in bold.

lived in the city, almost 76% had higher education, almost 48% worked in the medical profession, 21% suffered from chronic somatic diseases and 17% received psychiatric or psychological care (**Table 1**). Using the GHQ-28 scale showed that 39% of all respondents obtained more than 24 points, which suggests the presence of clinically relevant psychopathological symptoms. The mean GHQ-total score was 22.86 (SD: 12.9 points, range: 1–75). Over 27% of respondents reported losing income as a result of the lockdown, and over 45% reported difficult access to healthcare during the pandemic. In the study sample, 42% monitored the epidemiological situation every day, over 34% described the previously introduced lockdown as excessive, and 38% indicated the mainstream media as the main source of knowledge about the COVID-19 pandemic. In the questionnaire of knowledge about COVID-19 the average score was 6.0 points (SD: 2.1, range: 0–10). Compared to men in the study group, women were significantly more likely to work in health care, had a higher severity of social dysfunction and somatic symptoms, more often than men indicated limited access to health care, more often indicated the daily monitoring of the epidemic situation and more often relied on the mass media as the main source of information about the pandemic. Men in the study group achieved significantly higher results in the COVID-19 questionnaire and significantly more often indicated an excessive range of introduced lockdowns.

Bivariate Comparisons

Table 2 shows the comparison of the two groups in terms of the declared willingness to vaccinate. The first group included people definitely reluctant to vaccination (anti-vaccination), the second group included the remaining people considering or already decided to vaccinate (pro-vaccination). The pro-vaccination attitude was significantly more often observed among representatives of medical professions and people with chronic diseases. People declaring the willingness to vaccinate obtained significantly higher values on the GHQ-28 scale, both in relation to the total results and the subscales: anxiety and insomnia, social dysfunction and somatic dysfunction. Nearly 33% of people reluctant to get vaccinated and over 41% of those willing to vaccinate experienced significant clinical psychopathological symptoms. Respondents from the pro-vaccination group significantly more often confirmed the daily monitoring of the epidemiological situation and more often indicated the mass media as the main source of information about the pandemic. Anti-vaccination groups significantly more often experienced loss of income, loss of access to health care, and more often considered the epidemiological restrictions to be excessive. People from the anti-vaccination group obtained a significantly higher number of correct answers in the COVID-19 knowledge test.

Logistic Regression Analysis

Table 3 shows the results of binary logistic regression. In the first model, taking into account the following GHQ-28 domains: somatic symptoms, anxiety and insomnia and social dysfunction, no factors significantly correlating with reluctance to vaccinate were found. The first model had a Negelkere's R2 coefficient of 0.015. The second model was extended over the first to include the occupation and chronic diseases. A significant negative correlation was found between the practice of a medical profession, the presence of chronic diseases and reluctance to vaccinate against SARS-CoV-2. The second model

TABLE 2 | Comparison of the two groups in terms of the declared willingness to vaccinate.

	Anti-vaccination, $n = 243$	Pro-vaccination, $n = 758$	*p*-value	*Z*-value	ES
Sex (female)	182 (74.90%)	569 (75.07%)	0.976	−0.030	0.000
Age, years	38.74 ± 13.12	38.24 ± 15.08	0.252	−1.146	0.001
Place of residence (urban)	211 (86.83%)	690 (91.03%)	0.058	1.890	0.004
Education level (higher education)	175 (72.02%)	584 (77.04%)	0.143	1.464	0.002
Occupation (medical profession)	92 (37.86%)	387 (51.06%)	**<0.001**	−3.581	0.013
Chronic diseases (yes)	36 (14.81%)	174 (22.96%)	**0.004**	2.866	0.008
Psychiatric or psychological care	36 (14.81%)	136 (17.94%)	0.225	1.213	0.001
GHQ-28 positive scoring	80 (32.92%)	314 (41.42%)	**0.018**	2.280	0.005
GHQ-28—Total score	21.00 ± 12.90	23.47 ± 12.82	**0.001**	3.233	**0.**010
GHQ-28—somatic symptoms	5.08 ± 3.81	5.86 ± 3.77	**<0.001**	3.362	0.011
GHQ-28—anxiety and insomnia	5.77 ± 4.81	6.84 ± 4.60	**<0.001**	3.748	0.014
GHQ-28—social dysfunction	7.38 ± 3.07	7.75 ± 2.83	**0.032**	2.148	0.005
GHQ-28—severe depression	2.77 ± 3.56	3.02 ± 3.81	0.117	1.567	0.002
Loss of income	87 (35.80%)	190 (25.07%)	**0.001**	−3.341	0.011
Difficulty in accessing heathcare	139 (57.20%)	318 (41.95%)	**<0.001**	−4.039	0.016
Daily tracking of the epidemiological situation	68 (27.98%)	356 (46.97%)	**<0.001**	5.288	0.028
Opinion: the applied lockdown was excessive	158 (65.02%)	190 (25.07%)	**<0.001**	−11.356	0.129
Mass media as main source of information	64 (26.34%)	318 (41.95%)	**<0.001**	3.011	0.009
Knowledge about SARS-CoV-2: number of correct answers	6.83 ± 2.15	5.76 ± 2.07	**<0.001**	−6.842	0.047

n (%) or mean ± standard deviation.
Data expressed as n (%) or mean (SD).
Significant differences ($p < 0.05$) were marked with bold characters.

had a Negelkere's R2 coefficient of 0.037. In the third model we added the following variables: loss of income, difficult access to health care, daily monitoring of the epidemiological situation, opinion: the applied restrictions were excessive, mass media as the main source of information, and knowledge about COVID-19: number of correct answers. A significant negative relationship was found between the results of anxiety and insomnia in the GHQ-28, the practice of a medical profession, daily monitoring of the epidemiological situation, the mass media as the main source of information and reluctance to vaccinate. The following factors were found as significant positive determinants of the reluctance to vaccinate: loss of income, difficult access to health care, finding the applied lockdown as excessive and knowledge about SARS-CoV-2: number of correct answers. The third model was characterized by a definitely higher Negelkere's R2 coefficient of 0.252 as compared to the previously described models and described the effect on the dependent variable most fully.

DISCUSSION

In this study we aimed to describe the factors influencing the decision to vaccinate against SARS-CoV-2. We observed a significantly lower severity of psychopathological symptoms measured with the GHQ-28 in people reluctant to get vaccinated compared to those considering vaccination, both in terms of the total score and all its subscales, including somatic symptoms, severe depression, social dysfunction, anxiety and insomnia. As a result of the use of binary logistic regression, it was shown that only the values in the anxiety and insomnia subscale, significantly negatively correlated with reluctance to vaccinate, turned out to be the inverse determinant of vaccination refusal.

Regarding the effect of socio-demographic variables on the decisions regarding vaccination we observed that pro-vaccination attitude was significantly more often present among medical professionals, respondents suffering from chronic diseases as well as among city dwellers and respondents with higher education level, for whom however, statistical significance was not achieved. In relation to pandemic related factors pro-vaccination attitude was more often observed among respondents who indicated daily monitoring of the epidemiological situation and more often chose the mass media as the main source of information about the pandemic. Anti-vaccination attitude was significantly more often observed in relation to the respondents who pointed to loss of income, loss of access to health care, and more often considered the epidemiological restrictions to be excessive—which factor had the highest effect size of 0.129 among bivariate variables. People from the anti-vaccination group obtained a significantly higher number of correct answers in the COVID-19 knowledge test and had the second highest effect size of 0.047.

In the survey, among more than 1,000 people, 24% of participants were willing to get vaccinated against SARS-CoV-2, 57% were unsure about vaccination and 18% were reluctant to be vaccinated. The obtained results indicate a clear polarization of the respondents in regard to the decision about vaccination. However, it is worth noting that during the distribution of the survey, reports from manufacturers detailing the efficacy and side effects of vaccines were not widely available. At that time, only the

TABLE 3 | Factors related to the non-vaccination against SARS-CoV-2 using binary logistic regression analysis.

Model (Negelkere's R2)	Variable	Beta	S.E.	*p*-value	VIF	O.R.	95% CI
Model 1	GHQ-28—somatic symptoms	−0.016	0.036	0.650	3.150	0.984	0.917–1.056
(0.015)	GHQ-28—anxiety and insomnia	−0.046	0.030	0.122	3.289	0.955	0.901–1.012
	GHQ-28—social dysfunction	0.013	0.035	0.706	1.741	1.013	0.946–1.085
Model 2	GHQ-28—somatic symptoms	0.001	0.037	0.984	3.209	1.001	0.931–1.075
(0.037)	GHQ-28—anxiety and insomnia	−0.053	0.030	0.080	3.300	0.948	0.894–1.006
	GHQ-28—social dysfunction	0.006	0.035	0.862	1.750	1.066	0.939–1.078
	Occupation (medical profession)	−0.450	0.180	0.012	1.007	0.638	0.448–0.907
	Chronic diseases (yes)	−0.572	0.205	0.005	1.020	0.564	0.378–0.843
Model 3	GHQ-28—social dysfunction	−0.034	0.038	0.360	1.772	0.966	0.898–1.040
(0.252)	GHQ-28—anxiety and insomnia	−0.071	0.033	0.032	3.356	0.932	0.873–0.944
	GHQ-28—somatic symptoms	0.060	0.040	0.131	3.262	1.062	0.982–1.147
	Occupation (medical profession)	−0.484	0.196	0.014	1.017	0.616	0.420–0.906
	Chronic diseases (yes)	−0.387	0.225	0.085	1.044	0.679	0.437–1.056
	Loss of income	0.359	0.177	0.043	1.027	1.431	1.012–2.025
	Difficulty in accessing health care	0.542	0.167	0.001	1.038	1.719	1.240–2.384
	Daily tracking of the epidemiological situation	−0.504	0.178	0.005	1.068	0.604	0.426–0.856
	Opinion: the applied lockdown was excessive	1.327	0.176	<0.001	1.240	3.769	2.670–5.321
	Mass media as main source of information	−0.401	0.180	0.026	1.054	0.669	0.471–0.952
	Knowledge about SARS-CoV-2: number of correct answers	0.135	0.042	0.001	1.155	1.145	1.054–1.244

Significant associations ($p < 0.05$) were marked with bold characters. In parentheses below Models are given Negelkere's R2 values measuring the proportion of variance 'explained' by the regression.

assumed mechanism of action of vaccines based on mRNA and viral vector technologies was known.

In a study by Salali and Uysal (28) 31% of the participants from Turkey and 14% from the UK were unsure whether to get the COVID-19 vaccine. In both countries, 3% of the participants refused to vaccinate. In an Italian study published in December 2020, more than three-quarters of respondents wanted the vaccine, 10% did not have a clear opinion, and only 5% said they did not want the vaccine, and 9% did not answer. Therefore, these data indicate significant differences between countries in terms of attitudes to vaccination against SARS-CoV-2 (29). Moreover, the results of our study, compared with studies from other countries carried out in the same period, indicate greater distrust of vaccines in Poland. At the time of writing this article, in autumn 2021, compared to the above-mentioned countries, Poland has a much smaller percentage of fully vaccinated people—53%, while in Turkey it is 58%, in UK 67% and in Italy 72% (21). This observation may support the statement that the initial attitude toward SARS-CoV-2 vaccination, which we examined, did not change much under the influence of a vaccination campaign lasting almost a year and may be of key importance in understanding the causes of reluctance to vaccinate.

Almost 40% of the study participants had a high GHQ-28 score, indicating the presence of clinically significant psychopathological symptoms. These results correspond to other studies assessing the psychological burden during the COVID-19 pandemic, which is significantly greater than before the pandemic period, and moreover, it did not decrease significantly with the duration of the pandemic (16, 17). The high level of psychopathological symptoms in the study group is all the more important due to the fact that it characterized people from pro-vaccination group. In turn, reluctance to vaccinate was inversely determined by anxiety and insomnia. These results are consistent with the study by Yigit et al. (30), in which it was observed that people with high levels of anxiety of COVID-19 infection were more likely to agree to vaccination. At this point, it is worth referring to the study, where the authors, in the context of previous epidemics, described the so-called "adaptive" level of anxiety, prompting people to act prophylactically (31). According to them, this anxiety is based on a balance between excessive anxiety leading to panic inadequate to the actual threat and a complete lack of anxiety leading to ignoring the recommended preventive actions. On the other hand, when discussing the increasing anxiety in society, one should bear in mind the chronic stress theory, according to which prolonged activation of the hypothalamic-pituitary-adrenal axis negatively affects the immune system and overall health, leading to increased susceptibility to other diseases, including diseases of cardiovascular system and cancer (32). A binary logistic regression model showed that knowledge of SARS-CoV-2 is a positive determinant of anti-vaccine attitudes, which is in line with Chinese findings that greater understanding of COVID-19 does not correlate with greater vaccination propensity (33). In the study, over 90% of students declared their willingness to be vaccinated against SARS-CoV-2, while over 50% presented insufficient knowledge about the preventive behavior and symptoms of this disease. The significant difference in knowledge about COVID-19 between the anti-vaccine and pro-vaccine groups, coupled with prior observation of a lower level of anxiety in the anti-vaccine group, may indicate a potential difference in assessing the risk of infection with the virus: those who are reluctant to vaccinate may perceive the risk as lower

compared to the pro-vaccine group. The sense of risk of SARS-CoV-2 varies from country to country. For example, according to the study from 2021 by Bowman et al. (34). 97% of Hong Kong respondents rated the symptoms of COVID-19 infection as serious or very serious, compared to only 20% in the UK. The higher sense of risk in Hong Kong was associated with a greater degree of hygiene and social distancing compared to the UK. In particular, almost 99% of Hong Kong respondents reported wearing a face mask, compared to 3% of the UK respondents. These results indicate the potential real impact of government policy and media information on the sense of threat and the degree of compliance with epidemiological recommendations.

The aforementioned different assessment of the risk of the SARS-CoV-2 pandemic is confirmed by the noted difference in the frequency of checking epidemiological reports in media, which may indicate emotional involvement in the course of the pandemic: belonging to the anti-vaccination group is negatively correlated with daily monitoring of the epidemiological situation. In our study, 42% of respondents monitored the epidemiological situation in the media on a daily basis. The result from the second wave of the pandemic may indicate a downward trend compared to the US study conducted during the first wave, in which 57% checked COVID-19-related news several times a day, and 84% at least once a day (34). On the one hand, this tendency can be explained by the habituation effect, and on the other hand, a greater awareness of the real risk of SARS-CoV-2, overestimated during the first wave. The obtained results show a correlation between less frequent news tracking and a lower level of anxiety. The relationship between emotional involvement and monitoring information about the epidemic is also confirmed by studies on the H1N1 (swine flu) virus epidemic, indicating a higher level of anxiety in response to greater exposure to media materials about the epidemic (35).

When analyzing the differences between groups in terms of knowledge about the pandemic, the impact of information sources on the decision to vaccinate should also be considered. Based on the binary logistic regression model, people reluctant to vaccinate against SARS-CoV-2 less frequently reported using the mass media as a source of information about the pandemic. Nekliudov et al. (36). emphasized the role of the mass media in the excessive escalation of fear related to the pandemic. On the other hand, it is worth remembering that apart from mainstream media, there are also portals where fake news and conspiracy theories are overrepresented (37). Therefore, an extended analysis of vaccination decisions in the context of infodemia is justified (38). Research indicates that 90.3% of North Americans and 61.9% of the rest of the world actively use the Internet (39). The data show that 75–80% of internet users look for health information on websites, and 70% of them say that this content influences their treatment (40). Unfortunately, the Internet still does not allow for reliable data verification, hence it is there that the fake news about pandemic and vaccines is most often spread. We can conclude that the decision to vaccinate against SARS-CoV-2 is made without verifying the information gathered by the online media (41). Interesting results were brought by the study by Salali and Uysal (28), which investigated the influence of conspiracy theories on the decision to vaccinate against SARS-CoV-2 in Great Britain and Turkey. It turned out that the belief that the pandemic started naturally had a significant impact on the pro-vaccination attitude. Another study of around 1,500 Jordanian students found higher levels of anxiety among those who believed in COVID-19 conspiracy theories compared with students who rejected them (42). A study performed by Pisl et al. (43) found that students experiencing a typical dissociative situations more often believed in conspiracy theories related to COVID-19. Believing in them might be understand as an unconscious tendency to lower the level of anxiety associated with the pandemic based on a mechanism similar to the phenomenon of dissociation. A strong long-term relationship between adherence to conspiracy theories and vaccine hesitancy (44, 45) as well as the negative impact of exposure to conspiracy theories on the willingness to vaccinate have been described (46). Bronstein et al. (47), using cutting-edge machine learning algorithms and psychometric network analysis, described a mechanism that takes into account the dependencies between tasks measuring reasoning biases, belief in conspiracy theories and reluctance to vaccinate. Reasoning biases, such as reduced data gathering related to the currently increasing tendency to stay in so-called "information bubbles" seems to be a modifiable factor leading to conspiracy believes and vaccine reluctance. It has been reported that the fear of losing a sense of control during a pandemic exacerbated the perceptions of persecution, then increased the sense of danger associated with vaccine and vaccination, and ultimately influenced the emergence of conspiracy theories. Finally reluctance to vaccinate was identified as a likely cause of belief in a conspiracy theory subverting the common assumption that the opposite causal relation exists. Unfortunately, our study did not assess belief in conspiracy theories, which should definitely be considered in further conclusions. We postulate that mental health and decision to vaccinate might be mediated by conspiracy believes regarding virus origins, vaccines and vaccination.

During the first wave of the pandemic, as in other European countries (48), the Polish government introduced the so-called total lockdown, consisting in an order to stay at home except for the necessity to meet basic life needs and go to work if it is not possible to perform it remotely (49). During the second wave, the Polish government introduced a partial lockdown, including the closure of restaurants, shopping malls, guesthouses and hotels, and recommendations for remote work were maintained (50). During the first two waves of the pandemic, wearing masks in public places, including open spaces were obligatory (51). Another explanation for such a low percentage of people willing to be vaccinated in our study may be the anti-vaccination movement in Poland. Its groups spread false information to the public, creating chaos and thus undermining confidence in the validity and safety of vaccinations. Such action causes divisions in the society and, as indicated by several authors, evokes a strong reluctance to vaccinate (52, 53).

Among the determinants of reluctance to vaccinate, the belief about excessive restrictions and the introduction of lockdown was the most important. Moreover, loss of access to healthcare and loss of income as a result of the pandemic also determined belonging to the anti-vaccine group. Such results indicate a

broader aspect of the decision to vaccinate in the context of the negative impact of lockdown on the lives of citizens. Attitude toward vaccination appears to have a potential relationship to the degree of trust in the government, which imposes economic constraints, and is also involved in vaccine distribution. This hypothesis is confirmed by Italian studies conducted by Prati (29), in which the lack of intention to receive a vaccine was associated with a lower level of worry and institutional trust.

The observed ineffectiveness of lockdowns in reducing the number of SARS-CoV-2 infections, while at the same time causing the emotional burden of social isolation and economic costs should prompt governments to consider changing their strategies, especially due to the aforementioned impact of public confidence in the willingness to vaccinate against SARS-CoV-2.

Experiencing limitations and changes in many important spheres of life can cause a reaction based on the so-called defense mechanisms, e.g., denial, which in the time of a pandemic is not only to reduce the risk of infection with the virus, but also to reduce the perceived anxiety. For example, according to Johnson, "ignoring happens when an individual consciously knows that a problem exists, but chooses not to confront it" (54). Hence, there is a potential explanation that people with less severe GHQ-28 psychopathological symptoms, who are also reluctant to vaccinate, may ignore the actual situation so as not to exacerbate their anxiety.

Our study found that health care workers were less in the anti-vaccine group. These results are consistent with the studies by Akarsu et al. (55), where greater susceptibility to vaccination was also observed among medical professions. The majority of people who considered COVID-19 a very serious disease was the elderly, the chronically ill, men, people with lower incomes and lower levels of education. Therefore, it is worth considering the different social attitudes presented by the respondents at this point. People from the anti-vaccine group, due to their high knowledge of SARS-CoV-2, awareness of a relatively low risk of contracting the disease at an earlier age, no burden of chronic diseases and a lower risk of infection resulting from much less frequent work in the health service, may characterize an individualistic attitude. Focusing on your own health and the consequences of long-term lockdown restrictions can lead to opposition to vaccination as well as decisions to be made against society as a whole. In contrast, pro-vaccination people may present a collectivist attitude, characterized by respecting the common good and responsibility for the safety of the community. Our results showed that this group largely included representatives of medical professions, the elderly and people with chronic diseases, especially at risk of severe COVID-19. In the future, therefore, it is worth considering social attitudes when researching attitudes and beliefs about vaccinations.

In our study, we did not ask directly about the reasons for the reluctance to take the vaccine. In a study from Turkey, the most common reasons for refusal were concerns about the side effects of COVID-19 vaccines, a lack of knowledge about vaccine effectiveness, and distrust of vaccines from abroad (29). Similarly, in the study by Szmyd et al. (56), the desire to get vaccinated as quickly as possible was associated with lower concerns about side effects of the vaccine.

LIMITATIONS

The strength of our study is the use of an original tool to assess the level of knowledge about COVID-19 along with the standardized GHQ-28 questionnaire to measure mental health and the assessment of sociodemographic and pandemic factors in the context of vaccination decisions. However, we do recognize some of its limitations. First, the conclusions should be generalized with caution due to the limited representativeness of the sample. We did not register the initial number of people asked to participate and we did not report the reasons for non-participation. It should also be noted that the study did not include questions about the duration of selected symptoms, hence the results relate more to short-term psychopathological episodes than to long-term mental states. It is inevitable that both the online distribution and the form of the online questionnaires themselves run the risk of bias in the responses, hence the strength of the evidence should be treated with caution. The sampling bias consists in over representing people with a special interest in the COVID-19 pandemic. As a result, our study over-represented representatives of the medical professions. Due to the online nature of the study an overrepresentation of young people and a lower representation of older people were observed. Moreover, we did not ask about the direct reason for the declared willingness or reluctance to vaccinate against SARS-CoV-2, which could provide relevant information about the motives of attitudes and decisions. Another limitation of our study was the lack of a questionnaire assessing the severity of psychotic-like experiences and a paranoid attitude, which, according to recent studies, may influence refusal of vaccination (57). It is worth noting that the GHQ-28 scale assesses the severity of symptoms such as depression and anxiety, however, it does not allow for an unequivocal psychiatric diagnosis, which should be based on a clinical examination taking into account the DSM-V or ICD-10 criteria. We also did not use other scales that would allow for the differential diagnosis of mental disorders. Finally, a significant limitation is the inability to establish a causal relationship between psychopathological symptoms, sociodemographic and pandemic factors, and between the decision to be vaccinated hence we discussed the potential impacts.

CONCLUSIONS

Initial attitude toward SARS-CoV-2 vaccination, which we examined, may be of key importance in understanding the causes of reluctance to vaccinate. The presented study shows a significant social polarization depending on the decision to vaccinate. Greater readiness to vaccinate can be understood in terms of greater confidence in its effectiveness when a person experiences anxiety and mental deterioration, is physically burdened, is older, or is at risk of infection by working in the healthcare sector. Such an attitude may also result from relying on pro-vaccination information presented in the mass media, but also from a hypothetical collectivist attitude, in which the good of society exceeds the individual good. On the other hand, reluctance to vaccinate can be seen as greater awareness of the complexity of the disease, and thus less faith in the

safety and effectiveness of vaccines. Such decisions may also be conditioned by the assessment of the pandemic situation as not so threatening and thus not causing strong symptoms of psychopathology. Resistance to vaccination is also associated with a loss of confidence in health care and the experience of loss of income, which may indicate a strict focus on one's own situation, which is explained by an individualistic attitude. More research is needed regarding the evaluation of paranoid attitudes, psychotic-like experiences and vaccination refusal. Moreover, in view of the prolonged pandemic and voluntary nature of vaccinations, longitudinal studies on representative samples are needed in order to make a reliable assessment of the long-term health and social consequences, and regarding factors contributing to vaccination decision.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the Medical University of Wroclaw (Poland, No. 188/2020). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JM, BM, DS, and JR: conceptualization. JM, BM, and DS: methodology. JM and BM: software. WB: validation and data curation. ML-B: formal analysis. PG: investigation. JR: resources, supervision, and funding acquisition. JM, PG, and DS: writing—original draft preparation. ML-B, BM, DS, and JR: writing—review and editing. WB and PG: visualization. JM: project administration. All authors have read and agreed to the published version of the manuscript.

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The Psychological Impact of the Tertiary Hospital Reappraisal on Resident Doctors in the Post-pandemic Era: A Cross-sectional Study in Ningbo

Zhonghao Shao[1,2], Angyang Cao[1], Wenjun Luo[1], Yanling Zhou[1], Jianhua Wang[3], Yu Gui[1], Bin Gao[1], Zhipeng Xu[1], Binbin Zhu[1] and Zhiren Sheng[4]**

[1] Department of Anesthesiology, The Affiliated Hospital of Medical School of Ningbo University, Ningbo, China, [2] Department of Anesthesiology, Affiliated Hospital of Shaoxing University, Shaoxing, China, [3] Department of Radiology, The Affiliated Hospital of Medical School of Ningbo University, Ningbo, China, [4] Department of Nursing, The Affiliated Hospital of Medical School of Ningbo University, Ningbo, China

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***Correspondence:**
Binbin Zhu
pingchi1983@126.com
Zhiren Sheng
498769997@qq.com

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Participants: Competent resident doctor were expected to help the patients, advance medical knowledge, and promote public health. The time and effort necessary for residents to devote to standarized training is extensive. Anxiety and depression can negatively affect professional development and work efficacy. The study aimed to assess the psychosocial effects of the hospital reappraisal during the post-pandemic era of COVID-19 and analyze potential risk factors leading to their symptoms of anxiety and depression.

Method: In March 2021, the "Questionnaire Star" electronic questionnaire system was used to collect data. A total of 96 resident doctors from the affiliated hospital of the medical school of Ningbo University were invited to complete the questionnaires.

Results: According to our study, the prevalence of symptoms of anxiety and depression in the resident doctors in the institution was 61.5 and 59.4%, respectively. The residents who were worried about clinical skills tend to have anxiety symptoms under online education (OR = 3.436, 95%CI: 1.122–10.526). Compared with participants who were assigned by other hospitals, social trainees (OR: 7.579, 95%CI: 1.747–32.885), and full-time masters (OR: 5.448, 95% CI: 1.586–18.722) were more likely to have anxiety symptoms. Participants without a labor contract (OR = 3.257, 95% CI: 1.052–10.101) had a high risk of depression symptoms. Participants who spent more time learning the details prepared for the tertiary hospital reappraisal were significantly more likely to develop anxiety and depressive symptoms.

Conclusion: This study suggested that the tertiary hospital reappraisal program has an impact on the high incidence of anxiety and depression of the young resident doctors during the post-pandemic era of the COVID-19 in Ningbo.

Keywords: post-pandemic, the tertiary hospital reappraisal, resident doctor, mental health, psychological problem

HIGHLIGHTS

- As far as we know, few researches aimed to study the effect of a hospital reappraisal program on stress and mental conditions. Our study focused on the issue during the post-pandemic era of the COVID-19 crisis, and we investigated the psychosocial problems of the young residents in Ningbo.
- The results of our study suggested that most of the resident doctors have high degrees of mental problems in our institution, which indicated more effective interventions and support are needed.
- The main risk factors of the residents' mental problems involved both the ramifications of the epidemic, and the impact of the tertiary hospital reappraisal.
- In addition, due to the effective control of the COVID-19, the psychological impact of the regional fluctuation of the pandemic on the trainees was not severe. Besides, Ningbo had been categorized as a low-risk area, so preventive measures such as travel restrictions or making fewer trips outside doesn't have a major impact on the psychological burden of the residents.

INTRODUCTION

Resident doctors are an integral part of clinical teams and are vital to patient care in various clinical settings. Residents progress annually with the advancement of their roles within patient-care teams and participation in increasingly complicated operative cases. These training years are characterized by long work hours and little time for family (1). Meanwhile, clinical residency training primarily emphasizes the development of medical knowledge and technical skills. Yet, non-technical skills (NTS) are also vital to successful clinical practice (2). The NTS include social skills, cognitive skills and personal resource skills, which also contains Managing stress and coping with fatigue (3). Consequently, NTS also contributes to resident doctors have an excellent and efficient performance in work. However, the high incidence of psychological problems is detrimental to doctors' performance and destroys their careers. The medical residency is recognized as a risk period for the development of psychological problems, such as anxiety and depression (4). Resident doctors report the highest rate of having a formally diagnosed mental health condition. This may be because they are in the vulnerable age group when psychiatric disorders start (5). Mounting evidence from many studies suggests that anxiety and depression may affect the daily work of residents and interfere with their non-technical abilities, especially in some stressful situations (5, 6). Studies have consistently shown high levels of anxiety amongst resident physicians (7). To deal with this situation, more measures have been made on a large scale to improve doctors' mental health and fitness (8).

During the COVID-19 pandemic, to quickly control the epidemic and save the lives of infected patients, Chinese doctors have been extremely busy working hard over the past 1 year and great efforts have been made to cope with the tremendous public health crisis (9). In terms of the dangerous epidemic situation, the young resident doctors have experienced varieties of mental health challenges, such as overwork, frustration, loneliness, and other stressors (10). Even the family members of medical staff tend to appear symptoms of anxiety and depression (11). China has responded to COVID-19 in time and efficiently, but the current evidence and published literature on previous epidemics suggest that mental health issues may arise in the post-pandemic era (12). The so-called post-epidemic era does not mean that the epidemic completely disappears and everything goes back to normal as we imagined before. Rather, it means that the epidemic rises and falls, can erupt in small scale at any time, and has a seasonal outbreak (13). Existing evidence indicates that a number of medical health care workers developed mood disorders, anxiety disorders, or posttraumatic stress disorder (PTSD) in the wake of the SARS outbreak in 2003 (14). Therefore, there is an immediate need to identify the long- term mental health consequences of the COVID-19 in the post-pandemic era.

The tertiary hospital reappraisal is a kind of healthcare assessment mechanism of the Chinese government for hospitals. The reappraisal is similar to hospital accreditation, which has been adopted internationally as a way and solution for healthcare quality improvement in hospitals (15). In China, tertiary hospital reappraisal means providing patients with better medical conditions, medical technology and medical services, therefore it also represents the strict evaluation conditions of a tertiary hospital (16). During the period of the reappraisal, the expert groups reviewed the relevant documents and regimens of the hospital, and conduct necessary assessments on the hospital staff. It was a huge challenge for our hospital, which requires the efforts of every doctor, including young residents. The main purpose of the appraisal is to check the quality of health care in different regions, tremendous materials are prepared by young staff for the assessment, and knowledge of the hospital's ability in management, clinical, teaching, and scientific research should be memorized comprehensively (17). This reappraisal extended the working hours of residents to a certain extent

In a word, the mental health of resident doctors should be protected with timely interventions and proper information feedback (18). So far, little attention has been paid to this issue. We conducted a cross-sectional survey to evaluate the psychological conditions of tertiary hospital resident doctors. This work aims to study the effect of a hospital reappraisal program on symptoms of anxiety and depression during the post-pandemic era of the COVID-19 crisis in Ningbo.

RESEARCH METHODS

Research Participants and Study Design

During the period from March 15, 2021 to March 19, 2021, we distributed online questionnaires to 96 resident doctors of the Affiliated Hospital of the medical school of Ningbo University. Subsequently, we received 96 responses accordingly with an effective recovery rate of 100%. At the beginning of the questionnaire, we informed participants that they would be signing the consent by default if they accomplished the survey. All of the residents were invited to voluntarily participate in the online survey. Ethics approval was obtained from the Clinical Ethics Committee of the Affiliated Hospital of the medical

school of Ningbo University, and the ethical serial number is KY20210318.

Study Methods

Survey Methods

To prevent the spread of COVID-19 through droplets or contact, we used an online-based survey program "Questionnaire Star" to collect data. The "Questionnaire Star" is an application dedicated to send electronic questionnaires. Researchers can design different options for each question for participants to choose, and they can use web page to answer (10). We explained the purpose, content, and detailed methods of the survey to participants before filling. The content of the questionnaire included general information, problems related to the standardized training, the impact of the tertiary hospital reappraisal and COVID-19 on resident doctors, the mental health of them and so on. All of the questionnaires are anonymous.

Measures of Dependent Variables

Anxiety Symptoms

We employed the Chinese version of GAD-7 to assess the anxiety symptoms of resident doctors. GAD-7 is a self-report questionnaire that screens and measures the severity of generalized anxiety disorder (19). Participants rated seven items according to the frequency of symptoms in the past 2 weeks on a 4-point scale from 0 (not at all) to 3(nearly every day). Total scores ranged from 0 to 21, with higher scores indicating greater severity of anxiety symptoms. A score of 0–4 has no anxiety, a score of 5–9 may have mild anxiety, a score of 10–13 may have moderate anxiety, and a score of 14–18 may have moderate to severe anxiety, 19-21 may have severe anxiety (20). The GAD-7 has been widely applied in China and good reliability and validity of GAD-7 have been confirmed (21). The presence of mild anxiety symptoms was defined as a total score of $\geq$5 points in the GAD-7 in this survey (21).

Depressive Symptoms

We employed the Chinese version of PHQ-9 to assess the depressive symptoms of the resident doctors. PHQ-9 is a 9-item self-report measure to assess the severity of depression (22). Participants rated each item in accordance with the frequency of symptoms over the past 2 weeks on a 4-point scale from 0 (not at all) to 3 (nearly every day). Total scores ranged from 0 to 27, with the highest scores indicating greater severity of depressive symptoms. A score of 0–4 has no depression, 5–9 may have mild depression, 10–14 may have severe depression, 15–19 may have moderate to severe depression, 20–27 may have severe depression. The PHQ-9 has been widely used in China and good reliability and validity of the Chinese version of PHQ-9 have been demonstrated (23). The mild depressive symptom was defined as a total score of $\geq$5 points in the PHQ-9 in this survey.

Participants Characteristics

We designed the characteristics of the participants on the questionnaire, including gender, grade, major, education background, marital status, whether they have obtained the medical practitioner qualification certificate, whether have signed a contract with a hospital, and so on.

The Source of Stress

In the questionnaire, we arranged the options about the source of pressure close to the participants. The questionnaires for the source of stress of participants were self-developed specifically for this study, as there were no suitable scales available for measuring factors related to resident doctors during the post-pandemic era of the COVID-19 crisis. Due to the author's identity as a resident doctor, the following situations were set up for other participants to choose from: (1) numerous examinations; (2) acquiring the knowledge required for the tertiary hospital reappraisal; (3) whether having signed a contract with a hospital; (4) income; (5) Project; (6) COVID-19-related events;(7) interpersonal relationship;(8) the loss of investment; (9) marriage; (10) others. These options contain common sources of stress, which can be supplemented by others to enrich the need of the survey.

Ways to Relieve Stress

In the questionnaire, we arranged the options about the ways to relieve stress close to the participants. The questionnaires for the ways to relieve the stress of participants were self-developed specifically for this study, as there were no suitable scales available for measuring factors related to resident doctors during the post-pandemic era of the COVID-19 crisis. The following situations were set up for other participants to choose from: (1) indulge in food; (2) take a rest; (3) take a walk; (4) work; (5) review lessons; (6) chat; (7) go to shopping; (8) drink; (9) sing; (10) travel; (11) play games; (12) Others. These options contain common ways to cope with stress, which can be supplemented by others to enrich the need of the survey.

Statistical Analysis

This statistical analysis adopted categorical variable statistics. The categorical variables were expressed as percentages, and then the chi-square test is performed to analyze whether there was statistical significance. The binary logistic regression analysis was used to analyze the data of the chi-square test $p \leq 0.05$ in the categorical variables. Model discrimination and calibration were evaluated using Hosmer–Lemeshow goodness-of-fit statistic. Two-sided $P < 0.05$ was considered statistically significant. These statistical tools included SPSS v25.0 (IBM) and "questionnaire star" to collect statistical data.

RESULT

Demographic Characteristics

Table 1 presents the characteristics of participants. A total of 96 resident doctors from the affiliated hospital of medical school of Ningbo University completed the questionnaire, of whom 51 (53.13%) were men and 45 (46.88%) were women. Among them, 39 resident doctors (40.63%) were from first grade, 23 doctors (23.96%) from second grade, and 34 doctors (35.42%) from third grade. The education level of respondents varied from junior college to master. The participants included a junior

TABLE 1 | Sample characteristics and univariate analysis of variables related to symptoms of anxiety and depression.

Variables	*n* (%)	Anxiety symptoms (GAD-7 score)		*P*	Depressive symptoms(PHQ-9 score)		*P*
		<5 (*n* = 37)	≥5 (*n* = 59)		<5 (*n* = 39)	≥5 (*n*= 5 7)	
Demographics Gender				**0.572**			**0.594**
Male	51 (53.1)	21 (56.8)	30 (50.8)		22 (56.4)	29 (50.9)	
Female	45 (46.9)	16 (43.2)	29 (49.2)		17 (43.6)	28 (49.1)	
Grade				0.838			0.737
First grade	39 (40.6)	14 (37.8)	25 (42.4)		14 (35.9)	25 (43.9)	
Second grade	23 (24.0)	10 (27.0)	13 (22.0)		10 (25.6)	13 (22.8)	
Third grade	34 (35.4)	13 (35.2)	21 (35.6)		15 (38.5)	19 (33.3)	
Educational background				0.627			0.649
Junior college	1 (1.0)	0 (0.0)	1 (1.7)		0 (0.0)	1 (1.8)	
Undergraduate	61 (63.5)	25 (67.6)	36 (61.0)		26 (66.7)	35 (61.4)	
Master	34 (35.4)	12 (32.4)	22 (37.3)		13 (33.3)	21 (36.8)	
Marital status				0.722			0.504
Spinsterhood	77 (80.2)	29 (78.4)	48 (81.4)		30 (77.0)	47 (82.5)	
Married	19 (19.8)	8 (21.6)	11 (18.6)		9 (23.0)	10 (17.5)	
Fertility circumstance				0.311			0.066
Yes	5 (5.2)	3 (8.1)	2 (3.4)		4 (10.3)	1 (1.8)	
No	91 (94.8)	34 (91.9)	57 (96.6)		35 (89.7)	56 (98.2)	
The type of the standardized training				0.039			0.087
Full-time master	36 (37.5)	8 (21.6)	28 (47.4)		10 (25.6)	26 (45.6)	
Social being	18 (18.8)	9 (24.3)	9 (15.2)		7 (17.9)	11 (19.2)	
Resident doctors assigned by other hospitals	42 (43.8)	20 (54.1)	22 (37.2)		22 (56.5)	20 (35.2)	
Whether have signed a contract with a hospital				0.014			0.004
Yes	60 (62.5)	28 (75.6)	32 (54.2)		26 (66.7)	30 (52.7)	
No	36 (37.5)	9 (24.4)	27 (45.8)		13 (33.3)	27 (47.3)	
Whether the weekly nucleic acid test occupied their leisure time				0.035			0.047
Yes	60 (62.5)	28 (75.6)	32 (54.2)		9 (25.6)	31 (54.4)	
No	36 (37.5)	9 (24.4)	27 (45.8)		29 (74.4)	26 (45.6)	
Whether had concerns about clinical skills under the online education				0.013			0.401
Yes	37 (38.5)	20 (54.0)	17 (28.8)		17 (43.5)	20 (35.0)	
No	59 (61.5)	17 (46.0)	42 (71.2)		22 (56.5)	37 (65.0)	
The time of acquiring knowledge required for the tertiary hospital reappraisal				0.005			0.003
<1 h	18 (18.6)	13 (35.1)	5 (8.5)		14 (35.8)	4 (7.0)	
1–2 h	27 (28.1)	11 (29.8)	16 (27.1)		11 (28.2)	16 (28.0)	
2–3 h	22 (22.9)	7 (18.9)	15 (25.5)		6 (15.5)	16 (28.0)	
>3 h	29 (30.2)	6 (16.2)	23 (38.9)		8 (20.5)	21 (37.0)	

The bold values indicate the P values for gender.

college student (1; 1.04%), undergraduate students (61; 63.54%), graduate students (34; 35.42%). Among the participants, 77 (80.21%) were unmarried and 19 (19.79%) were married.

Related Issues During Standardized Training for Residents

In terms of employment, 47 residents have signed contracts with the different hospitals, and the rest of the 49 residents are without labor contracts. Among the participants, 60 residents (62.5%) have obtained the medical practitioner qualification certificate, and the remaining 36 residents (37.5%) have not yet obtained it. The survey also showed that 60 residents (62.5%) took up their rest time due to weekly nucleic acid testing, while 36 (37.5%) did not change their work schedule. After the change of teaching mode due to the epidemic, 37 residents (38.5%) were concerned about the practical skills assessment, and the rest of 59 residents (61.5%) were not concerned. Regarding the time of acquiring knowledge required for the tertiary hospital

TABLE 2 | Multivariate logistic regression analysis of variables related to anxiety symptoms.

Variables	Depressive symptoms (PHQ-9 score ≥ 5)		
	P	OR	95%CI
Whether have signed a contract with a hospital	0.118	2.590	0.786–8.547
Whether have obtained the medical practitioner qualification certificate	0.979	1.017	0.258–3.623
Whether the weekly nucleic acid test occupied their leisure time	0.129	2.294	0.786–6.667
Whether had concerns about clinical skills under the online education	0.031	3.436	1.122–10.526
The time of acquiring knowledge required for the tertiary hospital reappraisal	0.005		
<1 h		Reference	
1–2 h	0.012	6.84	1.536–30.303
2–3 h	0.004	10.86	2.151–55.55
>4 h	0.000	19.231	3.937–90.909
The type of the standardized training	0.004		
Resident doctors assigned by other hospitals		Reference	
Social trainees	0.007	7.579	1.747–32.885
Full-time master	0.007	5.448	1.586–18.722

TABLE 3 | Multivariate logistic regression analysis of variables related to depressive symptoms.

Variables	Depressive symptoms (PHQ-9 score ≥ 5)		
	P	OR	95%CI
Whether have signed a contract with a hospital	0.041	3.257	1.052–10.101
Whether have obtained the medical practitioner qualification certificate	0.403	1.661	0.505–5.464
Whether the weekly nucleic acid test occupied their leisure time	0.248	1.841	0.193–1.529
			0.654–5.181
The time of acquiring knowledge required for the tertiary hospital reappraisa		0.005	
<1 h		Reference	
1–2 h	0.018	5.102	1.319–19.608
2–3 h	0.003	9.346	2.179–40.000
>4 h	0.002	9.174	2.315–37.037

reappraisal, 18 residents (18.6%) studied for <1 h, 27 residents (28.1%) studied for 1–2 h, 22 residents (22.9%) studied for 2–3 h, and 29 residents (30.2%) studied for more than 3 h.

Mental Health Status

Anxiety Symptoms

The questionnaire suggested that 59 (61.5%) resident doctors in this survey had anxiety-related symptoms. In the logistic regression analysis, several factors were independently associated with anxiety symptoms, such as whether they have obtained the medical practitioner qualification certificate, whether have signed a contract with a hospital, the type of the standardized training, weekly nucleic acid test, whether there is concern about the skill assessment under the online education, and the learning time of acquiring knowledge required for the tertiary hospital reappraisal. However, there was no obvious correlation in gender, educational background, marital status, and grade (**Table 2**).

Depressive Symptoms

The questionnaire suggested that 57 (59.4%) resident doctors in this survey had depression-related symptoms. In the logistic regression analysis, several factors were independently associated with depression symptoms, such as whether they have obtained the medical practitioner qualification certificate, whether have signed a contract with a hospital, weekly nucleic acid test, and the learning time of acquiring knowledge required for the tertiary hospital reappraisal. However, there was no obvious correlation in gender, educational background, marital status, grade, the nature of the standardized training, and whether there is concern about the skill assessment under the online education (**Table 3**).

Multivariate Logistic Regression Analysis of Factors Significantly Associated With Anxiety and Depression Symptoms

Anxiety Symptoms

From the above data, we have learned that 61.5% of the resident doctors have symptoms of anxiety and 59.4% of them have symptoms of depression. Multiple logistic regression analysis demonstrated that residents who were worried about clinical skills tend to have anxiety symptoms under online education (OR = 3.436, 95%CI: 1.122–10.526). From the data in **Table 2**, taking 0–1 h on the study as a reference, compared with 1–2 h (OR = 6.84, 95%CI: 1.536–30.303), 2–3 h (OR = 10.86, 95%CI: 2.151–55.55), and 4 h or more (OR = 19.231, 95%CI: 3.937–90.909), participants who spent more time learning about the acquiring knowledge required for the tertiary hospital reappraisal were significantly more likely to develop anxiety symptoms. Taking participants who assigned by other hospitals as a reference, social being (OR: 7.579, 95%CI: 1.747–32.885) and full-time masters (OR: 5.448, 95% CI: 1.586–18.722) were more likely to have anxiety symptoms.

Depressive Symptoms

From the data in **Table 3**, participants without a contract (OR = 3.257, 95% CI: 1.052–10.101) were significantly more likely to have depression symptoms. Regarding the learning of the acquiring knowledge required for the tertiary hospital reappraisal, taking 0–1 h on the study as a reference, compared with 1–2 h (OR = 5.102, 95%CI: 1.319–19.608), 2–3 h (OR = 9.346, 95%CI: 2.179–40.000), and 4 h or more (OR = 9.174, 95%CI: 2.315–37.037), participants who spent more time on learning were significantly more likely to develop depression symptoms.

DISCUSSION

As far as we know, resident doctors are a significant part of medical teams and undertake a mass of tedious work (24, 25). Anxiety and depression at work will not only affect their daily life, but also reduce work efficiency and even cause medical accidents (26). This cross-sectional psychological survey suggested that the tertiary hospital reappraisal program has an impact on the high incidence of anxiety and depression of the young resident doctors during the post-pandemic era of the COVID-19 in Ningbo. This study also obtained the factors affecting the psychological condition of the resident doctors in our hospital through a questionnaire and provided suggestions for mitigating the psychological consequences. According to our survey, the prevalence of symptoms of anxiety and depression in the resident doctors in our institution was 61.5 and 59.4%, respectively, which are much higher than the level of the general population in China (27). After controlling for confounders, the main factors affecting residents' mental health are as follows: the worried about clinical skills under the online education; the type of standardized training; whether has signed a labor contract with a hospital; the time of acquiring the knowledge required for the tertiary hospital reappraisal; various examinations; tedious work; low income and so on.

While previous studies mainly focus on the effect of COVID-19 on resident doctors (28, 29), according to the current situation, the regional fluctuation of the pandemic had less impact on the mental health of residents, which was beyond our expectations. The bigger impacts came from the ramifications of the COVID-19 crisis. There were several reasons for this phenomenon. At present, the pandemic in China has been well-controlled through unremitting efforts. The Chinese people have great confidence in the COVID-19 vaccine, and the coverage rate has observably increased (30). Medical supplies such as masks and protective suits are sufficient. Nevertheless, the lack of personal protective equipment (PPE) increased the anxiety of health workers in some countries (31). Furthermore, Chinese authorities adopted early stage integrated psychological crisis interventions following novel corona virus outbreak (32). Besides, the hospital has provided training on COVID-19 prevention for residents, and the impact of COVID-19 on their mental health is gradually diminishing. However, the prevalence of the COVID-19 has changed the way of education (33, 34), and online classes have become the main teaching method for resident doctors (35). In order to prevent the spread of the epidemic, our hospital had also chosen online education as the main teaching strategy to strengthen the training of residents. Doctors need theoretical knowledge as the basis, and they also need to have clinical practice capabilities. Online education may be more focused on the learning of theoretical knowledge, but the young resident doctors require communication and interaction with patients (36). The resources of online education are relatively limited. Compared with teaching in the hospital, online education can provide typical cases and operation specifications (37). However, online learning is helpless in practical training (38). The lack of rehearsal for future operational assessment increased the psychological problems of residents. The unexpected COVID-19 crisis has disorganized medical education, but this may be a seminal opportunity for medical education to develop in the long view (39). Following the COVID-19 pandemic, the revolution of medical education has accelerated. The medical career will put more emphasis on telemedicine, virtual education, and greater national and international cooperation in the future (40). Doctors should be prepared for these changes.

During the period of the tertiary hospital reappraisal, the trainees' spare time was occupied by different levels of transactional work: preparing materials of the daily quality control, arranging documents and photocopies of teaching activities, reciting the inspection-related information and taking part in the reappraisal simulation. This accreditation is beneficial to achieving universal quality health coverage (41), so the criteria of the assessment were very strict, which suggested the complexity of the accreditation (42). As a result of the reappraisal to the hospital staff necessary assessment, repeated exams with various contents increased the pressure on the residents. In addition, most of the residents were assigned by other hospitals, and they were requested to study the acquiring knowledge required for the tertiary hospital reappraisal just to cope with the accreditation. According to our study, the length of study time was positively correlated with the severity of anxiety and depression. In other words, residents who spent more time learning about the acquiring knowledge required for the tertiary hospital reappraisal were significantly more likely to develop the symptoms of anxiety and depression. Due to the need to prepare materials and documents of reappraisal, the working hours of the resident doctors were prolonged. Indeed, several studies have reported that occupational stress, such as excessive workload or working time, was closely related to anxiety and depression (43, 44). To solve the difficulty and accomplish the tasks of the tertiary hospital reappraisal, the hospital manager could encourage the residents to actively participate in the training and give appropriate rewards to the outstanding trainees to strengthen their enthusiasm (45).

Employment is the foundation of the people, and it will generate greater pressure and affect health without work. A large amount of evidence supported that young people are especially vulnerable to mental health problems when unemployed (46, 47). There is essentially no big difference between the type of training and whether have signed a contract with hospitals. They are both employment issues. After the three-years training, the trainees will face the pressure of finding a job competing with fresh graduates, which also caused their anxiety and depression. In addition, lower wages and high-intensity work aggravate the life and work pressure of residents (48). To alleviate the pressure of the trainees, the administrator could increase the rest time of the resident doctors by reasonably planning the work schedule of the trainees, so that the residents have more spare time to regulate their moods. Moreover, the income of trainees can be appropriately increased as overtime subsidies. The pressure of residents both comes from heavy work and frequent tests. In order to cultivate outstanding resident doctors and improve the quality of medical care in China, various assessments of trainees cannot be avoided. The hospital could start several

interventions with the aim to optimize the learning skills of trainees and exam preparation to prevent test anxiety, comprising lectures on mental health and study guidance (49). Therefore, the hospital administrators and health authorities could provide efficient interventions with addressing their psychological needs and formulate effective strategies to ameliorate resident doctors' mental health status (50). With the improvement of anxiety and depression problems of the residents, they can work with a more positive attitude to serve patients, which is also conducive to the development of Chinese medical treatment.

LIMITATIONS

The study has limitations. First of all, our research is a single-center study. We collected data based on the resident doctor of the affiliated hospital of the medical school of Ningbo University. The sample size is relatively small, and whether the results are applicable to other tertiary hospitals remains to be further studied. Nevertheless, if the study is clinically significant, it will be used to develop a multicenter project to demonstrate external validity. Secondly, this was a cross-sectional study designed after the outbreak of COVID-19, we're not able to confirm that whether the mental health of resident doctors was more serious by the pandemic with a direct comparison to pre-pandemic conditions. Also, our research was conducted using an anonymous online questionnaire due to the limited research conditions caused by the pandemic, which may have information bias. Finally, the study may be subject to selection bias and the results need to be interpreted with caution.

CONCLUSION

According to this cross-sectional survey, most of the resident doctors in our hospital had symptoms of anxiety and depression to varying degrees. The sources of anxiety and depression were similar. Despite of the fact that the regional fluctuation of the pandemic had minorless impact on the mental health of residents, the main sources of psychological burden for residents come from the reduced clinical skills training on account of the impact of COVID-19. Due to the lack of actual practical processes, resident doctors are worried about their practical abilities, yet time after working was spent on the preparation for the tertiary hospital reappraisal, which could accelerate mental problems. The purpose of this survey was to help residents to identify their mental status and think about what need to be done to address their problems prior to any potential mental health conditions developing. More detailed work is urgently needed to explore effective interventions, as well as how we can better understand the needs of resident doctors.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

ZSha and YZ performed the experiment. AC, WL, and BZ contributed significantly to analysis and manuscript preparation. ZShe performed the data analyses and wrote the manuscript. JW, YG, BG, ZX, ZShe, and BZ helped perform the analysis with constructive discussions. ZSha and AC contributed equally to this work. All authors contributed to the article and approved the submitted version.

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Resilience and Anxiety Among Healthcare Workers During the Spread of the SARS-CoV-2 Delta Variant: A Moderated Mediation Model

Ying Liu[1,2†], *Tianya Hou*[1†], *Hongjuan Gu*[2], *Jing Wen*[1], *Xiaoqin Shao*[1], *Yawei Xie*[1], *Wenxi Deng*[1] *and Wei Dong*[1*]

[1] *Faculty of Psychology, Navel Medical University, Shanghai, China,* [2] *Department of Nursing, Hunan Provincial Crops Hospital, Chinese People's Armed Police Force, Changsha, China*

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***Correspondence:**
Wei Dong
sophiedongwei@163.com

[†] These authors have contributed equally to this work and share first authorship

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Introduction: The B.1.617.2 (Delta) variant of SARS-COV-2 has caused a surge in COVID-19 cases worldwide, placing a great burden on the health care system under the zero-tolerance epidemic prevention policy in China. The present study aimed to investigate the prevalence of anxiety among health care workers during the spread of the SARS-CoV-2 Delta variant, and to discuss the mediating role of positive coping style between resilience and anxiety, and the moderating role of general self-efficacy.

Method: Connor-Davidson Resilience scale (CD-RISC), Generalized Anxiety Disorder Scale (GAD-7), General Self-efficacy Scale (GSES) and Simplified Coping Style Questionnaire (SCSQ) were used in this cross-sectional study among 390 healthcare workers in Jiangsu Province, China. Mackinnon's four-step procedure was applied to test the mediation effect, and Hayes PROCESS macro was conducted to examine the moderated mediation model.

Results: The prevalence of anxiety among Chinese healthcare workers during the spread of the SARS-CoV-2 Delta variant was 41.8%. Male, unmarried, childless and younger subjects reported higher levels of anxiety. Positive coping partially mediated the effect of resilience on anxiety among healthcare workers and the indirect effect was stronger with the increase of general self-efficacy.

Conclusions: Anxiety was prevalent among healthcare workers during the spread of SARS-CoV-2 Delta variant. This research sheds new light on the potential mechanism underlying the association between resilience and anxiety and provides new insight into the prevention of anxiety among healthcare workers during the spread of the SARS-CoV-2 Delta variant.

Keywords: resilience, anxiety, general self-efficacy, positive coping style, coronavirus disease 2019 (COVID-19), healthcare workers

INTRODUCTION

The outbreak of the Coronavirus Disease 2019 (COVID-19) as a public health emergency with international concern (1) had an unprecedented impact on the daily life of people all over the world, causing approximately 4.5 million deaths and 216 million infections worldwide (2). Also, the continuously mutating severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) strain posed a major challenge to the health care systems.

Although the spread of COVID-19 in China has been controlled to a certain extent, the risk of being infected has not subsided (3). Moreover, the B.1.617.2 (delta) variant has delivered a huge shock even to countries that have been mass vaccinated, because of its higher load and faster spread than SARS-CoV-2 (4). Therefore, the first local case in May (5), 1 month after the previous outbreak, has caused a considerable degree of panic (such as anxiety) in China. To control the spread of the outbreak, patients need to be quickly identified and isolated by scaling up nucleic acid tests, which places a huge burden on the healthcare system. It can be inferred that the work efficiency and quality of healthcare workers have become the key to control the epidemic. However, the fear of being infected or bringing the virus to family, lack of knowledge about the Coronavirus, high levels of work stress and workload and inadequate psychological support during the COVID-19 pandemic have made healthcare workers more vulnerable to develop psychological problems than other groups (6–8). A great many of studies conducted early during the outbreak showed a high level of depression, anxiety and insomnia among healthcare workers (9, 10), suggesting that greater attention should be paid to the mental health of healthcare workers. Among these symptoms, anxiety as the most prevalent mental disorders (11) is of particular concern to us because it can directly or indirectly cause cognitive deficits, reducing job performance by limiting working memory (12) or affecting cognitive flexibility and decision-making (13). Anxiety disorder is a mental health condition characterized by excessive fear, anxiety, or avoidance of perceived threats to the external environment or internal as well as the actual response is not equal to the actual risk (14). It is one of the most predominant mental disorders in the general population (11). A large web-based cross-sectional study conducted across China reported that the overall prevalence of general anxiety disorder (GAD) during the COVID-19 epidemic was 35.1%, and healthcare workers were at a higher risk of mental illnesses (15). Numbers of recent studies in the field of positive psychology have focused on anxiety disorders (16–18), and psychological resilience as an important component of positive psychology is also suggested to have a protective effect on anxiety (16).

Resilience refers to the capacity that allows people to successfully adapt and face adversity, traumatic and stressful events (19). The negative association between resilience and anxiety has been confirmed by multiple studies (20, 21). Moreover, an observational longitudinal cohort study conducted in individuals with multiple sclerosis over 12 months confirmed a significant longitudinal relationship between resilience and anxiety (22). When confronted with stressful life events, individuals with higher levels of resilience were less likely to experience anxiety and depression (23). A recent study reported the protective role of resilience components against mental problems including anxious symptoms among Italian healthcare workers during COVID-19 pandemic (24). Thus, we speculate that resilience may have a protective effect on anxiety of Chinese healthcare workers during the COVID-19 pandemic.

The Mediating Role of Coping Style

Despite the associations between resilience and anxiety having been well established, the underlying mechanisms behind this association have not been fully explained. Specifically, whether the association between resilience and anxiety among healthcare workers during the spread of the SARS-CoV-2 Delta variant is mediated by coping style has not been tested.

Coping is the cognitive and behavioral effort of individuals to consciously manage external or internal changes (25), which can be divided into two types according to the ways of coping with problems: positive coping and negative coping (26). Positive coping refers to solving problems in a direct and rational way such as focusing on the positive and changing behaviors to solve problems and seeking social support (27), while negative coping refers to dealing with problems through avoidance, withdrawal and denial (28). However, extant literature has already documented that positive coping is the dominant coping style among medical students or people facing COVID-19 (29–31), whereas multitudes of studies only investigated the impact of negative coping style (28, 32, 33). Therefore, the present study would focus on the effects of positive coping, and we will consider positive coping in our study.

The association between resilience and coping styles has attracted much attention. Similarly, a study conducted among Chinese soldiers found that resilience was a positive predictor of positive coping (34). A recent study reported the positive association between resilience and positive coping based on a sample of healthcare workers during the outbreak (21). According to the transactional stress model, coping plays an important role when individuals face adversity, and rapid response to stress is beneficial to prevent the generation of psychological disorders (35). Many empirical studies have reached the consensus that positive coping was a protective factor for anxiety, while negative coping may exacerbate this symptom (36, 37). In addition, a longitudinal study conducted in the United States showed that a lower level of positive coping among patients with post myocardial infarction was associated with a higher level of anxiety (38). Moreover, several studies provided robust evidence for the negative association between positive coping and anxiety among healthcare workers (39, 40). Therefore, it could be speculated that positive coping mediated the association between resilience and anxiety among healthcare workers.

To date, the association between resilience, coping style and anxiety has been widely investigated (41–43). However, some of these studies focused on patients rather than medical staff, and others used coping style as an independent variable or resilience as a moderator. To the best of our knowledge, the association between resilience and anxiety *via* positive coping

among health care workers during the COVID-19 outbreak has not been studied.

The Moderating Effect of General Self-Efficacy

Although resilience may affect anxiety indirectly through positive coping, not all people who are more inclined to use positive coping reported a lower level of anxiety since some studies reported no association between positive coping and anxiety (44). Therefore, it is necessary to explore the influencing factors of the association between positive coping and anxiety. Self-efficacy was defined as a belief in one's ability to handle complex or new tasks and cope with adversity, which exerted an impact on how people feel, think and behave (45). General self-efficacy is a generalized sense of self-efficacy, which refers to global confidence in one's ability to cope with a variety of different demands or new situations (46). In the light of the Integrative Conceptual Framework of coping process, individual's self-efficacy as a personal characteristic can interact with coping styles or coping skills to influence personal health and well-being (47), indicating the effect of coping skills on health differs at different levels of self-efficacy. Previous literature presented the interaction effect of coping style and self-efficacy on the treatment outcome among problem drinkers (48), suggesting the influence of coping style on health outcomes is not the same at different levels of self-efficacy. Brands and colleagues explored the influence of self-efficacy and negative coping on quality of life and found self-efficacy moderated the impact of emotion-oriented coping on health outcome. Specifically, the effect of negative coping on health outcome was attenuated with the increase of self-efficacy (49). Hence, we speculate that self-efficacy may moderate the effect of positive coping on anxiety among healthcare workers during the crisis.

The Present Study

The purpose of this study is to investigate the prevalence of anxiety among health care workers during the spread of the SARS-CoV-2 Delta variant, and to discuss the mediating role of positive coping style between resilience and anxiety, and the moderating role of general self-efficacy. Taken together, our study proposes a moderated mediation model that general self-efficacy moderates the indirect effect (positive coping–anxiety) of resilience on anxiety through positive coping style (see **Figure 1**) among healthcare workers during the COVID-19 pandemic.

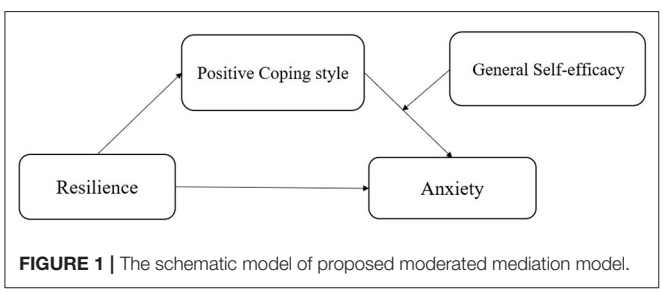

FIGURE 1 | The schematic model of proposed moderated mediation model.

METHODS

Participants and Procedures

The cross-sectional study was performed between May 14 and 25, 2021, during the spread of the SARS-CoV-2 Delta variant. A one-stage random cluster sampling technique was employed to recruit participants from a hospital in JiangSu Province. A total of 413 potential participants were contacted in the study. The inclusion criteria were as follows: (a) working in the hospital for at least 1 year, (b) no dyslexia or cognitive impairment, (c) age > 18 years. The exclusion criterion was set for respondents with psychiatric illnesses and those who did not respond seriously. Finally, 390 participants were included in the analysis, resulting in a valid response rate of 96.13% (390/413). The research project obtained an ethical approval from Suzhou Science & Technology Town Hospital (IRB201912002RI) before it was launched. All data were collected by conducting a self-administered questionnaire online. Prior to the online survey, informed consent online was given by all participants. Also, all participants were assured that their responses would be anonymous and confidential and that they were free to withdraw at any time without penalty.

Measures

Demographics Characteristics of Participants

Demographic information in this study included gender, age, educational level, professional title, marital status, and children situation. Age was divided into two groups (younger group and middle-age group). Educational level was categorized into two groups (college or lower, Master degree or above). Professional title was coded as a binary variable (junior title or no title, intermediate job title and senior title). Marital status was divided into married and unmarried (single, divorced, and widowed). Children situation was categorized into no child and having at least 1 child.

Measurement of Resilience

The Chinese version of Connor-Davidson Resilience scale (CD-RISC) (50) is a 25-item generic resilience instrument with three subscales: tenacity, strength, and optimism. Items were scored on a 5-point Likert scale ranging from 0 (never) to 4 (very often). A total score is calculated as the sum of all questions and ranged from 0 to 100, and the higher the score is, the higher the level of resilience is. The scale has been demonstrated good internal and external validity and widely employed in Chinese healthcare workers (51). In this study, the Cronbach's α coefficient of the scale was 0.968.

Measurement of Anxiety

The 7-item Generalized Anxiety Disorder Scale (GAD-7) was used to measured anxiety of patients during the last 2 weeks (52). The variables were scored on a four-point Likert scale with 0 indicating never,1 indicating several days, 2 indicating more than half the days, and 3 representing nearly every day. The total score was calculated as the sum of all items, with a total range of 0 to 21. The higher the total score is, the more severe the anxiety is. The cut-off point for identifying the symptoms of anxiety was 7 (53). The scale has been widely used in anxiety-related research and has high construct validity and reliability in Chinese population

(54, 55). In the present study, the Cronbach's α coefficient of the scale was 0.966.

Measurement of Positive Coping Style

Positive coping was measured by the positive coping subscale of Simplified Coping Style Questionnaire (SCSQ) (56). The SCSQ was an instrument widely used in China to reflect positive and negative responses when encountering stress (56). The positive coping subscale consists of 12 items (e.g., release through work, study or some other activities). The SCSQ was scored on a 4-point Likert scale ranging from 0 (do not take) to 3(often take). The positive coping subscale was calculated as the sum of all items. The total score of items represents the likelihood that the individual will adopt the corresponding coping style, with higher scores reflecting stronger coping style preferences (57). The scale has presented excellent psychometric properties and been widely used among healthcare workers (56), and the Cronbach's alpha of positive coping in this study was 0.947.

General Self-Efficacy

To assess general self-efficacy, we used the Chinese version of 10-item General Self-efficacy Scale (GSES) (58). Items were rated on a 4-pointed Likert scale ranging from 1 (not true at all) to 4 (exactly true), with a total score ranging from 10 to 40. Higher scores indicated higher levels of general self-efficacy. The scale has been found to have good reliability and validity among Chinese healthcare workers (58, 59). In this study, the Cronbach alpha coefficient for GSES was 0.954.

Statistical Analysis

SPSS 22.0 (IBM Corporation) was used for statistical analysis in this study. First of all, we conducted Harman single factor test to examine common method bias. Common method bias as a well-documented phenomenon observed in research based on self-reported measures is caused by the fact that the constructs are measured by the same methods (e.g., multiple-item scales in the same questionnaire), which might result in spurious effects because of measurement instruments (60). Then, an analysis of descriptive statistics was conducted to illustrate the demographic and other selected characteristics of the respondents. Independent *t*-test and one-way analysis of variance (ANOVA) were used to compare group differences in Anxiety. Secondly, Pearson correlation test was utilized to evaluate the bivariate correlations between interested variables. Thirdly, MacKinnon's four-step method (61) was applied to test the mediation effect in our research and four criteria need to be satisfied: (1) a significant association between the independent variable (resilience) and the dependent variable (anxiety); (2) a significant association between the independent variable (resilience) and the mediator (positive coping style); (3) a significant association between the mediator (positive coping style) and the dependent variable (anxiety) after controlling for the independent variable (resilience); (4) a significant coefficient for the indirect association between the independent variable (resilience) and the dependent variable (anxiety) *via* mediator (positive coping style). To examine the last condition, the bias-corrected percentile bootstrap method was used, obtaining the bias-corrected 95% confidence intervals with 5,000 bootstrapping iterations. If the interval range of 95% CI value does not contain 0, indicating that the mediating effect is significant. The mediation effect was analyzed by PROCESS version 3.0 macro for SPSS (Model 4), which is a free mediation and moderation software package published by Preacher and Hayes. Finally, the PROCESS macro (Model 14) was used to examine the moderated mediation effects. According to the foregoing, the effects were established if 95% bias-corrected bootstrap CI of the interaction does not contain zero. Then, Johnson-Neyman technique (62) was employed to plot the conditional effects and confidence bands at different values of general self-efficacy. In addition, gender, age, educational level, years of working, professional title, marital status, and children situation were entered into models as covariates and all continuous variables were standardized. In all data analysis, *p*-values of 0.05 or less ($p < 0.05$) were considered as statistical significance.

RESULTS

Common Method Bias Test

In this research, we used self-report approach to collect data, which may lead to common method bias problem (63). The Harman single factor test was employed to test common method bias (64). The KMO value was 0.95 ($p < 0.001$), indicating that the data in this study were suitable for exploratory factor analysis. After exploratory factor analysis, we found that the factors of eigenvalues >1 was 8 and the interpretation rate of the first factor was 37.42%, lower than the reference value of 40%. Therefore, the results showed that there was no serious common method bias problem in this research.

Demographic Characteristics and Anxiety

The sociodemographic characteristics and intergroup comparison of anxiety were displayed in **Table 1**. Among the 390 valid samples, the average age was 29.78 (±5.35) years old, and the average years of working was 7.84 (±5.73) years. Most of the participants were female [343(87.95%)], married [256(65.64%)], junior title [267 (68.46%)], aged below 30 years [249 (63.85%)], had at least one child [212 (54.36%)], had an educational level of college or lower.

The prevalence of anxiety among healthcare workers was 41.8%. There were no significant differences in the prevalence of anxiety among participants with different professional title and educational level. Of the total sample, males had higher levels of anxiety than females ($F = 7.51$, $P < 0.05$). Unmarried ($F = 5.59$, $P < 0.05$), childless ($F = 6.60$, $P < 0.05$) and younger group subjects ($F = 4.46$, $P < 0.05$) reported a higher level of anxiety.

Mean, Standard Deviations (SD), and Bivariate Correlation of all Study Variables

Table 2 shows the Pearson correlation coefficient among variables. Resilience was positively associated with positive coping style ($r = 0.70$, $P < 0.001$) and general self-efficacy ($r = 0.53$, $P < 0.001$). Also, positive coping was positively related to general self-efficacy ($r = 0.46$, $P < 0.001$). Besides, resilience ($r = -0.22$, $P < 0.001$) and positive coping style ($r = -0.32$,

$P < 0.001$) were negatively correlated with anxiety. However, general self-efficacy was not significantly related to anxiety ($P > 0.05$).

TABLE 1 | Demographic characteristics of respondents ($N = 390$) and group comparisons on anxiety.

	Respondents		Anxiety Scores		*F/t*	*p*-value
	n	%	*M*	SD		
Gender					7.51	0.01
Male	47	12.05	6.72	5.39		
Female	343	87.95	4.76	4.49		
Marital status					5.59	0.02
Unmarried	134	34.36	5.76	4.86		
Married	256	65.64	4.60	4.48		
Children situation					6.60	0.01
No child	178	45.64	5.65	4.77		
One child or more	212	54.36	4.45	4.47		
Professional title					2.53	0.11
Junior title	267	68.46	5.25	4.71		
Intermediate job title and senior title	123	31.54	4.45	4.46		
Age (29.78 ± 5.35)					4.46	0.04
Younger group (≤30)	249	63.85	5.37	4.83		
Middle-aged group (>30)	141	36.15	4.34	4.22		
Educational level					1.71	0.19
College or lower	360	92.31	5.09	4.70		
Master degree or above	30	7.69	3.93	3.83		

TABLE 2 | Pearson's correlation among resilience, self-efficacy, coping style and anxiety ($N = 390$).

	Mean (SD)	1	2	3
1. Resilience (CD-RISC)	63.28 (14.83)	1.00		
2. Positive coping style (SCSQ)	24.65 (6.07)	0.70***		
3. General self-efficacy (GSES)	25.96 (5.90)	0.53***	0.46***	
4. Anxiety (GAD-7)	5.00 (4.64)	−0.22***	−0.32***	−0.07

*** $P < 0.001$.

Mediating Effect of Positive Coping Style

After finding an internal links among resilience, anxiety, and positive coping style, the research examined the potential mediating role of positive coping style between resilience and anxiety. We used Mackinnon's four-step procedure to examine the mediation effect (see **Table 3**), which follows: above all, resilience was significantly correlated with anxiety ($\beta = -0.250$, $P < 0.001$) (see Model 1). Secondly, resilience was significantly associated with positive coping style ($\beta = 0.742$, $P < 0.001$) (see Model 2). Next, positive coping style was significantly related to anxiety when controlling for resilience (β =-0.286, $P < 0.001$) (see Model 3). Finally, the indirect effect of resilience on anxiety *via* positive coping style was significant (ab =-0.213, SE = 0.050, 95% CI = [−0.312, −0.117]). The mediation effect of positive coping style accounted for 85.31% of the total effect. The 95% CI did not contain zero, suggesting the indirect association between resilience and anxiety *via* positive coping style. In conclusion, mediation effect met all four conditions and positive coping style mediated the relation between resilience and anxiety among healthcare workers during the outbreak of COVID-19.

Moderating Effect of Self-Efficacy

The study hypothesized that general self-efficacy might moderate the indirect effect (the second stage of the mediation pathway: positive coping-anxiety) of resilience on anxiety. The results of conditional process analysis in **Table 4** showed the interaction of positive coping style and general self-efficacy had a significant effect on anxiety ($\beta = -0.183$, $P < 0.001$), indicating the association between positive coping style and anxiety was moderated by general self-efficacy. Therefore, the moderated mediation effect was established since the indirect pathway was moderated by general self-efficacy (65).

The conditional indirect effect of resilience on anxiety *via* positive coping style at different values of general self-efficacy (1 SD below the mean, mean, and 1 SD above the mean) is also showed in **Table 4**. The indirect effect of positive coping style at 1 SD above the mean [$\beta = -0.361$, 95% CI (−0.478, −0.248)] was stronger than 1 SD below the mean [$\beta = -0.090$, 95% CI (−0.195, 0.013)]. As shown in **Figure 2** by Johnson-Neyman technique (62), general self-efficacy would moderate the indirect effect of resilience on anxiety *via* positive coping when the standard scores of general self-efficacy were higher than −0.8982, in which the 95% CI did not contain zero.

TABLE 3 | Mediation analysis ($N = 390$).

	Model 1 (Anxiety)		Model 2 (Positive coping)		Model 3 (Anxiety)			Indirect effect of positive coping style			
	β	*t*	*β*	*t*	*β*	*t*		Indirect effect	SE	LLCI	ULCI
Resilience	−0.250***	−4.889	0.742***	18.906	−0.037	−0.529	Positive coping	−0.213	0.050	−0.311	−0.117
Positive coping					−0.286***	−4.415					
R^2_{adj}	0.099***		0.490***		0.142***						
F(df)	5.966		52.452		7.909						
P	0.001		0.001		0.001						

All models are adjusted for gender, marital status, age, children situation, educational level, and professional title.
*** $P < 0.001$.

TABLE 4 | Conditional process analysis ($N = 390$).

	β	SE	LLCI	ULCI
Dependent variable model (outcome: anxiety)				
Resilience	−0.121	0.071	−0.261	0.020
Positive coping style	−0.306***	0.064	−0.431	−0.181
Self-efficacy	0.179**	0.056	0.070	0.289
Positive coping style * Self-efficacy	−0.183***	0.038	−0.258	−0.109
	β	Boot SE	Boot LLCI	Boot ULCI
Conditional indirect effect analysis				
1 SD below the mean	−0.090	0.052	−0.195	0.013
Mean	−0.225	0.049	−0.325	−0.129
1 SD above the mean	−0.361	0.058	−0.478	−0.248
Index of moderated mediation	−0.136	0.025	−0.184	−0.085

All models are adjusted for gender, marital status, age, children situation, educational level, and professional title.
****P < 0.001, **P < 0.01.*

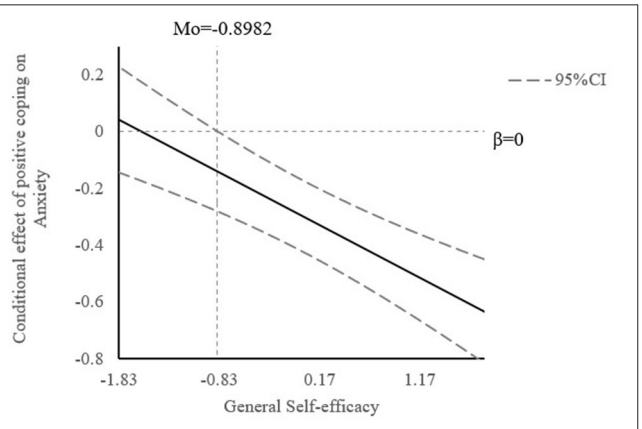

FIGURE 2 | The conditional effect of positive coping on anxiety at the value of general self-efficacy.

DISCUSSION

This study aimed to assess the prevalence of anxiety symptoms among healthcare workers 20 months during the spread of the SARS-CoV-2 Delta variant, and to discuss the mediating role of positive coping style in the association of resilience with anxiety, and the moderating role of general self-efficacy. As far as we know, this is the first research to investigate the association between resilience and anxiety *via* positive coping and the moderating role of general self-efficacy.

The results showed that the overall prevalence of anxiety among Chinese healthcare workers during the spread of the SARS-CoV-2 Delta variant was 41.8%, which is higher than the prevalence of 35.1% reported in a large-scale epidemiological survey conducted among Chinese during the COVID-19 pandemic (15). This is also higher than the prevalence of 25% among healthcare workers during the peak period of COVID-19 reported in a meta-analysis (66). These suggest that, under the circumstance of the COVID-19 pandemic the constantly mutating virus, makes healthcare workers even more likely to be anxious in comparison to the peak of the epidemic.

The demographic variables showed that male subjects had higher levels of anxiety than females, which is inconsistent with previous findings (67–69). This might be explained by several reasons. First, different samples and questionnaires were used among these studies, which resulted in certain differences. In addition, the cluster sampling method adopted in this study resulted in a large difference in the number of men (only 47) and women. This could be attributed to the fact that most nursing staff were female (70). The results also presented that unmarried, childless, and younger subjects reported a higher level of anxiety, which is in line with some published findings (69, 71, 72). These results may be due to the fact that medical workers with these characteristics tend to undertake more workload and frontline duties. Also, their professional experience and decision-making authority are lower than those of senior medical staff (69, 73).

The Mediating Role of Positive Coping

As expected, the results of MacKinnon's four-step method presented that the mediation effect accounted for 85.31% of the total effect, which indicated the effect of resilience on anxiety was largely through positive coping among healthcare workers during the spread of the SARS-CoV-2 Delta variant. This is consistent with the findings from previous literature (35, 74), which documented the mediating role of resilience in the association between resilience and health outcomes. Zhao et al. (35) found that resilience was correlated with positive coping, and coping style mediated the association between resilience and depressive symptoms. Chen (74) also proved that coping styles played a mediating role in the association between resilience and subjective well-being. The results could also be explained by the theory of psychological stress and coping developed by Lazarus et al., which claims that coping is a key mediator of stressful person-environment relations and their immediate and long-range outcomes (75). Therefore, appropriate coping styles play an important role in preventing individuals in stressful situations from developing short-term or long-term negative emotions. An individual with a higher level of resilience is more likely to develop positive coping strategies (76), which could further protect against anxiety disorders. Hence, positive coping, as a direct and rational way, could be a good mediator between the resilience and anxiety of medical staff under the COVID-19 pandemic, indicating resilience can have an impact on anxiety through positive coping.

The Moderating Role of General Self-Efficacy

In the moderated mediation analysis, the coefficient of the interaction term between self-efficacy and coping is significant, suggesting the moderating effect of self-efficacy on the indirect association between resilience and anxiety through positive coping among healthcare workers during the spread of the SARS-CoV-2 Delta variant since self-efficacy moderated the second

stage of the mediation pathway. The result is in line with the Integrative Conceptual Framework of coping process (47) and previous studies (48, 49), reporting the impact of coping on health outcomes differs at different levels of self-efficacy. Practically speaking, healthcare workers with a higher level of general self-efficacy showed a stronger association between resilience and anxiety *via* positive coping. As shown in the Johnson-Neyman technique, the association between resilience and anxiety through positive coping was weakened with the decrease of general self-efficacy. Specifically, when the standard score of general self-efficacy dropped to below −0.8496, the indirect mediation effect was not significant any more. This result could be explained by the theory of self-efficacy developed by Bandura (77). General self-efficacy will determine whether an individual takes coping measures and how much an effort he or she will make. People with a higher sense of self-efficacy are more confident to face problems, while those with a lower sense of self-efficacy will avoid or follow the crowd rather than resisting pressure (78). Hence, healthcare workers with a lower sense of general self-efficacy are more likely to feel anxious even if they adopt a positive coping style.

Implications

Our results have profound implications for the prevention of anxiety. The findings highlight the protective role of resilience and potential value of positive coping against anxiety among healthcare workers during the spread of the SARS-CoV-2 Delta variant. Programs combining resilience-building interventions [e.g., adopting a proactive orientation to solve problems, being flexible and adaptive (79)] and positive coping skills training [e.g., relaxation training, positive thinking, and problem solving (80)] should be designed and special attentions should be paid to healthcare workers with a higher sense of self-efficacy during the crisis.

Limitations and Contributions

Some limitations should be recognized. First of all, this survey used a cross-sectional design, which leads to the inability to infer causality. Longitudinal studies could be carried out in the later study to further verify the moderated mediation model. Secondly, the cluster sampling method used in this study contributed to a high proportion of women compared to men. The reason for this phenomenon might be explained by the fact some medical positions, such as nurses, are mostly occupied by women, and other studies have shown similar limitations (71, 81). Thirdly, the information about occupation was not collected in our study, which might influence the results and the generalization of the findings. Fourthly, all data were collected through online self-report, which resulted in self-reported biases. Further study could collect information from multiple informants. Fifthly, all subjects came from a hospital in Jiangsu Province and there were only 390 subjects, which limited the generalization of the findings. Follow-up studies could recruit subjects from multiple hospitals in multiple provinces and cities. Finally, anxiety could be affected by numerous factors, the pathway identified in this study was just a part of them. Future studies could construct a more integrated model to explore the influential factors of anxiety.

As far as we know, this is the first study to assess the association between resilience and anxiety *via* positive coping among healthcare workers during the spread of the SARS-CoV-2 Delta variant, and to assess the moderating role of general self-efficacy, which would give insight into how resilience affects anxiety. From a practical point of view, this study plays an important role in maintaining the mental health of healthcare worker during the spread of the SARS-CoV-2 Delta variant.

CONCLUSION

In summary, this study presented the protective effect of resilience on anxiety among healthcare workers during the spread of the SARS-CoV-2 Delta variant. Besides, positive coping could be one of the pathways through which resilience affects anxiety. Furthermore, the effect of resilience on anxiety *via* positive coping is enhanced with the increase of general self-efficacy.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Naval Medical University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

YL and TH contributed to the writing of this article and the statistical analysis. WDo led the whole study including carrying out this study and putting forward the study. HG, JW, XS, YX, and WDe contributed to the data collection and statistical analysis. All authors contributed to editing the manuscript and have approved the final manuscript.

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Mental Health Differences in Healthcare Workers Exposed to Different Risks During the Coronavirus Disease 2019 Pandemic

*Yihui Zhang[1], Da Li[2], Xuan Ouyang[1], Hanping Bai[3], Linlin Zhao[1], Yongyan Shi[1] and Liwen Tan[1]**

[1] Department of Psychiatry, National Clinical Research Center for Mental Disorders, China National Technology Institute on Mental Disorders, The Second Xiangya Hospital of Central South University, Changsha, China, [2] Institute of Anthropology, East China Normal University, Shanghai, China, [3] Department of Psychiatry, Renmin Hospital of Wuhan University, Wuhan, China

Background: The coronavirus disease 2019 (COVID-19) pandemic has caused a significant impact on the physical and mental health of healthcare workers. This study assessed the psychological status of healthcare workers who were exposed to different risk-levels in China and explored the factors that affected their mental health.

Methods: Demographic, occupational characteristics, and mental health measurements were collected from 810 workers in 41 hospitals in China, through online questionnaires from February 11 to March 3, 2020. The degree of symptoms for fatigue, anxiety, and insomnia were assessed using the Chinese versions of the Fatigue Severity Scale, 7-item Generalized Anxiety Disorder Scale, and Insomnia Severity Index, respectively. Binary logistic regression analysis was performed to identify factors associated with mental health symptoms.

Results: All 810 participants completed the relevant questionnaires without missing data. The prevalence of fatigue, anxiety, and insomnia symptoms was 74.3, 73.7, and 61.7%, respectively. Nurses, women, and workers exposed to high-risk areas were more likely to report mental health problems ($P < 0.05$). After controlling for confounders, exposure to high-risk areas was independently associated with increased symptoms of fatigue, anxiety, and insomnia (fatigue among high-risk areas: OR, 3.87; 95% CI, 2.26–6.61; $P < 0.001$; anxiety among high-risk areas: OR, 2.66; 95% CI, 1.58–4.51; $P < 0.001$; insomnia among high-risk areas: OR, 2.83; 95% CI, 1.68–4.79, $P < 0.001$).

Conclusion: The study demonstrated significant differences in psychological symptoms among healthcare workers exposed to different levels of risk, and those in high-risk areas were more vulnerable to experiencing mental health symptoms. These findings emphasize the importance of giving due attention to healthcare workers, especially women, nurses, and those working in high-risk settings during the COVID-19 pandemic.

Keywords: COVID-19, mental health, different risks, healthcare workers, China

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***Correspondence:**
Liwen Tan
tanliwen@csu.edu.cn

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INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has had devastating effects worldwide. Globally, as of October 29, 2021, there were 245,373,039 confirmed cases of COVID-19, including 4,979,421 deaths, reported to the WHO (1). As of October 29, 2021, there were 97,080 confirmed cases on the Chinese mainland, according to data from the National Health Commission (2).

The experience of previous pandemics has demonstrated that, in addition to the direct damage to physical functioning of the affected, emerging virus outbreaks also negatively impact mental health, particularly that of healthcare workers (3–5). The World Psychiatric Association has repeatedly issued statements calling attention to the mental health of healthcare workers (6). Previous studies on severe acute respiratory syndrome (SARS), Ebola, Middle East respiratory syndrome, and influenza A (H1N1) pandemic have revealed that public health emergencies significantly increase the workload of healthcare workers who face higher mortality rates and greater risks of infection than other communities due to the nature of their work; these factors can contribute to psychological problems among healthcare workers (7–10). Similarly, since the outbreak of COVID-19, studies on medical mental health have revealed that medical staff were particularly prone to anxiety (11, 12) and insomnia (13) at the early stage of the epidemic, with a higher prevalence of insomnia (14).

As per the experiences from previous pandemics, the exposure risks experienced by each healthcare worker vary, which may lead to differences in working hours, stress, and ultimately, differences in their mental health (15).

Over the course of the COVID-19 pandemic, the World Psychiatric Association has highlighted the different risks of exposure to healthcare workers (6). However, previous studies mostly investigated mental health problems of medical staff using regional or individual hospitals (13, 16) and did not analyze the mental health status of workers with different exposure risks in the early pandemic.

Therefore, we collected information on healthcare workers (doctors and nurses) who were exposed to varying levels of risk in China to explore the factors affecting their mental health in the early stage of COVID-19. Participants from different hospitals in Wuhan, Hubei province, and cities in other provinces were enrolled in this survey to analyze potential risk factors associated with symptoms such as fatigue, anxiety, and insomnia by quantifying the extent of these symptoms in participants and comparing differences in exposure to different levels of risk. The purpose of this study was to assess the psychological health of healthcare workers who were exposed to various risks in China, which may also serve as an effective evidence to guide the improvement of mental health of healthcare workers in various risk areas.

MATERIALS AND METHODS

Participants and Procedures

This study is part of an investigation into mental health symptoms, associated risk factors, and relevant coping methods among healthcare workers across the country during the peak of COVID-19 in China. The 810 participants comprised staff (including 239 [29.5%] doctors and 571 [70.5%] nurses) from 41 hospitals during the early pandemic. Since Wuhan was the hardest-hit region, we sampled more hospitals in Wuhan, accounting for approximately three-quarter of the total sample size. This study was approved by the Clinical Research Ethics Committee of the Second Xiangya Hospital of Central South University.

The specific procedures were as follows. The survey was conducted on "Questionnaire Star," a well-known online survey platform in China, from February 11 to March 3, 2020. The investigators distributed the link to the online questionnaire to workgroups at different hospitals through WeChat, spreading through a snowball sampling procedure (implying that each respondent was able to forward the link to another person). With informed consent, healthcare workers who received the link volunteered to participate in the study and could withdraw from the survey at any time. The online survey was anonymous and could only be completed once on the same device.

Measures

Demographic and Occupational Characteristics Data

Demographic information mainly included gender (male or female) and age (18–25, 26–30, 31–40, 41–50, or 51–60). Occupational characteristics data primarily included occupation type (doctor or nurse), technical title (junior, intermediate, or senior), type of hospital (secondary or tertiary), location (Wuhan, Hubei province outside Wuhan, or other cities outside Hubei province), designated hospitals (yes or no), current position (fever clinic, mild ward, intensive care unit, medical technology, or logistics), and exposure risk (low, medium, or high). For evaluating exposure risk levels, participants were asked to answer four questions related to exposure risk. First, they were asked to state the risk level of their local area (selected by themselves after consulting the local government announcement), and the following questions were set considering the different opportunities for medical staff to come into contact with patients: whether the protective materials at their posts were sufficient; whether they were in a front-line position; and what level of exposure risk did they think individuals have at work? These questions more clearly instruct participants to identify their individual exposure risk level, rather than simply filling in the risk level for their location.

Fatigue, Anxiety, and Insomnia Symptoms

Previous studies have revealed that in the early stages of the outbreak, medical staff are prone to fatigue, anxiety, insomnia, and other acute symptoms, whereas depression is relatively insignificant (11–13). To reduce the efforts for answering questions and assess the mental health status of healthcare workers more efficiently and quickly, we assessed symptoms of fatigue, anxiety, and insomnia using the Chinese version of the standardized measurement tools (17–19). It includes three scales. First, the Fatigue Severity Scale (FSS) is used to assess fatigue symptoms and consists of nine items with a total score ranging from 0 to 63, with 36 or more being subjective fatigue (17). Second, the Generalized Anxiety Disorder-7 (GAD-7) assesses

the severity of anxiety over the past 2 weeks, which contains seven items with a total score ranging 0–21 (18). The relationship between total scores and severity was as follows: normal (0–4), mild (5–9), moderate (10–14), and severe (15–21) anxiety. Lastly, the Insomnia Severity Index (ISI), a self-report tool that assesses the intensity of insomnia during the previous 2 weeks, contains seven items with a total score ranging 0–28 (19). The corresponding relationship between the total score and severity of insomnia was normal (0–7), mild (8–14), moderate (15–21), and severe (22–28) insomnia.

Statistical Analysis

SPSS statistical software (version 26.0; IBM Corp) was used for data analysis. The ranked data are shown as numbers and percentages, calculated from the scores of each level for symptoms of fatigue, anxiety, and insomnia. To assess the intensity of each symptom between two or more groups, the non-parametric Mann–Whitney *U*-test and Kruskal–Wallis test were used. Binary logistic regression analysis was used to identify potential risk factors for fatigue, anxiety, and insomnia symptoms in participants, and the associations between risk factors and outcomes were presented as odds ratios (ORs) and 95% confidence intervals (CIs), after controlling for confounders such as gender, age, occupation type, technical title, type of hospital, location, departments, designated hospital, current position, and exposure risk. Statistical significance was set at $P < 0.05$.

RESULTS

In the study, 810 healthcare professionals completed the survey, of whom 239 (29.5%) were doctors and 571 (70.5%) were nurses. Among the respondents, 577 (71.2%) were exposed to high-risk areas, 163 (20.1%) were exposed to medium-risk areas, and 70 (8.6%) were exposed to low-risk areas. The primary distribution of the respondents across gender, age, job title, affiliated hospital, and risk area was as follows: women (662 [81.7%]), 26–40 years old (505 [62.4%]), junior technical title (422 [52.1%]), working in a tertiary hospital (537 [66.3%]), working in a designated hospital (622 [76.8%]), and belonging to medium or high-risk areas (740 [91.3%]; **Table 1**).

The severity categories of fatigue, anxiety, and insomnia were measured in the total cohort and subgroups. Most of the participants had subjective fatigue (602 [74.3%]), anxiety (597 [73.7%]), and insomnia symptoms (500 [61.7%]). Compared with physicians, nurses were more likely to report severe symptoms of anxiety (86 [15.1] vs. 30 [12.6], $P = 0.024$) and insomnia (42 [7.4] vs. 12 [5.0], $P = 0.001$). Compared with men, women were more likely to report fatigue (505 [76.3%] vs. 97 [65.5%], $P = 0.007$), severe anxiety (97 [14.7%] vs. 19 [12.8%], $P = 0.021$), and moderate insomnia (123 [18.6%] vs. 17 [11.5%], $P = 0.006$). The healthcare workers who reported exposure to high-risk areas were more likely to experience fatigue, severe anxiety, and severe insomnia than those exposed to medium- and low-risk areas (fatigue: 462 [80.1%] vs. 106 [65.0%], and 34 [48.6%], $P < 0.001$; severe anxiety: 102 [17.7%] vs. 11 [6.7%], and 3 [4.3%], $P < 0.001$; and severe insomnia: 47 [8.1%] vs. 5 [3.1%], and 2 [2.9%], $P < 0.001$). Compared with those working in non-designated hospitals, participants working in COVID-19 designated hospitals were more likely to report symptoms of fatigue (476 [76.5%] vs. 126 [67.0%], $P = 0.009$) and severe insomnia (47 [7.6%] vs. 7 [3.7%], $P < 0.001$). Compared with healthcare workers in "Hubei outside Wuhan" and "outside Hubei," healthcare workers in Wuhan were more likely to report symptoms of fatigue (472 [76.7%] vs. 36 [58.1%], and 94 [70.7%], $P < 0.001$), anxiety (94 [15.3%] vs. 10 [16.1%], and 12 [9.0%], $P < 0.001$), and insomnia (94 [15.3%] vs. 10 [16.1%], and 12 [9.0%], $P < 0.001$; **Tables 2.1**, **2.2**).

For all participants, the median (IQR) scores on the FSS, the GAD-7, and the ISI scales were 44.0 (35.0–53.0), 7.0 (4.0–12.0), and 9.0 (5.0–14.0), respectively. Similarly, nurses, women, individuals exposed to high-risk areas, and those working in COVID-19 designated hospitals in Wuhan had higher scores on all scales. Specifically, among all participants, nurses scored higher than doctors on fatigue (46.0 [36.0–54.0] vs. 42.0 [33.0–48.0], $P < 0.001$), anxiety (7.0 [5.0–12.0] vs. 7.0 [4.0–11.0], $P = 0.004$), and insomnia (10.0 [6.0–15.0] vs. 8.0 [4.0–13.0], $P < 0.001$) symptom scales. Women were more likely than men to report high scores for fatigue (45.0 [36.0–54.0] vs. 40.0 [30.3–49.0], $P < 0.001$), anxiety (7.0 [5.0–12.0] vs. 6.0 [2.0–10.0], $P = 0.001$), and insomnia (10.0 [6.0–15.0] vs. 8.0 [3.0–13.0], $P = 0.001$) symptom scales (**Table 3.1**). Compared with those exposed to medium- and low-risk areas, participants who were exposed to high-risk areas reported higher scores in the three scales (fatigue: 46.0 [38.0–55.0] vs. 40.0 [31.0–51.0], 35.0 [26.8–43.0]; anxiety: 8.0 [5.0–13.0] vs. 6.0 [3.0–9.0], 5.0 [1.0–7.0]; and insomnia: 10.0 [6.0–15.0] vs. 8.0 [4.0–12.0], 6.0 [1.8–9.0]; $P < 0.001$). Moreover, participants working in a designated hospital reported higher scores than those working in a non-designated hospital (fatigue: 42.0 [32.0–49.0] vs. 45.0 [36.0–54.0], $P < 0.001$; anxiety: 7.0 [5.0–12.0] vs. 6.0 [2.0–11.0], $P = 0.001$; and insomnia: 10.0 [6.0–15.0] vs. 8.0 [3.3–12.0], $P < 0.001$). Similarly, compared to the participants in other cities of Hubei province (other than Wuhan) and other provinces, those in Wuhan reported higher scores in the three scales (fatigue: 45.0 [36.0–54.0] vs. 37.5 [27.5–47.3] and 43.0 [34.0–49.0], $P < 0.001$; anxiety: 7.0 [5.0–12.0] vs. 5.5 [2.0–9.3] and 6.0 [3.5–11.0], $P = 0.001$; and insomnia: 10.0 [6.0–15.0] vs. 8.0 [4.0–11.3] and 8.0 [4.0–13.0], $P = 0.002$; **Table 3.2**).

After controlling for confounding factors, binary logistic regression analysis revealed that nurses and women were more susceptible to fatigue (fatigue among nurses: OR, 0.54; 95% CI, 0.32–0.91; $P = 0.022$; fatigue among women: OR, 1.83, 95% CI, 1.07–3.14, $P = 0.028$). Compared with working in a secondary hospital, working in a tertiary hospital was associated with increased anxiety symptoms (OR, 1.45; 95% CI, 1.03–2.05; $P = 0.032$). Exposure to medium-risk areas was associated with increased anxiety symptoms than exposure to low-risk areas (OR, 1.91; 95% Cl, 1.06–3.45; $P = 0.031$). Compared with working in a non-designated hospital, working in a COVID-19 designated hospitals was associated with increased symptoms of insomnia (OR, 1.37; 95% CI, 0.95–1.97, $P = 0.090$). Exposure to high-risk areas was associated with increased fatigue, anxiety, and insomnia symptoms (fatigue: OR, 3.87; 95% CI, 2.26–6.61;

TABLE 1 | Demographic and occupational characteristics of participants.

Characteristic	Total (%)	Occupation		Exposure risk		
		Physician	Nurse	Low	Medium	High
	810 (100.0)	239 (29.5)	571 (70.5)	70 (8.6)	163 (20.1)	577 (71.2)
Gender						
Male	148 (18.3)	129 (54.0)	19 (3.3)	25 (35.7)	27 (16.6)	96 (16.6)
Female	662 (81.7)	110 (46.0)	552 (96.7)	45 (64.3)	136 (83.4)	481 (83.4)
Ages (years)						
18–25	119 (14.7)	7 (2.9)	112 (19.6)	8 (11.4)	18 (11)	93 (16.1)
26–30	217 (26.8)	26 (10.9)	191 (33.5)	14 (20.0)	41 (25.2)	162 (28.1)
31–40	288 (35.6)	116 (48.5)	172 (30.1)	27 (38.6)	69 (42.3)	192 (33.3)
41–50	149 (18.4)	72 (30.1)	77 (13.5)	16 (22.9)	30 (18.4)	103 (17.9)
51–60	37 (4.6)	18 (7.5)	19 (3.3)	5 (7.1)	5 (3.1)	27 (4.7)
Technical title						
Junior	422 (52.1)	56 (23.4)	366 (64.1)	30 (42.9)	69 (42.3)	323 (56.0)
Intermediate	315 (38.9)	125 (52.3)	190 (33.3)	28 (40.0)	78 (47.9)	209 (36.2)
Senior	73 (9.0)	58 (24.3)	15 (2.6)	12 (17.1)	16 (9.8)	45 (7.8)
Type of hospital						
Secondary	273 (33.7)	100 (41.8)	173 (30.3)	31 (44.3)	69 (42.3)	173 (30.0)
Tertiary	537 (66.3)	139 (58.2)	398 (69.7)	39 (55.7)	94 (57.7)	404 (70.0)
Location						
Wuhan	615 (75.9)	129 (54.0)	486 (85.1)	45 (64.3)	104 (63.8)	466 (80.8)
Hubei province	62 (7.7)	21 (8.8)	41 (7.2)	7 (10.0)	14 (8.6)	41 (7.1)
Outside	133 (16.4)	89 (37.2)	44 (7.7)	18 (25.7)	45 (27.6)	70 (12.1)
Designated hospitals						
Yes	622 (76.8)	147 (61.5)	475 (83.2)	44 (62.9)	113 (69.3)	465 (80.6)
No	188 (23.2)	92 (38.5)	96 (16.8)	26 (37.1)	50 (30.7)	112 (19.4)
Current position						
Fever clinic	64 (7.9)	25 (10.5)	39 (6.8)	4 (5.7)	10 (6.1)	50 (8.7)
Mild ward	358 (44.2)	87 (36.4)	271 (47.5)	43 (61.4)	74 (45.4)	241 (41.8)
Intensive care unit	247 (30.5)	27 (11.3)	220 (38.5)	5 (7.1)	29 (17.8)	213 (36.9)
Medical technology	102 (12.6)	85 (35.6)	17 (3.0)	12 (17.1)	37 (22.7)	53 (9.2)
Logistics department	39 (4.8)	15 (6.3)	24 (4.2)	6 (8.6)	13 (8.0)	20 (3.5)

$P < 0.001$; anxiety: OR, 2.66; 95% CI, 1.58–4.51; $P < 0.001$; and insomnia: OR, 2.83; 95% CI, 1.68–4.792; $P < 0.001$; **Table 4**).

DISCUSSION

This study assessed the mental health of healthcare workers exposed to different risks in the early stages of the COVID-19 pandemic and analyzed the risk factors. In 2022, the global pandemic and the epidemic in China have once again reached a severe state, and the results of our study may strengthen the government's early attention to the mental health of medical staff and provide more perspectives and evidence for psychological prevention and intervening measure of healthcare workers. In this survey, a total of 810 healthcare professionals who were exposed to different risks in China received and completed all questions in the online questionnaire. All participants were divided into three groups based on their exposure risk: low-risk areas (70), medium-risk areas (163), and high-risk areas (577), and interregional differences were compared. Our results showed that most of the participants had mental health concerns, with symptoms of fatigue (74.3%), anxiety (73.7%), and insomnia (61.7%). In addition, nurses, women, those working in tertiary hospitals, in COVID-19 designated hospitals, in Wuhan, and those exposed to medium-and high-risk areas were more likely to exhibit symptoms pointing to mental health concerns. In all aspects of interest, exposure to high-risk areas was an independent risk factor for poor mental health.

Thus, the results of this study highlight that more attention should be given to the mental health of healthcare workers who reported exposure to high-risk environments.

This study indicated that a significant proportion of healthcare workers had fatigue symptoms, but the rate was significantly higher than in one study of frontline nurses in Wuhan that reported 35.06% of respondents having fatigue (20). Moreover, a previous study conducted early in the SARS outbreak in Taiwan, China, showed that 77.4% of respondents reported anxiety and worry, 52.3% experienced sleep problems, and obvious anxiety symptoms were more prominent in the initial

TABLE 2.1 | Severity categories of fatigue, anxiety, and insomnia measurements in total cohort and subgroups.

Severity category	Total, No (%)	Occupation		Z	*P*	Gender		Z	*P*	Ages (years)					H	*P*
		Physician	Nurse			Male	Female			18–25	26–30	31–40	41–50	51–60		
FSS																
No.fatigue	208 (25.7)	69 (28.9)	139 (24.3)	−1.344	0.179	51 (34.5)	157 (23.7)	−2.703	0.007	24 (20.2)	48 (22.1)	75 (26.0)	49 (32.9)	12 (32.4)	5.178	0.270
Fatigue	602 (74.3)	170 (71.1)	432 (75.7)			97 (65.5)	505 (76.3)			95 (79.8)	169 (77.9)	213 (74.0)	100 (67.1)	25 (67.6)		
GAD-7																
Normal	213 (26.3)	76 (31.8)	137 (24)	−2.257	0.024	49 (33.1)	164 (24.8)	−2.303	0.021	30 (25.2)	47 (21.7)	88 (30.6)	41 (27.5)	7 (18.9)	7.315	0.120
Mild	311 (38.4)	89 (37.2)	222 (38.9)			58 (39.2)	253 (38.2)			48 (40.3)	86 (39.6)	109 (37.8)	59 (39.6)	9 (24.3)		
Moderate	170 (21.0)	44 (18.4)	126 (22.1)			22 (14.9)	148 (22.4)			21 (17.6)	48 (22.1)	56 (19.4)	31 (20.8)	14 (37.8)		
Severe	116 (14.3)	30 (12.6)	86 (15.1)			19 (12.8)	97 (14.7)			20 (16.8)	36 (16.6)	35 (12.2)	18 (12.1)	7 (18.9)		
ISI																
Normal	310 (38.3)	111 (46.4)	199 (34.9)	−3.273	0.001	72 (48.6)	238 (36)	−2.727	0.006	47 (39.5)	76 (35)	116 (40.3)	58 (38.9)	13 (35.1)	4.974	0.290
Mild	306 (37.7)	84 (35.1)	222 (38.9)			49 (33.1)	257 (38.8)			45 (37.8)	85 (39.2)	107 (37.2)	58 (38.9)	11 (29.7)		
Moderate	140 (17.3)	32 (13.4)	108 (18.9)			17 (11.5)	123 (18.6)			21 (17.6)	42 (19.4)	48 (16.7)	21 (14.1)	8 (21.6)		
Severe	54 (6.7)	12 (5.0)	42 (7.4)			10 (6.8)	44 (6.6)			6 (5)	14 (6.5)	17 (5.9)	12 (8.1)	5 (13.5)		

FSS, fatigue severity scale; GAD-7, 7-item generalized anxiety disorder; ISI, 7-item insomnia severity index.

TABLE 2.2 | Severity Categories of Fatigue, Anxiety, and Insomnia Measurements in Subgroups.

Severity category	Exposure risk			H	*P*	Designated hospitals		Z	*P*	Location			H	*P*
	Low	Medium	High			Yes	No			Wuhan	Hubei province	Outside Hubei		
FSS														
No.fatigue	36 (51.4)	57 (35.0)	115 (19.9)	52.478	0.000	146 (23.5)	62 (33.0)	−2.613	0.009	143 (23.3)	26 (41.9)	39 (29.3)	19.653	0.000
Fatigue	34 (48.6)	106 (65.0)	462 (80.1)			476 (76.5)	126 (67.0)			472 (76.7)	36 (58.1)	94 (70.7)		
GAD-7														
Normal	33 (47.1)	50 (30.7)	130 (22.5)	49.875	0.000	152 (24.4)	61 (32.4)	−1.569	0.117	152 (24.7)	19 (30.6)	42 (31.6)	13.726	0.001
Mild	23 (32.9)	76 (46.6)	212 (36.7)			246 (39.5)	65 (34.6)			235 (38.2)	23 (37.1)	53 (39.8)		
Moderate	11 (15.7)	26 (16.0)	133 (23.1)			134 (21.5)	36 (19.1)			134 (21.8)	10 (16.1)	26 (19.5)		
Severe	3 (4.3)	11 (6.7)	102 (17.7)			90 (14.5)	26 (13.8)			94 (15.3)	10 (16.1)	12 (9.0)		
ISI														
Normal	43 (61.4)	79 (48.5)	188 (32.6)	44.507	0.000	220 (35.4)	90 (47.9)	−3.657	0.000	220 (35.8)	30 (48.4)	60 (45.1)	12.130	0.002
Mild	19 (27.1)	61 (37.4)	226 (39.2)			237 (38.1)	69 (36.7)			231 (37.6)	25 (40.3)	50 (37.6)		
Moderate	6 (8.6)	18 (11.0)	116 (20.1)			118 (19.0)	22 (11.7)			115 (18.7)	6 (9.7)	19 (14.3)		
Severe	2 (2.9)	5 (3.1)	47 (8.1)			47 (7.6)	7 (3.7)			49 (8.0)	1 (1.6)	4 (3.0)		

FSS, fatigue severity scale; GAD-7, 7-item generalized anxiety disorder; ISI, 7-item insomnia severity index.

TABLE 3.1 | Scores of fatigue, anxiety, and insomnia measurements in total cohort and subgroups.

Scale	Total score median (IQR)	Occupation (IQR)		Z	P	Gender (IQR)		Z	P	Ages (years) (IQR)					H	P
		Physician	Nurse			Male	Female			18–25	26–30	31–40	41–50	51–60		
FSS (fatigue)	44.0 (35.0–53.0)	42.0 (33.0–48.0)	46.0 (36.0–54.0)	−3.909	0.000	40.0 (30.3–49.0)	45.0 (36.0–54.0)	−3.633	0.000	43.0 (37.0–54.0)	47.0 (37.0–54.0)	43.0 (35.0–50.8)	44.0 (31.0–55.0)	49.0 (23.0–57.0)	5.178	0.270
GAD-7 (anxiety)	7.0 (4.0–12.0)	7.0 (4.0–11.0)	7.0 (5.0–12.0)	−2.846	0.004	6.0 (2.0–10.0)	7 (5.0–12.0)	−3.287	0.001	7.0 (4.0–10.0)	7.0 (5.0–12.0)	7.0 (4.0–11.0)	7.0 (4.0–12.0)	11.0 (4.5–17.0)	7.315	0.120
ISI (insomnia)	9.0 (5.0–14.0)	8.0 (4.0–13.0)	10.0 (6.0–15.0)	−3.958	0.000	8.0 (3.0–13.0)	10.0 (6.0–15.0)	−3.375	0.001	10.0 (6.0–14.0)	10.0 (6.0–15.0)	9.0 (5.0–14.0)	8.0 (4.0–14.0)	11.0 (5.0–17.0)	4.974	0.290

FSS, fatigue severity scale; GAD-7, 7-item generalized anxiety disorder; ISI, 7-item insomnia severity index.

TABLE 3.2 | Scores of fatigue, anxiety, and insomnia measurements in subgroups.

Scale	Exposure risk			H	P	Designated hospitals		Z	P	Location			H	P
	Low	Medium	High			Yes	No			Wuhan	Hubei province	Outside Hubei		
FSS (fatigue)	35.0 (26.8–43.0)	40.0 (31.0–51.0)	46.0 (38.0–55.0)	52.478	0.000	45.0 (36.0–54.0)	42.0 (32.0–49.0)	−3.825	0.000	45.0 (36.0–54.0)	37.5 (27.5–47.3)	43.0 (34.0–49.0)	19.653	0.000
GAD-7 (anxiety)	5.0 (1.0–7.0)	6.0 (3.0–9.0)	8.0 (5.0–13.0)	49.875	0.000	7.0 (5.0–12.0)	6.0 (2.0–11.0)	−3.226	0.001	7.0 (5.0–12.0)	5.5 (2.0–9.3)	6.0 (3.5–11.0)	13.726	0.001
ISI (insomnia)	6.0 (1.8–9.0)	8.0 (4.0–12.0)	10.0 (6.0–15.0)	44.507	0.000	10.0 (6.0–15.0)	8.0 (3.3–12.0)	−4.155	0.000	10.0 (6.0–15.0)	8.0 (4.0–11.3)	8.0 (4.0–13.0)	12.13	0.002

FSS, fatigue severity scale; GAD-7, 7-item generalized anxiety disorder; ISI, 7-item insomnia severity index.

TABLE 4 | Risk factors for mental health symptoms identified by binary logistic regression.

Variable	No. of symptomatic cases/ No. of total cases (%)	Adjusted OR (95%CI)	*P*-value[a]
FSS, fatigue symptoms	629/859 (73.2)		
Occupation			
Physician	170/239 (71.1)	Reference	
Nurse	432/571 (75.7)	0.54 (0.32–0.91)	0.022
Gender			
Male	97/148 (65.5)	Reference	
Female	505/662 (76.3)	1.83 (1.07–3.14)	0.028
Exposure risk			
Low	34/70 (48.6)	Reference	
Medium	106/163 (65.0)	1.73 (0.96–3.12)	0.068
High	462/577 (80.1)	3.87 (2.26–6.61)	0.000
GAD-7, anxiety symptoms	621/859 (72.3)		
Occupation			
Physician	163/239 (68.2)	Reference	
Nurse	434/571 (76.0)	0.98 (0.6–1.6)	0.927
Gender			
Male	99/148 (66.9)	Reference	
Female	498/662 (75.2)	1.22 (0.73–2.06)	0.444
Type of hospital			
Secondary	188/273 (68.9)	Reference	
Tertiary	414/537 (77.1)	1.45 (1.03–2.05)	0.032
Exposure risk			
low	37/70 (52.9)	Reference	
Medium	113/163 (69.3)	1.91 (1.06–3.45)	0.031
High	447/577 (77.5)	2.66 (1.58–4.51)	0.000
ISI, insomnia symptoms	519/859 (60.4)		
Occupation			
Physician	128/239 (53.6)	Reference	
Nurse	372/571 (65.1)	1.1 (0.7–1.72)	0.689
Gender			
Male	76/148 (51.4)	Reference	
Female	424/662 (64.0)	1.42 (0.88–2.29)	0.149
Designated hospitals			
Yes	402/622 (64.6)	1.37 (0.95–1.97)	
No	98/188 (52.1)	Reference	0.090
Exposure risk			
Low	27/70 (38.6)	Reference	
Medium	84/163 (51.5)	1.55 (0.87–2.77)	0.140
High	389/577 (67.4)	2.83 (1.68–4.79)	0.000

FSS, fatigue severity scale; GAD-7, 7-item generalized anxiety disorder; ISI, 7-item insomnia severity index; OR, odds ratio.

[a] *P-value for each category vs. the reference.*

stage (7). Therefore, the results of our study are consistent with those of previous studies. However, compared with studies among healthcare workers during the COVID-19 pandemic in China and Italy, our study showed higher rates of anxiety (13, 21–23). Furthermore, the percentage of healthcare workers with insomnia in our study was higher than the pooled prevalence of sleep disorders in Chinese healthcare professionals during the COVID-19 pandemic, which was ∼45.1% (24). In the early pandemic period, longer working hours, a lack of protective equipment and supplies (25), and quarantine of self from family by healthcare workers significantly increased their perceived level of risk and psychological stress, which may exacerbate their daytime fatigue and affect mood and sleep patterns (14, 26, 27). In addition, the reasons why our study observed a higher rate of fatigue, anxiety, and insomnia may be due to differences in sample sources and sampling time. In this study, 71.2% of the participants worked in high-risk environments and may experience more work-related stress. Moreover, we discovered some differences in mental health between doctors and nurses, with nurses being more likely to experience fatigue, anxiety, and insomnia symptoms in the early pandemic period. Similarly, studies from other countries have revealed that the mental health burden on healthcare workers during the COVID-19 pandemic is significantly higher among nurses than doctors, owing to a greater exposure to both patients' and families' suffering and distress (28, 29).

More importantly, this survey showed that there were considerable disparities in the prevalence of fatigue, anxiety, and insomnia symptoms among healthcare professionals of different genders, with women scoring significantly higher than men. Similar results were also reported in a recent study of gender differences in mental health among healthcare workers during the COVID-19 pandemic (30). Moreover, it was consistent with earlier studies on healthcare professionals and the general public in the early stages of the SARS (7, 31) and COVID-19 pandemic (32, 33). Epidemiological studies have revealed that the lifetime prevalence of anxiety disorders is ∼1.5-times higher in women than in men (34, 35), and adult women had significantly higher rates of insomnia reported (36–38). These differences may be influenced by many physiological factors, such as sex chromosome genes, sex hormones, and the activity of the hypothalamic-pituitary-adrenal axis (39, 40). Additionally, under significant stress, women tend to adopt more emotion-centered coping styles, such as complaint, avoidance, and self-blame, which are associated with increased symptoms of anxiety and insomnia (34).

What makes the study more remarkable is that it discovered that health care professionals at different exposure risks had different rates of mental health symptoms, with those in high-risk areas more likely to experience fatigue, anxiety, and insomnia. Moreover, it is an independent risk factor for poor mental health. Studies in China, Poland, Italy, Switzerland, and other countries during the COVID-19 pandemic have also revealed that front-line workers, especially those in high-risk areas, such as the intensive care unit, the infectious diseases unit, and the emergency departments, were at a much higher risk of anxiety, insomnia, and depressive symptoms than second-line workers (15, 41–43). This result may be due to the following reasons. First, the workload of front-line staff is overwhelming, especially during the outbreak of COVID-19, and the number of infections has increased sharply, and staff are more prone to fatigue symptoms, anxiety, and other psychological problems (44–47). Second, with regard to psychological aspects, compared

with the staff in low-risk areas, the staff exposed to the high-risk setting and having a direct contact with a significant number of infected people, may have greater concerns about exposure to infection coupled with the patient's negative emotions, protective material shortage, lack of contact with family, and guilt from not being able to save each patient, leading to a significant increase in the psychological pressure of frontline staff (20, 26). Research has revealed that psychological stress is directly related to mental health problems such as anxiety and insomnia, and the greater the psychological stress, the higher the likelihood of these symptoms (45, 48, 49). The European Psychiatric Association also issued a statement highlighting the necessity of paying attention to psychological problems and early intervention among frontline workers (50). In addition, our study suggests that governments can allocate the number of mental health workers and the corresponding treatment model according to the level of exposure risk to more accurately maintain the mental health of healthcare workers and achieve a more effective use of resources.

Study Limitations

This study had some limitations. First, our study focused on risk factors affecting the mental health of healthcare workers and lacked analysis of protective factors during the pandemic. Recent research has argued that resilience, emotion regulation, and social support may play a protective role in healthcare workers during the pandemic, and these protective factors may be operating to grant healthcare workers the necessary resilience in facing the enormous challenges posed by the pandemic (51). Second, the study was cross-sectional, reflecting only the mental health of healthcare professionals at that point in time, and could not reflect causality. Third, all data were collected through self-reported questionnaires, which may have increased the recall bias. Moreover, a convenience sampling method was adopted to recruit participants, which may limit the representativeness of the samples and the generality of the research results to some extent. Finally, our survey did not consider respondents' prior mental and physical conditions, which may have had some impact on their reported results.

In conclusion, the study of healthcare workers revealed a significant prevalence of fatigue, anxiety, and insomnia, especially among women during the COVID-19 pandemic. The survey results also demonstrated significant differences in psychological symptoms among healthcare workers exposed to different levels of risk, in which those in high-risk areas are more vulnerable to experiencing mental health symptoms. These findings remind us to pay more attention to healthcare workers, especially women and nurses, and those working in high-risk settings during the COVID-19 pandemic, while providing them with more support, including medical material support, personnel support, family support, and as early as possible to carry on psychological intervention, to maintain their mental health.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Clinical Research Ethics Committee of the Second Xiangya Hospital of Central South University. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

LT, HB, DL, and XO contributed to the study concept and design. LZ and YS acquired and collected the data. YZ analyzed the data and drafted the manuscript. All authors read and approved the final manuscript.

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Factors Associated With Experiences of Fear, Anxiety, Depression, and Changes in Sleep Pattern During the COVID-19 Pandemic Among Adults in Nigeria: A Cross-Sectional Study

Morenike Oluwatoyin Folayan[1,2], Olanrewaju Ibigbami[3], Brandon Brown[1,4], Maha El Tantawi[1,5], Nourhan M. Aly[1,5], Oliver C. Ezechi[1,6], Giuliana Florencia Abeldaño[1,7], Eshrat Ara[1,8], Martin Amogre Ayanore[1,9], Passent Ellakany[1,10], Balgis Gaffar[1,11], Nuraldeen Maher Al-Khanati[1,12], Ifeoma Idigbe[1,6], Mohammed Jafer[1,13], Abeedha Tu-Allah Khan[1,14], Zumama Khalid[1,14], Folake Barakat Lawal[1,15], Joanne Lusher[1,16], Ntombifuthi P. Nzimande[1,17], Bamidele Olubukola Popoola[1,18], Mir Faeq Ali Quadri[1,19], Mark Roque[1,20], Ala'a B. Al-Tammemi[1,21], Muhammad Abrar Yousaf[1,22], Jorma I. Virtanen[1,23], Roberto Ariel Abeldaño Zuñiga[1,24], Nicaise Ndembi[1,25], John N. Nkengasong[1,25] and Annie Lu Nguyen[1,26]*

[1] Mental Health and Wellness Study Group, Ile-Ife, Nigeria, [2] Department of Child Dental Health, Obafemi Awolowo University, Ile-Ife, Nigeria, [3] Department of Mental Health, Obafemi Awolowo University, Ile-Ife, Nigeria, [4] Department of Social Medicine, Population and Public Health, Riverside School of Medicine, University of California, Riverside, Riverside, CA, United States, [5] Department of Pediatric Dentistry and Dental Public Health, Faculty of Dentistry, Alexandria University, Alexandria, Egypt, [6] Department of Clinical Sciences, Nigerian Institute of Medical Research, Lagos, Nigeria, [7] School of Medicine, University of Sierra Sur, Oaxaca, Mexico, [8] Government College for Women, Srinagar, India, [9] Department of Health Policy Planning and Management, School of Public Health, University of Health and Allied Sciences, Ho, Ghana, [10] Department of Substitutive Dental Sciences, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia, [11] Department of Preventive Dental Sciences, College of Dentistry, Imam Abdulrahman bin Faisal University, Dammam, Saudi Arabia, [12] Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Syrian Private University, Damascus, Syria, [13] Department of Preventive Dental Sciences, Saudi Arabia Department of Health Promotion, Faculty of Health, Medicine and Life Sciences, Jazan University, Maastricht University, Maastricht, Netherlands, [14] Department of Health Sciences, University of Genova, Genova, Italy, [15] Department of Periodontology and Community Dentistry, University of Ibadan and University College Hospital, Ibadan, Nigeria, [16] Director of People and Member of the Provost's Group, Regent's University, London, United Kingdom, [17] Department of Economic and Social Geography, University of Szeged, Szeged, Hungary, [18] Department of Child Oral Health, University of Ibadan, Ibadan, Nigeria, [19] Department of Preventive Dental Sciences, Division of Dental Public Health, College of Dentistry, Jazan University, Jizan, Saudi Arabia, [20] Department of Maternity and Childhood Nursing, College of Nursing, Taibah University, Medina, Saudi Arabia, [21] Migration Health Division, International Organization for Migration (IOM), The UN Migration Agency, Amman, Jordan, [22] Institute of Zoology, University of the Punjab, Lahore, Pakistan, [23] Faculty of Medicine, University of Turku, Turku, Finland, [24] Postgraduate Department, University of Sierra Sur, Oaxaca, Mexico, [25] Africa Centres for Disese Control and Preventon, African Union Commission, Addis Ababa, Ethiopia, [26] Department of Family Medicine, Keck School of Medicine, University of Southern California, Los Angeles, CA, United States

Background: Multiple facets of the pandemic can be a source of fear, depression, anxiety and can cause changes in sleep patterns. The aim of this study was to identify health profiles and the COVID-19 pandemic related factors associated with fear, depression, anxiety and changes in sleep pattern in adults in Nigeria.

Methods: The data for this analysis was extracted from a cross-sectional online survey that collected information about mental health and well-ness from a convenience sample of adults 18 years and above resident in Nigeria from July to December 2020. Study

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***Correspondence:**
Morenike Oluwatoyin Folayan
toyinukpong@yahoo.co.uk

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participants were asked to complete an anonymous, closed-ended online questionnaire that solicited information on sociodemographic profile, health profiles (high, moderate and low COVID-19 infection risk profile) including HIV status, COVID-19 status, and self-reported experiences of fear, anxiety, depression and changes in sleep patterns.

Results: In total, 4,439 participants with mean age of 38.3 (±11.6) years responded to the survey. Factors associated with higher odds of having COVID-19 related fear were health risk ($p < 0.05$); living with HIV (AOR: 3.88; 95% CI: 3.22–4.69); having COVID-19 symptoms but not tested (AOR: 1.61; 95% CI: 1.30–1.99); having a friend who tested positive to COVID-19 (AOR: 1.28; 95% CI: 1.07–1.53) and knowing someone who died from COVID-19 (AOR: 1.43; 95% CI: 1.24–1.65). The odds of feeling anxious was significantly higher for those with moderate or low health risk profile ($p < 0.05$); living with HIV (AOR: 1.64; 95% CI: 1.32–2.04); had a friend who tested positive for COVID-19 (AOR: 1.35; 95% CI: 1.08–1.68) or knew someone who died from COVID-19 (AOR: 1.53; 95% CI: 1.28–1.84). The odds of feeling depressed was significantly higher for those with health risk profile ($p < 0.05$); living with HIV (AOR: 2.49; 95% CI: 1.89–3.28); and respondents who had COVID-19 symptoms but had not taken a test (AOR: 1.41; 95% CI: 1.02–1.94). Factors associated with higher odds of having sleep pattern changes were having moderate and low health risk profiles ($p < 0.05$).

Conclusion: The study findings suggest that the pandemic may cause fear, anxiety, depression and changes in sleep patterns differently for people with different health profile, HIV status and COVID-19 status.

Keywords: SARS-CoV-2, mental health, HIV, COVID-19, Nigeria, mental distress

INTRODUCTION

For many individuals, the COVID-19 pandemic has been a source of fear, depression, and anxiety; all of which can lead to changes in sleep quality and patterns. Multiple facets and characteristics of the pandemic can be attributed to these outcomes. Concerns about mortality and morbidity associated with the COVID-19, scarcity of financial resources, and uncertainty about time of recovery from associated financial hardships are partly to blame (1). Patients with COVID-19 also fear abandonment, feelings of isolation and psychological sufferings (1). Some may fear infecting friends and family members, otherwise known as contamination fear (2–4). The fear of the unknown appears to be a core component of anxiety that accompanies situations that are unpredictable and uncontrollable (5, 6). Fear of these threats is often learned, irrespective of the probability of its occurrence, and results from the inability to tolerate uncertainty (7). The intolerance of uncertainty is also related to depressive symptomatology, and the fear of COVID-19 may explain part of the relation (8).

The COVID-19 pandemic is associated with up to a seven times higher prevalence of depression (9) and over 25% mental deterioration in some populations (10, 11). Persons with prior history of mental health disorders had higher rates of depression during the pandemic (12). Depressive symptoms were associated with testing positive for COVID-19 or having COVID-19 symptoms, exposure to social media, poor social support, unemployment, uncertainty about the future of jobs, and careers and economic crisis, especially for students (9). As with fear, depression is associated with anxiety (13, 14). The prevalence of anxiety during the COVID-19 pandemic is higher than 30% (15); and anxiety is higher in people with poor health (16). Anxiety disorder may lead to dysfunctional arousal that in turn results in persistent sleep-wake difficulties such as insomnia and hypersomnia (17, 18). Sleep disturbance is also a diagnostic symptom for generalized anxiety disorder (19), with young people being the worse-affected (20).

Though the prevalence of sleep problems, fear, anxiety and depression increased during the pandemic (21, 22), the impact may, however, differ between populations (23, 24). Fear, anxiety, depression and sleep disorder may be lower in the general population than it is in populations living with co-morbidities. Understanding the association between negative emotions and sleep pattern during the COVID-19 pandemic is important. However, research in this field is scarce (20). We hypothesize that respondent's COVID-19 related status would be associated with the experience of fear, depression, anxiety and changes in sleep pattern during the pandemic; that more people living with HIV will experience fear, anxiety, depression and sleep disorder; and

Abbreviations: AOR, Adjusted Odds Ratio; CI, Confidence Interval; COVID-19, Corona Virus Infectious Disease – 2019; HIV, Human Immunodeficiency Virus; PTSD, Post Traumatic Stress Disorder; SARS-CoV-2, Severe Acute Respiratory Syndrome Corona Virus Type 2.

that more people with fear, anxiety, depression and sleep disorder will use COVID-19 preventive measures.

The consolidation of contextual fear, depression, anxiety and avoidance of the shock evoke negative emotions and trigger alterations in sleep characteristics (25). Despite this, there is a little known about the aspects of the pandemic crisis that trigger negative emotions. One of the aims of this study was to identify COVID-19 pandemic related factors such as COVID-19 test positivity status, history of COVID-19 symptoms, and contact/relation with persons who have COVID-19, and their association with fear, depression, anxiety, and changes in sleep pattern. We also identified the association between fear, depression, anxiety, and changes in sleep pattern and the COVID-19 status. Finally, we determined if living with HIV was associated with the experience of fear, depression, anxiety, and changes in sleep pattern.

METHODS

Study Design and Study Participants

This was a sub-analysis data from an international cross-sectional study on the impact of COVID-19 on the mental health and wellness of adults using an online multi-country survey. Data were collected from a convenient sample of adults 18 years and above from July to December 2020. The study methodology had been reported in detail in prior studies (26, 27).

Study Instrument

The survey used a questionnaire, which was initially developed for a study that targeted a specific population in the United States and was consequently adapted and validated for use by a global audience (28). The questionnaire underwent four iterative processes content validation. The overall content validity index of the survey was 0.83. The responses collected for content validation were excluded from the final analysis. The study was approved by the Human Research Ethics Committee at the Institute of Public Health of the Obafemi Awolowo University Ile-Ife, Nigeria (HREC No: IPHOAU/12/1557). Participants received no incentive for taking part in the study.

Recruitment of the Study Participants

A call for collaboration for this study was made on Research gate. The 45 collaborators engaged through the public call were required to distribute their unique survey links to networks within and outside their countries and communities to ensure maximum representation and geographic spread. There were none data collectors recruited from Nigeria. The study participants were recruited through respondent-driven sampling. These links were posted on social media groups (Facebook, Twitter, and Instagram) and sent via WhatsApp or email to eligible participants in each collaborators' networks. The study participants were further asked to disseminate the links to those in their own networks using snowball sampling to facilitate further recruitment. The survey link was also posted on social media groups (Facebook, Twitter, and Instagram, WhatsApp) and network email lists.

Data Collection

Study participants were asked to complete an anonymous, closed-ended questionnaire to learn about how the COVID-19 pandemic has affected the people's mental health and psychological wellbeing. The questionnaire also enquired about respondents' sociodemographic profile, health profile, and various aspects of pandemic-related stress. The questionnaire was preceded by a brief introduction explaining the purpose of the study, and assuring participants of their voluntary participation, and confidentiality of their data. The questionnaire took an average of 11 min to complete and was administered in English. Each participant could only complete a single questionnaire through IP address restrictions, though they could edit their answers freely until they chose to submit. For the current analyses, we included only respondents who self-reported as residing in Nigeria. We also identified and removed survey responses that were completed below 7 min—the minimum time for filling the questionnaire by people familiar with the questionnaire in the pilot stage ($n = 77$); and those with incomplete data on fear, anxiety, depression and sleep disorder ($n = 32$).

Explanatory Variables

Sociodemographic Variables

The section on sociodemographic profile had questions on country of residence, age (in years), sex at birth, highest level of education attained (none, primary, secondary and tertiary) and employment status (retired, student, employed, and unemployed).

Health Profile

The section on health profile required respondents to select any of the 23 medical conditions listed that they experienced in addition to other health conditions not listed. These medical conditions put individuals at high risk for severe COVID-19 disease (pneumonia, diabetes, cancer, heart condition), those that might put people at moderate risk for severe COVID-19 disease (hepatitis, hypertension, neurological problems, neuropathy, respiratory problems, stroke, depression) and those conditions associated with low risk for severe COVID-19 disease (herpes, shingles and other sexually transmitted infections, dermatologic problems, migraines, arthritis, broken bones, hearing loss and vision loss) (29). As part of the list, participants were also asked about their HIV status. A tick on a checkbox on the list of health conditions was an indication that the individual had the health condition. All respondents were categorized as either having the health condition (indicated by a tick of the checkbox) or not having the health condition (indicated by not ticking the checkbox).

COVID-19 Status

Respondents were asked if they had tested positive for COVID-19, had COVID-19 symptoms but did not test, had a close friend who tested positive for COVID-19, or knew someone who died from COVID-19. Response choices for these items were "yes" or "no".

TABLE 1 | Factors associated with COVID-19 status by adults in Nigeria ($N = 4,439$).

Variables	Total $N = 4,439$ *n* (%)	COVID-19 positive			Had COVID-19 symptoms but no test			Friend tested positive to COVID-19			Knew someone who died of COVID-19		
		No $N = 4,329$ *n* (%)	Yes $N = 110$ *n* (%)	*P*-value	No $N = 3,973$ *n* (%)	Yes $N = 466$ *n* (%)	*P*-value	No $N = 3,724$ *n* (%)	Yes $N = 715$ *n* (%)	*P*-value	No $N = 3,072$ *n* (%)	Yes $N = 1,367$ *n* (%)	*P*-value
Age Mean (SD) in years	38.30 (11.63)	38.31 (11.59)	39.58 (12.72)	0.256	38.77 (11.71)	34.64 (10.15)	<0.001	38.11 (11.82)	39.55 (10.45)	0.002	37.16 (11.38)	40.99 (11.72)	<0.001
Sex													
Male	2,076 (46.8)	2,020 (97.3)	56 (2.7)	0.386	1,829 (88.1)	247 (11.9)	0.004	1,716 (82.7)	360 (17.3)	0.036	1,358 (65.4)	718 (34.6)	<0.001
Female	2,363 (53.2)	2,309 (97.7)	54 (2.3)		2,144 (90.7)	219 (9.3)		2,008 (85.0)	355 (15.0)		1,714 (72.5)	649 (27.5)	
Level of education													
No formal education	48 (1.1)	46 (95.8)	2 (4.2)	0.689	42 (87.5)	6 (12.5)	0.764	43 (89.6)	5 (10.4)	<0.001	37 (77.1)	11 (22.9)	<0.001
Primary	84 (1.9)	82 (97.6)	2 (2.4)		76 (90.5)	8 (9.5)		77 (91.7)	7 (8.3)		66 (78.6)	18 (21.4)	
Secondary	715 (16.1)	701 (98.0)	14 (2.0)		633 (88.5)	82 (11.5)		664 (92.9)	51 (7.1)		604 (84.5)	111 (15.5)	
College/university	3,592 (80.9)	3,500 (97.4)	92 (2.6)		3,222 (89.7)	370 (10.3)		2,940 (81.8)	652 (18.2)		2,365 (65.8)	1,227 (34.2)	
Employment status													
Current status													
Retired	122 (2.7)	118 (96.7)	4 (3.3)	0.163	117 (95.9)	5 (4.1)	0.002	112 (91.8)	10 (8.2)	<0.001	77 (63.1)	45 (36.9)	<0.001
Student	495 (11.2)	489 (98.8)	6 (1.2)		425 (85.9)	70 (14.1)		456 (92.1)	39 (7.9)		398 (80.4)	97 (19.6)	
Employed	3,131 (70.5)	3,045 (97.3)	86 (2.7)		2,822 (90.1)	309 (9.9)		2,517 (80.4)	614 (19.6)		2,053 (65.6)	1,078 (34.4)	
Unemployed	691 (15.6)	677 (98.0)	14 (2.0)		609 (88.1)	82 (11.9)		639 (92.5)	52 (7.5)		544 (78.7)	147 (21.3)	
Medical health profile													
High risk													
No	4,272 (96.2)	4,171 (97.6)	101 (2.4)	0.014	3,828 (89.6)	444 (10.4)	0.250	3,593 (84.1)	679 (15.9)	0.051	2,977 (69.7)	1,295 (30.3)	<0.001
Yes	167 (3.8)	158 (94.6)	9 (5.4)		145 (86.8)	22 (13.2)		131 (78.4)	36 (21.6)		95 (56.9)	72 (43.1)	
Moderate risk													
No	3,742 (84.3)	3,657 (97.7)	85 (2.3)	0.040	3,376 (90.2)	366 (9.8)	<0.001	3,166 (84.6)	576 (15.4)	0.003	2,647 (70.7)	1,095 (29.3)	<0.001
Yes	697 (15.7)	672 (96.4)	25 (3.6)		597 (85.7)	100 (14.3)		558 (80.1)	139 (19.9)		425 (61.0)	272 (39.0)	
Low risk													
No	3,986 (89.8)	3,895 (97.7)	91 (2.3)	0.013	3,596 (90.2)	390 (9.8)	<0.001	3,359 (84.3)	627 (15.7)	0.043	2,797 (70.2)	1,189 (29.8)	<0.001
Yes	453 (10.2)	434 (95.8)	19 (4.2)		377 (83.2)	76 (16.8)		365 (80.6)	88 (19.4)		275 (60.7)	178 (39.3)	
HIV Status													
Living with HIV	912 (20.5)	904 (99.1)	8 (0.9)	<0.001	819 (89.8)	93 (10.2)	0.740	830 (91.0)	82 (9.0)	<0.001	740 (81.1)	172 (18.9)	<0.001
Not living with HIV	3,527 (79.5)	3,425 (97.1)	102 (2.9)		3,154 (89.4)	373 (10.6)		2,894 (82.1)	633 (17.9)		2,332 (66.1)	1,195 (33.9)	
COVID 19 related fear													
Fear of getting infected													
No	2,189 (49.3)	2,108 (96.3)	81 (3.7)	<0.001	1,998 (91.3)	191 (8.7)	<0.001	1,858 (84.9)	331 (15.1)	0.078	1,565 (71.5)	624 (28.5)	0.001
Yes	2,250 (50.7)	2,221 (98.7)	29 (1.3)		1,975 (87.8)	275 (\12.2)		1,866 (82.9)	384 (17.1)		1,507 (67.0)	743 (33.0)	

(Continued)

TABLE 1 | Continued

Variables	Total N = 4,439 n (%)	COVID-19 positive			Had COVID-19 symptoms but no test			Friend tested positive to COVID-19			Knew someone who died of COVID-19		
		No N = 4,329 n (%)	Yes N = 110 n (%)	P-value	No N = 3,973 n (%)	Yes N = 466 n (%)	P-value	No N = 3,724 n (%)	Yes N = 715 n (%)	P-value	No N = 3,072 n (%)	Yes N = 1,367 n (%)	P-value
Fear of infecting someone else													
No	3,936 (88.7)	3,857 (98.0)	79 (2.0)	<0.001	3,599 (91.4)	337 (8.6)	<0.001	3,379 (85.8)	557 (14.2)	<0.001	2,794 (71.0)	1,142 (29.0)	<0.001
Yes	503 (11.3)	472 (93.8)	31 (6.2)		374 (74.4)	129 (25.6)		345 (68.6)	158 (31.4)		278 (55.3)	225 (44.7)	
Anxiety													
No	3,693 (83.2)	3,608 (97.7)	85 (2.3)	0.093	3,333 (90.3)	360 (9.7)	<0.001	3,140 (85.0)	553 (15.0)	<0.001	2,624 (71.1)	1,069 (28.9)	<0.001
Yes	746 (16.8)	721 (96.6)	25 (3.4)		640 (85.8)	106 (14.2)		584 (78.3)	162 (21.7)		448 (60.1)	298 (39.9)	
Depression													
No	4,050 (91.2)	3,953 (97.6)	97 (2.4)	0.251	3,653 (90.2)	397 (9.8)	<0.001	3,398 (83.9)	652 (16.1)	0.961	2,785 (68.8)	1,265 (31.2)	0.041
Yes	389 (8.8)	376 (96.7)	13 (3.3)		320 (92.3)	69 (17.7)		326 (83.8)	63 (16.2)		287 (73.8)	102 (26.2)	
Changes in sleep pattern													
No	3,432 (77.3)	3,347 (97.5)	85 (2.5)	0.992	3,093 (90.1)	339 (9.9)	0.013	2,894 (84.3)	538 (15.7)	0.149	2,396 (69.8)	1,036 (30.2)	0.105
Yes	1,007 (22.7)	982 (97.5)	25 (2.5)		880 (87.4)	127 (12.6)		830 (82.4)	177 (17.6)		676 (67.1)	331 (32.9)	

Outcome Variables

Fear, Anxiety and Depression

Respondents were asked to indicate if they had experienced fear, anxiety and depression during the pandemic by checking a response box. The questions were adapted from the Pandemic Stress Index (30).

Changes in Sleep Pattern

Respondents were asked to indicate if they had experienced changes in sleep patterns (sleeping more, sleeping less, or no changes) during the pandemic. Each respondent was required to check a response box that indicated if they had experienced any of these conditions. The questions were adapted from the Pandemic Stress Index (30). The responses were dichotomised to change (sleeping more, sleeping less) and no change in sleep pattern.

Data Analysis

Data were downloaded from Survey Monkey® as SPSS file version 23.0 (IBM Corp., Armonk, N.Y., USA), cleaned and prepared for analysis. T- test and chi square tests were used to assess the relationship between COVID-19 status (testing positive, suspected but not tested, friend testing positive and knowing someone who died of COVID-19) on one hand, and health profile, HIV status, fear, anxiety, depression, and changes in sleep pattern on the other hand. Also, the associations between the explanatory variables and the outcome variables were determined by conducting logistic regression analysis using four models: one for each outcome variable. The covariates for the study were the sociodemographic profile (age, sex, educational level, and employment status). Adjusted odds ratios, 95% confidence intervals (CIs) and *p*-values were calculated. Significance was set at 5%.

RESULTS

The mean age of the 4,439 respondents living in Nigeria was 38.3 years (SD = 11.6) ranging from 18 years to 85 years. **Table 1** highlights the demographic profile of respondents. More than half of the respondents were females (53.2%), the majority had college/university education (80.9%) and were employed (70.5%). Also, 110 (2.5%) respondents tested positive for COVID-19, 466 (10.5%) had COVID-19 symptoms but did not take a test, 715 (16.1%) had a friend who had tested positive to COVID-19, and 1,367 (30.8%) knew someone who died of COVID-19. The majority (52.9%) expressed fear in response to the pandemic—fear of getting infected (50.7%) or fear of infecting someone (11.3%). Moreover, 746 (16.8%) felt anxious, 389 (8.8%) felt depressed and 1,007 (22.7%) experienced changes in their sleep pattern.

Significantly more respondents with high ($p = 0.014$), moderate ($p = 0.040$) and low ($p = 0.013$) medical risks tested positive for COVID-19. Also, significantly more people not living with HIV than people living with HIV (PLHIV) had a positive SARS-CoV-2 test result ($p < 0.001$). In addition, significantly more people who had no fear of getting infected with COVID-19

TABLE 2 | Logistic regression analysis for factors associated with anxiety, depression and sleep changes during the COVID-19 pandemic by adults in Nigeria ($N = 4,439$).

Variables	Fear		Anxiety		Depression		Sleep changes	
	AOR (95% CI)	*P*-value	AOR (95% CI)	*P*-value	AOR (95% CI)	*P*-value	AOR (95% CI)	*P*-value
Age	1.00 (0.99–1.01)	0.965	1.00 (0.99–1.01)	0.892	0.95 (0.94–0.96)	<0.001	0.99 (0.98–0.99)	<0.001
Sex								
Male (ref: Not male)	1.15 (1.01–1.30)	0.030	0.77 (0.65–0.91)	0.002	0.90 (0.71–1.14)	0.389	0.82 (0.71–0.95)	0.007
Level of education								
No formal education	1.00	–	1.00	–	1.00	–	1.00	–
Primary	0.80 (0.31–2.04)	0.634	0.98 (0.68–2.08)	0.960	0.30 (0.11–0.79)	0.015	0.99 (0.30–3.31)	0.984
Secondary	0.67 (0.30–1.46)	0.315	0.46 (0.24–0.87)	0.017	0.49 (0.23–1.05)	0.066	1.47 (0.55–3.90)	0.442
College/university	0.56 (0.26–1.22)	0.146	0.43 (0.23–0.80)	0.008	0.48 (0.23–1.02)	0.057	1.39 (0.53–3.66)	0.504
Employment status								
Employed (ref: Not employed)	1.25 (1.08–1.46)	0.003	1.18 (0.97–1.43)	0.109	0.82 (0.64–1.06)	0.134	0.79 (0.67–0.94)	0.008
Health profile								
High risk (ref: No high risk)	1.69 (1.17–2.45)	0.005	1.40 (0.97–2.03)	0.075	1.66 (1.03–2.69)	0.038	1.25 (0.86–1.50)	0.245
Moderate risk (ref: No moderate risk)	1.61 (1.34–1.93)	<0.001	2.61 (2.15–3.18)	<0.001	7.88 (6.14–10.10)	<0.001	1.57 (1.29–1.92)	<0.001
Low risk (ref: No low risk)	1.16 (0.94–1.44)	0.160	1.50 (1.18–1.90)	0.001	1.50 (1.09–2.07)	0.013	1.86 (1.50–2.32)	<0.001
HIV status								
Living with HIV (ref: Not living with HIV)	3.88 (3.22–4.69)	<0.001	1.64 (1.32–2.04)	<0.001	2.49 (1.89–3.28)	<0.001	0.30 (0.23–0.39)	<0.001
COVID-19 status								
Tested COVID-19 positive								
Yes (ref: No)	0.56 (0.37–0.85)	0.006	1.01 (0.62–1.65)	0.966	1.41 (0.73–2.72)	0.300	0.78 (0.49–1.26)	0.309
Had COVID-19 symptoms but no test								
Yes (ref: No)	1.61 (1.30–1.99)	<0.001	1.28 (0.99–1.64)	0.059	1.41 (1.02–1.94)	0.038	1.15 (0.92–1.45)	0.226
Friend tested positive to COVID-19								
Yes (ref: No)	1.28 (1.07–1.53)	0.008	1.35 (1.08–1.68)	0.007	1.06 (0.76–1.49)	0.726	1.06 (0.86–1.30)	0.579
Knew someone who died of COVID-19								
Yes (ref: No)	1.43 (1.24–1.65)	<0.001	1.53 (1.28–1.84)	<0.001	0.79 (0.60–1.04)	0.089	1.05 (0.89–1.24)	0.551
Nagelkerke R^2	0.123		0.096		0.209		0.076	
Omnibus test of model coefficients	430.34	<0.001	261.12	<0.001	436.05	<0.001	227.29	<0.001
Hosmer and Lemeshow goodness of fit test	6.515	0.590	13.26	0.103	24.11	0.002	8.72	0.367

AOR, adjusted odds ratio; CI, confidence interval.

($p < 0.001$) and those who had the fear of infecting other persons ($p < 0.001$) tested COVID-19 positive.

Significantly more respondents who had COVID-19 symptoms but did not test were younger ($p < 0.001$), were males ($p = 0.004$), students ($p = 0.002$), had moderate ($p < 0.001$) and low ($p < 0.001$) health risks, had fear of getting infected ($p < 0.001$) and infecting someone else ($p < 0.001$), felt anxious ($p < 0.001$), depressed ($p < 0.001$) and had changes in sleep pattern ($p = 0.013$).

Significantly more respondents who had a friend who tested positive to COVID-19 were older ($p = 0.002$), males ($p = 0.036$), had college/university education ($p < 0.001$), were employed ($p < 0.001$), had moderate ($p = 0.003$) or low ($p = 0.043$) health risk, were not living with HIV ($p < 0.001$) and had the fear of infecting someone else ($p < 0.001$) and felt anxious ($p < 0.001$).

Significantly more respondents who knew someone who died of COVID-19 were older ($P < 0.001$), males ($p < 0.001$), had college/university education ($p < 0.001$), were retirees ($p < 0.001$), had mild, moderate or high health risk profiles ($p < 0.001$), were not living with HIV ($p < 0.001$), had the fear of getting infected ($p = 0.001$) or infecting others ($p < 0.001$), felt anxious ($p < 0.001$) and did not feel depressed ($p = 0.041$).

Table 2 highlights the factors associated with COVID-19 related fear, anxiety, depression and changes in sleep pattern. The *p*-values of the omnibus tests of model coefficients for the four models indicate that the models outperformed the null models. The goodness of fit tests also indicated that the models were robust except the model to determine the factors associated with depression.

The factors associated with significantly higher odds of having COVID-19 related fear were being a male (AOR: 1.15; 95% CI: 1.01–1.30); being employed (AOR: 1.25; 95% CI: 1.08–1.46); having high (AOR: 1.69; 95% CI: 1.17–2.45) and moderate (AOR: 1.61; 95% CI: 1.34–1.93) health risk; living with HIV (AOR:

3.88; 95% CI: 3.22–4.69); having COVID-19 symptoms but not yet tested (AOR: 1.61; 95% CI: 1.30–1.99); having a friend who tested positive to COVID-19 (AOR: 1.28; 95% CI: 1.07–1.53) and knowing someone who died from COVID-19 (AOR: 1.43; 95% CI: 1.24–1.65). Having tested positive to COVID-19 was associated with significantly lower odds of experiencing fear (AOR: 0.56; 95% CI: 0.37–0.85).

Also, respondents had significantly higher odds of feeling anxious when they had moderate (AOR: 2.61; 95% CI: 2.15–3.18) or low (AOR: 1.50; 95% CI: 1.18–1.90) health risk profile; living with HIV (AOR: 1.64; 95% CI: 1.32–2.04); had a friend who tested positive for COVID-19 (AOR: 1.35; 95% CI: 1.08–1.68) or knew someone who died from COVID-19 (AOR: 1.53; 95% CI: 1.28–1.84). The odds of feeling anxious were significantly lower for respondents who were males (AOR: 0.77; 95% CI: 0.69–0.91); and those with secondary (AOR: 0.46; 95% CI: 0.24–0.87) or college/university (AOR: 0.43; 95% CI: 1.25–4.39) education when compared with those that had no formal education. Respondents who had significantly higher odds of feeling depressed had high (AOR: 1.66; 95% CI: 1.03–2.69), moderate (AOR: 7.88; 95% CI: 6.14–10.10) and low (AOR: 1.50; 95% CI: 1.09–2.07) health risks; living with HIV (AOR: 2.49; 95% CI: 1.89–3.28); and respondents who had COVID-19 symptoms but had not taken a test (AOR: 1.41; 95% CI: 1.02–1.94). The odds of feeling depressed were significantly lower for respondents who were older (AOR: 0.95; 95% CI: 0.94–0.96); and who had primary school education (AOR: 0.03; 95% CI: 0.11–0.79) when compared with those that had no formal education.

Factors associated with significantly higher odds of having sleep pattern changes were having moderate (AOR: 1.57; 95% CI: 1.29–1.92) or low (AOR: 1.86; 95% CI: 1.50–2.32) health risk profiles. Factors associated with significantly lower odds of having sleep pattern changes were being older (AOR: 0.99; 95% CI: 0.98–0.99); being a male (AOR: 0.82; 95% CI: 0.71–0.95); employed (AOR: 0.79; 95% CI: 0.67–0.94); and living with HIV (AOR: 0.30; 95% CI: 0.23–0.39).

DISCUSSION

The study identified COVID-19 related factors associated with the experience of fear, depression, anxiety and changes in sleep pattern during the pandemic. First, we identified that respondents who had COVID-19 symptoms but not yet tested, who had a friend who tested positive and who knew someone who died from COVID-19 had higher odds of being afraid while those who had tested positive to COVID-19 had lower odds of experiencing fear. Anxiety was higher for persons who had a friend who tested positive for COVID-19 and who knew someone who died from COVID-19. Those who had COVID-19 symptoms but had not taken a test had higher odds of being depressed. Second, respondents with low and moderate health risks had higher odds of feeling depressed, anxious or having changes in sleep pattern during the pandemic while those with moderate and high health risk profiles had higher odds of having fears (fear of contracting infection or infecting others). Third, PLHIV had higher odds of having fears, feeling anxious or depressed than people not living with HIV. They also had lower odds of changes in sleep patterns than people not living with HIV. Fourth, males had higher odds of having COVID-19 related fears, and lower odds of having anxiety and changes in sleep patterns; older respondents had lower odds of feeling depressed and having changes in sleep patterns; those with secondary or college/university education had lower odds of feeling anxious, while those with primary school education had lower odds of feeling depressed than respondents without formal education.

The study provides evidence that the experience of fear, depression, anxiety, and changes in sleep patterns differ between different populations. We observed that some populations that had higher odds of being afraid and higher odds of having being anxious (having moderate and low health risk for COVID-19, PLHIV, having a friend tested positive to COVID-19, knowing someone who died from COVID-19); higher odds of being depressed (having high, moderate and low health risk for COVID-19) and higher odds of having changes in sleep patterns (having moderate and low health risk for COVID-19). Others had higher odds of being afraid but lower odds of having anxiety (males) and changes in sleep patterns (being employed, PLHIV). The complex relationship between fear, anxiety, depression, and changes in sleep patterns was reflected in the results we report about PLHIV. PLHIV had higher odds of having fears and feeling anxious or depressed, but lower odds of changes in sleep patterns.

Also, our study findings that respondents who had COVID-19 symptoms but not yet tested, who had a friend who tested positive and who knew someone who died from COVID-19 was associated with higher odds for fear and anxiety is an indication for identifying individuals with this profile and providing psychological support to them. Their fears and anxiety may be related with concerns about they themselves likely testing COVID-19 positive, the stigma associated with this status (31) and the concerns with being quarantined (32). Their fears and anxiety may also be due to concerns with the attendant consequences of testing positive (2) such as facing stigma (33), boredom, frustration, inadequate supplies, inadequate information, and financial loss while in quarantine or isolation (2). Quarantine and isolation are also associated with anger, confusion, and post-traumatic stress symptoms (2). Positive public messaging about COVID-19 positive status may also go a long way to ameliorates these concerns about COVID-19 that triggers negative emotions.

These associations suggest that there may be various factors that mediate and/or moderate the relationship between fear, depression, anxiety and changes in sleep patterns. One of these factors may be age: we observed that respondents who are older had lower odds of feeling depressed or having changes in sleeping patterns. Aging is associated with an intrinsic reduction in susceptibility to depression (34) though people with chronic illness are more likely to be depressed (34–41) and have changes in sleep pattern due to physiological alterations (42, 43). People with high health risks are usually

older (44–47). Our study findings indicated that those with high, moderate, and low health risk profiles had higher odds of reporting depression, anxiety and changes in sleep pattern corroborating prior findings (34–43). Populations with health concerns during the COVID-19 pandemic may however, have heightened concerns due to their susceptibility to infection and the absence of known therapies and vaccines. This may explain the high risk for depression, anxiety and changes in sleep pattern. On the other hand, this profile may have changed with the increased access to COVID-19 vaccines. The possibility of these changes may need to be explored in future studies.

Gender may act as a mediator and/or moderator of the relationship between fear, anxiety, and changes in sleep patterns. Though females were previously reported to be more likely to have fears (48), we observed in our study that males had higher odds of reporting fears. However, like a prior study, males had lower odds of reporting anxiety (49). We also observed that men had lower odds of changes in sleep patterns similar to prior studies that indicated that males had better sleep quality even during the pandemic (50, 51). This change in gender related association with fears during the pandemic may be related with men's concern about possible loss of income and the ability to provide the basic needs of the family. Although the International Labor Organization had stated that the pandemic had a greater impact on women than men in developed economies (52) this may not be the case for developing economies where men are responsible for securing food and life expenses and as such, may have greater concerns about losing their jobs due to COVID-19. Nigeria is a patriarchal society where men are the bread winners (53–55). With the loss of jobs and diminished income resulting from the pandemic (56–58), the affected male breadwinners may have fears. In the absence of welfare and social security packages during this pandemic for residents in Nigeria, there is a risk for an increase in health problems such as hypertension, high blood sugar and other metabolic disorders (59). This risk may be ameliorated by the lower risk for anxiety and sleep changes. This does not eliminate the possible need for palliative care for employees in Nigeria to absorb the economic shock they face because of the pandemic and reduce its impact on their quality of life.

Educational status is another possible mediator and/or moderator for anxiety and depression. Those with secondary education and above had lower odds of feeling anxious and those who had primary school education had lower odds of having depression than those without formal education. Prior studies indicated lower risk of depression and anxiety as the educational level improves (60, 61), while other evidence suggested no significant effect of educational level on anxiety (62). Like previous studies, we found that higher educational status was associated with lower odds of anxiety and depression during the pandemic. This finding may be because educated individuals may be more aware of modes of COVID-19 transmission and its consequences (63). Also, higher educational status may also be associated with better opportunities for employment, being male, lower risk for losing a job and thus, lower risk of experiencing anxiety and depression during the pandemic. This hypothesis needs to be tested further.

One of the strengths of this study is the large sample providing adequate study power. The data was also collected using validated tools and this strengthened the validity of the study findings. The data included information on the health status of respondents, which is relevant as differences in sickness status could influence anxiety, depression, and sleep pattern. The study has a few limitations despite its strengths. The self-reporting of fear, depression, anxiety, and HIV status is associated with high risk of social desirability and central tendency bias (64); and self-report may be more sensitive to identifying non-depressed, non-anxious and HIV negative individuals (65, 66). Also, we had an imbalance between participants on educational level, with comparably larger number of respondents with tertiary education which does not reflect the educational status of Nigeria. In addition, the study can only be generalized to those with internet access who could respond to the questionnaire; and it could not measure changes in the respondents' answers at different time points and phases of the pandemic as we know that the pandemic changed over time.

CONCLUSION

Various factors were identified to be significantly associated with experiencing fear, anxiety, depression and change in sleep patterns among the participants during the pandemic. The study findings suggest that the pandemic may have had significant impact on the psychological wellbeing and daily living of individuals. Capacity building and training on how to deal and cope with stressful events and to enhance individuals' resilience are of paramount importance during large-scale crisis like the current pandemic. Besides, our study findings open avenues for further longitudinal assessment of the impact of COVID-19 pandemic on various life domains, considering the dynamic nature of the crisis and human behavior.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Research Ethics Committee at the Institute of Public Health of the Obafemi Awolowo University Ile-Ife, Nigeria. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

The project was conceptualized by MF. The data for the research was collected by MF, II, FL, and BP. The data analysis was conducted by OI. All authors contributed to the article, read, and approved the submitted version.

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Modeling Rumor Diffusion Process With the Consideration of Individual Heterogeneity: Take the Imported Food Safety Issue as an Example During the COVID-19 Pandemic

Tinggui Chen[1,2], *Jingtao Rong*[1], *Jianjun Yang*[3] *and Guodong Cong*[4]*

[1] School of Statistics and Mathematics, Zhejiang Gongshang University, Hangzhou, China, [2] Academy of Zhejiang Culture Industry Innovation & Development, Hangzhou, China, [3] Department of Computer Science and Information Systems, University of North Georgia, Oakwood, GA, United States, [4] School of Tourism and Urban-Rural Planning, Zhejiang Gongshang University, Hangzhou, China

At present, rumors appear frequently in social platforms. The rumor diffusion will cause a great impact on the network order and the stability of the society. So it's necessary to study the diffusion process and develop the rumor control strategies. This article integrates three heterogeneous factors into the SEIR model and designs an individual state transition mode at first. Secondly, based on the influencing factors such as the trust degree among individuals, an individual information interaction mode is constructed. Finally, an improved SEIR model named SEIR-OM model is established, and the diffusion process of rumors are simulated and analyzed. The results show that: (1) when the average value of the interest correlation is greater, the information content deviation is lower, but the rumor diffusion range will be wider. (2) The increase of the average network degree intensifies influence of rumors, but its impact on the diffusion has a peak. (3) Adopting strategies in advance can effectively reduce the influence of rumors. In addition, the government should enforce rumor-refuting strategies right after the event. Also, the number of rumor-refuting individuals must be paid attention to. Finally, the article verifies the rationality and effectiveness of the SEIR-OM model through the real case.

Keywords: individual heterogeneity, rumor diffusion, SEIR-OM model, rumor control, COVID-19 pandemic

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Xenia Gonda,
Semmelweis University, Hungary

Reviewed by:
Hai Wang,
Saint Mary's University, Canada
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***Correspondence:**
Guodong Cong
cgd@mail.zjgsu.edu.cn

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INTRODUCTION

With the rapid development of Internet information technology, information diffusion has become more and more convenient. However, due to malicious tampering and other reasons, information will continue to be alienated in the diffusion process, which will increase its complexity and redundancy. While receiving a large amount of information, netizens cannot verify its authenticity and accuracy. This provides an opportunity for the large-scale rumor diffusion. At this time, if the hot information related to the national economy and people's livelihood is tampered with and not controlled in time, it will easily breed public anxiety, panic and other emotions, which will bring great economic impact to individuals, society or the country, and even threaten the harmony and stability of society. For example, when COVID-19 broke out at the end of 2019, rumors that "masks

cannot prevent viruses" diffuse on social platforms in many countries, thus many people failed to take correct epidemic prevention measures in time, causing the widespread diffusion of COVID-19 in many countries, which greatly affected the social and economic development in the world. As a result, analyzing the rumor formation, diffusion and its control strategy has an important theoretical and practical significance.

Scholars have conducted a lot of research on the diffusion and control of rumors and have achieved some results. At present, the research on rumors is mainly divided into two categories: (1) A qualitative analysis of the diffusion process of rumors from the phenomenon itself, mainly to study its causes and counter measures. However, most of these studies lack specific empirical investigations and quantitative methods, and their conclusions are subjective; (2) Use evolutionary game theory, communication dynamics and other related methods to construct mathematical models, and use mathematical derivation or computer simulation to achieve inter-group interactive simulation of information diffusion, and observe the results to explore the rules of rumor diffusion and counter measures.

However, most of these models simulate the diffusion process of rumors, but rarely consider the formation of rumors and psychological influence factors. Based on this, this article integrates the individual's diffusion willingness, the individual's forgetting degree, and the intensity of government punishment into the SEIR model, and designs a state transition mode at first. Secondly, it considers the individual's decision-making behavior in the process of rumor generation and diffusion, and establishes information interaction mode among individuals. Finally, an improved SEIR model named SEIR-OM model is established. Also, rumor generation and diffusion process are simulated and analyzed from two aspects: model parameter setting and rumor control strategy.

The structure of the article is organized as follows: section Literature Review is a literature review. Section Research Framework builds a SEIR-OM model. Section Model Construction simulates the rumor evolution process through simulation experiments, and studies the influences of model parameters and different rumor control strategies on the rumor evolution. Section Simulation Experiment validates the SEIR-OM model with the real case from the imported food safety issue during the COVID-19 Pandemic. Section Empirical Analysis makes the conclusions and prospects for future work.

LITERATURE REVIEW

This section reviews the relevant literature from two aspects: rumor diffusion and control.

With regard to the research on the rumor diffusion, most of the existing literature uses infectious disease models and evolutionary game models to analyze their diffusing process: (1) the first aspect is the research on the dynamics of rumor diffusion based on the infectious disease model. For instance, Zhang and Zhu (1) studied two kinds of rumor diffusing dynamics with quadratic relationship by establishing the I2S2R model, and concluded that the diffusing intensity of second rumors depended on the diffusing intensity of initial rumors. In addition, based on the SIR model, Huang and Jin (2) divided the immunized population into two categories: those who accepted rumors but were not interested in diffusing them, and those who did not believe rumors, and analyzed two strategies through numerical simulation: random immunization and target immunization. The results showed that the application of random or directed immunity could effectively prevent the diffusion of rumors while reducing the credibility of rumors. Jiang and Yan (3) proposed a piecewise SIR model to quantify the diffusing speed, scale and influence of online information. The simulation results showed that there was no proportional relationship between the sustained influence of a message and the number of diffusers. Zhou et al. (4) analyzed the influence of network topology on rumor diffusion based on SIR model. The mean field analysis showed that the number of infected nodes depended on the network topology. Moreno et al. (5) studied the dynamic process of rumor evolution in homogeneous network and scale-free network. The results showed that when rumor diffused in the latter, the number of people who did not diffuse rumor in the final state had nothing to do with the degree of the source of infection, but was closely related to the probability of infection. Zhang et al. (6) considered the influence of the attractiveness of information itself on the diffusion, and based on this, they proposed a rumor diffusion model based on the diffusion ability. Most of the above-mentioned literatures have added more diverse individual states on the basis of classic infectious disease models. However, since the individual interaction mechanism in the process of rumor diffusion is not considered, most studies still use fixed reception probability to describe the process of individuals receiving external information. (2) The second aspect is to use the evolutionary game model to describe the game decision-making process of individuals facing rumors. For instance, Fernández-Domingos et al. (7) established a prisoner's dilemma game model, and analyzed the behavior of each node in the topology during network information diffusion. This study showed that in small-scale networks, choosing cooperation was the optimal strategy of nodes. On the contrary, for large-scale networks, choosing non-cooperation was the optimal strategy. Furthermore, by using three real social network datasets, Li et al. (8) found that increasing the judgment ability of individuals could curb the diffusion of rumor effectively. Moreover, there existed some optimal risk coefficients and punishment fractions that could help more people refuse to diffuse rumor. Mojgan et al. (9) proposed an evolutionary game model to analyze the diffusion process of rumors in social networks. The model studied the factors affecting people's decision-making, such as social anxiety, and conducted sensitivity analysis experiments to illustrate the impact of different factors on the process of rumor propagation. The analysis showed that people's attitude toward rumor/anti-rumor had a significant impact on rumor diffusion. In addition, factors such as social anxiety and rumor intensity also accelerated the rumor diffusion. Most of the above-mentioned documents have studied the diffusion process of rumors among individuals on the Internet, but rarely studied the process of their formation, which cannot fully reflect the large-scale diffusion process of

rumors from its initiation, and from weak to strong of the whole evolution. However, the research on the formation mechanism of rumors can effectively reduce the generation of rumors, which is very important for rumor control. Therefore, it is necessary to study the formation mechanism of rumors.

In addition, regarding the research on rumor control, the methods used in the existing literature mainly include controlling high-influence nodes, controlling key connecting edges, and diffusing refuting information. The details are as follows: (1) Control high-influence nodes. This type of method aims to find nodes that contribute to the rumor diffusion, and then delete such nodes to reduce the influence of rumors. Some typical literature is as follows: based on a variety of complex network metrics of network centrality, e.g., centrality of degree, intermediate, proximity, etc., Comin et al. (10) analyzed three communication mechanisms and provided an effective method of hairstyle communication sources. Inspired by the idea of gravity formula, Ma et al. (11) took the *k*-shell value of the node as its mass and the shortest path length between the two nodes as the distance, proposed the gravity centrality method to determine the high influence node, and compared it with other centrality indexes. (2) Control key connecting edges. This type of method aims to find the edges that play key nodes in information dissemination and delete them to reduce the rumor diffusion. Some typical literature is as follows: Pallis (12) deleted *k* edges from the original network to diffuse rumors as little as possible, and explained which edge should be deleted depended on the eigenvalues of the network adjacency matrix. Yuan et al. (13) proposed a fine-grained heuristic algorithm to solve the rumor propagation minimization problem. The experiment showed that the heuristics based on betweenness and out-degree were orders of magnitude faster than the greedy algorithm in terms of running time. (3) Diffusing refuting information. This type of method diffuses information that is contrary to the content of the rumors, so that as many nodes as possible are not deceived by the rumors. Some typical literature is as follows: Zhang et al. (14) presented an in-depth analysis of the function of official rumor-refuting information (ORI) in suppressing and quashing rumors. They determined the influencing factors and constructed a competition model. The simulation results also indicated that government credibility and the release time of ORI played a critical role in controlling rumors. Zhang and Xu (15) presented a simple model to describe the interplay between rumors and rumor-refuting information based on biomathematics theory. By drawing from differential equations, a theoretical analysis reveals that this model exhibited three dynamic cases: extinction of rumors, extinction of rumor-refuting information and coexistence. Also, they studied the stability of the equilibrium points of three cases, found that stable condition of equilibrium point, and showed unstable case of model. Most of the above-mentioned literature studies the effects of different rumor control strategies adopted after the occurrence of hot events, but few literature explores the role of rumor prevention strategies adopted before the occurrence. However, proactive prevention strategy is also an important part of rumor control strategy, so it is necessary to study it.

To sum up, the academies have conducted a certain depth of research on the diffusion and control of rumors, but there are still deficiencies. Based on this, in section Model Construction, this article first designs a state transition mode based on SEIR model. At the same time, considering the rumor generating factors such as information tampering and individual heterogeneity factors such as personal reputation, an information interaction mode is constructed. Finally, SEIR-OM model is constructed by fusing state transition mode and information interaction mode. In addition, this article also divides the rumor control strategy into proactive strategy and reactive rumor refutation strategy, and analyzes their effects through simulation experiments.

RESEARCH FRAMEWORK

This article integrates the individual's diffusion willingness, the individual's forgetting degree, and the intensity of government punishment into the SEIR model, and designs the state transition mode at first. Secondly, it refers to the trust theory and information asymmetry theory, considers the main factors affecting information interaction among individuals, and establishes information interaction mode. Finally, an improved SEIR model named SEIR-OM model is constructed, and its formation and diffusing process are simulated and analyzed from two aspects: model parameter setting and rumor control strategy. The framework of the article is shown in **Figure 1**.

MODEL CONSTRUCTION

Classic SEIR Model

SEIR model is a classical infectious disease dynamics model, which is often used in the medical field to simulate the transmission process of infectious diseases (16, 17) and predict the development trend of epidemic situation (18, 19).

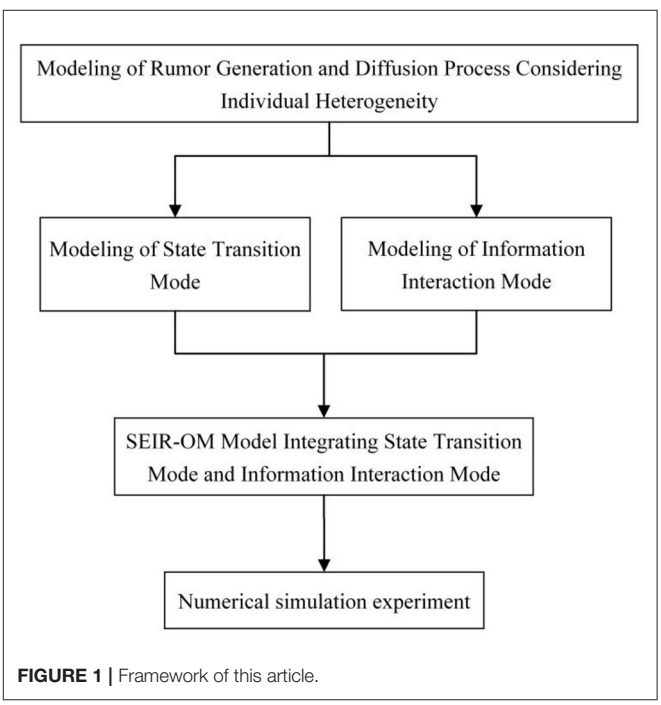

FIGURE 1 | Framework of this article.

The dissemination of public opinion information needs go through the process of germination, development, outbreak and finally decline, which is highly similar to the whole process of the development of infectious diseases. Therefore, in the existing research on information dissemination, a considerable proportion of studies uses SEIR model to analyze information dissemination.

The classic SEIR model divides individuals into four categories according to their different states in the diffusion process, namely: uninformed individual S, silent individual E, communication individual I, and immune individual R. Among them, uninformed individuals represent those who have not received information, corresponding to those who do not know the public opinion information in reality, and the initial states of most individuals are uninformed states; silent individuals represent those who have received information but have not diffused to uninformed ones; communication individuals represent those who receive information and diffuse information to other ones; immune individuals represent those referring to individuals who are no longer interested in information related to the event, which are the final states of individuals.

Moreover, the classic SEIR model has four assumptions: (1) The number of individuals always remains a constant, i.e., S+E+I+R=N (N is a constant); (2) Uninformed individuals turn into the silent after receiving information from the communication individual. Therefore, at $t + 1$, the number of newly-added silent ones is proportional to the number of communication ones at time t, and its proportional coefficient α is defined as the reception coefficient; (3) The number of newly-added silent ones at $t + 1$ is proportional to the total number of silent ones at time t, and its proportional coefficient σ is defined as the diffusing coefficient; (4) The communication individuals turn into immune ones after losing interest in the event-related information. Therefore, at time $t + 1$, the number of newly immunized individuals is proportional to the number of communication ones at time t, and the proportional coefficient ρ is defined as the immune coefficient. Based on the above four assumptions, the differential equations of the SEIR model are shown in formula (1):

$$\begin{cases} \frac{dS(t)}{dt} = -\alpha I(t)S(t) \\ \frac{dE(t)}{dt} = \alpha I(t)S(t) - \sigma E(t) \\ \frac{dI(t)}{dt} = \sigma E(t) - \rho I(t) \\ \frac{dR(t)}{dt} = \rho I(t) \end{cases} \quad (1)$$

Figure 2 is a schematic diagram of the classic SEIR model:

SEIR model uses fixed probability to describe the individual state transition process and information interaction process in the process of rumor propagation, ignoring the influence of individual heterogeneity factors on the process of rumor propagation. Based on this, next section will improve the classic SEIR model and construct the SEIR-OM model.

SEIR-OM Model Construction

In this section, the construction process of SEIR-OM model will be described in detail. The parameters and variables involved in the model are shown in **Tables 1**, **2**.

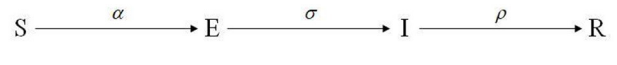

FIGURE 2 | Classic SEIR model.

State Transition Mode

The SEIR model uses a fixed probability to describe the transition of an individual's state, without considering the heterogeneity of the individual, so it cannot explain the internal mechanism of the individual's state transition. Based on this, the individual state transition mode of the SEIR model is improved here, and two factors describing individual heterogeneity are introduced, namely: individual's diffusion willingness and the individual's forgetting degree, which are used as the conditions for individual state transition.

(1) Individual's diffusion willingness. Diffusion willingness refers to "the sending intensity of sender's personal consciousness" (20), which is used to determine whether the individual diffuses the information to the outside world. It is important to determine whether the information can be diffused on a large scale in social networks. Generally, the factors that affect the one's diffusion willingness include two aspects: one is the degree of interest correlation between the individual and the event, which refers to the degree of influence of the occurrence and development of an event on a certain aspect of the person's interests (21), e.g., the occurrence of public health emergencies will damage the personal interests of local residents. The higher interest correlation of the individual to the event indicates the stronger willingness to diffuse relevant information; the other is accumulated gains due to external feedback after the information diffusion. If other individuals receive the information diffused by this individual, this individual's diffusion gains will increase, and his willingness to diffuse the information will be stronger. However, if other individuals reject the information diffused by the individual, his/her diffusion gains will decrease, and the corresponding diffusion willingness is also weaker. Therefore, the individual's diffusion willingness W_i is described by formula (2) (22):

$$W_i(t) = (b_{it} - 1)e^{1-m_{it}} + (1 - p) \quad (2)$$

where $b_{it} = b_{i(t-1)} + 0.1v_{it}$. Because each individual has a difference in the degree of interest correlation to a certain event, we assume that b_{i0} obeys a normal distribution with a mean value of μ_b and a variance of b^2, and is mapped to the interval [0,1]. $m_{i0} = 1$, when other individuals receive the information sent by individual i, and m_i is increased by 1.

(2) Individual's forgetting degree. Individual's attention to hot events will decay over time. Ebbinghaus research found that the failing of people's memory is fast at first and then slower. Considering that the degree of interest between individuals and the event will affect their attention to the event, referring to the Ebbinghaus forgetting curve equation, the individual forgetting degree F_i is described by the formula (3):

$$F_i(t) = 1 - e^{-\frac{t}{b_{it}}} \quad (3)$$

TABLE 1 | Involved parameters in the model.

Parameter	Description	Value
w	Diffusion threshold (refers to the critical value of information diffusion to the outside world)	[0,1]
f	Forgetting threshold (refers to the critical value of forgetting events)	[1,+∞)
b_{it}	Degree of interest correlation between individual i and public opinion events at time t	[0,1]
μ_b	Mean value of the degree of interest correlation between all individuals and public opinion events	[0,1]
s_b	Standard deviation of interest correlation between all individuals and public opinion events	[0,+∞)
c_i	Trust threshold of individual i (refers to the threshold at which the individual chooses to trust other individuals)	[0,1]
μ_c	Mean value of the trust thresholds of all individuals	[0,1]
p	Government punishment on rumors	[0,1]
m_{it}	Accumulated gain due to external feedback after the information diffusion	[0,+∞]
v_{it}	Amount of information received by individual i at time t	[0,+∞]
N	Total number of individuals in the network	(0,+∞)
s_{ij}	Shortest path between individual i and j	[0,+∞]
k_i	Number of neighbors of individual i	[0,+∞]
n_{ij}	Number of common neighbors of individuals i and j	[0,+∞]
d_{1i}	Subject deviation of the information content between mastered by individual i and original information	[0,2]
d_{2i}	Predicate deviation of the information content between mastered by individual i and original information	[0,2]
d_{3i}	Object deviation of the information content between mastered by individual i and original information	[0,2]
d_{4i}	Attribute deviation of the information content between mastered by individual i and original information	[0,2]
d_{5i}	Adverbial deviation of the information content between mastered by individual i and original information	[0,2]
s_{1i}	Deviation between the subject of the information content transmitted by individual i and that of the original information content	[0,2]
s_{2i}	Deviation between the predicate of the information content transmitted by individual i and that of the original information content	[0,2]
s_{3i}	Deviation between the object of the information content transmitted by individual i and that of the original information content	[0,2]
s_{4i}	Deviation between the attribute of the information content transmitted by individual i and that of the original information content	[0,2]
s_{5i}	Deviation between the adverbial of the information content transmitted by individual i and that of the original information content	[0,2]

TABLE 2 | Involved variables in the model.

Variable	Description	Value
W_i	Individual i's diffusion willingness	[0,1]
F_i	Individual i's forgetting degree	[0,1]
D_i	The set of deviations between the information content mastered by individual i and the original information content	
S_i	The set of deviations between the information content diffused by individual i and the original information content	
I_i	Social influence of individual i	[0,1]
R_{ij}	Strength of the relationship between individuals i and j	[0,1]
C_{ij}	The trust degree of individual i to individual j	[0,1]
K_i	Knowledge reserve of individual i	[0,1]
Σ_i	The degree of confusion of external information received by individual i in past information interactions	[0,1]
G_i	Individual i's mastery of event-related information	[0,1]
Δ_i	Individual i's tampered intensity with information content	[0,1]

Similar to the classical SEIR model, SEIR-OM model also divides individuals into four categories: uninformed individuals S, silent individuals E, communication individuals I, and immune individuals R. They also have the same meaning as the classical SEIR model.

In the individual state transition mode, the state transition rules are set as follows: when an uninformed person interacts with a communication one, the uninformed individual will transform into a silent one or a communication one according to his diffusion willingness. When the silent individual's diffusion willingness is greater than or equal to the diffusion threshold w, it turns into a communication one. When a communication individual's willingness is less than the diffusing threshold w and >0, he/she turns into a silent individual. If the individual's diffusion willingness is <0 or the forgetting degree is greater than forgetting threshold f, he/she turns into an immune one. The individual state transition rule is shown in **Figure 3**.

Note that although uninformed individuals and immune individuals do not participate in information dissemination, there are some differences between them. The uninformed individual means that the initial state of most individuals is uninformed state. After receiving the information, the state of the uninformed individual will change. On the contrary, the silent individual means that the final state of most individuals is silent state, and it will not change again. Also, the silent individuals will disconnect from other individuals.

Information Interaction Mode

The large-scale rumor diffusion is inseparable from the information interaction among individuals, and the information interaction process includes two stages, namely: the receiving stage and the diffusion stage of information. Existing studies mostly use SEIR model and evolutionary game model to describe this process. However, the SEIR model describes this process

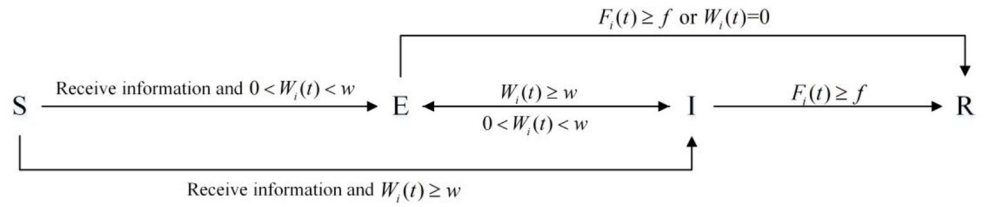

FIGURE 3 | Individual state transition rule.

through fixed reception probabilities and diffusion probabilities, ignoring the influence of individual heterogeneity factors on the information interaction process. While in the evolutionary game model, individuals choose whether to receive and diffuse information only based on the diffusion benefits. In addition, both the SEIR model and the evolutionary game model only describe the diffusion process after rumors are generated, and do not consider the rumor generation mechanism. Based on this, an information interaction mode is designed here to reflect the process of rumor generation and information interaction.

Information Content Deviation

Different people have different positions and opinions on the same public opinion event, and there are situations in the network where individuals distort and fabricate real information to gain attention. Therefore, in the process of information diffusion, information deviation is often caused, and a variety of different content of information coexist. In order to differentiate the information content mastered by different people and describe the difference between them and the original information content, the information content deviation set is established according to the Chinese sentence structure here.

In the Chinese context, a sentence is mainly composed of five parts, namely: subject, predicate, object, attributive, and adverbial. Therefore, the information content deviation set in the article is also composed of these five parts. Set the deviation set of the information grasped by the individual and the original information $D_i = < d_{1i}, d_{2i}, d_{3i}, d_{4i}, d_{5i} >$; the deviation set of the information content diffused by the individual and the original information $S_i = < s_{1i}, s_{2i}, s_{3i}, s_{4i}, s_{5i} >$. Among them, d_{1i}, d_{2i}, d_{3i}, d_{4i}, d_{5i}, s_{1i}, s_{2i}, s_{3i}, s_{4i}, s_{5i} are all described by values mapped to the interval [0,2]. d_{1i}, d_{2i}, d_{3i}, d_{4i}, d_{5i}, s_{1i}, s_{2i}, s_{3i}, s_{4i}, s_{5i} <1 means negative deviation, d_{1i}, d_{2i}, d_{3i}, d_{4i}, d_{5i}, s_{1i}, s_{2i}, s_{3i}, s_{4i}, s_{5i} <1 means positive deviation, d_{1i}, d_{2i}, d_{3i}, d_{4i}, d_{5i}, s_{1i}, s_{2i}, s_{3i}, s_{4i}, $s_{5i} = 1$ means it is consistent with the original information.

Factors Affecting Information Interaction Among Individuals

This section quantifies the two factors that affect the information interaction between people: one is the degree of trust between individuals and the other is the individual's mastery degree of event-related information.

(1) The degree of trust between individuals. Existing research on trust theory (23–25) generally believes that "trust is the premise of information exchange between individuals and the cornerstone of social networks. If there is no interpersonal trust, social networks will collapse." Taking the convenience of social networks into account, it can make two netizens who are not related in real life communicate, but the degree of mutual understanding of the interactive dual is not high. This leads to the fact that netizens in social networks can only determine whether to trust each other through their social influence and the strength of the relationship between netizens. Based on this, the degree of trust between individuals is determined by the individual's social influence and the strength of the relationship between them.

(1) Individual's social influence. A person's social influence refers to his/her ability to influence other ones' behaviors in a social network, and reflects the importance of an individual in the network. In complex network theory, tightness can be used as a measure of node centrality, which is defined as the average shortest path from a node to other reachable nodes. Generally, the higher the tightness is, the more important the node is. Therefore, the individual's tightness formula in the complex network is used to calculate the individual's social influence I_i, as shown in formula (4):

$$I_i = \frac{N-1}{\sum_j s_{ij}} \tag{4}$$

(2) Strength of relationships among individuals. In reality, people tend to trust their close friends more and trust the information they convey. Therefore, the strength of the relationship between individuals will have an impact on information diffusion, i.e., the closer the relationship between individuals is, the higher the degree of mutual trust is. Here, the concept of individual embedding degree (26), i.e., the number of common neighbor individuals that two individuals have in the network, is used to describe the strength of the relationship between these two individuals, as shown in formula (5):

$$R_{ij} = \begin{cases} \dfrac{n_{ij}}{(k_i - 1) + (k_j - 1)} & k_i, k_j \neq 1 \\ 1 & k_i = k_j = 1 \end{cases} \tag{5}$$

where k_i-1 represents the number of neighbors remaining for individual i except for individual j. (k_i-1) + (k_j-1) represents the maximum number of common neighbor individuals that may exist between individuals i and j. In addition, the premise of setting the interaction between two entities is that they have a direct connection in the network. Therefore, when $k_i = k_j = 1$, it means that individuals i and j are each other's exclusive

neighbors, and the relationship between the two is the strongest, i.e., $R_{ij} = 1$.

In summary, the calculation of the trust degree C_{ij} of individual i to individual j is shown in formula (6):

$$C_{ij} = I_i * R_{ij} \tag{6}$$

(2) The individual's mastery of event-related information. In social networks, only a small number of people can grasp more comprehensive information, while the vast majority only grasp part of the information and make behavioral decisions based on the limited information they have. This is called information asymmetry. The phenomenon of information asymmetry is an important driving force for the rumor diffusion (27). At present, the development of the Internet has made information acquisition more and more convenient, and the asymmetry of information between individuals will be weakened. However, at the same time, it will aggravate the level of information confusion in social networks. This is because the unique free speech space of the Internet allows any information to be diffused on a large scale in a short period of time, but it costs longer time to verify the information authenticity. Therefore, although the public have more opportunities and channels to obtain information, they cannot accurately judge the authenticity of the information, which further strengthens the asymmetry of individuals in terms of information accuracy. Based on this, this article introduces the individual knowledge reserve (28) and the degree of confusion in external information (29) to describe the individual's mastery of event-related information.

(1) Individual knowledge reserves. Because most individuals do not know the true situation of public opinion events, they can only judge whether to accept external information based on their own past experience and relevant knowledge. For example, during the outbreak of COVID-19, it was widely diffused on the Internet that dual yellow oral liquid could prevent virus infection. In fact, dual yellow oral liquid cannot prevent COVID-19 virus. However, due to the lack of knowledge of pathology and virology, the public chose to believe this information, which once triggered a panic buying wave. Based on this, the individual knowledge reserve K_i is assumed to follow a Poisson distribution with a mean value of λ to reflect the phenomenon that only a small number of individuals in the network have a relatively professional knowledge reserve.

(2) The degree of confusion in external information. After the diffusion of information, individuals gradually are aware of information with different contents. A large amount of redundant information will interfere with their judgment of the authenticity and accuracy of the information, so that there is a greater probability of accepting rumors or rejecting real information. Here, the degree of confusion in external information Σ_i is calculated by formula (7), as follows:

$$\Sigma_i(t) = \frac{1}{5}\sum_{j=1}^{5}\left(\sqrt{\sum_{l=1}^{n_i}(d_{jl}(t) - \sum d_{jl}(t)/n_i\ )/(n_i - 1)}\right) \tag{7}$$

In summary, the individual's mastery of event-related information G_i is described by formula (8).

$$G_i = K_i * \Sigma_i \tag{8}$$

Information Interaction Mechanism

When the information receiver has a high degree of trust in the communication individual, he/she will accept the information sent by the communication one. In addition, the communication ones are divided into ordinary communication individual O and malicious communication individual M according to diffuse intention. Among them, the ordinary communication individual diffuse information that he/she believes to be true to uninformed ones, who will not tamper or process the information in the processing of information diffusion. The malicious communication ones tamper and process the information for gaining attention and increasing influence, and diffuse processed information to others. Since the information receiving mechanism of all individuals is the same, and the information diffusion mechanism of different communication individuals is different, the information reception mechanism of the individual must be set first, and then the information diffusion mechanism of the general and the malicious communication individual must be set separately.

(1) Individual information reception mechanism

When a communication individual sends information to neighbors, the recipient of the information compares the communication individual's trust level with his/her own trust threshold at first. If the former's reputation is greater than the trust threshold, the information will be accepted by the information recipient, and vice versa. After receiving the information, the information recipient updates the content that he/she believes to be true according to his/her mastery of the event-related information. The specific reception mechanism is as follows:

When $C_{ij} \geq c_i$

$$\begin{aligned} d_{1i}(t+1) &= d_{1i}(t) + G_i(s_{1j}(t) - d_{1i}(t)) \\ d_{2i}(t+1) &= d_{2i}(t) + G_i(s_{2j}(t) - d_{2i}(t)) \\ d_{3i}(t+1) &= d_{3i}(t) + G_i(s_{3j}(t) - d_{3i}(t)) \\ d_{4i}(t+1) &= d_{4i}(t) + G_i(s_{4j}(t) - d_{4i}(t)) \\ d_{5i}(t+1) &= d_{5i}(t) + G_i(s_{5j}(t) - d_{5i}(t)) \\ d_i(t+1) &= \langle d_{1i}(t+1), d_{2i}(t+1), d_{3i}(t+1), d_{4i}(t+1), d_{5i}(t+1)\rangle \end{aligned} \tag{9}$$

When $C_{ij} < c_i$

$$d_i(t+1) = d_i(t) = \langle d_{1i}(t), d_{2i}(t), d_{3i}(t), d_{4i}(t), d_{5i}(t)\rangle \tag{10}$$

(2) Information diffusion mechanism of ordinary communication individuals

Generally speaking, while diffusing information to the outside world, ordinary communication individuals will directly diffuse the information they believe to be true to other individuals, i.e.,

$$\begin{aligned} s_i(t+1) = d_i(t+1) = \langle & d_{1i}(t+1), \\ & d_{2i}(t+1), d_{3i}(t+1), d_{4i}(t+1), d_{5i}(t+1)\rangle \end{aligned} \tag{11}$$

(3) Information diffusion mechanism of malicious communication individuals

Before diffusing information externally, malicious communication individuals will tamper with the information they believe to be true to a certain extent, and diffuse the tampered information to others. The degree of tampering will increase with the increase of the gain from the feedback of the tampered information, and decrease with the increase of the punishment of rumors. Therefore, the formula for calculating the tampered intensity Δ_i is as follows:

$$\Delta_i(t) = \ln(e^{1-p} - \frac{1}{m_{it}}) \tag{12}$$

Information diffusion mechanism of malicious communication individuals is as follows:

$$\begin{aligned} s_{1i}(t+1) &= d_{1i}(t+1) * (1 + (-1)^{\beta}\Delta_i(t+1)) \\ s_{2i}(t+1) &= d_{2i}(t+1) * (1 + (-1)^{\beta}\Delta_i(t+1)) \\ s_{3i}(t+1) &= d_{3i}(t+1) * (1 + (-1)^{\beta}\Delta_i(t+1)) \\ s_{4i}(t+1) &= d_{4i}(t+1) * (1 + (-1)^{\beta}\Delta_i(t+1)) \\ s_{5i}(t+1) &= d_{5i}(t+1) * (1 + (-1)^{\beta}\Delta_i(t+1)) \\ s_i(t+1) &= \langle s_{1i}(t+1), s_{2i}(t+1), s_{3i}(t+1), s_{4i}(t+1), s_{5i}(t+1) \rangle \end{aligned} \tag{13}$$

where β is a random number of either 0 or 1.

Framework and Simulation Steps of SEIR-OM Model

Based on the Barabási-Albert scale-free network (BA network) (30, 31), the Monte Carlo simulation method based on multi-agent is used to simulate the SEIR-OM model. Its construction process is shown in **Figure 4**.

Compared with the classical SEIR model, the state transition mode in SEIR-OM model can more reasonably and carefully describe the psychological mechanism of individual state transition. The information interaction mode in SEIR-OM model can not only distinguish different information contents, but also reflect the individual's psychological decision before receiving (transmitting) information.

The specific process of the formation and diffusion of rumors is as follows:

(1) At the initial moment, a certain number of malicious communication individuals and general communication individuals are randomly generated, and their initial diffusion willingness and the forgetting degree of public opinion events are generated according to formulas (1) and (2), respectively.

(2) At any time, the communication individual i randomly selects its neighbor individual j as the object of information interaction. If the trust degree of i is greater than or equal to the trust threshold of j, information interaction is carried out according to the state of j. Generally, there are the following two situations: (1) If j is an uninformed individual, he/she will fully accept the information diffused by i, form the initial diffusion willingness and the initial forgetting degree, and transform it into a communication individual or a silent individual according to the initial diffusion willingness. (2) When j is a silent individual or a communication individual, the communication individuals i and j exchange information according to the formulas (9–13). If the trust degree of the communication individual i is less than the trust threshold of j, they will not exchange information.

(3) At any time, after all communication individuals have completed their outward communication, they update

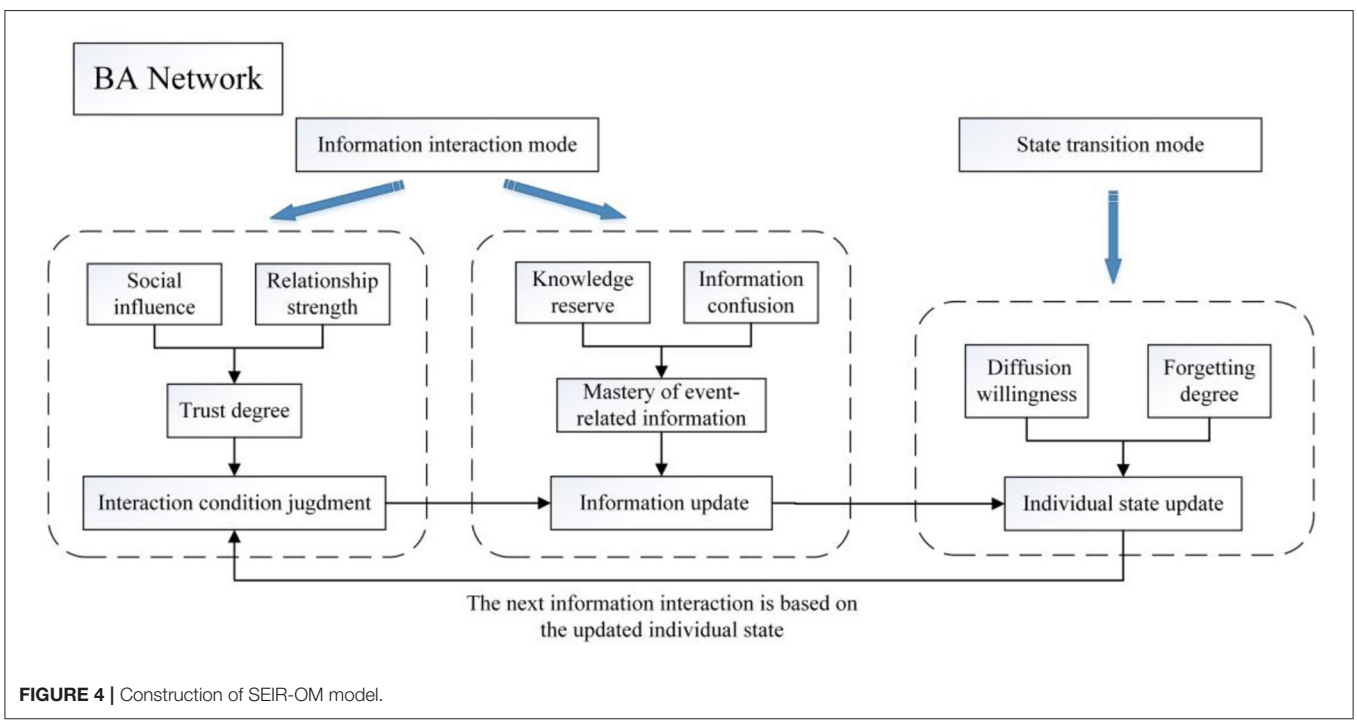

FIGURE 4 | Construction of SEIR-OM model.

the individual's diffusion willingness, forgetting degree, and individual state in the network.

(4) Determine whether the end condition is met. The conditions for ending the interaction are set as follows:

$$\frac{\sum_{i=1}^{N} v_i(t)}{N} \leq 0.1 \tag{14}$$

(5) If the interaction end condition is not satisfied, repeat steps (2)–(4) until formula (14) is satisfied, and the interaction process ends. The specific process is shown in **Figure 5**.

SIMULATION EXPERIMENT

This section uses the Monte Carlo simulation method based on multi-agent system to explore the influences of model parameters on the process of rumor diffusion and the implementation effects of different rumor control strategies. The simulation network is constructed with BA network, and the individual scale in the network is set to 300.

The Influence of Model Parameters on the Process of Rumor Diffusion

This section starts with the model parameters and analyzes its influence on the diffusion process of rumors. There are 2 comparison indicators used in the analysis:

(1) Entire network information content deviation: it refers to the average value of the deviation between the information content in the network and the actual information content. Here, the deviation $dev_i(t)$ between the information content diffused by the individual i and the real information content is set. The calculation is shown in formula (15), and the calculation of the deviation of the entire network information content deviation is shown in formula (16).

$$dev_i(t) = \frac{\sqrt{\sum_{x=1}^{5} (s_{xi}(t) - 1)^2}}{5} \tag{15}$$

$$Deviation(t) = \frac{\sum_{i=1}^{N} dev_i(t)}{N} \tag{16}$$

(2) Rumor diffusion range: it refers to the proportion of individuals holding rumors in the network to the total number of individuals on the network. Here, information with content deviation >0.5 is identified as a rumor, and the calculation is shown in formula (17). Based on this, the calculation of the rumor diffusion range is shown in formula (18):

$$d_i(t) \leftarrow \begin{cases} \text{rumor if } dev_i(t) \geq 0.5 \\ \text{truth if } dev_i(t) < 0.5 \end{cases} \tag{17}$$

$$Breath(t) = \frac{\sum \text{rumor}}{N} \tag{18}$$

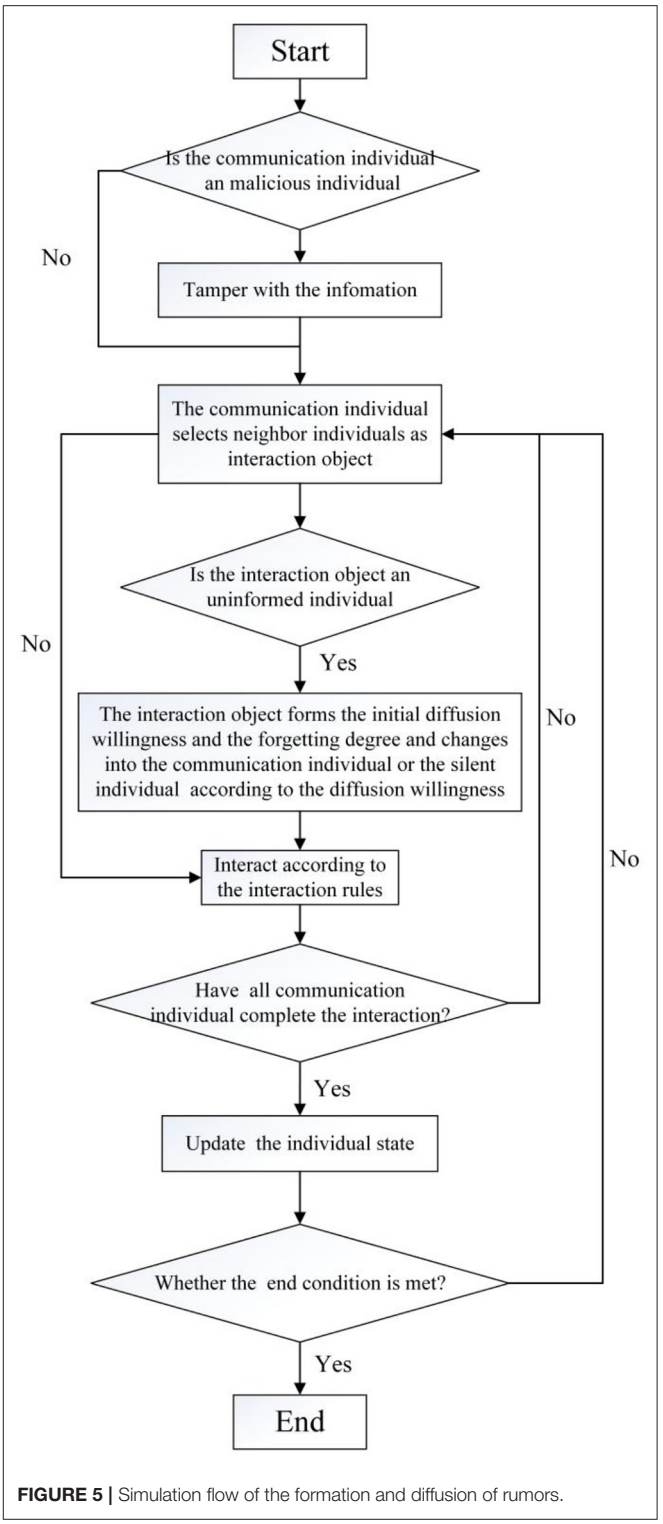

FIGURE 5 | Simulation flow of the formation and diffusion of rumors.

The Impact of μ_b on Rumor Evolution Process

The mean value of the degree of interest correlation between all individuals and public opinion events μ_b will affect the

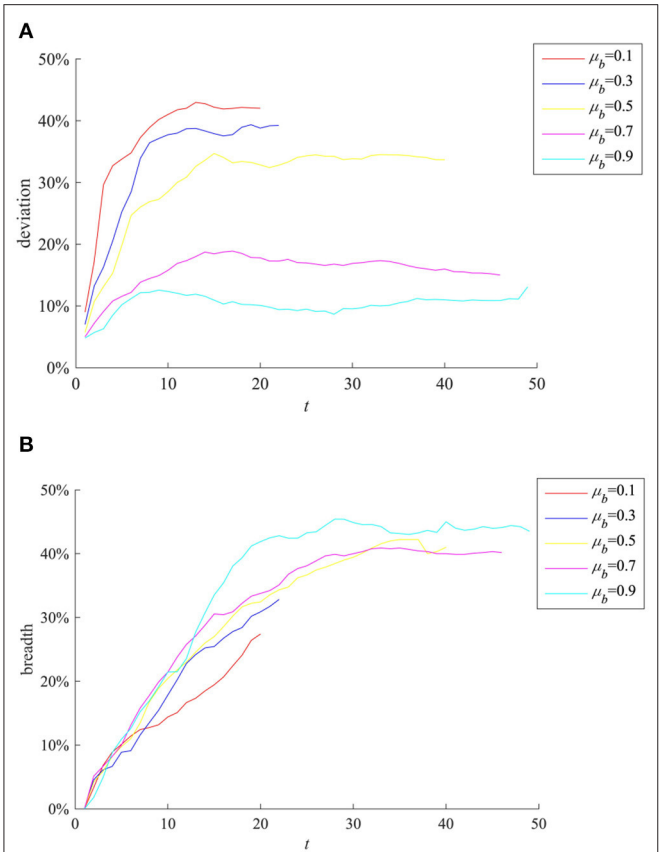

FIGURE 6 | The impact of μ_b on rumor evolution process. **(A)** Entire network information content deviation. **(B)** Rumor diffusion range.

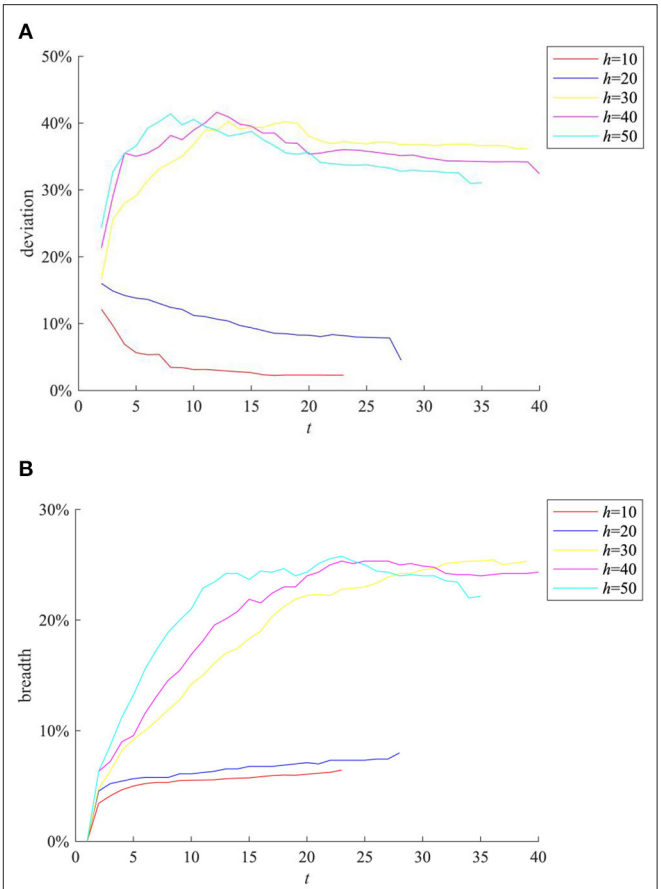

FIGURE 7 | The impact of network structure on rumor evolution process. **(A)** Entire network information content deviation. **(B)** Rumor diffusion range.

individual's attention to the event, and thus have an impact on the diffusion of event-related information. Here take μ_b as 0.1, 0.3, 0.5, 0.7, and 0.9, respectively, for comparison. The results are shown in **Figure 6**.

It can be seen from **Figure 6A** that as μ_b increases, the entire network information content deviation decreases. This shows that when the event is related to the interests of most individuals, they are more concerned about the authenticity of the information and more cautious about the information sent by the outside world, so that the entire network information content deviation of the entire network is lower. It can be seen from **Figure 6B** that as μ_b is larger, the rumor costs longer time to diffuse and its diffusion range is wider. This shows that individuals are more concerned about the incident and have a stronger willingness to forward information related to their own interests, and protect their own interests by expanding the influence of the incident, which also provides opportunities for the rumor diffusion and makes more widespread.

The Impact of Network Structure on Rumor Evolution Process

Social networks provide channels for information diffusion. If the network structure changes, the strength of relationships among individuals will change accordingly, which will affect the reception and diffusion of information. In order to study the influences of different network structures on the process of rumor diffusion, this section changes the value of h ($h \in [0,N]$) (Note that the BA network used in the simulation experiment is based on an interconnected network, after the introduction of several new nodes. The new nodes will be connected to h existing nodes). Our experiments generate BA networks of different structures, and compare the rumor diffusion under different network structures, then the results are as shown in **Figure 7**.

It can be seen from **Figures 7A,B** that when $h = 20$, the information content deviation of the entire network and the rumor diffusion range are higher than the case of $h = 10$. When $h = 30$, the information content deviation of the entire network exceeds 30%, and the rumor diffusion range also exceeds 20%. It can be seen that the increase of h can promote the rumor diffusion. This is mainly because when h is small, the average degree of network nodes is low, and the connection between individuals is weak, which makes the information diffusion channel blocked, resulting in small rumor diffusion range. With the increase of h, the average network degree of nodes increases, the connection among individuals is strengthened, and the information interactions among

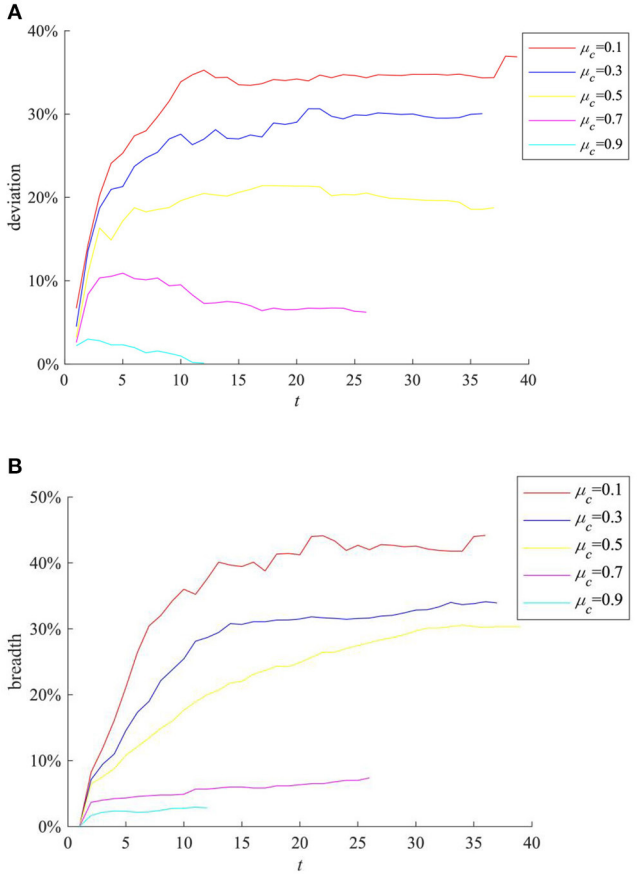

FIGURE 8 | The impact of μ_c on rumor evolution process. **(A)** Information content deviation. **(B)** Rumor diffusion range.

individuals become more frequent, which creates conditions for the rumor diffusion. However, it is easy to find that when $h \geq 30$, the increase of h no longer expands the entire network information content deviation of the entire network and the rumor diffusion range, indicating that the average network degree of nodes has a peak in the influence of rumor diffusion range.

The Impact of μ_c on Rumor Evolution Process

The trust threshold reflects the cautious of an individual treating external information, and its value will affect his/her reception of external information. Here we select the cases where the mean value of individual trust threshold $\mu_c(\mu_c = \sum (c_i)/N)$ is 0.1, 0.3, 0.5, 0.7, 0.9, respectively, for comparison, and the results are shown in **Figure 8**.

It can be seen from **Figures 8A,B** that with the increase of μ_c, the entire network information content deviation and the rumor diffusion range gradually decrease. This is because the increase in the average trust threshold means that the information recipients generally reduce their trust in the network, and they are increasingly inclined to refuse to information from the outside world, resulting in more obstacles for information diffusion, making it impossible for further diffusion.

TABLE 3 | Rumor control strategy classification.

Classification	Time	Measure
Proactive prevention strategy	Before the occurrence of public opinion incidents	Popularize relevant knowledge and improve the public's ability to discern rumors; establish a punishment mechanism to punish the communicator of rumors.
Reactive rumor-refuting strategy	After the occurrence of public opinion incidents	Organize some individuals to refute rumors

Analysis of Rumor Control Strategy

In this section, according to the time and means of implementing the rumor control strategies, they are divided into proactive prevention and reactive rumor refuting ones, as shown in **Table 3**. Among them, the prevention strategy refers to the preventive strategy taken before the occurrence of public opinion incidents. The reactive strategy refers to the refuting strategy taken after the occurrence of the rumors. Here, the effects of the two types of strategies are compared and analyzed through simulation experiments.

The current academic research on rumor control mainly focuses on how to reduce the impact of rumors, and rarely considers the negative impact of rumor control strategies, which leads to insufficient network activity. Currently, the social network has become an important channel for the media to release information, the public to obtain information, and the public to seek appeals. Insufficient network activity will prevent the important information from being diffused, and it will not satisfy the public's right to know public events. Based on this, the number of individuals participating in information interaction at different time moments is calculated as a measure of network activity to reflect the changes in network activity under different control strategies, so as to more comprehensively compare and analyze the positive and negative effects of different rumor control strategies.

Proactive Prevention Strategy

According to the different implementation methods of the strategy, the proactive prevention strategy is further divided into the knowledge popularization strategy and the punishment and restriction strategy.

(1) Knowledge popularization strategy

The knowledge popularization strategy refers to the one to restrict rumor diffusion by popularizing relevant knowledge in the field to individuals before the occurrence of public opinion events in a certain field. Here, the average knowledge reserves of network individuals reflect the implementation of the knowledge popularization strategy. They are set to follow the Poisson distribution with the mean λ of 1, 2, 3, 4, and 5, respectively, and the rumor diffusion when individuals have different levels of

knowledge reserves is compared. The results are shown in **Figure 9**.

It can be seen from **Figures 9A,B** that with the increase of λ, the higher level of individual knowledge reserves in the network represents the greater probability of the authentic identification information and greater possibility of rejecting rumors, reducing the scale of information content deviation and rumor diffusion range. It can be seen that adopting knowledge popularization strategies can effectively reduce the influence of rumors. In addition, it can be seen from **Figure 9C** that with the increase of λ, the peak value of network activity decreases, but its descend range is smaller. This is because when individual knowledge reserves are small, the public knows less about the causes and consequences of public events. In order to satisfy their own curiosity, they often trigger large-scale discussions on the Internet. However, with the increase of individual knowledge reserves, individuals can reason and derive the causes and consequences of events based on their own knowledge, which reduces the discussion on the network, and decreases network activity.

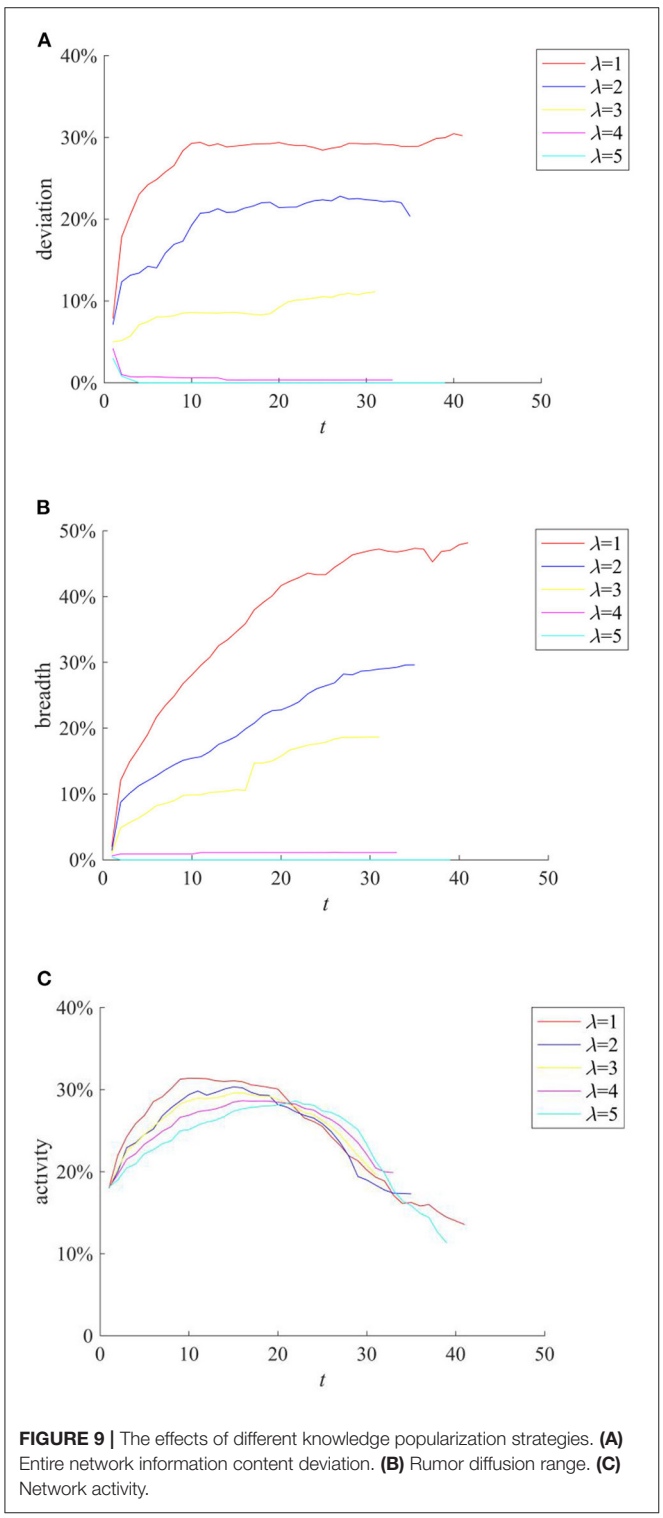

FIGURE 9 | The effects of different knowledge popularization strategies. **(A)** Entire network information content deviation. **(B)** Rumor diffusion range. **(C)** Network activity.

(2) Punishment and restriction strategy

Punishment and restriction strategy refers to the establishment of online code of conduct and punishment mechanism before the occurrence of public opinion incidents to restrict the individual behavior and rumor diffusion. Here we compare the rumor diffusion when the government punishment is 0.1, 0.3, 0.5, 0.7, and 0.9. The results are shown in **Figure 10**.

It can be seen from **Figures 10A–C** that as the punishment p increases, the entire network information content deviation range, the rumor diffusion, and the network activity decrease accordingly. In addition, when $p = 0.1$, the information content deviation has decreased, but it is close to the situation when there is no punitive measures. When p is equal to 0.5, 0.7, and 0.9, respectively, although the information content deviation and the rumor diffusion range are very low, the network activity is insufficient. In contrast, when $p = 0.3$, while avoiding low network activity, the entire network information content deviation and the rumor diffusion range are well-controlled.

(3) Analysis of combined proactive strategies

After analyzing the above two proactive strategies separately, this section analyzes the different combined effects of the two strategies. Here, set p equal to 0.1, 0.3, 0.5, 0.7, 0.9, and λ equal to 1,2 3, 4, and then combine p and λ with different values to form different strategy combinations, and compare the effects of different strategy combinations at $t = 1$, 15, 30, and 45. The results are shown in **Figures 11–13**.

It can be seen from **Figures 11–13** that with the increase of p and λ, the entire network information content deviation, the rumor diffusion range, and the network activity are continuously reduced. In addition, when λ is fixed, with the increase of p, the information content deviation, network activity and the rumor diffusion will be significantly reduced. When p is fixed, with the increase of λ, the decrease in network activity will be smaller, and the rumor diffusion range will be slightly reduced. Although the information content deviation of the entire network is greatly reduced, the rate of decrease is relatively slow. It can be seen that the rumor control effect of the punishment and restriction strategy is better than that of the knowledge popularization one, but its restraining influence on the

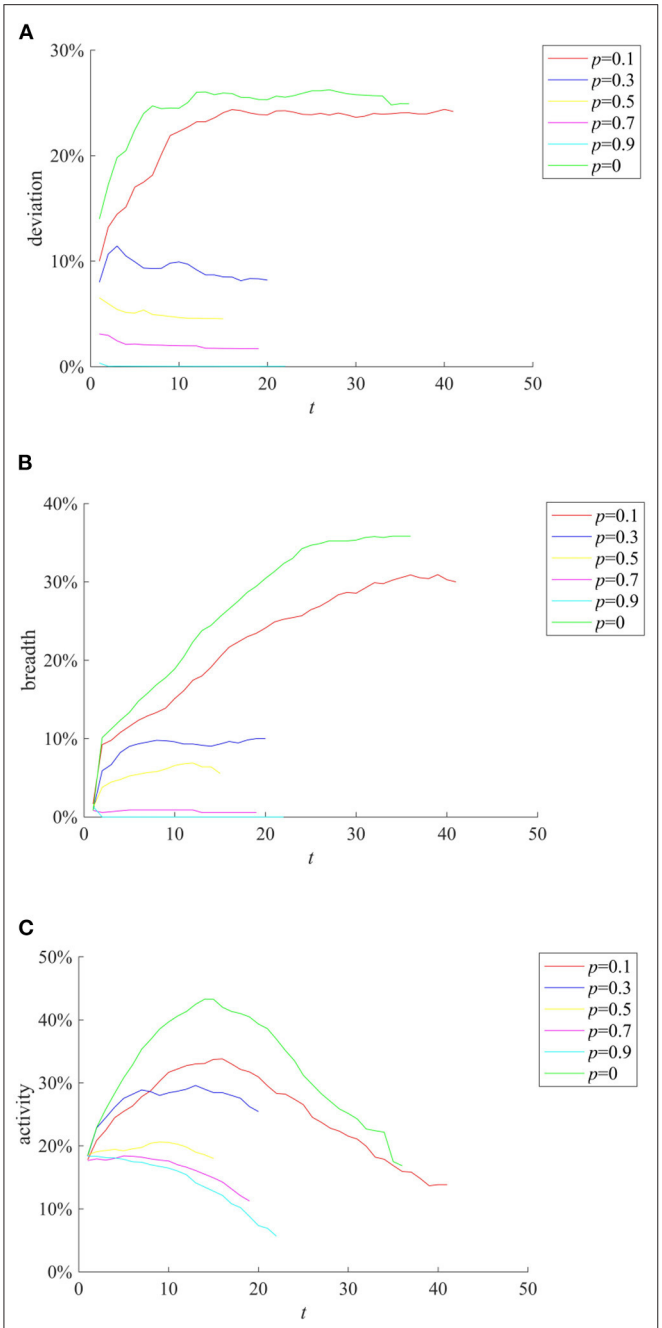

FIGURE 10 | The effects of different punishment and restriction strategies. **(A)** Entire network information content deviation. **(B)** Rumor diffusion range. **(C)** Network activity.

network activity is also far greater than that of the knowledge popularization strategy.

Reactive Strategy

After the rumors are formed, it is necessary to adopt a strategy of dispelling the rumors to suppress the rumor diffusion. In general, the basic idea of the rumor rejection strategy is as

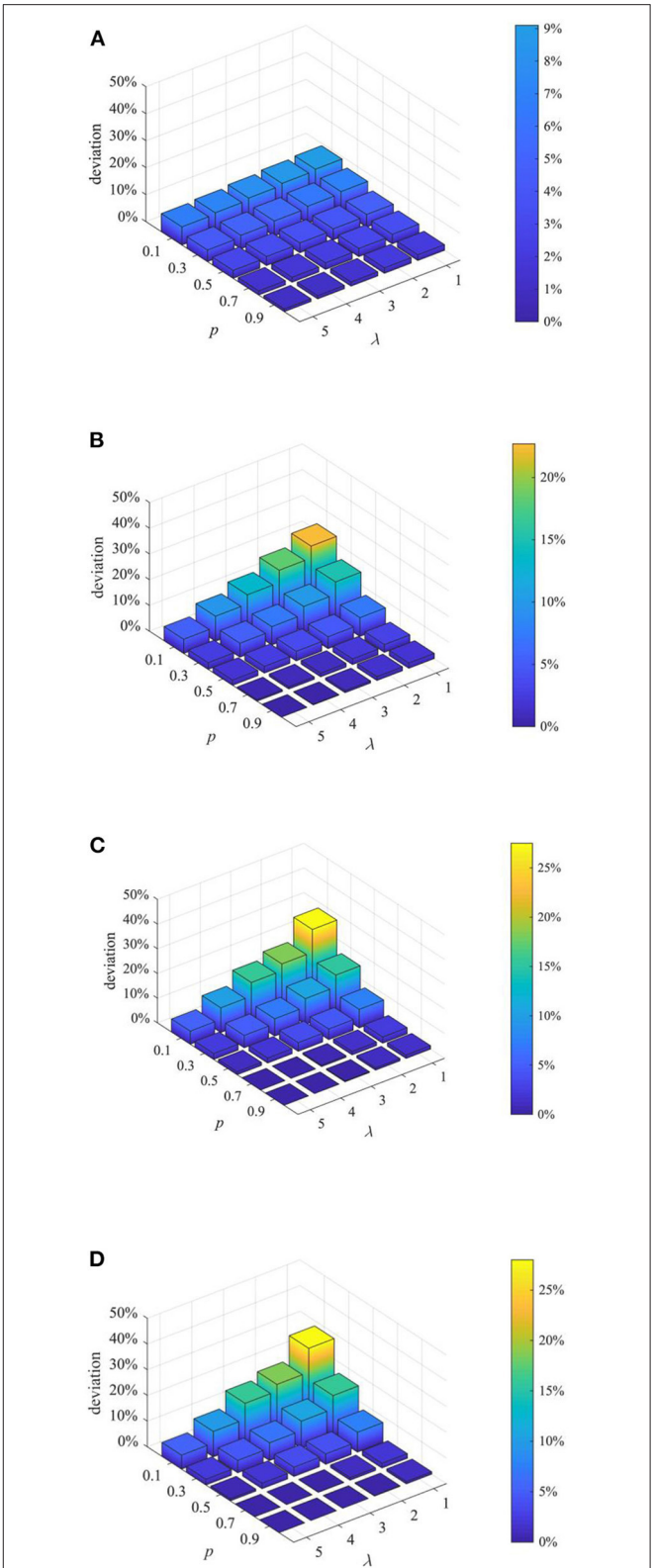

FIGURE 11 | The entire network information content deviation under different strategy combinations. **(A)** $t = 1$. **(B)** $t = 15$. **(C)** $t = 30$. **(D)** $t = 45$.

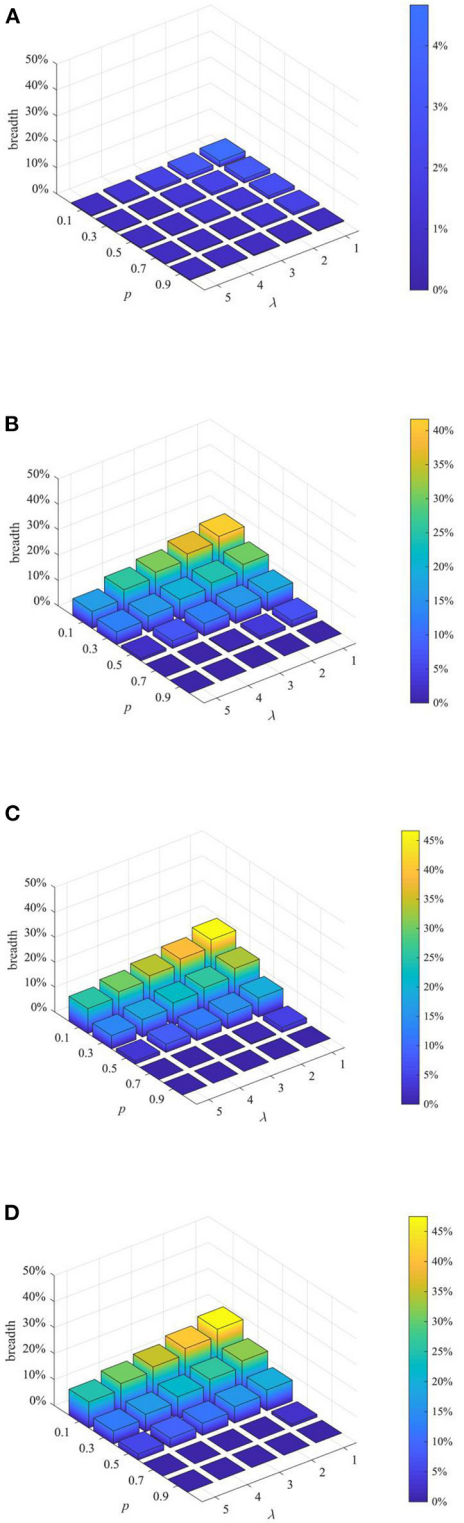

FIGURE 12 | Rumor diffusion range under different strategy combinations. **(A)** $t = 1$. **(B)** $t = 15$. **(C)** $t = 30$. **(D)** $t = 45$.

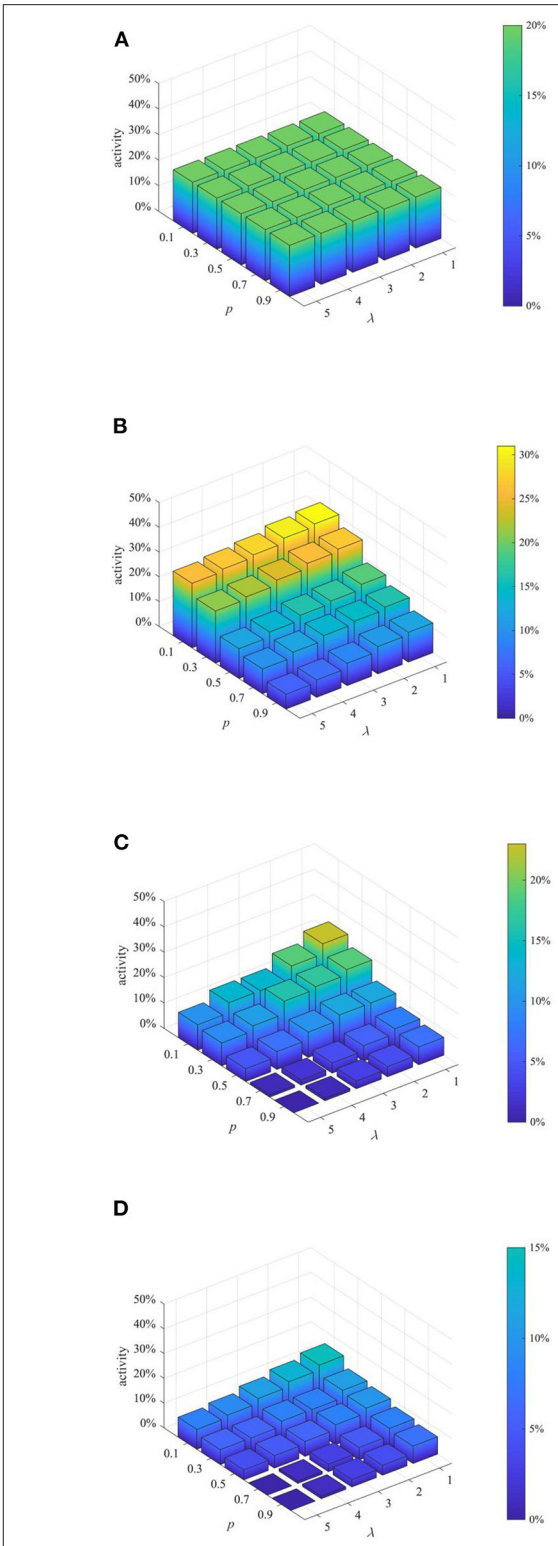

FIGURE 13 | Network activity under different strategy combinations. **(A)** $t = 1$. **(B)** $t = 15$. **(C)** $t = 30$. **(D)** $t = 45$.

follows: when the rumors diffuse to a certain extent, a certain number of nodes are randomly selected as the rumor-refuting individuals, which will diffuse real information to other nodes at a certain frequency, and finally achieve the effect of suppressing the rumors.

Here, we first compare the influence of the time moment on the effect of rumor refuting strategy. **Figure 14** compares the implementation effects of selecting the same number of network nodes as rumor-refuting individuals when the rumors diffusion range reaches 3, 6, 9, 12, and 15%, and disseminating rumors at the same frequency.

It can be seen from **Figure 14** that there are significant differences between the entire network information content deviation and the rumor diffusion range under the rumor refuting strategy. After adopting rumor-refuting strategy, the entire network information content deviation and the rumor diffusion range immediately changed from a rapid rise to a rapid decline. It can be seen from **Figures 14A–C** that when the rumor diffusion range reaches 3 or 6%, the rumor refuting strategy can quickly reduce the influence of rumors in a short period of time, purify relevant network information content, and finally make the rumors almost disappear. Although adopting a strategy to refute rumors when the scale of rumor diffusion range reaches 9, 12, and 15% can also greatly reduce the impact of rumors, as the time moment of the strategy is postponed, the rumors have formed a certain scale and the difficulty of refuting rumors has increased. The final effect of the strategy gradually deteriorated. In addition, the adoption of rumor refuting strategy has greatly increased network activity, and has caused a new round of useful discussions on public opinion events. To sum up, after a public opinion incident occurs, the government should adopt a rumor-refuting strategy as soon as possible to minimize the impact of rumors.

In addition, during the implementation of the rumor-refuting strategy, the time interval of rumor-refuting (the time interval between two adjacent rumor-refuting behaviors) and the number of individuals that refute the rumors (the individuals that refute the rumors point to other individuals who diffuse the true information content) will affect the ultimate effect of the rumor-refuting strategy. **Figure 15** compares the implementation effects of selecting 10, 20, 30, 40, and 50 network nodes as individuals to dispel rumors when the rumor diffusion reaches 10%. **Figure 16** compares the implementation effect of selecting the same number of network nodes as the rumor-refuting individuals and diffusing the rumor-refuting information at intervals of 1, 2, 3, 4, and 5 when the rumor diffusion reaches 10%.

It can be seen from **Figures 15A,B** that with the increase of the number of rumor-refuting individuals, the scale of entire network information content deviation and rumor diffusion range has dropped significantly. In addition, it can be seen from **Figures 16A,B** that the shorter the time interval of refuting rumors, the more effective the rumor-refuting strategy will be. Moreover, from **Figures 15C**, **16C**, it can be seen that the increase in the number of rumor-refuting individuals and the expansion of the time interval for rumor-refuting have significantly improved network activity.

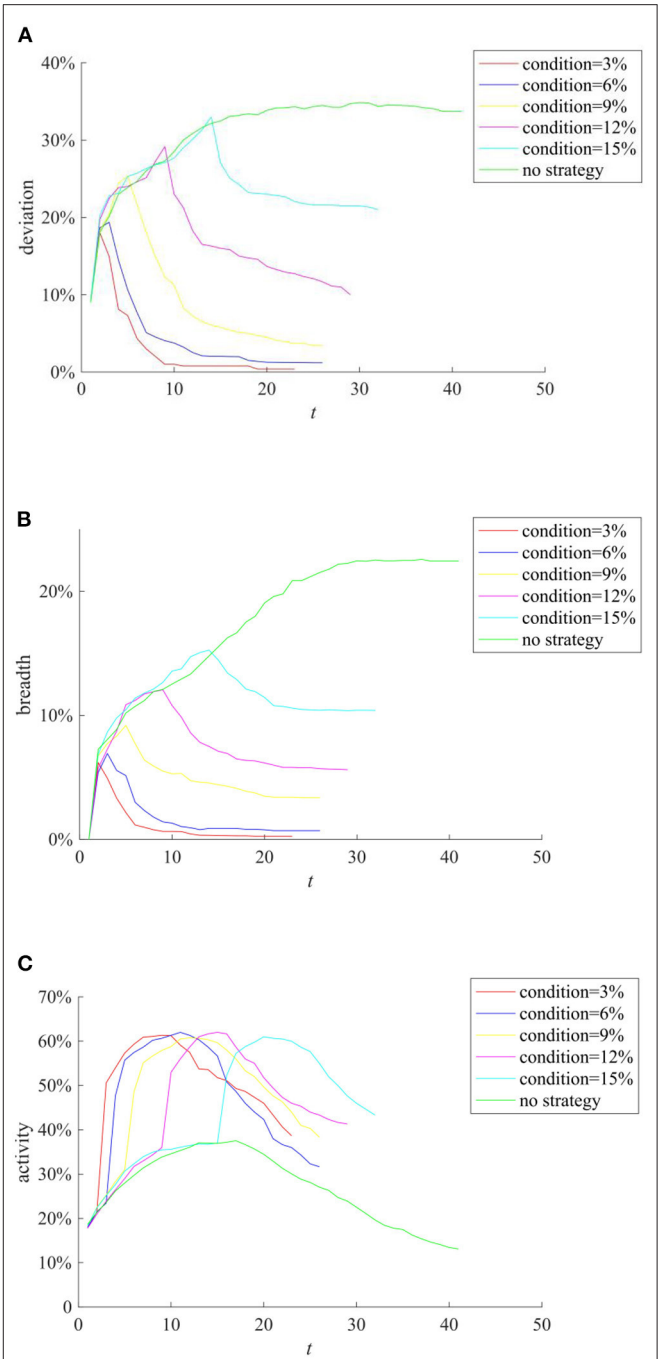

FIGURE 14 | The influence of the time moment on the effect of rumor refuting strategy. **(A)** Entire network information content deviation. **(B)** Rumor diffusion range. **(C)** Network activity.

Furthermore, considering the urgency and necessity of rumor control, it is necessary to find out the most critical factors in the process of refuting rumors. Based on this, a combined analysis of the number of rumor-refuting individuals and the time interval of rumor-refuting is conducted. Here, the numbers of rumor-refuting individuals are 10, 20, 30, 40, 50, and the time intervals

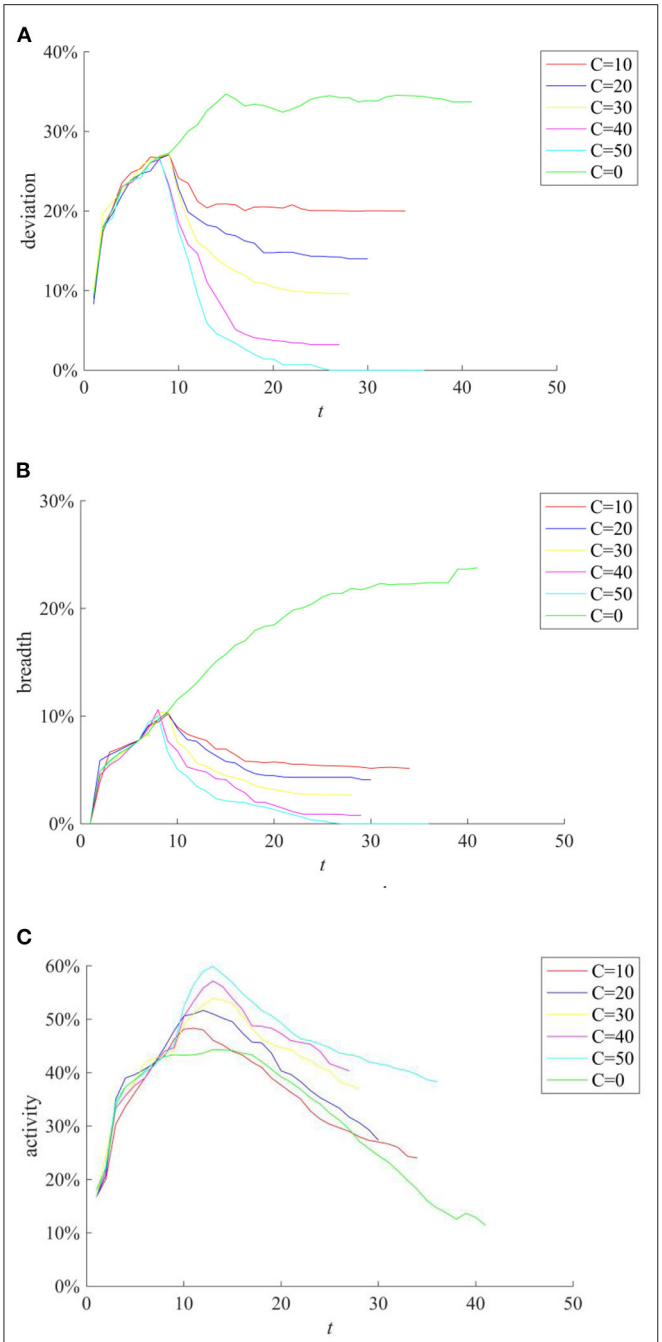

FIGURE 15 | The effect of rumor-refuting strategies based on different rumor-refuting individuals. **(A)** Information content deviation. **(B)** Rumor diffusion range. **(C)** Network activity.

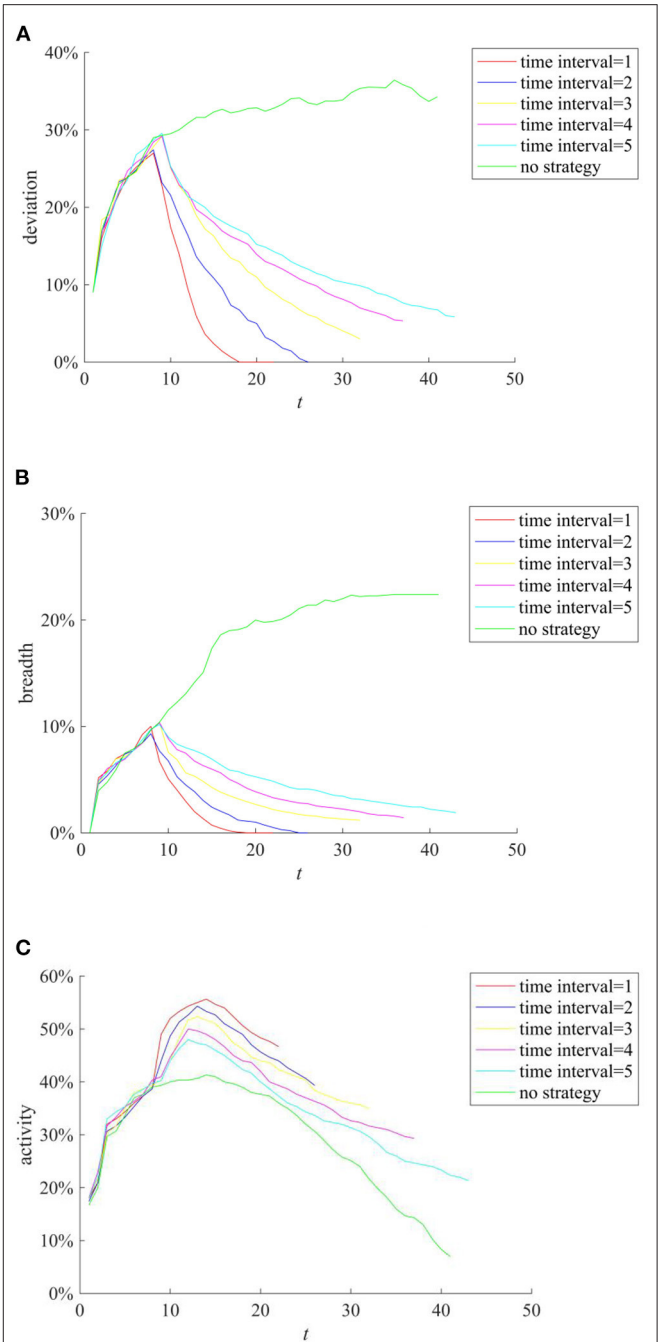

FIGURE 16 | The effect of rumor-refuting strategies based on different rumor time refuting interval. **(A)** Entire network information content deviation. **(B)** Rumor diffusion range. **(C)** Network activity.

of rumor-refuting are 1, 2, 3, 4, 5, and then combine in pairs to form 25 different strategies. The implementation effects of the combination at $t = 1$, 15, 30, and 45 are compared, and the results are shown in **Figures 17–19**.

As can be seen from **Figures 17–19**, when the time interval of rumor-refuting is fixed, as the number of refuting rumor individuals increases, the entire network information content deviation decreases rapidly, the rumor diffusion range is significantly reduced, and the network activity increases significantly. On the other hand, when the number of refuting rumors remains the same as the time changes, the reduction of the time

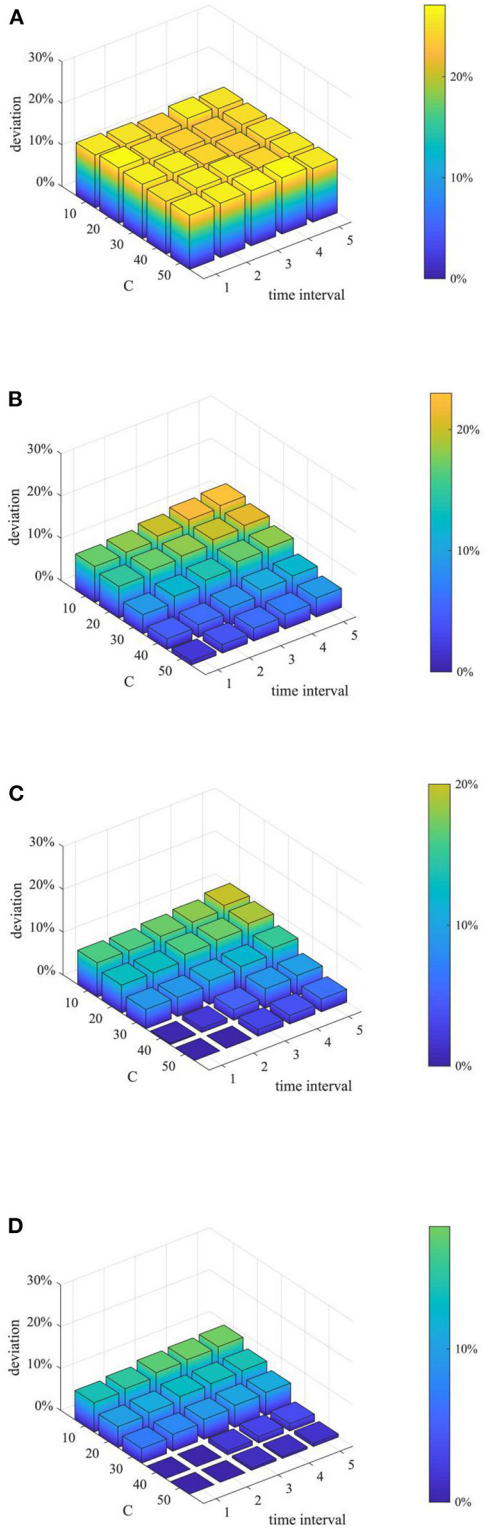

FIGURE 17 | Entire network information content deviation based on different combination. **(A)** $t = 10$. **(B)** $t = 20$. **(C)** $t = 30$. **(D)** $t = 40$.

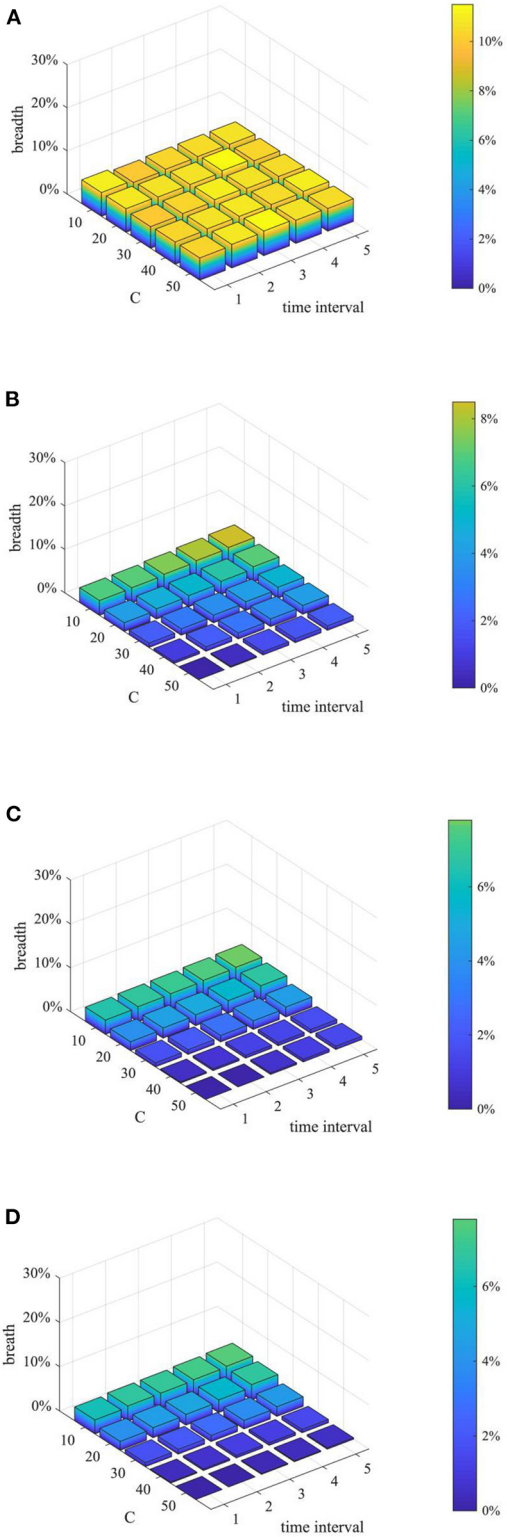

FIGURE 18 | Rumor diffusion range based on different combination. **(A)** $t = 10$. **(B)** $t = 20$. **(C)** $t = 30$. **(D)** $t = 40$.

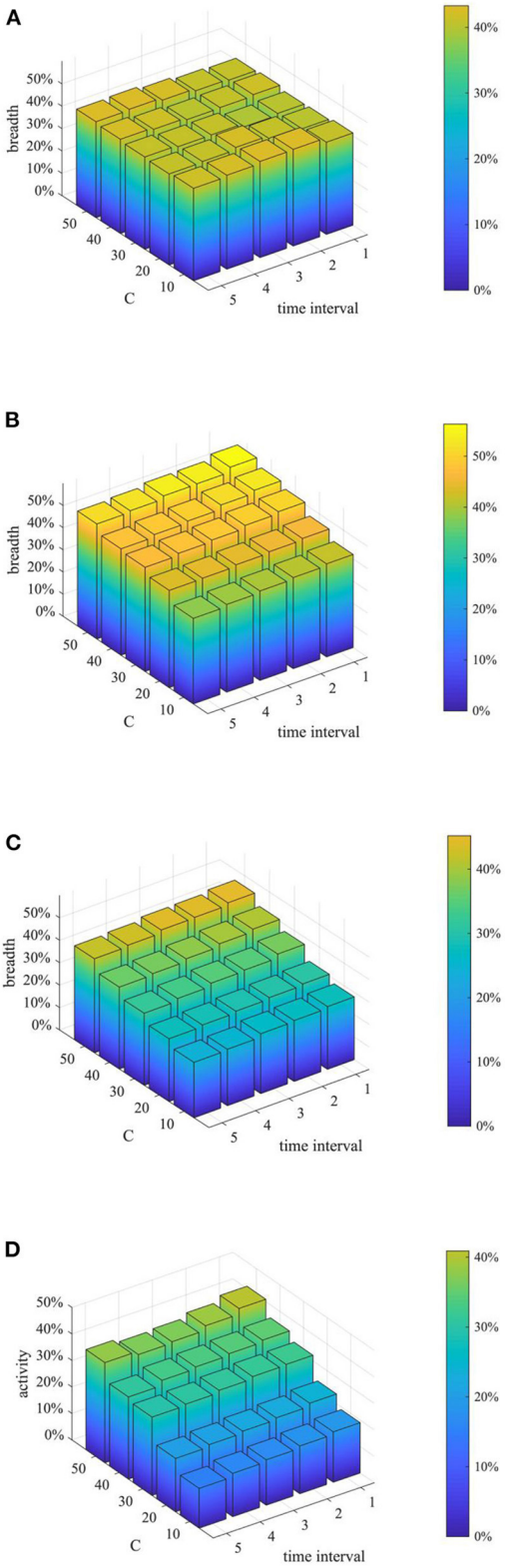

FIGURE 19 | Network activity based on different combination. **(A)** $t = 10$. **(B)** $t = 20$. **(C)** $t = 30$. **(D)** $t = 40$.

interval of rumor-refuting can speed up the decline of entire network information content deviation and rumor diffusion range, but it has little effect on the final information content deviation and the rumor diffusion range, and it has no obvious effect on the improvement of network activity. This shows that when adopting a rumor-refuting strategy, more attention should be paid to the number of rumor-refuting individuals.

Analysis and Discussion

In this section, some simulation results and findings are given firstly. Subsequently, the limitations of our study are also discussed.

Simulation Results and Findings

Through simulation experiments, the influence of model parameters on the evolution of rumors is analyzed, and the following conclusions are obtained:

(1) The higher average value of the interest correlation between individuals and the event that caused the rumors represents the lower deviation between the network information content and the real information content, and the larger scale of the rumor diffusion range.

(2) Increasing the average network degree of nodes can expand the influence of rumors, but its influence on the rumor diffusion range has a peak.

(3) The higher average trust threshold of all individuals in the network represents the lower entire network information content deviation, and the smaller scale of the rumor diffusion range.

In addition, according to the implementation effects of different rumor control strategies, the following conclusions are obtained:

(1) Before a public opinion incident occurs, adopting a knowledge popularization strategy and a punishment and restriction strategy for the public can effectively minimize the information content deviation and the rumor diffusion range after the public opinion incident occurs. Besides, the rumor control effect of the punishment and restriction strategy is better than that of the knowledge popularization strategy, but its inhibitory effect on network activity is far greater than that of the knowledge popularization strategy.

(2) After a public opinion incident occurs, the government should adopt a strategy of refuting rumors as soon as possible to minimize the impact of rumors. Moreover, when adopting a rumor-refuting strategy, more attention should be paid to the number of rumor-refuting individuals.

Limitations

In this study, there are still some shortcomings in simulation analysis as follows: the BA network constructed in the simulation analysis does not consider the growth of nodes in the diffusion of sudden hot events at the initial moment. Therefore, the network structure needs to be further optimized in the follow-up.

EMPIRICAL ANALYSIS

This section selects "Imported Food Safety Issue during the COVID-19 Pandemic" (hereinafter referred to as "Imported Food Safety") as an example to verify the effectiveness of the SEIR-OM model.

After the outbreak of COVID-19, in order to prevent the import of the virus from abroad, General Administration of Customs People's Republic of China (GACC) has strengthened the testing of imported food. In June 2020, the COVID-19 was detected on the surface of the imported salmon cutting board at the Xinfadi Seafood Wholesale Market in Beijing, which quickly caused panic among Chinese residents, leading to intense discussions on imported food safety issue. Since then, GACC has repeatedly detected positive samples of COVID-19 virus nucleic acid on the outer packaging of imported food or on the surface of the food, which has caused heated discussions on many occasions.

In order to analyze the diffusion of rumors in the "Imported Food Safety" incident, two incidents with a large amount of topic discussion are selected as the analysis objects based on the topic search on the Weibo platform. Firstly, the COVID-19 was detected on the surface of the imported salmon cutting board at the Xinfadi Seafood Wholesale Market in Beijing. Discussions on this incident were mainly focused on June 12, 2020–June 22, 2020. Secondly, the COVID-19 was detected on the surface of the imported cherry in Wuxi, Jiangsu Province in China on January 22, 2021. Discussions on this incident mainly focused on January 22, 2021–February 8, 2021. There are discussions about these two incidents on the Internet, such as "Eating imported food will get COVID-19" and "Eating imported food is dangerous." In response to these remarks, many Chinese official media continues to quote expert opinions to clarify and refute rumors.

The relevant Weibo data is crawled through python, and a total of 41,351 data is obtained. The schematic diagram of the data is shown in **Figure 20**.

After obtaining and preprocessing the data, it is necessary to identify the content of the comments. Here, we first establish two corpus sets including rumors and truths related to "Imported Food Safety," and then use JIEBA (32) word segmentation algorithm and word2vec algorithm to calculate the similarity between the review content and the two corpora sets one by one. If the similarities between the review content and the two corpora sets are low, it will be recognized as an irrelevant comment. If a comment is more similar to the rumor text set than the real content corpus set, it will be recognized as a rumor, otherwise it will be recognized as a truth. After removing irrelevant comments, there are 20,502 pieces of data in the two cases. Although the amount of data here is limited, according to the six-degree separation theory (33) in interpersonal relationships, the statistical results of these user data can reflect the universality of Weibo user behavior to a large extent. The data information involved in the case analysis is shown in **Table 4**.

In order to verify the validity of the SEIR-OM model constructed in this article, the existing evolutionary game model is introduced and compared with SEIR-OM model. We make the following three assumptions about the evolutionary game model: (1) The individuals in the network are divided into uninformed individuals and informed individuals according to their states. (2) Only the game behavior between informed individuals and uninformed individuals is discussed in the model. (3) There are malicious individuals in the network. The rules of game gains in the model are set as follows: (1) When an informed individual chooses to diffuse information, if the uninformed individual receives the information, the informed individual will get a higher gain a ($a > 1$), and the uninformed individual's gain is equal to 1; (2) When an informed individual chooses to diffuse information, if the uninformed individual does not receive the information, the informed individual's gain will be damaged and become -1, and uninformed individual's gain will be 0; (3) When the informed individual does not diffuse information, the gains of both parties are 0; (4) If malicious individuals successfully diffuse rumors to uninformed individuals, they can obtain excess gains; (5) Individuals who diffuse rumors will be punished by the government, and their gains will decrease by g. According to the above rules, the gain matrix of the evolutionary game model is shown in **Table 5**.

In addition, the individual strategy update rules in the evolutionary game model are as follows: individual i randomly selects a neighbor individual j, and imitates the strategy of j with a certain probability, as shown in formula (19).

$$W(S_i \leftarrow S_j) = \frac{P_j - P_i}{\max(k_i, k_j)H} \tag{19}$$

where S_i and S_j are the strategies adopted by i and j; P_i and P_j are the cumulative gains of i and j after the game; k_i, k_j are the degrees of i and j; H is the maximum difference in the game gains between individuals.

Since the evolutionary game model cannot reflect the difference of information content, i.e., it cannot calculate the deviation degree of information content, the comparison content of different models only includes the rumor diffusion range and network activity. In order to make the simulation environment closer to the real situation of the two incidents, some parameters in the two models will be adjusted according to the data of different time periods: (1) According to the Pareto principle (34), 20% of the people in society will produce 80% impact, and malicious individuals play a major role in the rumor diffusion. Therefore, the proportion of malicious individuals in the two models is set to be 20%; (2) The Chinese government takes a strong management measures on online rumors, so the intensity of government punishment p is set to 0.5 in the SEIR-OM model, and the government punishment g in the evolutionary game model is set to 0.5, too; (3) On June 14, 2020, when the deviation of the online information content of the "COVID-19 was detected on the surface of the imported salmon cutting board in Beijing" reached more than 10%, the official media refuted the rumor for the first time. Therefore, in response to this incident, when the entire network information content deviation is >10%, the government adopts a rumor-refuting strategy. Similarly, for the "the COVID-19 was detected on the surface of the imported cherry in Wuxi, Jiangsu," it is set that when the

	A	B	C	D	E	F	G	H
1	Topic	Publisher ID	Publish Time	Weibo	Commenter	Comment Time	Comment	Like
2	#COVID-19 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	MT-04	2020/6/13 0:17	Ever since the outbreak of the epidemic abroad, I have had this concern. I think imported foods are inedible and may become infected if we eat them	141
3	#COVID-20 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Laster00	2020/6/13 0:17	This is terrible! If we eat these salmon, we'll get infected	46
4	#COVID-21 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	imyourjoy_	2020/6/13 0:17	Please don't eat the salmon! The salmon has the novel coronavirus	39
5	#COVID-22 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Vancoshan	2020/6/13 0:18	Other imported foods also need to be tested. It's too dangerous	32
6	#COVID-23 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Serendipity_	2020/6/13 0:18	I think all the imported things carry virus	32
7	#COVID-24 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	leerphen	2020/6/13 0:18	Fortunately,I was poor,poor saved my life,ha ha ha	19
8	#COVID-25 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	LouieJung	2020/6/14 0:18	It's terrible. The salmon carry the virus	11
9	#COVID-26 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Jmile-H	2020/6/15 0:18	I don't think it's a problem even if I eat it	1
10	#COVID-27 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Katerince	2020/6/13 0:19	I immediately threw away the salmon that I hadn't eaten at home	4
11	#COVID-28 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Tsooo	2020/6/13 0:19	Is salmon the source of infection?	1
12	#COVID-29 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	bololo_	2020/6/13 0:19	It seems that salmon can't be eaten recently.	1
13	#COVID-30 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	cwd918123	2020/6/13 0:19	I just had salmon yesterday. I'm so worried.	1
14	#COVID-31 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	momery668	2020/6/13 0:19	Imported food can spread virus! The government should take measures quickly!	3
15	#COVID-32 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	yipinshutang	2020/6/14 0:20	Fortunately, I don't like salmon.	2
16	#COVID-33 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	kappafiy	2020/6/15 0:20	The government should stop importing seafood	12
17	#COVID-34 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	201912220v	2020/6/16 0:20	Please don't eat imported seafood. It's too dangerous.	1
18	#COVID-35 was detected in imported	Sina Finance	2020/6/13 0:16	On the evening of June 12th, Zhang Yuxi, chairman of Beijing Xinfa wholesale market, said	Luuvy	2020/6/17 0:20	Is there any problem with other seafood?	2

FIGURE 20 | Schematic diagram of the data.

TABLE 4 | Relevant data.

Case	Time	Comments	Users	Duration
COVID-19 was detected on the surface of the imported salmon cutting board at the Xinfadi Seafood Wholesale Market in Beijing	From June 12, 2020 to June 22, 2020	8,275	5,601	10 days
COVID-19 was detected on the surface of the imported cherry in Wuxi	From January 22, 2021 to February 8, 2021	12,227	9,134	9 days

TABLE 5 | Gain matrix of the evolutionary game model.

				Uninformed individual	
				Receive	Not receive
Informed individual	General individual	Truth	Diffuse	(a,1)	(−1,0)
			Not diffuse	(0,0)	(0,0)
		Rumor	Diffuse	(a-g,1)	(−1,0)
			Not diffuse	(0,0)	(0,0)
	Malicious individual	Truth	Diffuse	(a,1)	(−1,0)
			Not diffuse	(0,0)	(0,0)
		Rumor	diffuse	(a+d-g,1)	(−1,0)
			Not diffuse	(0,0)	(0,0)

entire network information content deviation is >3%, the government adopts a rumor-refuting strategy; (4) As experts keep responding to the doubts about the safety of imported foods, the public's knowledge reserves going up. Therefore, it is assumed that the individual knowledge reserves in the SEIR-OM model obey the Poisson distribution with the mean λ is 1 and 3 in the two time periods, respectively; (5) In these two incidents, the government's time interval for rumor-refuting was 5 and 2 days, respectively. Therefore, the government's rumor-refuting time interval in the SEIR-OM model was set to 5 and 2 days, respectively; (6) Because the difficulty of diffusing rumors after the government has refuted the rumors will increase, the excess gain of malicious individuals diffusing false information will decreases. As a result, the excess gain of malicious individuals diffusing false information in the evolutionary game model before the government refuting the rumors is assumed to be 0.7, and becomes 0.3 after the government refuting the rumors. In addition, the other parameters of the SEIR-OM model are set as: $\mu_b = 0.9$, $\mu_c = 0.5$. The other parameters in the evolutionary game model are set as: $a = 0.12$, $H = 5$. It is assumed that the number of simulation network nodes of the two models is both 500.

SEIR-OM model and the evolutionary game model are used to simulate the changes in the rumor diffusion in the two incidents here, and the two change curves are compared with the actual curves shown in **Figure 21**. In this figure, the blue line represents the rumor diffusion curve simulated by the SEIR-OM model, the red line represents rumor diffusion curve simulated by the evolutionary game model, and the yellow line represents the rumor diffusion curve based on real data. In addition, the Root Mean Square Error (RMSE) is used

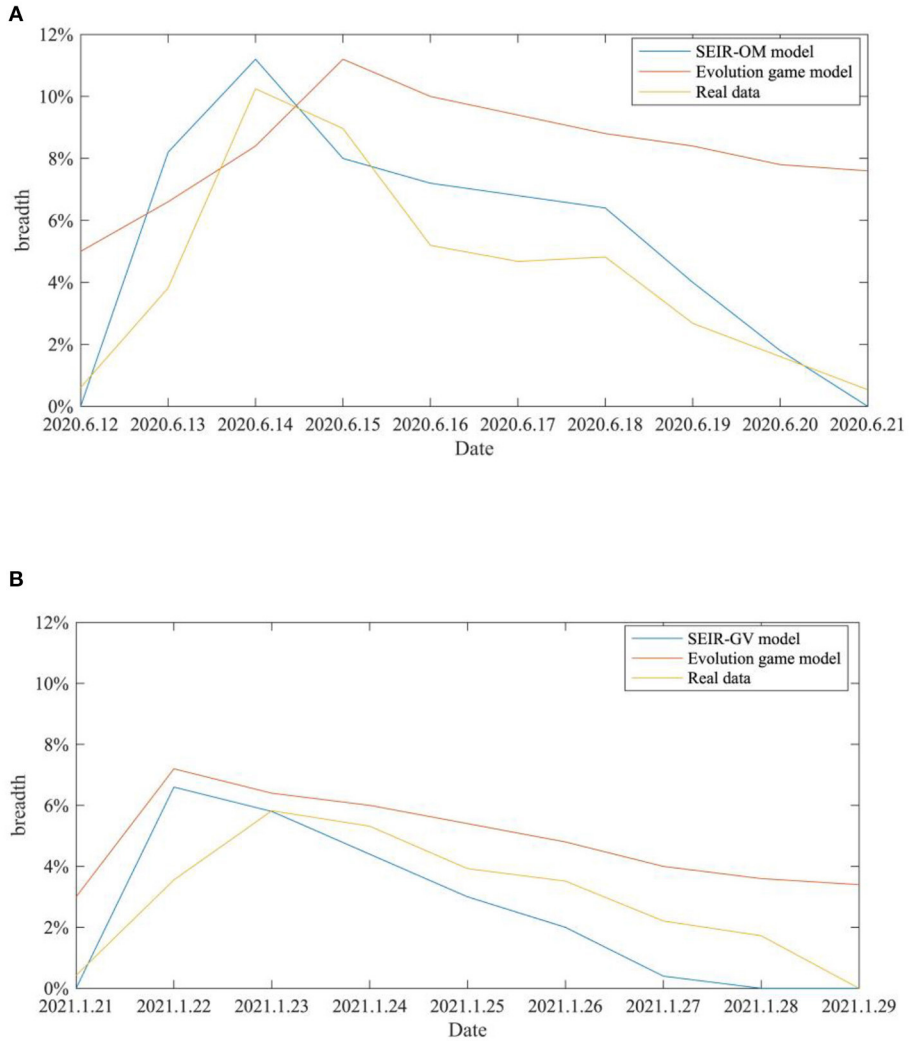

FIGURE 21 | Comparison of the rumor diffusion ranges in two events. **(A)** COVID-19 was detected on the surface of the imported salmon cutting board in Beijing. **(B)** COVID-19 was detected on the surface of the imported cherry in Wuxi.

here to accurately reflect the error between the variation curve of the rumor diffusion range simulated by SEIR-OM model, evolutionary game model and the real data. The results are shown in **Table 6**.

It can be seen from **Figures 21A,B** that the rumor diffusion curves simulated by the two models both show an upward trend before the government adopts the intervention strategy, and the curve simulated by the SEIR-OM model rises faster. After the government adopts the intervention strategy, the curve simulated by the evolutionary game model shows a gentle downward trend. In contrast, the curve simulated by the SEIR-OM model declines faster, and the change trend is similar to the real curve. According to **Table 6**, in terms of rumor diffusion, the error of the simulation results of the SEIR-OM model in the two incidents is smaller than that of the evolutionary game model, and the simulated curve is closer to the real curve, indicating that the SEIR-OM model is closer to real situation in terms of rumor diffusion.

TABLE 6 | RMSE of rumor diffusion scale.

Event / Model	COVID-19 was detected on the surface of the imported salmon cutting board in Beijing	COVID-19 was detected on the surface of the imported cherry in Wuxi
SEIR-OM model	0.0186	0.0435
evolutionary game model	0.0467	0.0683

In addition, the SEIR-OM model and the evolutionary game model are used to simulate the changes in network activity in the two events and compare with the real

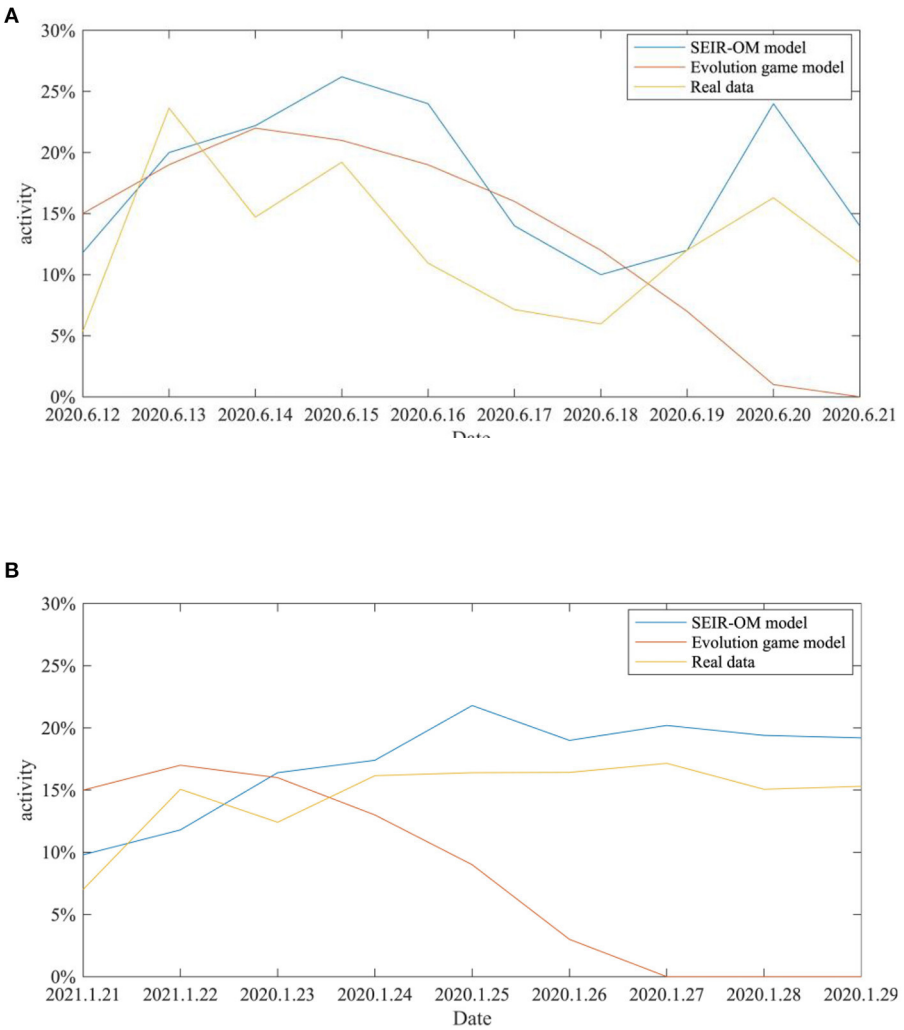

FIGURE 22 | Comparison of the network activities in the two incidents. **(A)** COVID-19 was detected on the surface of the imported salmon cutting board in Beijing. **(B)** COVID-19 was detected on the surface of the imported cherry in Wuxi.

situation shown in **Figure 22**. In this figure, the blue line represents the network activity curve simulated by the SEIR-OM model, the red line represents the network activity curve simulated by the evolutionary game model, and the yellow line represents the network activity curve drawn based on real data. In addition, the RMSE is used here to accurately reflect the error between the network activity curve simulated by the SEIR-OM model and the evolutionary game model and the real curve. The results are shown in **Table 7**.

TABLE 7 | RMSE of network activity.

Event / Model	COVID-19 was detected on the surface of the imported salmon cutting board in Beijing	COVID-19 was detected on the surface of the imported cherry in Wuxi
SEIR-OM model	0.068	0.0647
Evolutionary game model	0.0855	0.0832

From **Figures 22A,B**, it can be seen that the network activity curves of the two events simulated by the evolutionary game model both show an upward trend, and then a downward trend after the government adopts an intervention strategy, and the rate of decline keeps accelerating. In contrast, due to the different frequency of government refuting rumors, the two curves simulated by the SEIR-OM model have certain differences. The simulated network activity curve for the "COVID-19 was detected on the surface of the imported salmon cutting board in Beijing" event has two peaks, while the simulated network activity for the other incident remained stable at about 20% after the government frequently refuted rumors. After comparing the actual curve,

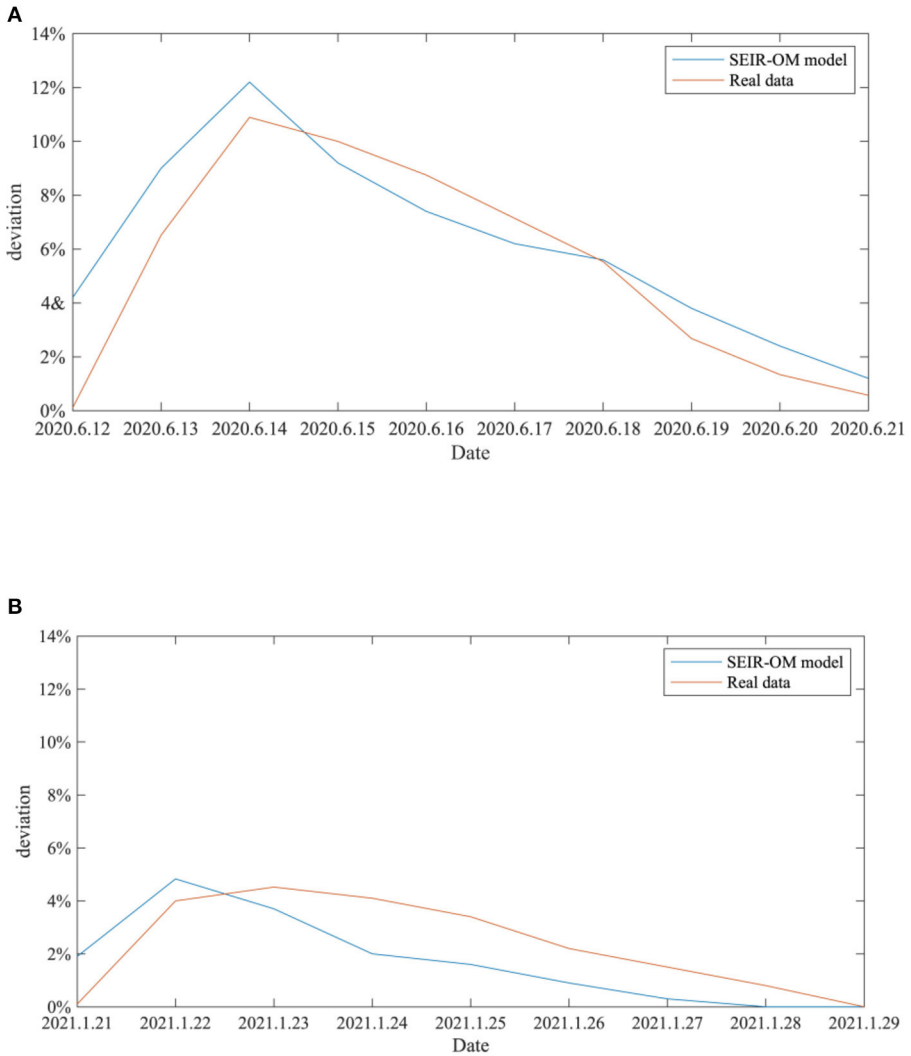

FIGURE 23 | Comparison of entire network information content deviations in two events. **(A)** COVID-19 was detected on the surface of the imported salmon cutting board in Beijing. **(B)** COVID-19 was detected on the surface of the imported cherry in Wuxi.

it is easy to find that the curve simulated by the SEIR-OM model is closer to the actual curve, indicating that the SEIR-OM model is closer to the real situation in terms of network activity.

In addition, in order to reflect the effectiveness of the SEIR-OM model in terms of entire network information content deviation, this curve simulated by the SEIR-OM model is compared with the actual curve, and the result is shown in **Figure 23**. In **Figure 23**, the blue line represents the information content deviation curve simulated by the SEIR-OM model, and the red line represents the information content deviation curve drawn based on real data.

It can be seen from **Figure 23** that in terms of entire network information content deviation, although the curve simulated by the SEIR-OM model is different from the real data curve, the trend of the two is similar. Therefore, it shows that SEIR-OM model performs well in the entire network information content deviation.

CONCLUSIONS

This article integrates individual heterogeneity factors into the SEIR model, and designs an individual state transition mode at first. Subsequently, based on trust theory and information asymmetry theory, it establishes an individual information interaction mode, and constructs an improved SEIR model named SEIR-OM model. Then the diffusion process of rumors and the implementation effects of different rumor control strategies are simulated and analyzed. Finally, the article verifies the rationality and effectiveness of the SEIR-OM model through

the real case from the imported food safety issue during the COVID-19 Pandemic.

However, this article still has the following shortcomings, which need further study:

(1) The BA network constructed in the article only considers the exit of the interconnection among nodes, but does not consider the growth of nodes in the diffusion of sudden hot events at the initial moment. Therefore, the network structure needs to be further optimized in the follow-up.

(2) Rumors in the constructed model are transmitted through random pairwise information interaction between the Internet and the people. In reality, a netizen can send the information to a designated person, or send it in groups to his friends or strangers. Therefore, it is necessary to consider a variety of forms of private information transmission on the Internet, such as group sending, and directional sending.

DATA AVAILABILITY STATEMENT

The data used to support the findings of this study are available from the corresponding author upon request.

AUTHOR CONTRIBUTIONS

TC described the proposed framework and wrote the whole manuscript. JR implemented the simulation experiments. JY collected data. GC revised the manuscript. All authors read and approved the final manuscript.

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Well-Being at Home During Forced Quarantine Amid the COVID-19 Pandemic

Elzbieta Krajewska-Kułak[1], Agnieszka Kułak-Bejda[2], Wojciech Kułak[3], Grzegorz Bejda[4], Cecylia Łukaszuk[1], Napoleon Waszkiewicz[2], Mateusz Cybulski[1], Andrzej Guzowski[1], Joanna Fiłon[1], Paulina Aniśko[5] and Magda Popławska[6]*

[1] Department of Integrated Medical Care, Medical University of Białystok, Białystok, Poland, [2] Department of Psychiatry, Medical University of Białystok, Białystok, Poland, [3] Department of Pediatric Rehabilitation and Center of Early Support for Handicapped Children "Give a Chance", Medical University of Białystok, Białystok, Poland, [4] The School of Medical Science in Białystok, Białystok, Poland, [5] Doctoral School, Medical University of Białystok, Białystok, Poland, [6] Students' Scientific Society, Department of Integrated Medical Care, Medical University of Białystok, Białystok, Poland

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***Correspondence:**
Agnieszka Kułak-Bejda
agnieszka.kulak.bejda@gmail.com

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Introduction: People recently or currently in forced quarantine or isolation at home have shown high levels of depression and symptoms of generalized anxiety.

Aim of the Study: To assess the impact of the COVID-19 pandemic on certain aspects of people's day-to-day functioning.

Materials and Methods: The study involved using an online diagnostic survey including a proprietary questionnaire, the DASS 21, and the Liebowitz Social Anxiety Scale.

Results: Information about the pandemic in Poland and around the world was systematically obtained by 48.8 and 27.4% of respondents, respectively (N = 1,312). Whereas, 75.6% of respondents declared having knowledge about the number of infected people in Poland, only 28.7% declared having such knowledge about infections worldwide. Most often, respondents had obtained information online (65.9%). According to 45.7% of respondents, infection with COVID-19 is a major threat, and not enough has been done to reduce its spread in Poland (66.7%) or worldwide (56.1%). Respondents considered social distancing (68.3%), quarantining people arriving from abroad (63.4%), and wearing protective masks and/or gloves (60.4%) to be the most effective actions for combatting the pandemic. Most often, in compulsory quarantines, respondents surfed the Internet (48.8%) and experienced a lack of energy or fatigue (40.2%) and anxiety (54.9%). The severity of anxiety (mean = 4.6 points), stress (7.5 points), and depression (7.3 points) were within normal ranges, and the respondents could generally be included in the group showing mildly severe social phobia (57.9 points).

Conclusions: Most respondents considered infection with COVID-19 to be a major threat and feared another quarantine. During quarantine, respondents most often experienced fatigue, a lack of energy, nervousness, anxiety, anger, and sadness. Despite demonstrating anxiety, stress, and depression with severity in the normal range,

respondents showed no statistically significant correlation between severity and age, gender, place of residence, or level of education. Although they also showed mildly severe social phobia, only gender, not age, place of residence, or level of education, showed a statistically significant correlation with its severity.

Keywords: pandemic, COVID-19, quarantine, anxiety, stress, depression

INTRODUCTION

Contemporary recommendations for forced isolation during epidemics follow the centuries-old tradition of protecting people from serious infectious diseases (1). Today, however, awareness of the dire consequences of isolating large numbers of people in quarantine means that such measures are taken only in the most serious of situations. Isolation due to epidemics indeed presents several challenges, including a diminished sense of control that can promote a sense of fear, largely because quarantine and social isolation restrict people's mobility, social interaction, and range of daily activities.

During the current pandemic, to limit the spread of COVID-19 infection worldwide, quarantine strategies have been introduced the world over, including short- and mid-term blockades, curfews, the cancellation of planned social events, the restriction of social gatherings and sport activities, the introduction of travel bans, and airspace and border closures (1–4). However, because most societies have never experienced such restrictions, people have associated the introduction of quarantines with the restriction of freedoms and imprisonment and even treated them as a form of punishment and condemnation. After all, social isolation is a form of quarantine with a recommendation not only to stay at home but also to avoid social contact outside the home, which implies separation from family, friends, and wider social networks, as well as disengagement from social activities (5–7).

Literature on people in quarantine conducted before the COVID-19 pandemic is rather sparse and most often concerns the SARS-CoV-1, MERS, Ebola, and influenza epidemics (8). In response, research on the scale and severity of emotional distress, including symptoms of depression and anxiety, in various countries remains necessary, especially to identify groups at a clinically severe risk of those symptoms. Indeed, staying in forced quarantine or home isolation is associated with several stressors that risk emotional problems, including severe symptoms of depression and/or generalized anxiety, insomnia, burnout syndrome (BOS), and post-traumatic stress disorders (PTSD) (9–14). In addition, people recently or currently in forced quarantine or isolation at home have shown relatively high levels of depression and symptoms of generalized anxiety, as well as a significantly higher severity of suicidal ideation and/or thoughts of self-harm than people not in quarantine (9). Beyond that, Logie and Turan (15) have shown that people diagnosed with COVID-19 may also experience rejection and stigmatization, which may most severely affect individuals who face discrimination daily (e.g., people of low socioeconomic status, refugees, immigrants, and minorities).

According to Chirico et al. (16), lockdown measures effectively curbing COVID-19 related new infections and deaths and overburden on the healthcare system. However, these measures are difficult to be maintained for a long time for economic reasons. This has an important implication because COVID-19 may exacerbate social inequities. Indeed, countries, where economic inequity is prevalent may be disadvantaged in the fight against the COVID-19 pandemic because the lockdown measures are unsustainable for a longer time.

Brooks et al. (9) have confirmed that people in quarantine or isolation at home may also sense a serious threat to their health and life, as well as worry that they may infect other people. Quarantine and isolation at home may also be associated with boredom, frustration due to the lack of personal freedom, and a sense of separation from the rest of the world, including loved ones. In addition, people in quarantine depend on the help of others to meet their basic needs, even in acquiring food, and awareness of such dependence can generate strong negative emotions that may increase if appropriate support from others is not received (9). Moreover, similarly to Logie and Turan (15), Brooks et al. (9) emphasized that people in quarantine or isolation may experience stigmatization and rejection from their immediate social environments, further intensifying their negative emotions.

In the study reported here, we decided to assess how the COVID-19 pandemic has influenced certain aspects of people's day-to-day functioning.

MATERIALS AND METHODS

All respondents were Poles. Inclusion criteria: age over 18 years, staying at forced 14 days quarantine amid the COVID-19 pandemic. Exclusion criteria: age below 18 years, no staying at forced 14 days quarantine amid the COVID-19 pandemic.

The study group comprised ($N = 1{,}312$) people, including 88.4% women and 11.6% men. The respondents' age ranged from 19 to 79 years; the mean age was 57.3 ± 19.1 years. Eighty-four percent of the respondents lived in the city, and 16% in the countryside. Forty-seven percent of the respondents had higher education, secondary - 37.2%, bachelor's - 6.7, and 8.5% during their studies, and 0.6% of people had primary education.

The study used a diagnostic survey using an Internet platform over 26 days (from January 3, 2021, to June 28, 2021). The questionnaire was anonymous. All data obtained during the study will be generalized and used in a scientific study. Participation in the study was voluntary. Entering the survey was

tantamount to agreeing to fill in the survey. Respondents had the right to resign at any time, regardless of the survey stage.

The questionnaire consisted of an in-house questionnaire, the Depression Anxiety and stress scale (DASS-21), and The Leibowitz Social Anxiety Scale—LSAS.

The Bioethics Committee approved the study of the Medical University of Bialystok-APK.002.33.2021.

Lovibond and Lovibond developed the used version of the Depression Anxiety and stress scale (DASS-21) scale in 1995 (16–18);[1] it consisted of 21 items into three groups of 7 articles each: depression, anxiety, and stress. The tool applies to the last seven days. The respondents assessed individual items on a scale from 0 to 3 points, where 0- never, 1 - sometimes, 2 - often, and 3 - always / almost always. In case of depression - normal this 0–9 point, mild this 10–13 point, moderate this 14–20 point, severe this 21–27, extremely severe this 28+. In case of anxiety - normal this 0–7 point, mild this 8–9 point, moderate this 10–14 point, severe this 15–19, extremely severe this 20+. In case of stress - normal this 0–14 point, mild this 15–18 point, moderate this 19–25 point, severe this 26–33, extremely severe this 34+.

The Leibowitz Social Anxiety Scale (LSAS) allowed assessing the severity of social phobia symptoms and their impact on everyday functioning (19). The respondent must read the descriptions of all the situations presented in the table. Each case answers two questions: "how much anxiety or fear do I experience in this situation" and "how much am I willing to avoid such a situation." For fear/drug questions - 0 is none, 1 - mild, 2 - moderate, 3 - strong; in the case of avoiding situations - 0 - never, 1- sometimes, 2- often, and 3- always (16). The scoring scale: 0–29 No social anxiety; 30–49 Mild social anxiety; 50–64 Moderate social anxiety; 65–79 Marked social anxiety; 80–94 Severe social anxiety; >95 Very severe social anxiety.

Statistical Analysis

All statistical analysis was performed with Statistica PL 13.0. Results are presented as mean values ± SD. Non-parametric Wilcoxon test was applied to compare differences. Spearman's analysis was used to measure the dependence age, sex, place residence, education, and the severity of depression, stress, and anxiety symptoms in the DASS 21 scale. The critical level for all tests of significance was $p < 0.05$.

RESULTS

Information on the COVID-19 pandemic in Poland was systematically interested in 48.8% of respondents. In turn, 27.4% of respondents were systematically interested in information about the world's coronavirus pandemic.

Almost 76% of respondents declared knowing the number of infected people in Poland, only 28.7% declared having such knowledge about infections worldwide. Most often, respondents had obtained information online (65.9%).

According to 45.7% of respondents, infection with COVID-19 is a major threat, and not enough has been done to reduce its spread in Poland (66.7%) or worldwide (56.1%).

Fifty percent of respondents reported the probability of infection with the COVID-19.

Almost 67% of Poland respondents reported that not enough had been done to protect the country against the coronavirus epidemic. Nearly 20% of respondents expressed the opposite opinion. Respondents considered social distancing (68.3%), quarantining people arriving from abroad (63.4%), and wearing protective masks and/or gloves (60.4%) to be the most effective actions for combatting the pandemic.

Almost a half (48.8%) of respondents preferred Internet surfing (42.7%), mobilizing and trying to do everything to protect themselves from infection, watching movies (39.6%), or reading (33.5%). **Table 1** presents other indications.

The respondents declared that they most often spent between 8 and 12 h in front of the TV. The respondents often felt fatigue (40.2%), nervousness (39.6%), depression (37.2%), irritability (37.2%), or difficulty sleeping (32.9%). Details are presented in **Table 2**.

The quarantine evoked the following various emotions in the respondents: anxiety (54.9%), exhaustion (46.3%), anger (39.6%), and sadness (38.4%).

The severity of anxiety (mean = 4.6 points), stress (7.5 points), and depression (7.3 points) was within normal ranges, and the respondents could generally be included in the group showing mildly severe social phobia (57.9 points). The detailed results are presented in **Table 3**.

No significant relationship between age, sex, place of residence, and education and the severity of depression, stress, and anxiety symptoms in the DASS 21 test was found.

Almost half (45.1%) of the respondents had no social phobia on the LSAS scale. Mild social phobia had 16.5% of respondents, moderate phobia – 17.1%, severe social phobia – 9.9%, and very severe – 11.4% of respondents. The results are presented in **Table 4**.

No significant relationship between the severity of social phobia and age, place of residence, and education was found. The only positive correlation between the severity of social phobia and gender ($R = 0.16904$; $p = 0.0304$) was found.

DISCUSSION

Due to the COVID-19 pandemic, sudden and severe restrictions influenced many people's mental health in the world. The quarantined people had to deal with stressful living conditions without prior preparation (20, 21). Each crisis or disaster pandemic carries a high risk of diminished wellbeing and individuals and societies as a whole (5, 22–24).

Hamer et Baran (22) conducted a study four times in 2020 (in March, April, at the turn of May and June, and in December) the CAWI (Computer-Assisted Web Interview) on a sample of 1,098 people aged 18 and over. They demonstrated a relatively high level of nervousness at the beginning of the pandemic in April. At the turn of May and June, a significant decrease was the lowest

[1]Available online at: https://www.healthfocuspsychology.com.au/tools/dass-21/ (cited 29.12.2021).

TABLE 1 | Methods of the behavior of respondents in a situation of forced quarantine*.

Behavior of respondents	Very often	Often	Rarely	No
Asking for advice and help from other people what to do in order not to get infected	2.4%	12.2%	36.6%	48.8%
Mobilizing and trying to do everything to protect yourself from infection	36.0%	42.7%	11.0%	10.4%
Reaching for alcohol, cigarettes, other psychoactive substances so as not to think about it	1.2%	7.3%	20.7%	70.7%
Consoling myself with the thought that it could be even worse, and for now, I am healthy	11.6%	48.2%	20.1%	20.1%
Giving up, not knowing what to do, not knowing what would happen - so I did nothing	4.9%	7.9%	23.2%	64%
Taking sedatives so as not to think about it	0.6%	3.0%	12.2%	84.1%
Praying for help from God	10.4%	23.2%	22%	44.5%
Watching movies	18.3%	39.6%	25%	17.1%
Reading	21.3%	33,5%	28.7%	16.5%
Cleaning	10.4%	29.9%	42.1%	17.7%
Watching TV	13.4%	29,9%	27.4%	29.3%
Internet surfing	33.5%	48.8%	13.4%	4.3%
Learning	15.2%	31.7%	28.7%	24.4%
Writing a thesis / doctoral / other scientific thesis	9.8%	7.9%	13.4%	68,9%
Taking care of the various distractions and moods	25.6%	47.6%	17.1%	9.8%

Possibility of multiple answers.

TABLE 2 | Complaints occurring in respondents during their stay in forced quarantine.

Complaints	Very often	Often	Rarely	No
Headaches	11.6%	20.7%	33.5%	34.1%
Stomach pain	2.4%	8.5%	39.0%	50.0%
Dizziness	6.1%	9.8%	28.0%	56.1%
Difficulty falling asleep	23.2%	32.9%	17.1%	26.8%
Nervousness	19.5%	39.6%	26.8%	14.0%
Depression	26.2%	37.2%	25.0%	11.6%
Fatigue	28.0%	40.2%	21.3%	10.4%
Irritation	18.9%	37.2%	31.1%	12.8%

compared to the remaining months, then increased again to the level from April in December.

In a study from China (24), most respondents spent 20–24 h a day (84.7%) at home. In a study by Huang and Zhao (21), in a group of 603 randomly selected respondents, 264 people spent more than 3 h each day tracking information about the virus and the epidemic.

Information about the pandemic in Poland and around the world was systematically obtained by 48.8 and 27.4% of respondents, respectively ($N = 328$). The respondents most often obtained information about the pandemic from the Internet (65.9%) and television (22%).

The COVID-19 pandemic is a potent stressor affecting the functioning of many countries and aggravates social stress (9).

According to 40.9% of respondents, COVID-19 is a grave threat to Poles' lives in the present study. The probability of developing the coronavirus was most often determined by fifty percent of the respondents.

In the literature (25–34) quarantine may reveal mental health problems in people who did not before. Symptoms of post-traumatic stress and emotional exhaustion are also described.

The scientific publications show that in about 33% of people in isolation, their mental wellbeing worsened, and the severity of these symptoms was individual.

The pandemic clinical picture's most typical and common feature is an acute stress disorder. According to Heitzman (34), it is a prolonged anxiety reaction and the inability to break away from trauma's constant experience.

In a study from India, 12.5% of respondents reported sleep problems and, 37.8% had thoughts related to the possibility of COVID-19 infection. Furthermore, over 80% of respondents felt the need for mental support from the health care system (3).

The respondents reported mainly fatigue, nervousness, depression, and irritability in the current study.

Our results are similar to Pierce et al. (35) in the United Kingdom. The prevalence of clinically significant mental distress levels in the population increased from 18.9% in 2018–2019 to 27.3% in April 2020, 1 month after the UK economy closed. The increases were most significant among people aged 18–34, women living with young preschool children, and working before the epidemic.

TABLE 3 | Assessment of the respondents with the DASS 21 test.

Answer	Never	Sometimes	Often	Always
Stress				
I found it hard to wind down	17.1%	45.7%	1.8%	35.4%
I tended to over-react to situations	23.2%)	39.0%	6.1%	31.7%
I felt that I was using a lot of nervous energy	33.5%	34.1%	6.1%	26.2%
I found myself getting agitated	28.0%	48.8%	3.7%	19.5%
I found it difficult to relax	18.9%	47.6%	5.5%	28.0%
I was intolerant of anything that kept me from getting on with what I was doing	36.0%	39.6%	4.9%	19.5%
I felt that I was rather touchy	34.8%	46.3%	5.5%	13.4%
Mean 7.5 ± 2.5 points				
Anxiety				
I was aware of dryness of my mouth	46.3%	36.0%	3.0%	14.6%
I experienced breathing difficulty(eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	56.7%	29.9%	1.8%	11.6%
I experienced trembling (e.g., in the hands)	67.7%	23.2%	3.0%	6.1%
I was worried about situations in which I might panic and make a fool of myself	45.7%	33.5%	4.9%	15.9%
I felt I was close to panic	58.5%	27.4%	3.7%	10.4%
I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	50.6%	36.0%	3.7%	9.8%
I felt scared without any good reason	43.3%	38.4%	3.7%	14.6%
Mean 4.6.± 1.5 points				
Depression				
I could not seem to experience any positive feeling at all	25.0%	45.7%	1.2%	28.0%
I found difficulty to work up	14.6%	40.9%	10.4%	34.1%
I felt that I had nothing to look forward to	45.1%	29.9%	7.3%	17.7%
I felt down-hearted and blue	10.4%	43.3%	11.0%	35.4%
I was unable to become enthusiastic about anything	28.7%	51.2%	4.9%	15.2%
I felt I was not worth much as a person	43.9%	32.9%	5.5%	17.7%
I felt that life was meaningless	54.3%	25.0%	4.3%	6.5%
Mean 7.3 ± 2.4 points				

In China, the impact of quarantine on the mental state, level of anxiety, depression, and stress during the initial stage of the COVID-19 outbreak in a group of 1,210 people was assessed by Wang et al. (36). More than half (53.8%) of respondents rated the psychological impact of the COVID-19 pandemic on wellbeing as moderate or severe; 16.5% of respondents had severe depression, and 28.8% had severe anxiety symptoms. Women and students had higher levels of stress, anxiety, and depression. Lower levels of stress, anxiety, and depression positively correlated with accurate health information about the COVID-19 epidemic.

In a large study group of 52,730 respondents from 36 provinces of China, Qiu et al. (37) evaluated the impact of stress amid COVID-19. Moderate stress was found in 29% of respondents, while 5% had severe stress intensity. Women had more severe stress than men. Furthermore, the subjects aged 18–30 and over 60 and higher education levels had greater stress intensity.

Another Chinese study of 600 general population during national quarantine (25) demonstrated that women had 3.01 times higher risk of anxiety than men. Respondents over 40 years of age had a lower risk of anxiety than people under 40. The risk of depression depended on the level of education.

Similar findings were reported (29) in a 603 randomly selected respondents study. Generalized anxiety had 34% of participants, and depressive disorders - in 18.1%-were more often observed respondents 35 years of age.

In an online survey from India, Roy et al. (3) assessed the level of anxiety and level of knowledge about the course of COVID-19 using. More than 80% of surveyed had a high level of anxiety. On the other hand, most of the respondents had a moderate level of knowledge about COVID-19 and a high level of knowledge about prevention.

In the current study, the severity of anxiety, stress, and depression was within normal ranges, and the respondents could be included in the group showing mildly severe social phobia (57.9 points). In addition, most respondents considered quarantine of people coming from abroad (63.4%), and cancellation of all mass events (59.1%) as the most effective actions in the fight against the spread of the coronavirus in Poland. Also, the respondents indicated keeping a safe distance between people in public space (68.3%), protective masks and gloves when leaving the house (60.4%), frequent washing of hands with soap (59.8%), the use of special disinfectants (57.3%) and avoiding public transport (43.3%).

TABLE 4 | Assessment of social anxiety in respondents using the Leibowitz scale.

Questions	How much you experience anxiety or fear in this situation?				How willing you are to avoid this situation?			
	None	Mild	Moderate	Severe	Never	Occasionally	Often	Usually
Using a telephone in public	42.1%	35.4%	7.1%	5.5%	24.4%	36.0%	29.3%	10.4%
Participating in small groups	65.9%	25.6%	8.5%	0	54.3%	32.3%	11.0%	2.4%
Eating in public places	51.2%	29.3%	11.0%	8.5%	47.0%	28.0%	15.9%	9.1%
Drinking with others in public places.	55.5%	25.0%	11.6%	7.9%	42.7%	28.0%	14.6%	14.6%
Talking to people in authority	20.1%	35.4%	32.9%	11.6%	27.4%	37.8%	25.0%	9.8%
Acting, performing or giving a talk in front of an audience	12.8%	23.2%	32.9%	31.1%	17.7%	28.0%	30.5%	23.8%
Going to a party	42.7%	31.7%	16.5%	9.1%	39.0%	36.0%	14.0%	11.0%
Working while being observed	16.5%	39.0%	30.5%	14.0%	25.0%	37.8%	25.6%	11.6%
Writing while being observed	28.0%	40.9%	20.1%	11.0%	29.9%	39.6%	20.1%	10.4%
Calling someone you don't know very well	20.7%	38.4%	25.6%	15.2%	22.0%	40.2%	23.8%	14.0%
Talking with people you don't know very well	25.6%	36.6%	26.2%	11.6%	26.2%	44.5%	20.1%	9.1%
Meeting strangers	27.4%	39.0%	22.6%	11.0%	38.4%	34.1%	18.3%	9.1%
Urinating in a public bathroom	33.5%	26.8%	21.3%	18.3%	34.1%	22.6%	20.7%	22.6%
Entering a room when others are already seated	29.3%	36.6%	21.3%	12.8%	36.0%	32.9%	20.7%	10.4%
Being the center of attention	26.2%	28.0%	26.2%	19.5%	26.8%	29.9%	25.6%	17.7%
Speaking up at a meeting.	18.3%	25.0%	26.8%	29.9%	18.3%	31.1%	24.4%	26.2%
Taking a test	23.8%	32.9%	32.9%	10.4%	31.7%	38.4%	23.2%	6.7%
Expressing a disagreement or disapproval to people you don't know very well	22.0%	39.6%	30.5%	7.9%	23.8%	35.4%	27.4%	13.4%
Looking at people you don't know very well in the eyes	30.5%	39.0%	20.7%	9.8%	31.7%	36.6%	20.7%	11.0%
Giving a report to a group	15.2%	23.2%	36.0%	25.6%	20.7%	29.9%	28.0%	21.3%
Trying to pick up someone	19.5%	32.3%	28.7%	19.5%	28.0%	26.8%	20.1%	25.0%
Returning goods to a store	25.6%	31.7%	23.2%	19.5%	27.4%	22.6%	20.1%	29.9%
Giving a party	31.7%	36.0%	23.8%	8.5%	36.0%	37.8%	18.3%	7.9%
Resisting a high pressure salesperson	29.3%	36.6%	22.6%	11.5%	28.7%	32.9%	17.1%	21.3%

In the present study, very common ways of behaving in a situation of forced quarantine were surfing the Internet (48.8%), mobilizing and trying to do everything to protect yourself from infection (42.7%), watching movies (39.6%), or reading (33.5%).

Heitzman (34) noted that people who test positive for the coronavirus, who are sick or quarantined, and their families would develop acute stress disorder symptoms (308.3, DSM-5) of the nature of distress.

In some countries, expert guidance was published at the pandemic's start. For example, the Korean Neuropsychiatric Association has published guidelines based on the assumption that quarantine induced by the COVID-19 epidemic may cause severe psychological effects in acute stress disorder, depression, post-traumatic stress disorder (PTSD), insomnia, irritability, and emotional exhaustion. The guidelines mention groups that are particularly vulnerable to the psychological consequences of quarantine. Experts include parents caring for children, young children, people quarantined after contact with COVID-19, doctors dealing with infected patients (38).

A study from Brazil (20), on 1,468 volunteers via an online survey, demonstrated that people who had to work outside live with an older adult have at least one common comorbid disease experienced more significant psychological discomfort and distress during the pandemic. Conversely, children's presence protected the subjects from depression.

It is impossible to compare the data to the norms as there are no standards for measuring quarantine response. Therefore, there is a need to understand the role of behavioral and psychosocial factors in predicting mental health in people in confinement and social isolation. Heitzman (34) notes that not everyone confronted with the pandemic will reveal post-traumatic psychiatric symptoms and will need psychological help and support from others. In the available works on the topics mentioned above, it was emphasized:

- the need for special care for vulnerable groups when planning preventive psychological interventions during the COVID-19 epidemic (37)
- the need to raise awareness of the psychological consequences of this COVID-19 pandemic and to intensify preventive measures to avoid long-term consequences (3)
- the need to support groups such as young people, the elderly, women, and migrants through the healthcare system, improving telemedicine and interventions during quarantine to prevent long-term consequences in the form of mental disorders (36)

- the need to identify the weakest people who may need the most help from health care systems, which seems particularly important as the human resources of psychologists or psychiatrists are limited and should be wisely (based on reliable parameters) used to fight the consequences of the COVID-19 pandemic (20)
- the need for the state to maintain access to assistance in the event of domestic violence, but also to prioritize the availability of childcare (36)
- that obtaining and relying on reliable information about an epidemic may reduce the intensity of the anxiety response, which is expected in the situation (38)
- when planning prophylaxis and interventions, one of at least six groups should be considered—healthcare professionals, people who have direct contact with patients, patients who refuse treatment, and people susceptible to infection (39).

It is well known that women were more likely to suffer from psychological stress than men. Females are more than twice as likely as males to be afflicted by mood disorders (40). This sex disparity indicates a potential role for gonadal hormones in the etiology of anxiety and depressive disorders. Women often experience anxiety, and depression during times of hormonal flux, such as puberty, menopause, perimenstrual and post-partum periods (41). According to Bucciarelli et al. (42), study gender represents a potential modifying factor in cardiovascular disease and depression and COVID-19 short- and long-term outcomes, particularly in cases involving long-term COVID complications. Results from emerging studies indicate that the COVID-19 pandemic affected male and female populations differently. Women seem to experience less severe short-term complications but suffer worse long-term COVID complications, including depression, reduced physical activity, and deteriorating lifestyle habits, all of which may impact cardiovascular risk. Mass-quarantine, self-quarantine, and isolation are associated with depression, anger, and chronic stress. The stressor factors suggested included longer quarantine duration, frustration, boredom, inadequate supplies, inadequate information, financial loss, and stigma (43).

Our current study has some potential limitations. First, the study group was too small to generalize the results to the entire population of people in Poland. Secondly, there was an overrepresentation of women in the studied subgroups. Hence the results should be verified in an equally numerous group of men. Nevertheless, despite these limitations, this study's results may provide a starting point for further research into the problems arising from quarantine.

CONCLUSIONS

1. Most respondents considered infection with COVID-19 to be a significant threat and feared another quarantine.
2. During quarantine, respondents most often experienced fatigue, a lack of energy, nervousness, anxiety, anger, and sadness.
3. Respondents demonstrated anxiety, stress, and depression severity in the normal range.
4. Respondents showed mildly severe social phobia.
5. Due to their frequent occurrence of anxiety disorders and depression, it is worth educating people on recognizing them to seek professional help in time (a psychologist, psychotherapist, or psychiatrist). It is important to disseminate the most important advice and tips of mental health experts during a pandemic among the public. TV and social media channels that fuel a spiral of anxiety and stress should be limited. Information should be sought from reliable sources. We have to try as much as possible to keep the current, personal way of spending time and the rhythm of the day. Do not give up on favorite activities and interests.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Bioethics Committee of the Medical University of Białystok-APK.002.33.2021. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

EK-K and AK-B designed the study and wrote the protocol. EK-K, AK-B, WK, GB, CŁ, NW, MC, AG, JF, PA, and MP data collection. WK undertook the statistical analysis. EK-K, AK-B, and GB wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

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One Year Facing COVID. Systematic Evaluation of Risk Factors Associated With Mental Distress Among Hospital Workers in Italy

Matteo Bonzini[1,2*], *Anna Comotti*[1], *Alice Fattori*[1], *Filippo Cantù*[2], *Elisa Colombo*[3], *Valentina Tombola*[3], *Eralda Myslymi*[2], *Michele Gatti*[2], *Giulia Stucchi*[1], *Carlo Nava*[1], *Lorenzo Bordini*[1], *Luciano Riboldi*[1] *and Paolo Brambilla*[2,3*]

[1] Occupational Medicine Unit, IRCCS Maggiore Policlinico Hospital Foundation, Milan, Italy, [2] School of Medicine, University of Milan, Milan, Italy, [3] Psychiatric Unit, IRCCS Maggiore Policlinico Hospital Foundation, Milan, Italy

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Catholic University of the Sacred Heart, Italy

***Correspondence:**
Matteo Bonzini
matteo.bonzini@unimi.it
Paolo Brambilla
paolobrambilla.ter@gmail.com

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Introduction: Italy was the first Western country affected by the COVID-19 pandemic that still constitutes a severe challenge for healthcare workers (HCWs), with a deep impact on their mental health. Several studies confirmed that a considerable proportion of HCW developed adverse psychological impairment (PsI). To focus on preventive and rehabilitation measures, it is fundamental to identify individual and occupational risk factors. We systematically assessed possible PsI among all employees in a large university hospital in Italy, using validated psychometric scales in the context of occupational health surveillance.

Methods: In the period of July 2020 to July 2021, we enrolled 990 HCWs. For each subject, the psychological wellbeing was screened in two steps. The first-level questionnaire collected gender, age, occupational role, personal and occupational COVID-19 exposure, general psychological discomfort (GHQ-12), post-traumatic stress symptoms (IES-R), and anxiety (GAD-7). Workers showing PsI (i.e., test scores above the cutoff in at least one among GHQ-12, IES-R, and GAD-7) have been further investigated by the second-level questionnaire (psycho-diagnostic) composed by PHQ-9, DES-II, and SCL-90 scales. If the second-level showed clinically relevant symptoms, then we offered individual specialist treatment (third level).

Results: Three hundred sixteen workers (32%) presented signs of PsI at the first-level screening questionnaire. Women, nurses, and subjects engaged in the COVID-19 area and with an infected family member showed significantly higher PsI risk. PsI prevalence was strongly associated with the pandemic trend in the region but sensibly decreased after January 2021, when almost all workers received the vaccination. A proportion of subjects with PsI presented clinically relevant symptoms (second-level screening) on PHQ-9 (35%), DES (20%), and SCL-90 (28%). These symptoms were associated neither to direct working experience with patients with COVID-19 nor to COVID-19 experience in the family and seemed not to be influenced by the pandemic waves or workers vaccination.

Conclusions: The evaluation of psychological wellbeing of all hospital workers, directly or indirectly exposed to pandemic consequences, constitutes a unique condition to detect individual, occupational, and non-occupational risk factors for PsI in situations of high stress and/or disasters, as well as variables associated with symptom chronicization.

Keywords: healthcare workers, mental health, risk factors, psychological impairment, COVID-19 vaccine

BACKGROUND AND AIMS

Italy was the first Western country to be affected by the COVID-19 pandemic since February 2020, when the exponential rise of cases required a national lockdown and imposed a rapidly increasing extraordinary amount of work on the healthcare system in terms of critical care and reorganization.

Under such circumstances, healthcare workers (HCWs) experienced heavy workload, physical exhaustion, frustration and helplessness, and fear of infecting themselves and their relatives (1). Thus, besides physical safety, HCWs' mental health was a major concern for authorities (2) and occupational physician. Moreover, studies conducted during previous epidemics [SARS, MERS, and Ebola; (3, 4)] and primary studies conducted in China at the very beginning of the COVID-19 pandemic showed a high prevalence of post-traumatic stress disorder (PTSD), depression, and anxiety disorders among HCWs (5–7). More recently, several studies, including reviews, have been conducted from the very beginning of the COVID-19 pandemic on HCW mental health and confirmed that a considerable proportion of workers developed adverse psychological outcomes during the COVID pandemic (8–12). These studies found that being frontline workers, female gender, younger age, lower job seniority, and nursing profession predicted worsened mental health (13, 14).

Most of these studies are focused on critical care workers and data collected through web-based questionnaires, being able in several cases to collect only a proportion of the workers' data. Thus, results could be partially affected by the self-selection of respondents, and the comparison of mental health outcomes between more exposed workers and other colleagues is limited. Another relevant common limitation is the lack of information of non-occupational important risk factors (such as COVID infection in the family): although HCWs of intensive care units faced a large number of COVID-19 deaths and substantial work-related stress, all healthcare professionals were also exposed to personal grief and family concerns (15). Finally, because the majority of the published studies were conducted during the first phases of the pandemic, results are focused on the early onset symptoms with little evidence on the persistence of symptoms and delayed-onset PTSD, which typically occurs a few months after exposure.

This is why we point out that, even in the current pandemic scenario, it is crucial to evaluate and monitor the mental health of HCWs during different phases and waves of the COVID pandemic (1) to prevent possible mental disorders, (2) to discover work-related and individual risk factors that can exacerbate psychological distress, and (3) to target rehabilitation strategies on more vulnerable people. For these reasons, we designed a prospective study that systematically evaluates the mental wellbeing of all workers employed in a large second-level general hospital in Milan, Italy. They were followed by the occupational physician health surveillance, using a multistep approach to assess psychological workload and symptoms with validated scales. The study covered almost a period of 1 year and has been characterized by two waves of the epidemic as well as a massive and rapid campaign of health workers' vaccination that in our region (Lombardy) occurred in January to February 2021.

METHODS

Study Design

We developed a multi-step process to evaluate workers mental health to encourage participation with a first brief screening and then offering further support to those who need it. To take into account the requirements of both brevity and validity, we adopted extensively used screening instruments for common psychological impairment (PsI) related to COVID-19 pandemic [an extensive description of the methodology adopted for this study was illustrated in a previous report (16)]. We proposed our screening to all workers employed in our hospital.

1. First level: to detect possible PsI with standardized scales during a structured medical-assisted interview in the context of occupational health surveillance;
2. Second level: when first-level scales show PsI, workers are invited to undergo a second-level questionnaire to better assess possible psychological distress;
3. Third level: to offer a specialist evaluation and psychological support and/or psychiatric treatment to workers who show specific symptoms at the second-level questionnaire.

We plan to perform a follow-up re-evaluation on all participants within 12 months from enrollment to evaluate trends in psychological burden, recognize delayed onset of symptoms, and evaluate the efficacy of specialist treatments.

Setting and Participants

The study is conducted jointly by the units of Occupational Medicine and Psychiatry.

From July 2020 onward, all workers have been invited to participate, independently from age, sex, department, and job title. The only two exclusion criteria were being employed after the beginning of the study and the refusal to sign the informed consent; there were no exclusion criteria on pre-existing pathologies, aiming to include the overall and most general pool of the population. An extended informed-consent form has to be signed before the first-level evaluation. Formal

ethical approval was also obtained from the Hospital Ethical Committee in July 2020.

Assessment Measures

First-level evaluation is composed of an occupational physician interview collecting (i) socio-demographic characteristics (age and gender); (ii) occupational data, including information about occupational role (administrative staff, heath assistant, nursing staff, physicians, and others), hospital unit/department, and engagement in COVID-19 area (none, concluded, and still ongoing) with respective intensity (high/low) and length; and (iii) clinical information regarding chronic conditions and habitual medications, specifying which drugs were taken after pandemic began and a psychometric questionnaire.

The questionnaire is collected directly on digital support and consists of the following:

- The General Health Questionnaire (GHQ-12) (17) in the validated Italian version (18, 19) for assessing psychological distress and short-term changes in mental health. We adopted the dichotomous scoring method (0-0-1-1) and a score above or equal to 4 as the cutoff point (20, 21).
- Impact of Event Scale-Revised (IES-r) for assessing post-traumatic stress symptoms (22). A brief description guides subjects to answer the following questions by assessing their subjective responses related to the COVID-19 emergency in the previous 7 days with 22 questions exploring intrusion, avoidance, and hyperarousal symptoms. A total score of 33 on the IES-r yielded a diagnostic sensitivity of 0.91 and specificity of 0.82 (23). The Italian version has also shown optimal psychometric properties and validity (24).
- Generalized Anxiety Disorders (GAD-7) (25) to screen anxiety symptoms. With robust psychometric properties and strong validity, a score of 10 or greater represents a reasonable cutoff point to identify cases of GAD; increasing scores on the GAD-7 are also strongly associated with multiple domains of functional impairment and disability.
- A section collecting individual COVID-19 exposure and COVID-related health concerns/beliefs: to have been positive of COVID-19 and duration of the condition, to have been in quarantine and duration, to have family members that tested positive/were hospitalized/died of COVID-19, personal concern for infecting family members, the experience of social discrimination outside the hospital, changes in family's habits, thoughts about changing job, fear for their own safety, and the experience of moral injury at work.

The second-level questionnaire contains specific scales to further investigate psychopathological symptoms and disorders:

- Symptom Checklist-90-Revised (SCL-90-R) (26) is a self-administered scale for the evaluation of psychiatric symptomatology;
- The Dissociative Experience Scale II (DES II) (27, 28). Dissociative symptoms are frequently found in the aftermath of trauma and occur to some degree in individuals without mental disorders and are thought to be more prevalent in persons with major mental illnesses. The DES II has been developed to offer a means of reliably measuring dissociation in normal and clinical populations;
- Patient Health Questionnaire-9 (PHQ-9) (29). The PHQ-9 is aimed at assessing depression disorder by scoring each of the nine DSM-IV criteria.

A specialist psychiatric feedback of second-level evaluation results is sent to the occupational physician who, if tests are indicative of impairment in psychological functioning, proposes to the worker a specialist consultation in person. That third-level evaluation is comprised of the specialist consultation within 1 week from the second-level evaluation and is followed, according to every single case, by an eventual psychiatric follow-up or psychotherapy. To individuate late signs and to assess individual changes in psychological distress, all subjects repeat tests after no more than 12 months.

Statistical Analysis

Data were collected through an automatic database generated by the REDCap platform (30), which was subsequently analyzed by R software (31). An independent coded dataset accessible only to the PI guarantees data protection linking individual information (i.e., name and surname) with an alphanumeric code.

Statistical analysis was aimed to individuate risk factors for sub-optimal psychological wellbeing and/or impaired psychological function.

In univariate analysis, the relationship between each potential risk factor and outcomes, treated as continuous variables, was preliminarily investigated in terms of mean differences across subgroups through independent samples *t*-test and one-way ANOVA. Comparison in the percentage of subjects with a total score higher than the cutoff for each scale was evaluated through the Chi-square test.

In multivariate analysis, each potential risk factor is included in multiple logistic regression models to explore the relative contributions [in terms of odds ratios (ORs)] of the various risk factors to the dependent variables including potential covariates and confounders. The overall significance of each variable was tested through the likelihood ratio test.

The relationship between personal concerns and feelings about COVID-19, collected through six questions with multiple answers (not at all, little, enough, and very), and first-level outcome variables was graphically explored, and the difference in the distribution was investigated through the Kolmogorov–Smirnov test for discrete variables. To study their effect on first-level scores in terms of risk factors, they have been converted into dichotomous variables (yes = not at all and little; no = enough and very) and put one by one in the multivariate logistic regression model.

The effect of vaccination on psychological scales has been investigated exploring differences between workers enrolled before and after the COVID-19 vaccination campaign, which started in January 2020. To study how the effect of risk factors, in particular of the variables related to COVID-19 exposure, varied after the vaccination, we performed multivariate logistic regression on first-level screening dividing the dataset into two sub-samples ($N = 584$ and $N = 406$, before and

after vaccination campaign, respectively). The significance of the relationship between these variables and vaccination was evaluated including an interaction term in the multivariate logistic regression model on the whole dataset, using a binary variable indicating enrollment before or after the vaccination campaign.

A $p < 0.05$ will be considered statistically significant. ORs are calculated with their relative 95% confidence intervals.

RESULTS

The occupational medicine unit, where workers underwent the periodical health surveillance already prescribed by the current Italian legislation, proposed the study protocol to all workers since July 2020. By July 2021, we had enrolled 990 subjects out of a total population of 1,610. The participation rate was 62%. In detail, 220 (13%) workers did not answer

TABLE 1 | First level screening scales across subgroups: number of enrolled subjects, means, standard deviations and frequencies of scorings above the cutoff at the different first level psychometric scales.

		GHQ-12		IES-R		GAD-7	
	***N* (%)**	**Mean (sd)**	***N* (%) > cutoff**	**Mean (sd)**	***N* (%) > cutoff**	**Mean (sd)**	***N* (%) > cutoff**
Gender							
Male	297 (30%)	2.79 (3.07)	96 (32%)	16.2 (15.3)	46 (16%)	4.58 (4.43)	44 (15%)
Female	693 (70%)	3.27 (3.32)	270 (39%)	20.5 (17.0)	146 (21%)	6.38 (5.30)	161 (23%)
p-value		*0.03**	*0.06****	*<0.001**	*0.05****	*<0.001**	*0.003****
Age group							
20–30	137 (14%)	3.73 (3.54)	62 (45%)	20.6 (16.5)	30 (22%)	6.55 (4.93)	33 (24%)
30–40	276 (28%)	3.21 (3.17)	110 (40%)	19.3 (15.5)	55 (20%)	5.92 (4.84)	56 (20%)
40–50	245 (24.5%)	3.27 (3.43)	90 (37%)	19.9 (18.6)	53 (22%)	6.13 (5.60)	60 (25%)
>50	332 (33.5%)	2.72 (3.02)	104 (31%)	17.9 (16.0)	54 (16%)	5.27 (5.02)	56 (17%)
p-value		*0.01***	*0.02****	*0.35***	*0.32****	*0.06***	*0.17****
Occupational role							
Administrative staff	119 (12%)	2.44 (2.83)	34 (29%)	16.8 (14.3)	14 (12%)	5.32 (4.92)	20 (17%)
Health assistant	63 (6.5%)	2.67 (3.45)	17 (27%)	23.1 (18.2)	15 (24%)	5.98 (5.23)	17 (27%)
Nursing staff	416 (42%)	3.79 (3.52)	188 (45%)	23.0 (18.4)	115 (28%)	6.71 (5.52)	111 (27%)
Physician	233 (23.5%)	2.81 (2.89)	80 (34%)	15.0 (13.6)	27 (12%)	4.96 (4.49)	34 (15%)
Others	159 (16%)	2.55 (2.97)	47 (29%)	15.6 (14.0)	21 (13%)	5.20 (4.68)	23 (14%)
p-value		*<0.001***	*<0.001****	*<0.001***	*<0.001****	*<0.001***	*<0.001****
COVID-19 area working experience							
Never	544 (55%)	2.54 (2.92)	160 (29%)	16.7 (14.3)	72 (13%)	5.27 (4.79)	90 (17%)
Yes†							
Previously	202 (20%)	3.63 (3.47)	86 (43%)	21.5 (17.9)	48 (24%)	6.04 (5.25)	46 (23%)
Currently	244 (25%)	4.01 (3.52)	120 (49%)	23.9 (18.6)	72 (30%)	7.04 (5.49)	69 (28%)
p-value		*<0.001***	*<0.001****	*<0.001***	*<0.001****	*<0.001***	*<0.001****
<4 months	227 (23%)	3.93 (3.54)	107 (47%)	22.7 (18.6)	58 (26%)	6.38 (5.44)	54 (24%)
>4 months	219 (22%)	3.74 (3.45)	99 (45%)	23.1 (18.1)	62 (28%)	6.81 (5.38)	61 (28%)
p-value		*<0.001***	*<0.001****	*<0.001***	*<0.001****	*<0.001***	*<0.001****
Low-intensity area	101 (10%)	3.26 (3.41)	37 (37%)	18.6 (15.2)	19 (19%)	5.70 (4.94)	21 (21%)
High-intensity area	345 (35%)	4.01 (3.51)	169 (49%)	24.1 (19.0)	101 (29%)	6.85 (5.52)	94 (27%)
p-value		*<0.001***	*<0.001****	*<0.001***	*<0.001****	*<0.001***	*<0.001****
Positive nasoph. swab							
Yes	153 (15%)	3.15 (3.40)	55 (36%)	18.9 (16.2)	31 (20%)	5.89 (4.84)	28 (18%)
No	837 (85%)	3.13 (3.23)	311 (37%)	19.3 (16.7)	161 (19%)	5.83 (5.17)	177 (21%)
p-value		*0.93**	*0.83****	*0.83**	*0.85****	*0.87**	*0.48****
Family member positive to COVID-19							
Yes	209 (21%)	3.43 (3.15)	89 (43%)	19.1 (15.6)	44 (21%)	6.04 (4.72)	45 (22%)
No	781 (79%)	3.16 (3.29)	277 (36%)	19.3 (16.9)	148 (19%)	5.79 (5.22)	160 (21%)
p-value		*0.30**	*0.07****	*0.86**	*0.56****	*0.55**	*0.9****

**t-test.*

***One-way ANOVA.*

****Chi-square test.*

†p-values refer to comparisons between subjects with working experiences in COVID-19 area (current/previous, number of days, intensity area) and subjects with no experience in COVID-19 area.

our calls or were unavailable and 400 (25%) refused to participate.

Table 1 summarizes the numbers and main characteristics of enrolled subjects and the results of the first-level questionnaires. The percentage of subjects scoring above the cutoff of the first-level scales widely differed by gender, age, occupational role, and COVID-19 exposure at work and in their own family. No significant differences were found dividing subjects with or without a previous COVID-19 infection (stated by a positive swab). Similar results were found considering average values in each psychometric scale, instead of cutoffs.

Table 2 presents multivariate logistic regression analysis for first-level screening scales. Adjusted OR showed that gender, occupational role, working experience with patients with COVID-19, and having a family member with previous COVID-19 infection were risk factors for PsI. Women had an increased risk of developing anxiety symptoms by around 70% (see GAD-7 scale), being a nurse almost tripled the risk for developing

TABLE 2 | Multivariate logistic regression for f first level screening scales: adjusted OR for scoring above the cut-offs with associated 95% confidence intervals and corresponding LR test *p*-values.

	N (%)	GHQ-12 AdjOR (95% CI)	IES-R AdjOR (95% CI)	GAD-7 AdjOR (95% CI)
Gender				
Male	297 (30%)	1.00	1.00	1.00
Female	693 (70%)	1.37 (1.01, 1.85)	1.44 (0.99, 2.13)	1.72 (1.19, 2.54)
p-value		*0.04*	*0.06*	*0.003*
Age				
>50	332 (33.5%)	1.00	1.00	1.00
20–30	137 (14%)	1.12 (0.72, 1.76)	0.69 (0.39, 1.20)	1.02 (0.59, 1.72)
30–40	276 (28%)	1.05 (0.73, 1.51)	0.79 (0.50, 1.24)	0.96 (0.61, 1.49)
40–50	245 (24.5%)	1.05 (0.73, 1.46)	1.06 (0.68, 1.66)	1.35 (0.88, 2.07)
p-value		*0.03*	*0.31*	*0.17*
Occupational role				
Physician	233 (23.5%)	1.00	1.00	1.00
Administrative staff	119 (12%)	1.07 (0.63, 1.80)	1.58 (0.74, 3.27)	1.44 (0.75, 2.75)
Health assistant	63 (6.5%)	0.66 (0.34, 1.22)	2.27 (1.09, 4.61)	2.07 (1.04, 4.05)
Nursing staff	416 (42%)	1.41 (1.00, 2.01)	2.90 (1.82, 4.73)	1.95 (1.26, 3.06)
Others	159 (16%)	0.99 (0.62, 1.56)	1.60 (0.84, 3.05)	1.14 (0.75, 2.75)
p-value		*0.003*	*<0.001*	*0.007*
COVID-19 area working experience				
Never	544 (55%)	1.00	1.00	1.00
Yes[†]				
Previously	202 (20%)	1.75 (1.20, 2.52)	2.08 (1.31, 3.29)	1.43 (0.91, 2.22)
Currently	244 (25%)	2.27 (1.59, 3.25)	2.80 (1.82, 4.34)	1.96 (1.29, 2.96)
p-value		*<0.001*	*<0.001*	*0.007*
<4 months	227 (23%)	2.07 (1.44, 2.97)	2.26 (1.45, 3.54)	1.49 (0.97, 2.29)
>4 months	219 (22%)	1.95 (1.35, 2.82)	2.66 (1.71, 4.15)	1.93 (1.26, 2.96)
p-value		*<0.001*	*<0.001*	*0.009*
Low-intensity area	101 (10%)	1.41 (0.87, 2.28)	1.67 (0.90, 3.03)	1.35 (0.75, 2.37)
High-intensity area	345 (35%)	2.22 (1.61, 3.09)	2.69 (1.81, 4.05)	1.80 (1.23, 2.66)
p-value		*<0.001*	*<0.001*	*0.009*
Positive nasoph. swab				
No	837 (85%)	1.00	1.00	1.00
Yes	153 (15%)	0.78 (0.53, 1.15)	0.94 (0.58, 1.48)	0.73 (0.45, 1.16)
p-value		*0.55*	*0.98*	*0.21*
Family member positive				
No	781 (79%)	1.00	1.00	1.00
Yes	209 (21%)	1.48 (1.05, 2.08)	1.17 (0.77, 1.76)	1.11 (0.74, 1.65)
p-value		*0.02*	*0.64*	*0.61*

[†]*p-values refer to comparisons between subjects with working experiences in COVID-19 area (current/previous, number of days, intensity area) and subjects with no experience in COVID-19 area.*

TABLE 3 | Second level screening scales ($N = 316$): means, standard deviations and frequencies of scorings above the cutoff across subgroups.

		PHQ-9		DES		SCL-90	
	***N* (%)**	**Mean (sd)**	***N* (%) > cutoff**	**Mean (sd)**	***N* (%) > cutoff**	**Mean (sd)**	***N* (%) > cutoff**
Gender							
Male	81 (26%)	8.63 (4.79)	22 (27%)	9.94 (10.4)	12 (15%)	0.66 (0.48)	17 (21%)
Female	235 (74%)	9.54 (5.44)	88 (37%)	13.2 (13.7)	50 (21%)	0.84 (0.64)	73 (31%)
p-value		*0.16**	*0.12****	*0.03**	*0.27****	*0.01**	*0.12****
Age group							
20–30	57 (18%)	9.11 (5.15)	15 (26%)	11.3 (9.29)	9 (16%)	0.73 (0.57)	13 (23%)
30–40	91 (29%)	8.95 (5.29)	27 (30%)	14.4 (14.2)	27 (30%)	0.78 (0.61)	29 (32%)
40–50	81 (25.5%)	9.98 (5.49)	34 (42%)	11.3 (13.1)	13 (16%)	0.84 (0.60)	25 (31%)
>50	87 (27.5%)	9.18 (5.21)	34 (39%)	11.9 (13.8)	13 (15%)	0.81 (0.63)	23 (26%)
p-value		*0.59***	*0.14****	*0.37***	*0.04****	*0.72***	*0.62****
Occupational role							
Administrative staff	27 (8%)	8.44 (5.01)	9 (33%)	14.4 (17.5)	6 (22%)	0.86 (0.71)	10 (38%)
Health assistant	16 (5%)	12.2 (4.62)	11 (69%)	21.3 (19.1)	8 (50%)	1.27 (0.83)	9 (56%)
Nursing staff	173 (55%)	10.3 (5.43)	64 (37%)	14.1 (13.3)	43 (25%)	0.86 (0.60)	55 (32%)
Physician	62 (20%)	7.34 (4.58)	13 (21%)	6.48 (6.29)	2 (3%)	0.54 (0.32)	6 (10%)
Others	38 (12%)	7.18 (4.46)	13 (34%)	8.92 (9.17)	3 (8%)	0.67 (0.61)	10 (26%)
p-value		*<0.001***	*0.008****	*<0.001***	*<0.001****	*<0.001***	*<0.001****
COVID-19 area working experience							
Never	138 (44%)	8.65 (4.92)	47 (34%)	12.2 (12.8)	23 (17%)	0.80 (0.62)	41 (30%)
Yes†							
Previously	64 (20%)	10.1 (5.47)	26 (41%)	12.0 (11.9)	16 (25%)	0.77 (0.60)	15 (24%)
Currently	114 (36%)	9.64 (5.56)	37 (32%)	12.8 (13.9)	23 (20%)	0.80 (0.59)	34 (30%)
p-value		*0.13***	*0.53****	*0.89***	*0.37****	*0.95***	*0.63****
<4 months	82 (26%)	10.0 (5.50)	31 (38%)	13.5 (14.1)	22 (27%)	0.77 (0.60)	19 (23%)
>4 months	96 (30%)	9.65 (5.55)	21 (33%)	11.6 (12.5)	17 (18%)	0.81 (0.58)	30 (31%)
p-value		*0.14***	*0.79****	*0.61***	*0.15****	*0.93***	*0.47****
Low-intensity area	30 (9%)	9.20 (5.46)	10 (33%)	12.9 (14.2)	8 (27%)	0.80 (0.69)	9 (30%)
High-intensity area	148 (47%)	9.94 (5.54)	53 (36%)	12.4 (13.1)	31 (21%)	0.79 (0.57)	40 (27%)
p-value		*0.12***	*0.93****	*0.95***	*0.39****	*0.97***	*0.86****
Positive nasopharyngeal swab							
Yes	51 (16%)	9.69 (5.08)	18 (35%)	13.4 (15.7)	8 (16%)	0.76 (0.56)	12 (24%)
No	265 (84%)	9.23 (5.33)	92 (35%)	12.1 (12.5)	54 (20%)	0.80 (0.61)	78 (29%)
p-value		*0.56**	*0.9****	*0.58**	*0.56****	*0.63**	*0.47****
Family member positive to COVID-19							
Yes	76 (24%)	9.14 (4.72)	23 (30%)	10.9 (9.91)	11 (15%)	0.74 (0.51)	16 (21%)
No	240 (76%)	9.36 (5.46)	87 (36%)	12.8 (13.9)	51 (22%)	0.81 (0.63)	74 (31%)
p-value		*0.74**	*0.41****	*0.19**	*0.25****	*0.32**	*0.12****

**t-test.*

***One-way ANOVA.*

****Chi-square test.*

†p-values refer to comparisons between subjects with working experiences in COVID-19 area (current/previous, number of days, intensity area) and subjects with no experience in COVID-19 area.

symptoms of post-traumatic distress (see IES-R scale), almost doubled the risk of anxiety (GAD-7), and increased by 41% the risk of general discomfort (GHQ-12). Direct experience with patients with COVID-19 was associated with an increased risk of PsI in all three scales. In detail, the risk to score above the cutoff (for all measured scales) increased with time spent in the COVID-19 area, with a higher level of clinical intensity, or dividing subject with none, former, or current involvement in COVID-19 units.

For subjects with a family member that was previously infected by COVID-19, *the risk of general discomfort (GHQ-12) was increased by 48%*; age was not found as a significant risk factor for PsI.

Table 3 shows the univariate analysis for the second-level scales, collected among 316 subjects. Similar to first-level screening, gender and occupational role resulted as statistically significant factors associated with psychological distress: means and percentage of scoring above the cutoff were higher for

TABLE 4 | Multivariate logistic regression for second level scales: adjusted OR of scoring above the cut-offs with associated 95% confidence intervals (CI) and corresponding LR test *p*-values.

		PHQ-9	DES	SCL-90
	***N* (%)**	**AdjOR (95% CI)**	**AdjOR (95% CI)**	**AdjOR (95% CI)**
Gender				
Male	81 (26%)	1.00	1.00	1.00
Female	235 (74%)	1.40 (0.77, 2.60)	1.68 (0.80, 3.79)	1.48 (0.78, 2.94)
p-value		*0.14*	*0.1*	*0.11*
Age				
>50	87 (27.5%)	1.00	1.00	1.00
20–30	57 (18%)	0.39 (0.17, 0.88)	0.78 (0.27, 2.21)	0.68 (0.328 1.64)
30–40	91 (29%)	0.44 (0.21, 0.91)	1.71 (0.72, 4.17)	1.05 (0.50, 2.24)
40–50	81 (25.5%)	0.93 (0.48, 1.79)	0.88 (0.35, 2.20)	1.19 (0.58, 2.48)
p-value		*0.14*	*0.05*	*0.61*
Occupational role				
Physician	62 (20%)	1.00	1.00	1.00
Administrative staff	27 (8%)	2.12 (0.70, 6.40)	8.23 (1.61, 62.65)	5.41 (1.62, 19.6)
Health assistant	16 (5%)	9.45 (2.79, 36.3)	26.7 (5.48, 202.3)	11.9 (3.29, 47.5)
Nursing staff	173 (55%)	2.79 (1.34, 6.10)	8.53 (2.39, 54.6)	4.81 (1.99, 13.6)
Others	38 (12%)	2.35 (0.89, 6.30)	2.53 (0.39, 20.5)	3.52 (1.13, 11.8)
p-value		*0.004*	*<0.001*	*<0.001*
COVID-19 area working experience				
Never	138 (44%)	1.00	1.00	1.00
Yes[†]				
Previously	64 (20%)	1.59 (0.79, 3.20)	1.41 (0.60, 3.29)	0.71 (0.32, 1.51)
Currently	114 (36%)	1.32 (0.70, 2.50)	1.19 (0.54, 2.62)	1.20 (0.62, 2.33)
p-value		*0.34*	*0.65*	*0.38*
<4 months	82 (26%)	1.51 (0.78, 2.96)	1.55 (0.69, 3.48)	0.71 (0.34, 1.46)
>4 months	96 (30%)	1.35 (0.70, 2.60)	1.05 (0.46, 2.39)	1.27 (0.65, 2.49)
p-value		*0.38*	*0.44*	*0.27*
Low-intensity area	30 (9%)	1.19 (0.44, 3.09)	1.80 (0.57, 5.55)	1.03 (0.37, 2.75)
High-intensity area	148 (47%)	1.47 (0.82, 2.67)	1.20 (0.58, 2.52)	0.97 (0.52, 1.81)
p-value		*0.37*	*0.55*	*0.97*
Positive nasopharyngeal swab				
No	51 (16%)	1.00	1.00	1.00
Yes	265 (84%)	0.92 (0.44, 1.88)	0.85 (0.32, 2.02)	0.80 (0.36, 1.71)
p-value		*0.6*	*0.52*	*0.31*
Family member positive to COVID-19				
No	76 (24%)	1.00	1.00	1.00
Yes	240 (76%)	0.77 (0.41, 1.42)	0.66 (0.29, 1.41)	0.61 (0.30, 1.17)
p-value		*0.4*	*0.29*	*0.13*

[†]*p-values refer to comparisons between subjects with working experiences in COVID-19 area (current/previous, number of days, intensity area) and subjects with no experience in COVID-19 area.*

females, nurses, and health assistants (although the latter are composed by a few cases). Contrary to first-level outcomes, working exposure to COVID-19 and having a family member with previous COVID infection were not associated with higher psychological scales scoring.

Table 4 presents multivariate logistic regression analysis for psychological distress (second-level questionnaire results). Nurses and health assistants had sensibly higher adjusted OR for developing symptoms of depression or other psychological symptoms than physicians. ORs were greater in women considering all the three scales (even if not statistically significant). Similar to univariate analysis, the occupational exposure with COVID-19 seemed not to be an independent risk factor for psychological distress.

Figure 1 illustrates the distribution of health beliefs and COVID-19 concerns for each answer, which significantly differed according to the first-level screening result (Kolmogorov–Smirnov test). Worries, discomfort, and fear were expressed more frequently by subjects who scored above the cutoff on at least one scale compared to colleagues with no evidence of PsI. Adjusted ORs of having a first-level scale above the cutoff dividing subjects according to their personal concerns and beliefs

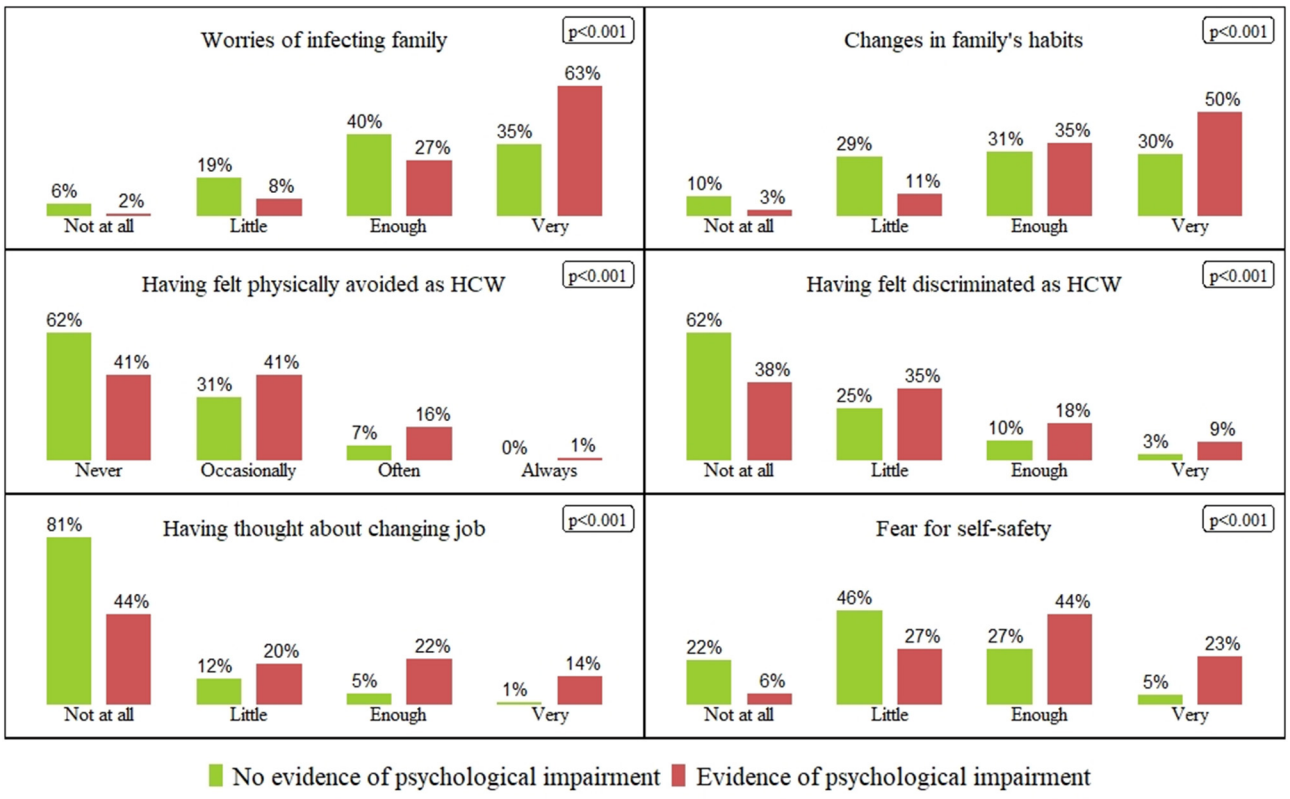

FIGURE 1 | Health beliefs and COVID-19 related concerns: percentage of each answer dividing subjects with evidence of psychological impairment (red columns) and without psychological impairment (green columns).

TABLE 5 | Personal concerns about COVID-19 and risk to score above the cut-off at the first levels scales (reference subject answering No).

		GHQ-12	IES-R	GAD-7
	***N* of positive (%)**	**AdjOR* (95% CI)**	**AdjOR* (95% CI)**	**AdjOR* (95% CI)**
Worries of infecting family	792 (80%)	2.43 (1.60, 3.47)	4.13 (2.30, 8.11)	2.15 (1.34, 3.59)
Changes in family's habits	695 (70%)	3.22 (2.31, 4.54)	4.89 (3.04, 8.25)	4.34 (2.78, 7.04)
Having felt physically avoided as HCW	111 (11%)	1.72 (1.13, 2.61)	3.50 (2.25, 5.43)	2.54 (1.63, 3.91)
Having felt discriminated as HCWs	179 (18%)	2.07 (1.44, 2.86)	3.46 (2.37, 5.03)	2.16 (1.48, 3.13)
Having thought about changing job	175 (18%)	6.71 (4.58, 10.0)	6.17 (4.21, 9.08)	6.38 (4.36, 9.37)
Fear for self-safety	445 (45%)	3.59 (2.72, 4.77)	5.65 (3.89, 8.35)	3.92 (2.79, 5.56)

**ORs are adjusted by gender, age group, occupational role, COVID-19 area, personal infection and family member infection.*

about COVID-19 are presented in **Table 5**. Each variable resulted in a statistically significant risk factor with a high OR, indicating a strong relationship with psychological distress. The highest risks that increased by more than six times were associated with thoughts about changing jobs and fear for self-safety.

Figure 2 shows the time trends in the percentage of subjects, resulting in scores above cutoff in first- and second-level scales. Looking at the first-level screening, the highest levels were reached between October and December 2020, during the second pandemic wave in Italy. In particular, the percentage above the cutoff of the GHQ-12 scale increased from September to December, reaching a peak of around 60%. A rapid increase in September to October was present also for GAD-7 and IES-R scales. From January 2021 percentages of subjects with PsI started to decrease, returning to baseline values in a few months.

Time trends of second-level questionnaires were more irregular and different from each other: percentage of overpass PHQ-9 cutoff was constant around 30–40%, and for DES and SCL-90, no clear trend during the study period was found.

In the period of January-February 2021, more than 90% of HCWs received anti–COVID-19 vaccination. We explored the effect of vaccination on psychological wellbeing, comparing results in subjects evaluated before and after the vaccination campaign started.

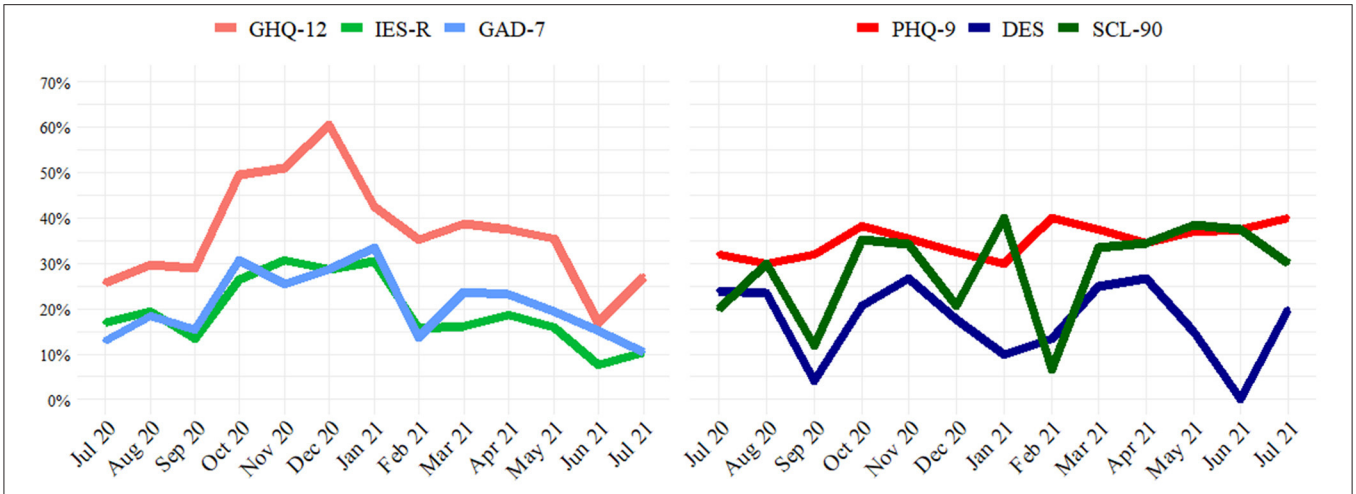

FIGURE 2 | Time trend of first level screening **(left)** and second level evaluation **(right)**. Percentage of subjects scoring above scales cut-off over time.

Values of OR for PsI related to exposure to the COVID-19 working area did not vary with vaccination: although statistical significance was lost in the post-vaccine subsample, results showed a stable increased risk among subjects working in the COVID-19 area. Similarly, a personal COVID-19 infection was not a risk factor before or after vaccination. Having a family member previously infected was a risk factor for PsI only for workers enrolled before the vaccination campaign (ORs are equal to 2.25 for GHQ-12, 1.46. for IES-R, and 1.71 for GAD-7) but not for vaccinated workers (ORs are equal to 1.18, 1.10, and 0.86, respectively). Detailed data for GHQ-12, IES-R, and GAD-7 scales are illustrated in **Table 6**.

CONCLUSIONS

We conducted a 12-month-long systematic evaluation of mental health in all workers that underwent occupational surveillance ($n = 990$) in a tertiary hospital in Milan that was identified as one of the COVID-19 hub centers in the Lombardia Region (Italy). Our study investigated psychological wellbeing (by GAD-7, IES-R, and GHQ-12) and specific psychiatric symptoms (by PHQ-9, DES, and SCL-90) with a focus on risk factors associated with mental health issues.

As consistently stated by the previous investigation, PsI was more frequent among nurses and female workers (13, 14, 32).

By comparing psychological scales in workers with or without direct involvement with patients with COVID, we observed a statistically increased risk for impairments (in all considered scales) in exposed workers, which was confirmed when we considered the duration of employment in COVID wards (>6 months, < 6 months, and none) and the level of intensity of care (high, low, and none). This is consistent with research on previous coronavirus outbreaks, showing the exposure level as a major risk factor for mental health problems (9, 33). On the other hand, we observed a not negligible proportion of workers with PsI even in HCWs without experience with patients with COVID-19 and among administrative staff (34). These results are both compatible with a background proportion of mental health issues in the working population and with the effect of pandemic-related changes and concerns that involved the entire working population. COVID-19 pandemic represented a psychological challenge and a trigger of psychological distress for all, and our data confirmed that personal concerns and health beliefs related to COVID-19 (e.g., worries about infection or about infecting family members) strongly impact the risk for PsIs.

In this regard, our observation of increased psychological distress in workers as having a family member with previous COVID-19 infection confirmed the multidimensional (occupational and non-occupational) impact of the pandemic on workers' mental health (35, 36).

Three hundred and sixteen workers (32%) presented signs of PsI at the first-level screening (i.e., with scores above the cutoff in at least one scale among GAD-7, IES-r, and GHQ-12); among these, only a proportion of subjects presented clinically relevant symptoms (second-level screening) on PHQ-9 (35%), DES (20%), and SCL-90 (28%). The relative frequency of PsI was strongly associated with the pandemic trends in the region (with a rapid increase in the last trimester 2020) but sensibly decreased after January 21, when almost all workers received the vaccination. Differently, specific psychiatric symptoms showed a different pattern of association with potential risk factors and different time trends compared to PsI. In fact, results of second-level scales were associated neither to direct working experience with patients with COVID nor to COVID experience in the family and seemed not to be influenced by pandemic waves or workers vaccination. Instead pre-existing and more stable conditions (specifically gender and occupational levels) resulted associated with sensibly higher ORs.

These results are not completely surprising as psychiatric symptoms may have pre-existed and therefore are not associated with COVID-19 risk factors; also, we cannot exclude that a self-selection bias had occurred as HCW involved in high-intensity wards may have more resilience, psychological wellbeing and

TABLE 6 | ORs (adjusted for gender, age, occupational role) of scoring above cut-off of first level screening scales before and after vaccination campaign.

	N (%)		GHQ-12			IES-R			GAD-7		
	PRE	POST	AdjOR (95% CI)		*p*	AdjOR (95% CI)		*p*	AdjOR (95% CI)		*p*
	N = 584	*N* = 406	PRE	POST		PRE	POST		PRE	POST	
COVID-19 area working experience											
Never		295 (73%)									
Yes[†]	249 (43%)		1.00	1.00		1.00	1.00		1.00	1.00	
Previously	133 (23%)	69 (17%)	1.72 (1.05, 2.83)	1.54 (0.82, 2.87)	0.75	1.97 (1.08, 3.64)	1.60 (0.72, 3.49)	0.67	1.44 (0.79, 2.63)	1.15 (0.54, 2.38)	0.71
Currently	202 (34%)	42 (10%)	1.99 (1.25, 3.18)	2.64 (1.23, 5.70)	0.71	2.25 (1.29, 4.01)	2.55 (0.94, 6.63)	0.73	1.86 (1.07, 3.28)	1.66 (0.66, 4.01)	0.64
Low-intensity area	65 (11%)	36 (9%)	1.11 (0.59, 2.06)	2.04 (0.87, 4.76)	0.3	1.19 (0.52, 2.59)	2.30 (0.77, 6.61)	0.56	1.31 (0.61, 2.72)	0.99 (0.33, 2.72)	0.71
High-intensity area	270 (46%)	75 (18%)	2.17 (1.40, 3.39)	1.80 (0.99, 3.27)	0.57	2.47 (1.45, 4.31)	1.74 (0.80, 3.69)	0.68	1.78 (1.05, 3.07)	1.43 (0.70, 2.85)	0.58
Positive nasoph. swab											
No	515 (88%)	322 (79%)	1.00	1.00		1.00	1.00		1.00	1.00	
Yes	69 (12%)	84 (21%)	0.58 (0.32, 1.03)	1.03 (0.60, 1.77)	0.28	1.00 (0.51, 1.88)	1.00 (0.47, 2.01)	0.84	0.52 (0.24, 1.04)	0.98 (0.49, 1.85)	0.58
Family member positive to COVID-19											
No	500 (86%)	281 (69%)	1	1		1	1		1	1	
Yes	84 (14%)	125 (31%)	2.25 (1.34, 3.83)	1.18 (0.73, 1.91)	0.06	1.46 (0.81, 2.58)	1.10 (0.57, 2.05)	0.28	1.71 (0.95, 3.03)	0.86 (0.47, 1.54)	0.11

P-values are referred to the significance of the interaction term.

[†]*p-values refer to comparisons between subjects with working experiences in COVID-19 area (current/previous, number of days, intensity area) and subjects with no experience in COVID-19 area.*

better coping resources compared to colleagues involved in other wards (37, 38).

However, to detect susceptible populations that develop psychiatric problems in a context of generalized and persistent stress, as was the experience during the pandemic, it is a key challenge in terms of occupational medicine. For example, the higher proportion of mental health issues observed among nurses and health assistants (when compared with doctors) is a matter of concern and suggests targeting specific efforts and care to preserve psychological wellbeing in those working groups.

Our results must be considered in light of several limitations. First of all, we have no data collected before COVID. Thus, we cannot attribute to the pandemic, all the observed psychological distress. We were aware that psychological symptoms are present in all working populations and that HCWs, in particular, experienced a high level of job stress and even burnout from work shifts, long working hours, and several other job-related psychological risk factors. However, the increasing trend in PsIs with increasing direct working involvements with patients with COVID suggested that care for patients with COVID had a specific and independent effect in determining psychological burden even if (or maybe because of) HCWs constitute a population previously exposed to a high level of job strain.

We collected both exposure and effect with questionnaires; thus, our study is prone to potential biases as self-selection of respondents (39) and common methods bias (40). We managed to minimize those risks grounding our investigation on the occupational physician health surveillance (obtaining a very high participation rate and minimizing the risk of untrue or uncompleted answers in describing job tasks) and by assessing individual "COVID exposure" by objective data (hospital wards, duration of employments, and swab results etcetera).

Our results about the effect of vaccination campaigns among HCWs are interesting and, nowadays, represent one of the first shreds of evidence collected in Europe. However, we were not able to evaluate each worker before and after vaccination, and we only compared mental wellbeing in the same population in the period before and after the vaccination campaign. Thus, we cannot exclude that the better psychological scores observed were a consequence of another unmeasured time-dependent factor, first of all, a general improvement of the pandemic situation in Italy. In this respect, we must say that, in Italy, vaccination among HCWs was performed sensibly before (2–4 months as average) the general population, and we experienced, within the study period (March to July 2021), a sensible increase of cases and hospital admission (COVID-19 pandemic third wave in Europe) without observing an evident effect on workers psychological burden after their vaccination.

Our study plans to follow all enrolled workers for another year to properly assess both late onsets of symptoms, to analyze the risk factors for symptoms persistency, and to overcome some of the abovementioned limitations. The next results may provide further insights on preventive and beneficial interventions to support HCW mental health during and after a pandemic. Indeed, different programs aimed at addressing mental health issues in HCWs during pandemics have been found to be effective (41, 42). In this respect, it is also crucial to maintain an ongoing

cooperation with public health stakeholders, policymakers, and the occupational health and safety players within hospital contexts (43).

The evaluation of the psychological wellbeing of all hospital workers, directly or indirectly exposed to pandemic consequences, constitutes a unique condition to detect individual, occupational, and non-occupational risk factors for PsI in situations of high stress and/or disasters, as well as variables associated with symptom chronicization.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because collected variables include information about occupational stress, job satisfaction and psychological wellbeing. For ethical reasons, to avoid any possible workers identification, data are available only in aggregate format upon reasonable request to the corresponding authors. Requests to access the datasets should be directed to matteo.bonzini@unimi.it; paolo.brambilla@unimi.it.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Milan Area 2 Ethical Committee, n.652_2020 of July 21, 2020. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MB, AF, and PB conceived the study, wrote the study protocol, and wrote the paper. MB and AC performed the statistical analyses. FC, EC, and VT supervised the second level questionnaires and contributed to study interpretation. EM, MG, LB, CN, and GS supervised the first level questionnaire and performed occupational health surveillance. LR supervised the study and contributed to results interpretation. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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"Post-lockdown Depression": Adaptation Difficulties, Depressive Symptoms, and the Role of Positive Solitude When Returning to Routine After the Lifting of Nation-Wide COVID-19 Social Restrictions

Shoshi Keisari[1,2,3], *Yuval Palgi*[2,4], *Lia Ring*[4], *Adi Folkman*[5] *and Boaz M. Ben-David*[6,7,8]*

[1] School of Creative Arts Therapies, University of Haifa, Haifa, Israel, [2] The Centre for Research and Study of Aging, University of Haifa, Haifa, Israel, [3] The Emily Sagol Creative Arts Therapies Research Center, University of Haifa, Haifa, Israel, [4] Department of Gerontology, University of Haifa, Haifa, Israel, [5] Department of Counseling and Human Development, University of Haifa, Haifa, Israel, [6] Baruch Ivcher School of Psychology, Reichman University (IDC), Herzliya, Israel, [7] Department of Speech-Language Pathology, University of Toronto, Toronto, ON, Canada, [8] Knowledge, Innovation, Talent, Everywhere (KITE), Toronto Rehabilitation Institute, University Health Networks, Toronto, ON, Canada

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***Correspondence:**
Boaz M. Ben-David
boaz.ben.david@idc.ac.il

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Objectives: The aim of the current study was to identify difficulties in adapting to normal life once COVID-19 lockdown has been lifted. Israel was used as a case study, as COVID-19 social restrictions, including a nation-wide lockdown, were lifted almost completely by mid-April 2021, following a large-scale vaccination operation.

Methods: A sample of 293 mid-age and older Israeli adults (*M* age = 61.6 ± 12.8, range 40–85 years old) reported on return-to-routine adaptation difficulties (on a novel index), depression, positive solitude, and several demographic factors.

Results: Of the participants, 40.4% met the criteria of (at least) mild depressive symptoms. Higher levels of adaptation difficulties were related to higher ratios of clinical depressive symptoms. This link was moderated by positive solitude. Namely, the association between return-to-routine adaptation difficulties and depression was mainly indicated for individuals with low positive solitude.

Conclusions: The current findings are of special interest to public welfare, as adaptation difficulties were associated with higher chance for clinical depressive symptoms, while positive solitude was found to be as an efficient moderator during this period. The large proportion of depressive symptoms that persist despite lifting of social restrictions should be taken into consideration by policy makers when designing return-to-routine plans.

Keywords: depressive symptoms, adaptation difficulties, positive solitude, mid-life, older adults, lockdown

INTRODUCTION

The response to the COVID-19 pandemic has led to unprecedented social distancing measures worldwide. These included lockdowns, where individuals were ordered to stay at home for weeks (1). These restrictions were found to yield psychological distress for many, with various aspects of mental health disturbance, including inflated rates of depressive symptoms, occurring across

populations (2, 3). In response to the pandemic, global efforts have been made to vaccinate entire populations to lessen mortality and lift social restrictions (4, 5). Paradoxically, however, achieving the return to normal life may itself have a cost. Although many people waited for the restrictions to be lifted, these same restrictions provided a respite and changed the life course of many individuals who may experience adaptation difficulties and depressive symptoms during the transition period to their former routine. We hypothesize that the long-term effects of social restrictions may be also manifested when people are faced with a return to daily routines and obligations.

Although social restrictions helped mitigate the spread of the virus, they had severe psychological consequences. Social distancing incurred significant life changes that could be experienced as negative or positive, such as losing or changing jobs and un/healthy lifestyle changes (6). Restrictions also severely disrupted social interactions, social presence, communication and daily routines, all important to maintain cognitive performance and wellbeing [see (7, 8)]. Taken together, social restrictions have been found to impair mental health, including an increase in anxiety, depressive symptoms, loneliness and social isolation (9–11). The current study focuses on depressive symptoms when returning to routine following the release from COVID-19 lockdown.

Depressive disorders are usually conceptualized along a continuum, progressing from mild to moderate to severe, characterized by the duration and severity of the symptoms (12). Moderate and severe depression are leading causes for disability, with greater stability and a higher risk for suicidality (13). However, mild symptoms are still considered as a serious medical condition that leads to professional and personal disabilities, social problems and reduced quality of life (14, 15). Mild depression often represents a maladaptive response of the individual to environmental stressors and is frequently prodromal to major depression disorders (16). Note, mild depression is different than normal sadness, as based on the number, duration and quality of presented symptoms, and can be diagnosed by linguistic indicators (17). Recent literature shows that since the COVID-19 outbreak, the prevalence of depressive symptoms increased among the adult population worldwide (2). For example, in 2020 ∼24.6% of adults in the USA experienced mild depressive symptoms vs. 16.2% before the pandemic. A similar trend was also noted for moderate depressive symptoms, with an increase from 5.7% before the pandemic to 14.8% for US adults [(18, 19); for European samples, see (20, 21)].

Demographic characteristics have been found to have a large impact on the extent of the effects of COVID-19 social restriction (11, 22). For example, a higher prevalence of depression and anxiety symptoms were indicated for women, and for people who are not partnered. In addition, caregivers who must adapt their work routines to care for others at home were at a higher risk of psychological burden (23). Middle-aged adults appear to be more susceptible to experiencing symptoms of mental illness during the pandemic, as compared to older adults (11). In the current study, we examine the possible contribution of these demographic characteristics to depressive symptoms, following the termination of a COVID-19 lockdown.

Coping strategies, skills and personality traits were also associated with the impact of the pandemic (24). For example, centrality appraisals and planning, controllability appraisals, as well as coping strategies were related to the differences in subjective wellbeing among adults during the early stage of the pandemic (25). High levels of arts engagement constituted a potent buffer against subsequent COVID-19 anxiety (26, 27). Personality traits of neuroticism and extroversion were also associated with mental health during the COVID-19 pandemic: neuroticism negatively related and extroversion positively related to mental health (28).

In the current study, we focus on positive solitude—the volitional positive experience while being by oneself (29)—as a possible moderator for the negative effects of lockdown. Positive solitude is defined as the choice to dedicate time to a meaningful, enjoyable activity or experience conducted by oneself. This activity/experience might be spiritual, functional, recreational or of any chosen type, and it is independent of any external or physical conditions (30). It is not surprising to find that positive solitude has been identified as a source for resilience during social restrictions (31). In general, it is associated with wellbeing and better emotion regulation and introspection (32, 33). Moreover, a high capacity of solitude was associated with low levels of depression (34) and post-traumatic stress symptoms (35). During COVID-19 social restrictions, it was found that the preference for solitude (in tandem with other personality variables) predicted individuals' improved mental health and creativity. Namely, people who experience themselves as more stable when they are alone expressed a lower level of loneliness and performed better than their peers on a creative insight task (31).

As aforementioned, numerous studies have examined the effects of social restrictions on mental health. However, no study to date has directly explored the negative impacts of returning to normal life after social restrictions have been lifted. Nevertheless, the literature points to the possible negative impacts of returning to routine. For example, during the first COVID-19 wave, Europeans expressed negative expectations regarding the future and return to normal life, fears of an economic depression, and concerns regarding dangers to freedom (36). A study in our lab showed that even after COVID-19 vaccinations, mental health symptoms were not alleviated (5). Indeed, even the release from incarceration, a much stronger form of restriction, incurs post-prison adaptation difficulties and psychological symptoms (37). Paradoxically, as social restrictions can be experienced as a break from work life (6) and even relate to improved wellbeing for some individuals (38, 39), the difficulties involved in return-to-routine when they are lifted can be related to difficulties adapting to daily work when returning from vacation (40).

In the current study, our main aim was to identify difficulties in adapting to normal life once a nation-wide COVID-19 lockdown (imposed on the whole population) was lifted during April 2021 in Israel. Our second aim was to test whether a higher level of return-to-routine adaptation difficulties is associated with higher depressive symptoms. Our third aim was to test whether this link is moderated by positive solitude, after controlling for

individual demographic characteristics (gender, age, SES and family status).

Israel constitutes a special case study, as it was one of the first countries to initiate a large-scale vaccination operation (41), with social restrictions lifted almost completely by mid-April 2021. Israel is also unique as every Israeli citizen is entitled to healthcare services under the National Health Insurance Law. This was at the base of the success of the early vaccination campaign that lead to a quick nation-wide (rather than regional) release from lockdown and other social restrictions, and full re-opening of schools for the first time in over a year, at the end of the COVID-19 third wave (41, 42).

METHODS

Participants and Procedure

Data from 293 Israeli adults (age $\geq$ 40) were collected *via* social media platforms from April 12 to May 3, 2021 (342 individuals replied and 49 individuals did not complete the survey). By April 12, the first day of distribution of the questionnaire, 57.3% of the population had received the first dose of the vaccination. Only 225 Israelis tested positive for COVID-19 on that day, and the Israeli government announced a return to routine including the re-opening of schools, workplaces and shopping centers (41).

Data were obtained using a convenience sample of 293 Israelis [M age = 61.57, SD = 12.81, range (40–85) years old]. Most of them were women (n = 222, 75.8%), married or cohabitating (n = 232, 79.2%). Socio economic status was self-reported as M = 3.88, SD = 0.88 (on a scale ranged from 1 = *"Not good at all"* to 5 = *"Very good"*). All participants were informed about the subject of the research and electronically provided their informed consent to participate. Ethical approval was received from the Institutional Review Board of Reichman University, Herzliya.

Measures

Participants completed a demographic questionnaire, including age, gender, marital status as well as economic status.

Depression

Depression was assessed using the 9-item Patient Health Questionnaire-9 (PHQ-9). Participants were asked: "Over the last 2 weeks, how often have you been bothered by the following problems?" An example of a problem is: "Little interest or pleasure in doing things." Items were rated on a scale of 0 (Not at all) to 3 (Nearly every day). In this study, the Cronbach's coefficient was $\alpha = 0.837$.

Positive Solitude

Positive Solitude was assessed by the 9-item Positive Solitude Scale (43). An example of an item is: "When I find time for myself, I succeed better at making future plans." Items were rated on a scale ranging from 1 (Not at all) to 5 (Most of the time). In this study, the Cronbach's coefficient was $\alpha = 0.913$.

Adaptation Difficulties in Returning to Routine Following COVID-19 Lockdown

Adaptation Difficulties in Returning to Routine Following COVID-19 Lockdown, is a new 6-item index that was developed for this study. In this novel index, participants were asked to rate how much they agreed with statements on a scale of 1 ("Strongly disagree") to 5 ("Strongly agree")—i.e., higher scores on the index represented more difficulties in returning to routine. Six statements were presented: "Although the days of social restrictions were difficult___" ___: (1) "… I miss the days of social restrictions;" (2) "… I have some concerns returning to routine;" (3) "…I would rather gradually return to routine;" (4) "…I wish I could stay at home for a longer time;" (5) "…I find it difficult to return to routine;" (6) "…I find it difficult to leave behind the days of social restrictions." In this study, the Cronbach's coefficient was $\alpha = 0.845$. A summary of the properties of this new measure is available in **Table 1**.

TABLE 1 | Adaptation difficulties in returning to routine following COVID-19 scale.

			Sum	Variance of sum	α
	M	*sd*	If item deleted	If item deleted	If item deleted
1.	2.17	1.07	12.29	16.97	0.78
2.	2.44	1.15	12.02	16.75	0.79
3.	3.35	1.16	11.11	20.16	0.87
4.	2.27	1.13	12.19	16.04	0.76
5.	2.32	1.18	12.14	15.85	0.77
6.	1.91	1.03	12.55	16.55	0.76

Scores are on a scale of 1 ("Strongly disagree") to 5 ("Strongly agree").
The six items are: "Although the days of social restrictions were difficult_____".
1) "…I miss the days of social restrictions".
2) "…I have some concerns returning to routine".
3) "…I would rather gradually return to routine".
4) "…I wish I could stay at home for a longer time".
5) "…I find it difficult to return to routine".
6) "…I find it difficult to leave behind the days of social restrictions".

Data Analysis

At the first stage, we examined the means for the study variables. Namely, depression: M = 4.44, range (0–17), SD = 3.87; return-to-routine adaptation difficulties: M = 2.42, range (1–5), SD = 0.81; and positive solitude: M = 3.69, range (1–5), SD = 0.76. We also examined the preliminary links between the study variables with Pearson's correlations (see **Table 2** for means, standard deviations, and correlation for the study variables).

Subsequently, to examine our hypotheses, we conducted a multiple hierarchical linear regression analysis. Demographic variables (age, gender, marital status, and social economic status) were entered in Step 1. Level of return-to-routine adaptation difficulties and the moderator, positive solitude, were entered in Step 2. The interaction between level of return-to-routine adaptation difficulties and positive solitude was entered in Step 3. All predictors were mean-centered prior to moderation analysis. Significant interactions were probed with the PROCESS computational tool [V3.5; (44)]. This tool probes the significance of slopes at different levels of the moderator (i.e., positive solitude).

TABLE 2 | Demographics and correlations for the study variables.

	M/%	*SD*	1	2	3	4	5	6
1. Depression[a]	4.44	3.87	-					
2. Adaptation difficulties	2.42	0.81	0.21**	-				
3. Solitude	3.69	0.76	−0.15*	0.01	-			
4. Age	61.57	12.81	−0.14*	−0.39**	−0.18**			
5. Gender[b]	75.8%	-	−0.13	−0.19**	−0.15*	0.20**		
6. Marital status[c]	79.20%	-	−0.30**	−0.01	0.15*	−0.05	0.21**	
7. Economic status[d]	3.88	0.88	−0.27**	−0.06	0.07	0.035	0.08	0.27**

Total N = 293 (Regression included N = 234).
[a]*Depression, PHQ-9.*
[b]*Gender, woman.*
[c]*Marital status, currently married, or living with a partner.*
[d]*Higher score (range 1–5) reflect better economic status.*
*$p < 0.05$, **$p < 0.01$.

RESULTS

Based on the PHQ-9 cut-off score of ≥5, the sample demonstrated that 40.4% of the participants met the criteria of mild depressive symptoms and above, while 10.8% of the sample met the criteria of moderate to severe level of depressive symptoms, based on the PHQ-9 cut-off score of ≥10.

The median of *return-to-routine adaptation difficulties* was 2.33. In our sample, 44% reported moderate-to-high level of adaptation difficulties (≥2.50), whereas only a third of responders reported a low level (a score of < 2) of adaptation difficulties.

As presented in **Table 2**, the level of return-to-routine adaptation difficulties was positively correlated with depressive symptoms ($r = 0.21$, $p < 0.01$). The level of positive solitude was negatively correlated with depressive symptoms ($r = -0.15$, $p < 0.05$). However, no significant correlation was found between the level of return-to-routine adaptation difficulties and the level of positive solitude. Return-to-routine adaptation difficulties, positive solitude and depressive symptoms were also negatively correlated with age ($r = -0.14$, $p < 0.05$; $r = -0.39$, $p < 0.005$; $r = -0.18$, $p < 0.005$, respectively).

Notably, older adults in our sample (age ≥ 65, $N = 145$) had lower rates of depressive symptoms (32.2%) than those of middle-aged adults (48.7%). Similarly, only 8.6% of the older adults in our sample reported a high level of return-to-routine adaptation difficulties (a score of ≥3) vs. 24.7% of middle-aged adults. Yet, for older adults the positive correlation between level of return-to-routine adaptation difficulties and depressive symptoms persisted ($r = 0.38$, $p < 0.001$).

The hierarchical regression analysis is presented in **Table 3**. It revealed that higher levels of return-to-routine adaptation difficulties were related to higher levels of depressive symptoms ($\beta = 0.15$, $t = 2.34$, $p < 0.05$). However, higher levels of positive solitude were related to lower levels of depressive symptoms ($\beta = -0.15$, $t = -2.38$, $p < 0.05$).

The combination between level of return-to-routine adaptation difficulties and level of positive solitude was entered in the third step, revealing a significant interaction ($\beta = -0.23$, $t = -3.95$, $p < 0.001$), accounting for an additional 5% of the variance in depressive symptoms. The whole model explained 23.4% of the variance. Appling Hayes's (44) computational procedure showed that for individuals reporting low level of positive solitude (−1 SD), each additional return-to-routine adaptation difficulties score was associated with a significant increase of 1.62 points in level of depressive symptoms ($B = 1.62$, $t = 4.31$, $p < 0.001$)—i.e., the slope of return-to-routine adaptation difficulties × depressive symptoms was statistically significant. However, for individuals with a high level of positive solitude (+1 SD) each additional increase in return-to-routine adaptation difficulties was associated with an insignificant change in the level of depressive symptoms ($B = -0.40$, $t = -0.97$, $p = 0.33$) (**Figure 1**).

DISCUSSION

The current study tested difficulties in adapting to routine following lifting of COVID-19 social restrictions and the cessation of a nation-wide lockdown in Israel. About half of the responders reported moderate-to-high levels of return-to-routine adaptation difficulties. These difficulties were positively correlated with depressive symptoms, while positive solitude was found to moderate this link. Namely, the association between return-to-routine adaptation difficulties and depression was mainly indicated for individuals with low positive solitude.

Given the global efforts to lift social restrictions, it is of interest to find that a large portion of adult individuals, express difficulties and concerns returning to normal life. For example, about half of our respondents agreed to some extent (provided a rating of 3 and above on a 1–5 scale) with the statement: "Although the days of social restrictions were difficult, I have some concerns returning to routine." In other words, respondents were hoping to return to normal life, but now that social restrictions have been lifted, they express some anxiety. This seemingly paradoxical result confirms our hypothesis, indicating that the toll of social restrictions may have prolonged effects.

The current findings are of special interest to public welfare, as return-to-routine adaptation difficulties were associated

TABLE 3 | Regression coefficients for the association between return-to-routine adaptation difficulties, positive solitude and depressive symptoms.

		Depressive symptoms (PHQ-9)	
	Predictor	***B (SE)***	**β**
Step 1	Age	−0.04* (0.02)	−0.13
	Gender[a]	−0.35 (0.60)	−0.04
	Marital status[b]	−0.28*** (0.63)	−0.24
	SES[c]	−0.83** (0.28)	−0.19
Step 2	Adaptation difficulties	0.72* (0.31)	0.15
	Positive solitude	−0.76* (0.32)	−0.15
Step 3	Adaptation difficulties × Positive solitude	−1.30*** (0.33)	−0.23
Total R^2	0.23		

Total N = 293 (Regression included N = 234).
[a]*Gender, woman.*
[b]*Marital status, currently married, or living with a partner.*
[c]*Higher score (range 1–5) reflect better economic status.*
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.*

with higher chance for clinical depressive symptoms. Note, for individuals with high positive experience while being by themselves (high positive solitude) the level of return-to-routine adaptation difficulties was not significantly associated with depressive symptoms. The finding supports the role of positive solitude as an efficient moderator in this period (30, 31). This should come of no surprise, as the main stressors during the COVID-19 pandemic are related to extreme social restrictions and lockdown (45).

In the current study, older adults report on less depressive symptoms than those reported by adults in general following COVID-19. This trend is in line with previous findings in the literature (11, 22). Interestingly, older adults have also reported fewer return-to-routine adaptation difficulties than have middle-aged adults. This may be related to retirement, as fewer older adults must return to work following the termination of social restrictions, and to increased resilience in older age [specifically emotional regulation; (46)]. Importantly, the link between adaptation difficulties and depressive symptoms persists in older age, indicating its strength across the adult life span.

Moreover, the ratio of individuals with mild (or more severe) depressive symptoms in our sample was very high, 40.4%, as compared to the pre- COVID-19 rate, 18.6%, found for Israeli adults (47). This extremely high proportion of depressive symptoms echoes other studies conducted during the pandemic across the globe (3, 11), pointing to the long-term negative effects of social restrictions. In addition, the literature indicates a link between life transitions and higher levels of depressive symptoms (48). Transitions, even from restrictions to improved conditions, might lead to psychological distress as indicated in our study. The large proportion of depressive symptoms that persist despite lifting social restrictions should lead policy makers to take actions incorporating clinical support on the national and personal levels, as part of the return to routine plan.

Finally, our analyses show that being able to enjoy spending time alone, as represented by high levels of positive solitude, was related to lower levels of depressive symptoms. It appears that these individuals are more resilient, not only during, but also after the end of a lockdown. More specifically, the moderation model indicates that higher levels of positive solitude could compensate for the deleterious outcomes of high levels of return-to-routine adaptation difficulties, and relate to lower levels of depressive symptoms. These findings support previous studies that

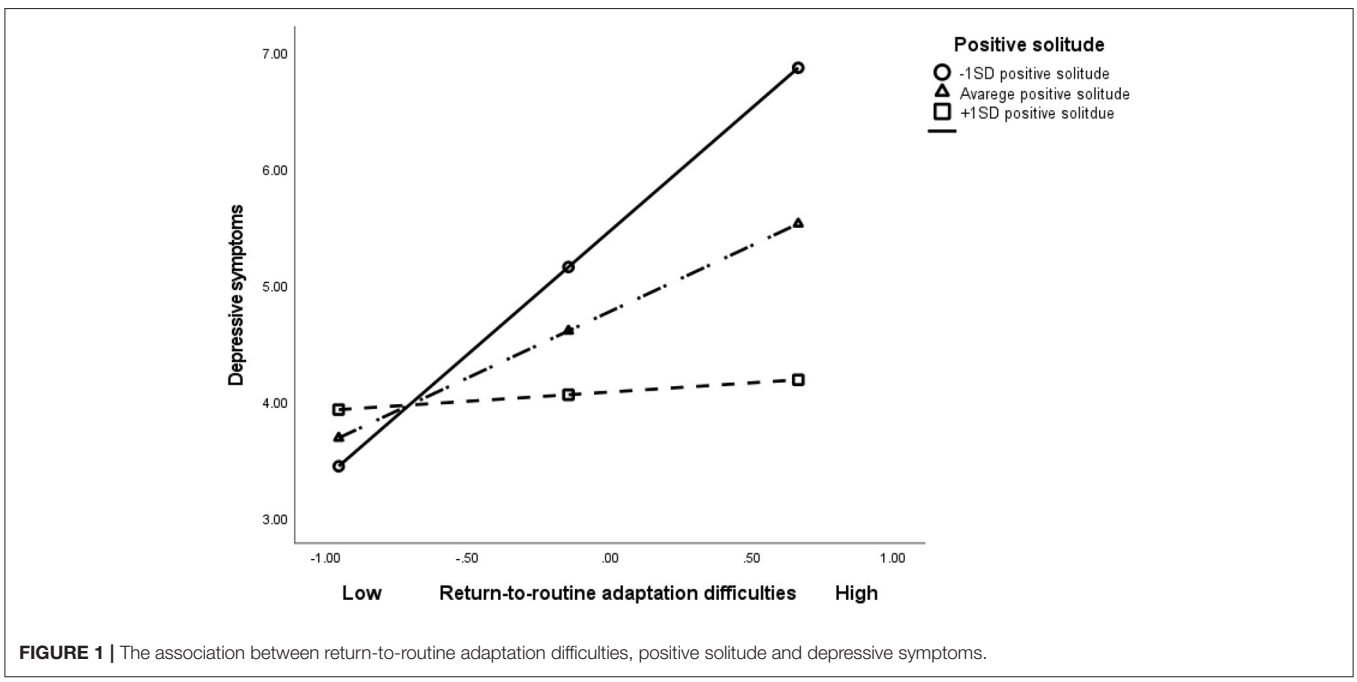

FIGURE 1 | The association between return-to-routine adaptation difficulties, positive solitude and depressive symptoms.

present positive solitude as a potent capacity related to resilience (35).

Limitations and Future Directions

This preliminary foray to the psychological cost of the transition to routine has several limits. The time sensitivity of the study (during the transition of Israel out of lockdowns) led to the choice of a cross-sectional and self-report design. This was also a convenience sample that may not represent the Israeli adult population. For example, 76% of our responders were women, possibly impacting the results [note, a higher proportion of female participants is not uncommon in this age group; e.g., (26, 49)]. The study was conducted in Israel with unique cultural aspects (51). Future studies may consider adapting our novel index to other languages and try to replicate the results in other countries and cultures (50), providing a more general statement regarding the association between return-to-routine adaptation difficulties and other indices of mental health. Moreover, due to the cross-sectional nature of the study, causality cannot be inferred. Thus, future studies should examine the long-term effects of social restrictions on mental health using additional cohorts, employing longitudinal and/or experimental designs.

CONCLUSIONS

The current study offers a pioneering insight into the adaptation difficulties during the transition period from COVID-19 restrictions to routine. To the best of our knowledge, this is among the first studies to directly test post-lockdown psychological implications. The results point to the long-term effects of the pandemic on mental health issues, even when restrictions are lifted, and to positive solitude as a coping mechanism in time of stress (**Figure 1**). The current findings have global implications for clinicians as well as for governments, social organizations and other stakeholders. We hope the findings will raise awareness to adaptation difficulties returning to routine following social restrictions. We call policy makers to initiate programs informing the public on these issues. Simply put, it appears that negative psychological implications linger, even after the lockdown and associated restrictions have been lifted. In accordance, there is a need to develop accessible interventions and assessments, both *via* traditional face-to-face interactions and *via* tele-health platforms (7), to support a wide range of the population during social restrictions and upon return to routine. These interventions may wish to use positive solitude as a resource for coping during social isolation.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Reichman University, Herzliya. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SK, YP, and BB-D contributed to the study design, data collection and analysis, and reporting and discussion. LR and AF contributed to the study design, data collection, reporting and review. All authors contributed to the article and approved the submitted version.

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Psychological Impact in Healthcare Workers During Emergencies: The Italian Experience With COVID-19 First Wave

Elisabetta Pisanu[1]*, *Annalisa Di Benedetto*[2], *Maria Rita Infurna*[2] and *Raffaella I. Rumiati*[1,3]

[1] Neuroscience Area, International School for Advanced Studies (SISSA), Trieste, Italy, [2] ANVUR, Rome, Italy, [3] Scuola Superiore di Studi Avanzati Sapienza (SSAS), Rome, Italy

Background: The COVID-19 outbreak imposed an overwhelming workload as well as emotional burdens on Healthcare workers (HCWs). In May 2020, an online survey was administered to HCWs in Italy to assess the pandemic's psychological impact and to investigate possible predictive factors that led to individual differences.

Methods: The psychological experience was measured based on the prevalence of self-reported feelings during the pandemic, including negative and positive emotional states. We analyzed the relationship between factors of gender, age, geographic region, professional role, and operational unit, and the four-point scale used to rate the frequency of each emotional state experienced by performing several multinomial logistic regressions, one for each emotion.

Results: Our findings suggest that more than half of HCWs experienced psychological distress during the first COVID-19 outbreak in Italy. Female and younger respondents, especially those operating in northern Italy experienced more frequently negative emotional states such as irritability, anxiety, loneliness, and insecurity. However, positive feelings, first of all solidarity, were also reported especially by female and older workers. The majority of the negative as well as positive emotional states were experienced almost equally by both doctors and nurses, and independently of the operational unit in which they operated.

Conclusions: This study can be very useful as a contribution to the current literature on the psychological effects of this pandemic on health workers. Moreover, our findings can provide useful information in planning more tailored psychological interventions to support this category of workers in the ongoing and future emergencies.

Keywords: COVID-19, pandemic, psychological impact, mental health, healthcare workers (HCWs)

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Silvia Pellegrini,
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***Correspondence:**
Elisabetta Pisanu
episanu@sissa.it

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INTRODUCTION

On December 31, 2019, the World Health Organization (WHO) received the news about an unusual rise in pneumonia cases in the city of Wuhan, China. This was the first manifestation of the coronavirus disease-19 (COVID-19) caused by an acute and highly contagious virus (SARS-CoV-2) that rapidly affects the respiratory system (1). Due to the rapid increase in the number of

cases outside of China, on March 11, 2020, the WHO general director announced the global pandemic (2), leading to a global health emergency that has strongly marked and affected our era.

In Italy, the first outbreak of COVID-19 began at the end of February 2020 in the North and then rapidly spread to the rest of the country. Consequently, in order to limit the infection, the Government declared the *lockdown* from March 9 until May 3 of the same year. During this first wave, highly restrictive measures were adopted such as physical and social distancing, quarantine, movement restrictions, military control (3). In the following summer, given the reduction in the number of infections, the restrictions were revised with the re-opening of commercial activities after adopting safe measures ensuring social distancing and specific hygiene rules to avoid the contagion. However, with new waves of infections, from the end of October 2020 new restrictions were adopted, including the closure of numerous activities (schools, restaurants, bars, gyms, swimming pools, cinemas, theaters etc.), movement limitations, and the introduction of the curfew (from 10 pm to 5 am) (4). Furthermore, color coded zones were established throughout Italy defined by specific parameters to be adopted individually by each region, based on the level of risk of the virus spreading (*Rt* index). In May 2021, we exited what was defined as the third wave thanks to a successful vaccine campaign which has clearly helped keeping the spread of the virus under control. However, at the end of July, we have entered the fourth wave fuelled by the delta variant of the virus.

This pandemic can be defined as one of the most challenging of the twenty-first century for the scientific communities and societies world-wise (5). The socio-economic impact of the COVID-19 pandemic is upsetting, characterized by a global economic loss due to the abovementioned measures adopted to contain the spread of the virus (6–8).

Although the economic aspect is pivotal, the severe impact on the population's mental health is no less important (9–13). Indeed, we can refer to this situation as a collective trauma, during which we have been living our daily life in a dramatic climate of uncertainty, fear and loss (14, 15). The fear of contracting the virus, as well as the fear of infecting other members of the family, in a climate of total loss of control where social relationships are discouraged, has led to a strong increase of mental diseases such as anxiety and depression (9, 16–18). Furthermore, repeated media exposure as well as the spread of fake or contradictory news has heightened stress responses, negatively affecting health overall (19, 20).

The COVID-19 outbreak has imposed an overwhelming workload as well as emotional burdens in particular on Healthcare workers (HCWs). Indeed, since the beginning of the health emergency, they have been on the frontline fighting the epidemic, being at higher risk of becoming infected and experiencing an emotional overload. The literature on work-related stress has reported the presence of psychosocial risk factors in the healthcare sector (21–23) that are associated with staff's working conditions, safety and health: the emergency has been amplifying these factors (23–26). Psychological and physical stress among HCWs could be also increased by social isolation, social distancing and quarantine measures or even discrimination as potentially infected people in the common imagination, and the lack of family support due to fear of infection (27–29). Furthermore, the psychological distress might have been enhanced by the lack of effective treatments and shortages of dedicated equipment, as well as by witnessing people dying alone, without their loved ones (30, 31).

As a result, HCWs might have felt angry, hostile, frustrated or helpless, experience symptoms of depression and anxiety accompanied by physical complaints, and suffer from insomnia (25, 32–34). Additionally, frontline HCWs are also exposed to the risk of developing secondary stress disorder by taking care of patients who are both physically and psychologically suffering from the emergency (32, 35). Because of this strong physical and emotional overload experienced by HCWs, various listening and psychological support numbers as well as teleconsultation services have been activated. However, only a small number of them exploited these services and their effectiveness still remains unclear (36–38). Recent studies reported that sometimes these services were not considered adequate enough by HCWs because they are disorganized, difficult to reach, incompatible with HCWs' work schedules, with an insufficient number of sessions, and characterized by an individual modality (typically, *ad hoc* created listening services). In contrast, a group approach would have been more adequate as it allows sharing needs and difficulties together. However, HCWs also reported to believe their problems were not severe enough to require these services and to be able to manage them on their own, despite the high psychological distress reported (39–42).

The main aims of this study consist in analyzing the nature and the severity of the mental complaints reported by the HCWs during the first COVID-19 outbreak in Italy, and in highlighting possible predictive factors that led to significant differences in experiencing this psychological distress. A further aim is to analyze the possible experience of positive emotions, in spite of the dramatic situation, to highlight possible protective factors. In fact, positive emotions have been associated with increased well being and improved psychological resources needed for adaptive coping (43, 44).

MATERIALS AND METHODS

Study Design and Sampling

Two *ad hoc* questionnaires were designed to be administered online via Google Forms specifically to doctors and other healthcare workers. Respondents were invited to participate in the study via social media (Facebook, Whatsapp) and email, as well as through the website of scientific societies. The procedure involved filling in an online consent form and all data were collected anonymously and organized in electronic format in the password-protected Google Drive archive. The questionnaires were answered individually and voluntarily by participants. The survey was run from April 28 to May 31 2020. The study and procedures of informed consent have been approved by the corresponding author's institutional ethics committee.

Measures

Two structured questionnaires were designed and administered to HCWs operating in Italy. Both questionnaires consisted of 31 closed-ended questions dedicated to their emotional experience during the emergency. Moreover, beyond the demographic information including age, gender, geographical place of employment, professional role, and operational unit, different thematic areas were addressed:

- Possible sources of work-related stress (temporal and content aspects of the workday and the work activity, the organization conditions);
- Specific aspects related to COVID-19 (emotional responses, stress factors specific to frontline staff, resilience and psychosocial support);
- Governance and care responsibilities (governance actions and medical support, psychological actions and tools adopted, psychological assessment areas).

In this study we analyzed in particular the psychological impact. This was measured based on the prevalence of self-reported feelings during the pandemic, including negative and positive emotional states, such as loneliness, anxiety, irritability, sadness, tiredness, insecurity, apathy, intolerance, frustration, insomnia, fear, impatience, impotence, anger, resignation, pride, satisfaction, trust, hope, solidarity, quiet ("*During the emergency, how often did you feel...*"). The responses were scored on a four-point Likert scale, depending on the frequency of each feeling experienced ("*Never or almost never*," "*Sometimes*," "*Often*," "*Always or almost always*").

Data Analysis

Descriptive statistics were carried out to analyse categorical variables; percentage of responses was calculated according to the number of respondents for each question compared to the total number of responses to a question.

We analyzed the relationship between factors of gender, age, geographic region, professional role, and operational unit, and the four-point scale used to rate the frequency of each emotional state experienced by performing several multinomial logistic regressions, one for each emotion, using the R function "multinom" (45). We performed this analysis to test whether the five abovementioned factors could be good predictors of the emotional experience by considering each emotion independently. Therefore, we built several models, one for each emotion that represented our categorical dependent variable with four levels, where we entered the five factors as independent categorical variables. The categorical nature of our variables made suitable this type of analysis; however, the data were previously evaluated to ensure that all the other model's assumptions were fulfilled too (sample size, outliers, multicollinearity). More specifically, first we used G*Power (46) software to confirm the minimum sample size necessary to detect a small population effect size at power = 0.95 for $\alpha = 0.05$ for the study's number of variables. Then, we checked carefully our data to avoid the possibility of outliers, and we ruled out multicollinearity by means of a correlation matrix.

Additionally, Spearman rank correlation was computed to assess correlations with all the emotions. P values < 0.05 were considered statistically significant, and missing values were excluded for analysis purposes. Data were processed and analyzed in accordance with the privacy protection legislation, and the results of the data analysis were disclosed exclusively in aggregate form.

Furthermore, we performed the Harman's single factor test by using the R function "fa" and choosing the principal axis factoring for extraction to rule out common-method variance bias.

RESULTS

Sample Details

In total 577 people completed the online survey. One participant was excluded due to an excessive lack of demographic information, yielding a final sample of 576 participants (68% females) with mean age of 44.3 (SD = 11.9, range = 22–69). Of these, 38.7% were doctors, while 61.3% were other Healthcare workers, mostly nurses (81%) and for this reason, in the tables and in the results section, we used the label "nurses" to indicate the respondents belonging to all the other healthcare professions involved. About 68.9% of the sample was from northern Italy (54.5% North-East, 14.4% North-West), and 30.9% was from central-southern regions (21% central regions, 8.3% South, 1.6% islands). Regarding the operating unit or department, 16.3% worked within the *ad hoc* created COVID units, 5.6% in anesthesia, reanimation and intensive care, and 73.4% in other departments. **Table 1** summarizes the details of the study sample.

TABLE 1 | Demographic characteristics of the sample.

***N* = 576**	***N* (%)**
Gender	
F	392 (68.1%)
M	184 (31.9%)
Age category	
≤34	162 (28.1%)
35–54	268 (46.5%)
≥55	146 (25.3%)
Professional role	
Doctor	223 (38.7%)
Nurse	353 (61.3%)
Region of Italy	
North	397 (68.9%)
Centre-South	178 (30.9%)
Missing	1 (0.2%)
Operational Unit	
Anesthesia/Reanimation/Intensive care	32 (5.6%)
New COVID unit	94 (16.3%)
Other	423 (73.4%)
Missing	27 (4.7%)

TABLE 2 | Self-reported prevalence of negative feelings.

N = 576	*N* (%)	*N* = 576	*N* (%)	*N* = 576	*N* (%)
Loneliness		**Insecurity**		**Fear**	
Never or almost never	264 (45.8%)	Never or almost never	160 (27.8%)	Never or almost never	212 (36.8%)
Sometimes	213 (37.0%)	Sometimes	278 (48.3%)	Sometimes	266 (46.2%)
Often	89 (15.5%)	Often	123 (21.4%)	Often	85 (14.8%)
Almost always or always	10 (1.7%)	Almost always or always	15 (2.6%)	Almost always or always	13 (2.3%)
Anxiety		**Intolerance**		**Impatience**	
Never or almost never	135 (23.4%)	Never or almost never	205 (35.6%)	Never or almost never	233 (40.5%)
Sometimes	276 (47.9%)	Sometimes	238 (41.3%)	Sometimes	242 (42.0%)
Often	139 (24.1%)	Often	118 (20.5%)	Often	87 (15.1%)
Almost always or always	26 (4.5%)	Almost always or always	15 (2.6%)	Almost always or always	14 (2.4%)
Irritability		**Frustration**		**Impotence**	
Never or almost never	106 (18.4%)	Never or almost never	189 (32.8%)	Never or almost never	157 (27.3%)
Sometimes	256 (44.4%)	Sometimes	221 (38.4%)	Sometimes	244 (42.4%)
Often	187 (32.5%)	Often	144 (25.0%)	Often	143 (24.8%)
Almost always or always	25 (4.3%)	Almost always or always	22 (3.8%)	Almost always or always	32 (5.6%)
Missing	2 (0.3%)				
Sadness		**Insomnia**		**Anger**	
Never or almost never	144 (25.0%)	Never or almost never	246 (42.7%)	Never or almost never	186 (32.3%)
Sometimes	263 (45.7%)	Sometimes	170 (29.5%)	Sometimes	236 (41.0%)
Often	147 (25.5%)	Often	117 (20.3%)	Often	134 (23.3%)
Almost always or always	22 (3.8%)	Almost always or always	43 (7.5%)	Almost always or always	20 (3.5%)
Tiredness		**Apathy**		**Resignation**	
Never or almost never	72 (12.5%)	Never or almost never	400 (69.4%)	Never or almost never	279 (48.4%)
Sometimes	232 (40.3%)	Sometimes	124 (21.5%)	Sometimes	195 (33.9%)
Often	233 (40.5%)	Often	41 (7.1%)	Often	88 (15.3%)
Almost always or always	37 (6.4%)	Almost always or always	11 (1.9%)	Almost always or always	13 (2.3%)
Missing	2 (0.3%)			Missing	1 (0.2%)

Psychological Impact

Descriptive analysis showed that more than half of the HCWs experienced all the emotional states investigated, in respecting of the valance, with the exception of apathy (30.5%), at least sometimes (loneliness 54.2%, anxiety 76.5%, irritability 81.2, sadness 75%, tiredness 87.2%, insecurity 72.3%, intolerance 64.4%, frustration 67.2%, insomnia 57.3%, fear 63.3%, impatience 59.5%, impotence 72.8%, anger 67.8%, resignation 51.5%, pride 68.6%, satisfaction 83.8%, trust 87.5%, hope 90.4%, solidarity 94.8%, quiet 79.9%) (**Tables 2**, **3**). Correlation analysis across all the emotional states experience during the COVID-19 outbreak is reported in **Table 4**.

Multinomial logistic regressions determined the relationship between demographic factors of gender, age, geographic region, professional role, and operational unit and scores (never, sometimes, often, always) obtained from the psychological impact category (loneliness, anxiety, irritability, sadness, tiredness, insecurity, apathy, intolerance, frustration, insomnia, fear, impatience, impotence, anger, resignation, pride, satisfaction, trust, hope, solidarity, quiet) (**Tables 5**, **6**).

Furthermore, Harman's single factor test showed the total variance explained by a single factor was 28%, which falls well below the threshold of 50%. Thus, common method bias does not appear to be a significant factor in the current research.

Multinomial Logistic Regression: Negative Feelings

Gender was found to be a good predictor of all negative feelings, except for apathy, impatience, anger, and resignation. These last four emotions seemed to be equally not well predicted by the gender factor; among the others, the relationship between gender and loneliness was the one with the lowest significance, while those with insecurity, insomnia, and fear showed high significance. Females experienced more distress (loneliness 58.1%, anxiety 82.1%, irritability 83.6%, sadness 79.3%, tiredness 90.4%, insecurity 72.3%, intolerance 78%, frustration 69.6%,

TABLE 3 | Self-reported prevalence of positive feelings.

N = 576	*N* (%)	*N* = 576	*N* (%)
Pride		**Hope**	
Never or almost never	181 (31.4%)	Never or almost never	55 (9.5%)
Sometimes	216 (37.5%)	Sometimes	201 (34.9%)
Often	144 (25.0%)	Often	249 (43.2%)
Almost always or always	35 (6.1%)	Almost always or always	71 (12.3%)
Satisfaction		**Solidarity**	
Never or almost never	93 (16.1%)	Never or almost never	30 (5.2%)
Sometimes	272 (47.2%)	Sometimes	133 (23.1%)
Often	186 (32.3%)	Often	299 (51.9%)
Almost always or always	25 (4.3%)	Almost always or always	114 (19.8%)
Trust		**Quiet**	
Never or almost never	72 (12.5%)	Never or almost never	116 (20.1%)
Sometimes	266 (46.2%)	Sometimes	263 (45.7%)
Often	202 (35.1%)	Often	170 (29.5%)
Almost always or always	36 (6.2%)	Almost always or always	27 (4.7%)

insomnia 64.3%, fear 69.7%, impotence 76%) than males (loneliness 45.7%, anxiety 64.7%, irritability 76%, sadness 65.8%, tiredness 80.5%, insecurity 59.8%, intolerance 56.5%, frustration 62%, insomnia 42.4%, fear 49.5%, impotence 65.8%).

Age was predictive of loneliness, and insecurity, with a high significance, and of anxiety, irritability, and apathy with a medium significance; however it did not affect the other feelings among which, resignation was the only one to approach a low significance although without reaching it. The < 34-year-old age group experienced psychological distress more often (loneliness 67.9%, anxiety 83.3%, irritability 84%, insecurity 79%, apathy 40.1%) than the > 55 year-old-age group (loneliness 43.1%, anxiety 72%, irritability 78.8%, insecurity 65.7%, apathy 25.7%).

Region was found to be a good predictor of loneliness, anxiety, irritability, tiredness, insecurity, intolerance, frustration, and impotence. The relationship between region and loneliness was the one with the lowest significance, while those with tiredness, insecurity, and frustration showed quite high significance. Respondents from northern Italy showed higher distress (loneliness 52.9%, anxiety 79.4%, irritability 83.3%, tiredness 89.4%, insecurity 76.8%, intolerance 67.8%, frustration 72%, and impotence 76.5%) than those working in the central-southern Italy (loneliness 46.1%, anxiety 70.3%, irritability 76.4%, tiredness 82%, insecurity 62.4%, intolerance 57.3%, frustration 56.7%, and impotence 64.7%).

With regard to the *Professional role*, only tiredness and impatience were found to be predicted by this factor, with a high significance for the former and a medium one for the latter;

TABLE 4 | Spearman correlation coefficient rho: associations across all the emotional states.

	Loneliness	Pride	Anxiety	Satisfaction	Irritability	Sadness	Tiredness	Insecurity	Intolerance	Trust	Frustration	Insomnia	Hope	Apathy	Fear	Solidarity	Impatience	Quiet	Impotence	Anger
Loneliness	–																			
Pride	−0.016	–																		
Anxiety	**0.331*** **	**−0.099***	–																	
Satisfaction	**−0.125*** **	**0.590*** **	**−0.149*** **	–																
Irritability	**0.276*** **	**−0.086***	**0.520*** **	**−0.151*** **	–															
Sadness	**0.411*** **	−0.071	**0.455*** **	**−0.131*** **	**0.410*** **	–														
Tiredness	**0.281*** **	0.063	**0.418*** **	0.003	**0.458*** **	**0.432*** **	–													
Insecurity	**0.221*** **	−0.069	**0.476*** **	**−0.134*** **	**0.347*** **	**0.394*** **	**0.338*** **	–												
Intolerance	**0.300*** **	−0.078	**0.353*** **	**−0.259*** **	**0.467*** **	**0.383*** **	**0.325*** **	**0.416*** **	–											
Trust	**−0.190*** **	**0.288*** **	**−0.194*** **	**0.509*** **	**−0.236*** **	**−0.182*** **	−0.065	**−0.243*** **	**−0.250*** **	–										
Frustration	**0.336*** **	**−0.113***	**0.461*** **	**−0.253*** **	**0.454*** **	**0.440*** **	**0.359*** **	**0.378*** **	**0.443*** **	**−0.308*** **	–									
Insomnia	**0.333*** **	0.013	**0.393*** **	−0.01	**0.348*** **	**0.401*** **	**0.400*** **	**0.281*** **	**0.295*** **	**−0.083***	**0.354*** **	–								
Hope	**−0.130*** **	**0.249*** **	**−0.112*** **	**0.413*** **	**−0.144*** **	**−0.082***	0.012	**−0.126*** **	**−0.148*** **	**0.605*** **	**−0.152*** **	−0.025	–							
Apathy	**0.238*** **	**−0.116*** **	**0.293*** **	**−0.180*** **	**0.303*** **	**0.304*** **	**0.227*** **	**0.297*** **	**0.367*** **	**−0.231*** **	**0.349*** **	**0.223*** **	**−0.210*** **	–						
Fear	**0.294*** **	−0.001	**0.533*** **	−0.032	**0.329*** **	**0.391*** **	**0.238*** **	**0.416*** **	**0.253*** **	**−0.107***	**0.346*** **	**0.300*** **	0.003	**0.250*** **	–					
Solidarity	**−0.022**	**0.280*** **	0.029	**0.392*** **	−0.025	0.066	**0.101***	−0.006	**−0.103***	**0.401*** **	−0.008	**0.128*** **	**0.520*** **	**−0.169*** **	**0.092***	–				
Impatience	**0.218*** **	−0.021	**0.282*** **	**−0.100***	**0.461*** **	**0.290*** **	**0.294*** **	**0.285*** **	**0.485*** **	**−0.113*** **	**0.315*** **	**0.298*** **	−0.072	**0.428*** **	**0.184*** **	−0.053	–			
Quiet	**−0.253*** **	**0.118*** **	**−0.374*** **	**0.313*** **	**−0.356*** **	**−0.276*** **	**−0.239*** **	**−0.322*** **	**−0.240*** **	**0.502*** **	**−0.293*** **	**−0.208*** **	**0.421*** **	**−0.156*** **	**−0.272*** **	**0.242*** **	**−0.195*** **	–		
Impotence	**0.275*** **	−0.053	**0.395*** **	**−0.193*** **	**0.324*** **	**0.450*** **	**0.266*** **	**0.350*** **	**0.359*** **	**−0.174*** **	**0.492*** **	**0.351*** **	−0.028	**0.279*** **	**0.380*** **	**0.151*** **	**0.326*** **	**−0.251*** **	–	
Anger	**0.286*** **	−0.059	**0.362*** **	**−0.139*** **	**0.490*** **	**0.464*** **	**0.313*** **	**0.301*** **	**0.415*** **	**−0.202*** **	**0.462*** **	**0.288*** **	**−0.094***	**0.348*** **	**0.304*** **	−0.026	**0.411*** **	**−0.254*** **	**0.492*** **	–
Resignation	**0.274*** **	**−0.083***	**0.266*** **	**−0.195*** **	**0.248*** **	**0.327*** **	**0.232*** **	**0.313*** **	**0.390*** **	**−0.181*** **	**0.352*** **	**0.198*** **	**−0.166*** **	**0.385*** **	**0.245*** **	**−0.108***	**0.331*** **	**−0.197*** **	**0.423*** **	**0.427*** **

*Bold data indicate significant correlations; *** $p < 0.0001$, ** $p < 0.01$, * $p < 0.05$.*

TABLE 5 | Multinomial logistic regressions omnibus Likelihood Ratio tests for psychological impact category encompassing negative feelings and demographic factors (gender, age, geographical region, professional role, operational unit).

	χ^2	Df	*p*
Gender			
Loneliness	7.94	3	**0.047**
Anxiety	24.83	3	**<0.001**
Irritability	10.57	3	**0.014**
Sadness	14.72	3	**0.002**
Tiredness	16.1	3	**0.001**
Insecurity	18.29	3	**<0.001**
Intolerance	10.41	3	**0.015**
Frustration	15.5	3	**0.016**
Insomnia	24.65	3	**<0.001**
Apathy	4.47	3	0.214
Fear	22.811	3	**<0.001**
Impatience	0.678	3	0.878
Impotence	13.14	3	**0.004**
Anger	3.96	3	0.266
Resignation	3.16	3	0.367
Age			
Loneliness	29.07	6	**<0.001**
Anxiety	14.93	6	**0.021**
Irritability	16.60	6	**0.011**
Sadness	7.96	6	0.240
Tiredness	9.95	6	0.126
Insecurity	21.80	6	**0.001**
Intolerance	11.41	6	0.076
Frustration	7.95	6	0.241
Insomnia	2.10	6	0.91
Apathy	15.67	6	**0.016**
Fear	5.58	6	0.472
Impatience	10.27	6	0.114
Impotence	11.14	6	0.084
Anger	7.88	6	0.247
Resignation	11.74	6	0.068
Region			
Loneliness	7.96	3	**0.047**
Anxiety	11.13	3	**0.011**
Irritability	10.06	3	**0.018**
Sadness	3.066	3	0.381
Tiredness	14.6	3	**0.002**
Insecurity	12.06	3	**0.007**
Intolerance	9.22	3	**0.026**
Frustration	13	3	**0.005**
Insomnia	5.8	3	0.123
Apathy	3.86	3	0.277
Fear	1.35	3	0.717
Impatience	5.76	3	0.124
Impotence	9.28	3	**0.026**
Anger	6.87	3	0.076
Resignation	4.1	3	0.251
Professional Role			
Loneliness	2.89	3	0.409
Anxiety	3.39	3	0.335
Irritability	4.09	3	0.252
Sadness	1.31	3	0.727
Tiredness	16.1	3	**0.001**
Insecurity	3.23	3	0.35
Intolerance	6.69	3	0.082
Frustration	3.72	3	0.293
Insomnia	1.46	3	0.69
Apathy	6.26	3	0.099
Fear	0.437	3	0.933
Impatience	10.97	3	**0.012**
Impotence	1.53	3	0.674
Anger	2.68	3	0.443
Resignation	4.42	3	0.219
Operational unit			
Loneliness	10.28	6	0.113
Anxiety	15.80	6	**0.015**
Irritability	8.61	6	0.197
Sadness	8.78	6	0.186
Tiredness	15.1	6	**0.019**
Insecurity	7.15	6	0.307
Intolerance	2.84	6	0.828
Frustration	1551	6	**0.016**
Insomnia	10.99	6	0.088
Apathy	4.87	6	0.559
Fear	7.86	6	0.248
Impatience	3.42	6	0.754
Impotence	4.97	6	0.548
Anger	4.8	6	0.569
Resignation	4.18	6	0.651

Significant P values are highlighted in bold.
Chi-square value, degrees of freedom and significance are reported.

doctors reported feeling tired always or almost always (9.4%) and impatient often (19.7%) to a greater extent than nurses (respectively 4.5% and 12.2%). All the other feelings were far from being affected by this factor. This data shows that all health workers experienced psychological stress almost equally.

Lastly, *Operational unit* was predictive only of anxiety, tiredness, and frustration with medium significance for all these feelings. HCWs working in the *ad hoc* created COVID-19 units experienced more often the psychological distress (anxiety 78.7%, tiredness 93.6%, frustration 81.9%), than those working in anesthesia, reanimation and intensive care unit (anxiety 68.7%, tiredness, 78.1% frustration 53.1%). **Table 5** summarizes multinomial logistic regressions omnibus Likelihood Ratio tests for psychological impact category encompassing negative feelings and demographic factors (all the models coefficients, standard errors and relative significance are reported in the **Supplementary Material**).

TABLE 6 | Multinomial logistic regressions omnibus Likelihood Ratio for psychological impact category encompassing positive feelings and demographic factors (gender, age, geographical region, professional role, operational unit).

	χ^2	Df	*p*
Gender			
Quiet	23.16	3	**<0.001**
Solidarity	8.5	3	**0.036**
Hope	5.22	3	0.156
Trust	7.97	3	**0.046**
Satisfaction	15.22	3	**0.002**
Pride	2.892	3	0.409
Age			
Quiet	20.96	6	**0.001**
Solidarity	19.51	6	**0.003**
Hope	24.55	6	**<0.001**
Trust	18.25	6	**0.005**
Satisfaction	9.45	6	0.150
Pride	5.429	6	0.490
Region			
Quiet	2.48	3	0.478
Solidarity	7.07	3	0.069
Hope	2.23	3	0.526
Trust	1.43	3	0.696
Satisfaction	2.77	3	0.428
Pride	0.338	3	0.953
Professional role			
Quiet	6	3	0.111
Solidarity	0.43	3	0.935
Hope	1.65	3	0.648
Trust	1.62	3	0.654
Satisfaction	9.62	3	**0.022**
Pride	1.758	3	0.624
Operational unit			
Quiet	7.73	6	0.257
Solidarity	12.90	6	**0.044**
Hope	2.48	6	0.87
Trust	7.60	6	0.269
Satisfaction	5.49	6	0.483
Pride	6.323	6	0.388

Significant P values are highlighted in bold.
Chi-square value, degrees of freedom and significance are reported.

Multinomial Logistic Regression: Positive Feelings

Gender was found to be a good predictor of quiet, solidarity, satisfaction, and trust but not of hope, and pride. Particularly, quiet and satisfaction were the best feelings predicted by this factor with a high significance, followed by solidarity and trust with a medium to low significance. These feelings were more prevalent among females (quiet 79.9%, solidarity 94.8%, satisfaction 83.8%, trust 86.2%). *Age* was predictive of all positive emotions, showing a high significance, except for satisfaction and pride. The > 55-year-old age group experienced more often these feelings (trust 91.2%, hope 94.5%, solidarity 98.6%, quiet 85%) than the > 34-year-old age group (trust 81.5%, hope 85.8%, solidarity 92.5%, quiet 75.4%). As to the *Professional role*, only satisfaction was found to be predicted with a medium to low significance by this factor; this feeling was felt to a greater extent by doctors (86.5%) than nurses (82.1%). Lastly, one low significant relationship was only found between the *Operational unit* and solidarity: HCWs based in anesthesia, reanimation, intensive care units experienced more often this feeling (99.9%) than other units (94.6%). All the other feelings were far from being affected by this factor. However, *Region* did not likely affect the experience of all the positive emotions. This data suggests that HCWs contacted with our questionnaires across Italy experienced the same feelings.

Table 6 summarizes multinomial logistic regressions omnibus Likelihood Ratio tests for psychological impact category encompassing positive feelings and demographic factors (all the models coefficients, standard errors and relative significance are reported in the **Supplementary Material**).

DISCUSSION

Since the beginning of the pandemic, HCWs have been called on the frontline to cope with the current global health emergency. The emergency has imposed on them an overwhelming workload and emotional involvement, thus amplifying those psychosocial risk factors that normally characterize the healthcare sector (21–23, 25, 47). The situation was aggravated by the necessary measures adopted by governments to reduce the spread of the virus such as social distancing and quarantine, which significantly affected their emotional stability and which made impossible for them to benefit from the normal support of family members and friends who are known to represent an asset, a protective factor, especially in difficult times (48–51).

Previous studies have shown that frontline HCWs treating COVID-19 patients experienced higher risk of several symptoms such as anxiety, depression, and insomnia as well as negative feelings including tense, scared, angry, sad, afraid, and impressed (13, 25, 32, 33, 52). Italian health workers, for instance, reported a high level of burnout, psychological symptoms, and emotional exhaustion during COVID-19 pandemic (53). Positive feelings, on the other hand, including conscientiousness and self-sacrifice for patients were also reported by HCWs while they were putting their health and live at risk for patients (43, 44). This finding is particularly interesting as positive emotional states have rarely been investigated in HCWs working in similar circumstances.

With the present study we enrich the extant literature by analyzing the nature and the severity of the psychological complaints reported by the HCWs during the first COVID-19 outbreak in Italy, and by identifying possible predictive factors that led to significant differences in experiencing such psychological distress. Furthermore, we analyzed the possible experience of positive emotions to highlight possible protective factors needed for adaptive coping. We carried out multinomial logistic regressions to investigate

the relationship between 21 accurately selected emotional states, negative and positive (loneliness, anxiety, irritability, sadness, tiredness, insecurity, apathy, intolerance, frustration, insomnia, fear, impatience, impotence, anger, resignation, pride, satisfaction, trust, hope, solidarity, quiet), and five possible predictor factors (gender, age, region of Italy, professional role, operational unit).

Regarding the negative feelings, we found that more than half of the HCWs experienced all the emotional states investigated at least sometimes, with the exception of apathy (30.5% of the sample). The most frequently felt emotions were tiredness, irritability, anxiety, and sadness respectively. Factors associated with a higher psychological impact included being a woman, living in northern Italy and young age. These results are in line with the recent literature reporting higher levels of psychological distress in women and young adults (9, 18, 54). Our findings have shown that this holds true for HCWs.

More than half of the HCWs also experienced all positive feelings with the most frequently felt being solidarity, a feeling that has also been reported for the general population in different countries during this health emergency (55). Factors associated with higher experience of these emotional states included female gender and older age.

Differently from other studies, in which the role of health workers and the type of unit mattered (32, 56), we found that the majority of the negative as well as positive emotional states were experienced almost equally by both doctors and nurses, and independently of the operational unit in which they operated. Our finding highlights the importance of investigating both the working role and unit that led to the psychological discomfort, as it has been done in most studies on this subject to date, and the specific emotions as the distinct, contributing factors.

Our results showed also that, overall, female respondents experienced emotional states, be them negative or positive, more often than men. The prevalence of the psychological impact on women may partly reflect gender differences in self-disclosure and in expressing one's feelings: women have been reported before being more likely than men to report their emotional states, especially the negative ones associated with psychological difficulties (57–59). On the other hand, younger health workers suffered psychological distress more frequently than the older ones who, instead, experienced more positive emotions. This pattern of results observed with HCWs extends the observation during this pandemic that, in the general population, younger adults were subjected to stress, depression and anxiety, while older adults were found to score low on ratings about these measures, thus demonstrating more resilience and higher coping strategies (9, 18, 54). Lastly, territorial differences were found only in the negative emotions of the HCWs operating in northern Italy, as this was the most affected region especially around the time of our data collection.

Our results are in line with the research on the psychological impact caused by the present pandemic on the general population (9, 17, 60–62), as well as with that on a specific category of workers like HCWs (25, 26, 32, 53, 63–65). This study has several other merits. First, we considered differences in emotions experienced by respondents depending on their professional role, work units or departments, and regional territory, in addition to the other most studied demographic variables such as gender and age. Second, we investigated a broad spectrum of negative emotional states to better grasp for the complexity of the psychological experience during the pandemic. Third, we also analyzed positive feelings, often overlooked, as they can help us to better characterize to the full the HCWs emotional experience during the pandemic.

This study suffers from a number of weaknesses. First, we administered questionnaires that were not validated and contained one-item scale. This choice was motivated by our purposes to survey a broad spectrum of emotions of HCWs while the health emergency that imposed heavy timing and accessibility limits. Although single-item measures are very useful and accepted in circumstances like ours, with limited time and the need to minimize the burden of respondents who were already highly busy, suffering and tired, the use of multiple items is generally suggested because it helps to average out errors and specificities that are inherent in single items, thus leading to increased reliability and construct validity. Second, being a self-report, this questionnaire may suffer from social desirability bias which can confound relationships among the variables of interest, particularly regarding negative emotions, by obscuring or producing them artificially despite having been guaranteed anonymity. Third, another risk for self-report measures is the recall bias, especially when respondents have experienced heavy emotional events, as in our case, that may have distorted their memories by leading to an over or under-estimation of positive and/or negative past emotional experiences. However, since the questionnaire was spread a few months after the start of the health emergency, with questions relating to the recent and also current experience of the respondents, we believe the influence of this bias is low, even if it should be taken into account. Fourth, we spread the questionnaire in a period in which the workload was overwhelming for the respondents. This factor might have affected the participation, as well as the representativity of the sample which leans toward the female gender. In future studies more representative and balanced samples should be involved. As an exploratory study, the data were analyzed without multiplicity adjustment and the results were interpreted primarily as preliminary insights (66); therefore, future confirmatory studies are needed to test specific and definitive hypotheses. Moreover, the cross-sectional nature of the study and the lack of longitudinal follow-up do not allow inferences about the causal relationships among the variables, and the long-term consequences of the psychological impact we documented.

CONCLUSION

Our findings suggest that more than half of HCWs experienced psychological distress during the first COVID-19 outbreak in Italy, and that the factors associated with higher psychological impact included being female, young and living in northern Italy. The most frequently negative emotions reported were tiredness, irritability, anxiety, and sadness. However, positive feelings were

also experienced, first of all solidarity, especially by women and older people. Despite some limitations, we believe this study can be very useful as a contribution to the current literature on the psychological effects of this pandemic on health workers. Moreover our findings can inform future policies aimed at providing more tailored and effective psychological interventions in the ongoing and future emergencies. Noteworthy, the HCWs' burdens and mental sufferance affect not only their own health, but pose great concern on their families and friends, as well as on their patients (67). The emergency has been amplifying psychosocial risk factors, already present in the healthcare sector (21–23), that are associated with staff's working conditions, safety and health. Consequently, in addition to support interventions, it would be desirable that hospitals consider adopting work-family policies to foster HCWs' psychological wellbeing by improving their resilience and coping strategies (68). It has become ever so evident that the safeguard of these professionals is necessary and urgent to promote a positive quality of life for them and for the people they come into contact with.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories together with the R syntax file used for the analysis, and the questionnaires. The names of the repository/repositories and accession number(s) can be found below: OSF repository, https://osf.io/h8xyu/.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee, International School for Advanced Studies (SISSA). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

EP conducted the data analyses and wrote the first draft of the manuscript. All authors made important contributions to its final version, have read and approved the final version of the manuscript, and contributed to the study design of the study and its implementation.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.818674/full#supplementary-material

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Prevalence and Factors of Anxiety During the Coronavirus-2019 Pandemic Among Teachers in Saudi Arabia

Riyadh A. Alhazmi[1], Sultan Alghadeer[2], Mohamed N. Al-Arifi[2], Asma A. Alamer[3], Abdullah M. Mubarak[4], Abdulrahman Alwhaibi[2], Raghad Alfayez[2] and Sara Alsubaie[2]*

[1] Department of Emergency Medical Services, Prince Sultan Bin Abdulaziz College for Emergency Medical Services, King Saud University, Riyadh, Saudi Arabia, [2] Department of Clinical Pharmacy, College of Pharmacy – King Saud University, Riyadh, Saudi Arabia, [3] Department of Curricula and Teaching Methods, College of Education, King Faisal University, Al-Ahsa, Saudi Arabia, [4] Department of Basic Science, Prince Sultan Bin Abdulaziz College for Emergency Medical Services, King Saud University, Riyadh, Saudi Arabia

Background: Teachers play a central role in successful education. Due to the COVID-19 pandemic, regular in-person attendance in classes at all levels of education has been disrupted for more than 1 year in many countries. These lockdowns, which include the discontinuation of in person learning at schools and universities has presented a significant challenge for teachers to adapt to online teaching. Given this rapid format change, occupational anxiety levels among educators has increased.

Objective: The primary objective of this study was to assess the prevalence of anxiety among teachers in Saudi Arabia. A secondary objective was to explore characteristics of teachers associated with the level of anxiety level during the period of lockdown.

Methods: An anonymous, online cross-sectional study was carried for 3 months (February 2021 through April 2021). The questionnaire consisted of four sections and included the Generalized Anxiety Disorder instrument (GAD-7). Chi-square tests were completed for categorical comparisons while binary logistic regressions were used for associative relationship exploration. The IRB at King Saudi University Medical City, Saudi Arabia approved this study.

Results: A total of 742 respondents completed the survey yielding an anxiety prevalence of 58.2 % among teachers. Medium degree of statistically significant differences identified as marital status ($p = 0.046$). women had higher anxiety (65.3%) than men (34.7%) but gender with anxiety was low degree of statistical significance compared with non-anxiety status ($p = 0.697$). The odds of anxiety among middle teachers was twice (OR = 2.01) as high as the odds of anxiety among other levels of teacher ($p = 0.01$, 95% CI 0.94–4.26).

Conclusions: This study identified that many teachers experienced anxiety during the lockdown, especially women and middle school teachers. Future studies should identify contributing factors to estimate the magnitude of the exposure to anxiety between different types of teachers to help establish better preventive measures based on the workplace environment.

Keywords: COVID-19, pandemic, anxiety, education, occupational health, educator, teacher, mental

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****Correspondence:***
Riyadh A. Alhazmi
rialhazmi@ksu.edu.sa
orcid.org/0000-0002-7084-5645

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INTRODUCTION

With advances in education and curriculum, the teacher still plays a central role in a successful educational experience. Formal education is an integrated system, relying upon systematic and structural approaches provided in educational facilities (1). Through teachers, the learning process of formal education is intended to provide students with essential knowledge and skills required to achieve their desired goals. Therefore, regular in-person attendance for teachers and students is mandatory in most educational environments (2). However, many of the standard approaches have been suspended due to the COVID-19 pandemic.

While the disease is theorized to have emerged in Wuhan, China in December 2019 in <3 months the World Health Organization (WHO) declared COVID-19 a global pandemic (3–5). Shortly thereafter, the WHO announced comprehensive recommendations and preventive measures to reduce transmission and decrease the rate of new infections (5). The rapid onset and global spread of COVID-19 is not only one of the most critical public health emergencies in modern times, but the cascading effects on the health and wellbeing of persons is concurrently impacted across many areas of like. As a result of the pandemic, the changing of many aspects of life combined with a constant concern of transmission of infection, has increased anxiety worldwide (6).

Many countries adhered to WHO's recommendations including travel and work restrictions and educational institutions lockdown (5). In addition to their regular workload, teachers experienced a significant shift to online learning in many countries. The additional burdens of developing and deploying new teaching methods while potentially being exposed to a novel pathogen in-person led to a cumulative impact on the stress and anxiety among teachers (7, 8).

Temporary feelings of being anxious or tense will impact persons differently than chronic anxiety as these tend to be acute episodes. However, an event like a pandemic, can lead to extended anxiety, whether a formal anxiety disorder or chronic feelings of anxiousness, these episodes ng can have an adverse effect on one's quality of life as well as mental and physical health (9). Extended periods of anxiety and anxiety disorders can lead to other serious medical conditions such as heart diseases and cancer (10, 11). Otherwise healthy people experiencing high levels of stress can eventually develop health anxiety (12) which will cause people to suffer more, and have influence their thinking and decision-making processes in day to day life (13).

One study showed increased anxiety levels among teachers during the COVID-19 pandemic (14). High school teachers were found to develop an anxiety disorder more than teachers in other stages of education (15). Studies have assessed the incidence of anxiety among different occupations, finding teachers among the most impacted among occupations (16–23). Specifically, female teachers had higher levels of anxiety than male teachers. On the other hand, previous studies have not addressed an association between married teachers and anxiety level, as may be a step in realizing a contributing factor in anxiety level. Although, studies shown positive association between media exposure and anxiety level (24). More precisely, several studies showed exposure to different types of media information such as a twitter, TV news and other sources can a play an important role in anxiety level (25–27). Similarly, social media greatly impacted the level of anxiety during the period of COVID-19 (16, 26, 28). Evidence suggests that sharing concerns by social media improved people's mental condition for the period of COVID-19 crisis (29).

In Saudi Arabia, the first confirmed case was on March 2, 2020, resulting in implementing preventive measures in a line with the WHO guidelines (30). Our restrictive lockdowns included the closure of schools and universities was created a huge challenge to teachers to find ways to adapt to online teaching method. The stress of the pandemic and its impact on daily life can has significant effects on occupational health. Teachers around the world have been impacted by the lockdowns, however, there is very limited research examining teacher's mental health during COVID-19 in many nations, including Saudi Arabia. The primary objective of this study was to assess the prevalence of a state of anxiety among teachers in Saudi Arabia. A secondary objective was to explore characteristics of Saudi teachers and their association with anxiety level during the period of lockdown.

METHODS

Study Design and Population

A cross sectional study was completed using an anonymous online survey to assess the anxiety among Saudis' teachers during the period of COVID-19 pandemic. An invitational email was sent to educational regions in Saudi Arabia, in turn they distributed the survey link to comprehensive list of public and private education from primary through college teachers, instructors and faculty members. Study instructions and an electronic cover letter were shown at the beginning of the survey. The survey was conducted for 3 months (February 2021 through April 2021) to assess the prevalence of anxiety and its contributing factors. It was estimated that the total number of teachers in public schools and universities in Saudi Arabia is around 577,700 teachers according to the latest annual report of the Saudi Arabia Monetary Agency for population and workforce (31). Based on this number, the minimum sample size was calculated, with 95% confidence level and 5% margin of error, to be 384 participants. The institutional research board (IRB) at King Saud University Medical City approved the conduction of study (No. E-21-5914).

Survey Instrument and Data Analysis

The questionnaire consists of three sections, including demographics (i.e., age, gender, educational level, type of school, school location, and income), in addition to sources for gaining information about COVID-19. The second section included the behavioral status and commitment of teachers to the health policy restricted regulations toward COVID-19. All behavioral questions such as wearing mask, increased hand washing, social distancing, and limited family gatherings were categorized into three levels: high (if all answers were correct), moderate (with some correct answers), and low/none (with incorrect answers for all questions). The final section was

the Generalized Anxiety Disorder instrument (GAD-7) of an Arabic version and was used after the permission of author was obtained.

Cronbach's alpha has been calculated with 0.817 ($\alpha > 0.7$) of the behavioral status and GAD-7 all together and reported in additional file (**Supplementary Material 3**). A comparison of the instruments found the Cronbach's alpha was 0.763 (32). The Inter-Item Correlation Matrix showed there is sufficiently weak correlation between the independent variables (<0.7) (**Supplementary Material 3**). It was assessed by scores of 0, 1, 2, and 3 to answers options of (never, several days, more than half the days and nearly every day). The total score ranged from 0 to 4 indicated no anxiety, scores of 5–9 indicated mild anxiety, scores of 10 to 14 showed moderate anxiety and scores of 15–21 showed severe anxiety.

Categorical data were shown as frequency, mutually exclusive and had expected count <5 with 20.14 of the minimum expected count, compared using chi-squared test. Categorical data were shown as frequency including dichotomous outcome with, dichotomous nominal and ordinal independent variables. Spearman's rho was performed to test outliers and correlation (**Supplementary Material 2**). Consequently, the data successfully met the assumptions that are required for Binary logistic regression model used to obtain odds ratio (OR) and their associated 95% confidence interval (CI).

The degree of statistical significance was set based on near or far from a *P*-value of = 0.05 with very high, high, medium, low, and very low significance to a *P*-value of = 0.05. Analysis was performed using Statistical Package for the Social Sciences 24 (IBM-SPSS-24). The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

RESULTS

A total of 742 respondents completed the survey. Most respondents (64.6%) were women. According to an Arabic version of GAD-7 survey, the prevalence of anxiety in Saudi teachers was 58.2%, showed by **Figure 1**. Of these 742 respondents, 42, 35, 15, and 8%. Had no, mild, moderate and severe anxiety, respectively, described in **Figure 1**.

Table 1 presents the features of respondents by anxiety vs. non-anxiety status with the only medium degree of statistically significant differences identified as marital status ($p = 0.046$). Our results showed that women had higher anxiety (65.3%) than men (34.7%) but gender with anxiety was low degree of statistical significance compared with non-anxiety status ($p = 0.697$). In addition, fears teaching online and getting infected were very high degree of statistical significance $P = 0.001$ with OR and 95%CI of 1.936 (1.319–2.841) and 1.739 (1.246–2.426), respectively. However, the behavior status was very low degree of statistical significance.

Participant's responses were explored to look for an association using binary logistic regression with binary outcome of anxiety and without anxiety as shown in **Table 2**. Male gender was found to have very low degree of a statistically significantly association ($p = 0.36$, OR 0.830, 95% CI 0.556–1.240). However, the odds of anxiety among middle teachers was twice (OR = 2.01) as high as the odds of anxiety among other levels of teacher ($p = 0.01$, 95% CI 0.94–4.26). Furthermore, teachers who used social media as source of pandemic information had increased 1.6 times the odds of anxiety compared to persons not reporting pandemic related information from social media (95% CI, 1.08–2.3) with $p = 0.02$.

DISCUSSION

Education is a fundamental institution for development of social and cultural aspects in every country. Schools serve not only as learning centers but as centers for development. The COVID-19 pandemic response resulted in schools and universities in most countries including Saudi Arabia being closed and moved to online educational methods (5). The rapid proliferation of online education through various digital platforms not only impacts a person's teaching skills but also their mental health.

In this study of 742 teachers completing an online cross-sectional survey, the majority of teachers (58.2%, $n = 433$) reported increased anxiety during the lockdown, with 35.3% reporting mild anxiety. While globally there is limited research in this area, these findings align with previously conducted research confirming teacher anxiety during lockdown (14). However, we believe there may be significant underreporting of anxiety due in part to the time of this study and that the teachers may be underestimating the situation. The nature of teaching requires continuous work and daily preparations to carry out the educational objectives. This effort, by its nature, is a source of increasing stress and anxiety level among teachers (7, 8). Nevertheless, the anxiety felt by the teachers during the COVID-19 pandemic has been higher than prior to the lockdowns (14). This is likely due to restricted social movements and consistent health anxiety and concerns about the pandemic (33). In addition, utilizing online teaching method involves a high level of anxiety among teachers (14).

Teachers serve different stages of education such as primary, middle, high school and… etc. Therefore, they face varying levels of anxiety and stress. In COVID-19 pandemic, previous research found high school teachers confronted an increased level of anxiety and stress compared to other stages of education (15). In our study, the findings showed an association between the types of teacher stage and anxiety, in which middle teachers were highly associated with anxiety level during the lockdown. In contrast, Ozamiz-Etxebarria et al. found primary teachers showed a high level of anxiety during lockdown (14). These results indicate teachers are exposed to a great amount of anxiety and stress depends on the stage of education. Our result showed ages group of middle education (13–15 years) could cause more stress and pressure to the teachers. This could be students at these ages want to be more independent and give physiological changes can be more irritable, distant, and disobedient (34). Consequently, it can be a source of stress and conflict for teachers working in the middle school education. Not to mention, online teaching requires more attention from teachers which increases challenges

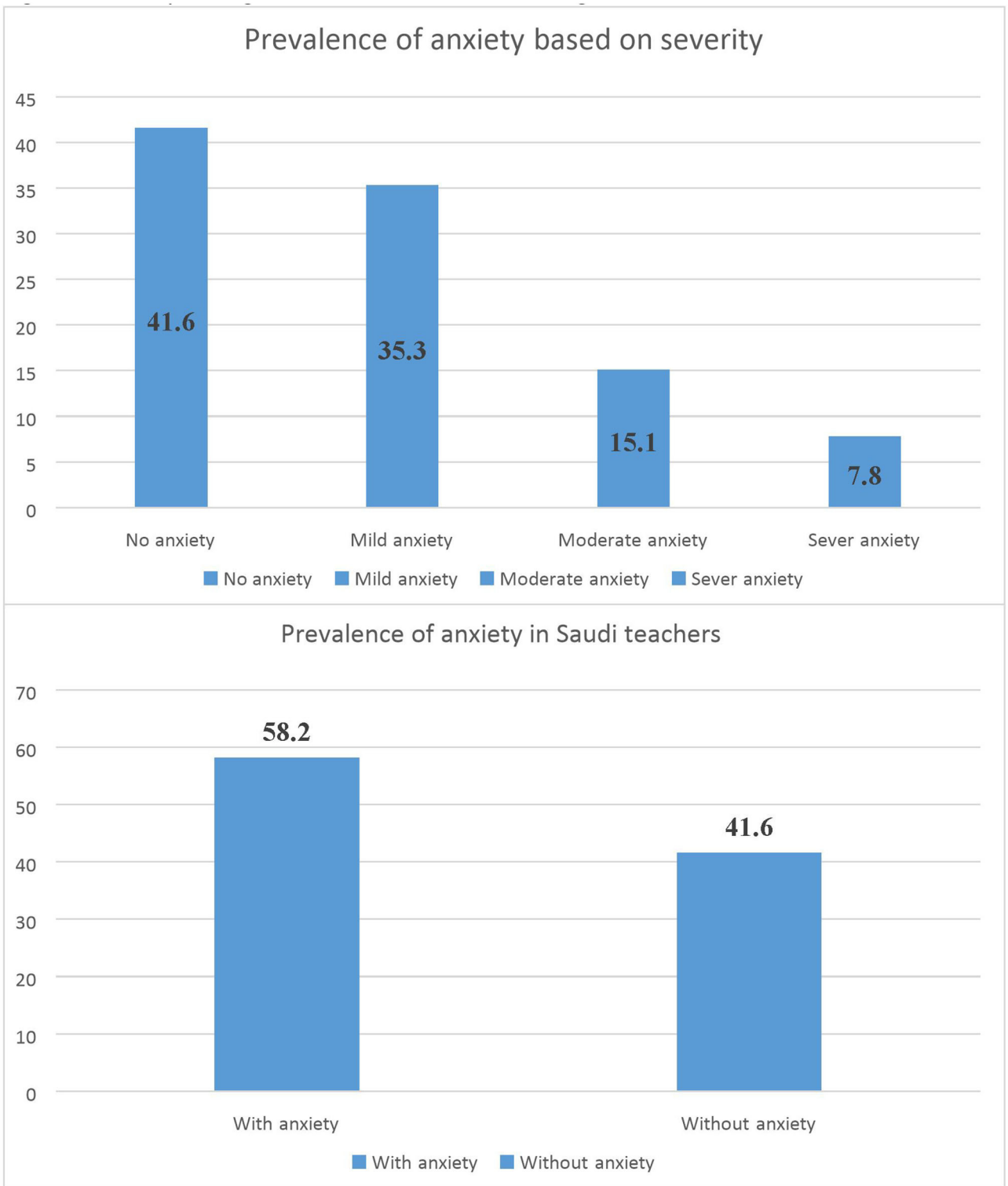

FIGURE 1 | Anxiety among teachers in Saudi Arabia during COVID-19 pandemic.

TABLE 1 | Demographics of the teachers based on their anxiety status.

Demographics	All respondent (n = 742)	With anxiety (n= 432)	Without anxiety (n = 310)	*P*-value*
Sex				0.697
Male	263 (35.4%)	150 (34.7%)	112 (36.2%)	
Female	479 (64.6%)	282 (65.3%)	197 (63.8%)	
Marital status				0.046
Married	426 (57.4%)	233 (54.2%)	192 (63.4%)	
Single	271 (36.5%)	172 (40.1%)	99 (32.7%)	
Divorced	36 (4.9%)	24 (5.6%)	12 (9.0%)	
Type of teachers				0.051
Primary teachers	206 (27.8%)	108 (25%)	98 (31.7%)	
Secondary teachers	88 (11.9%)	61 (14.1%)	27 (8.7%)	
High teachers	239 (32.2%)	114 (33.3%)	95 (30.7%)	
University teachers	209 (28.2%)	119 (27.55%)	89 (28.8%)	
Information resources				
Internet	281 (37.9%)	147 (34.3)	133 (43.2)	
Friends	2.8 (21.0)	13 (3.0)	8 (2.6)	0.061
Social media	329 (44.3)	208 (48.6)	121 (39.3)	
TV	106 (14.3)	60 (14.0)	46 (14.9)	
Teach online				0.003
Yes	217 (29.2)	145 (33.8)	72 (23.8)	
No	516 (69.5)	284 (66.2)	231 (76.2)	
COVID 19 infected				
Yes	346 (46.6)	223 (51.6)	123 (39.8)	0.002
No	396 (53.4)	209 (48.4)	185 (60.2)	

**P-value is calculated by Chi Square test.*

in completing all the new requirements in a timely manner. The result indicates a need for further research to identify factors that might be a cause of anxiety for middle teachers during COVID-19 outbreak and lockdown.

The sex differences in anxiety levels have been the subject of numerous studies with women more likely to report anxiety during the current pandemic (16–23). In our study, the results found similar degree of evidence between anxiety and sex. However, our study showed marital status to be a factor at increased level of anxiety. This suggests married teachers are more likely to display higher levels of anxiety than their single counterpart. The pandemic could have an amplifying effect to anxiety especially for teachers with children because they have to adapt to new teaching strategies using different medium of instruction along with childcare and household responsibilities.

In our study, there is also a positive association between anxiety and social media exposure compared to other information resources. Recent research has recognized a positive association between media exposure and anxiety before and during the current pandemic (16, 24, 26, 28). In addition, studies conducted in Saudi Arabia (25), UK (26), and China (27) showed the effects of different types of media sources on person's anxiety level. A consensus was reached that social media consumption is linked to higher levels of anxiety compared to other media platforms. Similarly, our findings suggest that teachers who receive their information about the pandemic from social platforms are also more likely to have anxiety. However, it is unclear whether persons with anxiety tend to use social medial platforms to seek information or that social media consumption aggravates mental health issues. Therefore, establishing any cause and effect relation could be misleading. Social media could have positive effect on mental health such as providing social support through this difficult period (29). On the other hand, misinformation along with rumors are easily disseminated through social media platforms in comparison to traditional platforms where information is verified and controlled. Future research should evaluate the difference between types of information shown in different types of media resources as well as how fast it can impact teachers' perspective.

LIMITATIONS

In our study, numerous limitations need to be recognized. First, our findings are not generalizable to the entire population because of the cross-sectional nature of the research. Second, the study did not cover age groups and years of experience of teachers. Varying ages and years of experience might be a factor of negatively or positively increasing a level of anxiety in the COVID-19 pandemic. Third, there is also the possibility of selection bias since the research was performed with an online questionnaire. Teachers who are unable or unwilling to

TABLE 2 | Association between participants responses with presence of anxiety.

Demographics	OR (95% CI)	*p*-value*
Gender		
Sex	Reference	-
Male	0.830 (0.556–1.240)	0.363
Marital status		
Married	Reference	-
Single	1.334 (0.835–2.130)	0.228
Divorced	1.543 (0.684–3.485)	0.296
Education level		
Primary/secondary school	0.957 (0.162–5.638)	0.961
High school	2.005 (0.944–4.262)	0.070
University	1.352 (0.767–2.384)	0.307
High education	Reference	-
Type of teachers		
Primary teachers	Reference	-
Secondary teachers	2.091 (2.091–1.169)	0.013
High teachers	1.128 (0.728–1.749)	0.590
University teachers	1.123 (0.664–1.901)	0.665
Information resources		
Internet	Reference	-
Friends	2.068 (0.713–5.998)	0.181
Social media	1.557 (1.083–2.237)	0.017
TV	1.315 (0.789–2.189)	0.293
Teach online		
No	Reference	-
Yes	1.936 (1.319–2.841)	0.001
COVID 19 infected		
No	Reference	-
Yes	1.739 (1.246–2.426)	0.001

OR, odds ratio; CI, confidence interval.
**Significant result at a = 0.05.*

use smartphones or email could not participate in the study. Fourth, the study did not include a section related to teachers with pre-existing anxiety disorders such as panic attack, social health anxiety, social phobia, or generalized anxiety disorder (GAD) that can be associated with teachers. Future research should consider pre-existing anxiety disorders when carrying out teachers' mental health study. Last, the study showed marital status is associated with level of anxiety, and yet, the study did not address the number of children one's have and their possible effect on anxiety.

CONCLUSION

This study identified that many teachers experienced anxiety during the lockdown. We found that most teachers (58.2%, $n = 432.5$) reported anxiety during the lockdown especially women and middle school teachers. Future studies should identify contributing factors to estimate the magnitude of the exposure to anxiety between different types of teachers to help establish better preventive measures based on the workplace environment. In addition, our study showed a positive association between anxiety and social media exposure compared to other information resources. Future research should evaluate the difference between types of information shown in different types of media resources as well as how fast it can impact teachers' perspective.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by IRB approval letter. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

RAA, SAlg, and MA-A provided the main framework and identified main factors and materials. AAla, AAlw, and RA collaborated in identifying appropriate references and collaborated in writing the manuscript. SAls and SAlg were involved in data collection and cleaning data. AM and MA-A were involved in data analysis, interpreted the results, and collaborated in writing the manuscript. SAlg, RAA, and AAla collaborated in writing and editing the paper. All authors read and agreed to the published version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.827238/full#supplementary-material

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Initial Psychometric Evidence of Physical Inactivity Perceived Experience Scale (Pipes): COVID-19 Pandemic as a Pilot Study

Noomen Guelmami[1,2,3], *Nasr Chalghaf*[1,2,4], *Amayra Tannoubi*[1,2,3,4], *Luca Puce*[5], *Fairouz Azaiez*[1,2,4] *and Nicola Luigi Bragazzi*[1,6,7]*

[1] Postgraduate School of Public Health, Department of Health Sciences (DISSAL), University of Genoa, Genoa, Italy, [2] Group for the Study of Development and Social Environment (GEDES), Faculty of Human and Social Science of Tunis, Tunis, Tunisia, [3] Department of Human and Social Sciences, Higher Institute of Sport and Physical Education of Kef, University of Jendouba, Jendouba, Tunisia, [4] Department of Human Sciences, Higher Institute of Sport and Physical Education of Sfax, University of Sfax, Sfax, Tunisia, [5] Department of Neuroscience, University of Genoa, Genoa, Italy, [6] Laboratory for Industrial and Applied Mathematics (LIAM), York University, Toronto, Toronto, ON, Canada, [7] Department of Mathematics and Statistics, York University, Toronto, ON, Canada

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Xenia Gonda,
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***Correspondence:**
Nicola Luigi Bragazzi
robertobragazzi@gmail.com

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Aims: Our study aimed to develop a two-factor self-administered orthogonal questionnaire to assess the experience of perceived physical inactivity, to test its psychometric properties, to confirm its relationships with fear of COVID-19, and finally, with perceived stress during the pandemic.

Methods: A total of 481 Tunisian subjects collected in several cities, aged from 16 to 67 years with a mean age = 32.48 ± 9.46, and of both sexes participate in our study with (male: 51.8%) and (female: 48.2%), divided according to the level of study into three categories. All subjects voluntarily answered the PIPES questionnaire, the IPAQ scale, the COVID-19 fear scale and the PSS-10 test.

Results: The results of the exploratory and confirmatory factor analysis supported the robustness of the tool measure. In addition, examination of configurational, metric, scalar, and strict invariance supported the equivalence of the structure by gender and educational level. Concurrent validity was established by the positive association of a negative perception of physical inactivity with scores measured by the IPAQ scale and a negative association with scores of COVID-19 fear and perceived stress. Whereas, a positive perception of physical inactivity from the COVID-19 scale was negatively associated with the IPAQ and positively associated with fear of COVID-19 and perceived stress.

Conclusion: The PIPES-10 scale can be used to measure the perception of physical inactivity in different situations.

Keywords: COVID-19, physical inactivity, fear, perceived stress, factorial invariance, scale validation

INTRODUCTION

The benefits of physical activity and exercise on physical and mental health, as well as the negative impacts of physical inactivity, have been well documented in the scientific literature for both adults and children (1–4). For physical health, many researchers have highlighted the role of physical inactivity in the prevalence of various pathologies. Several longitudinal and cross-sectional studies for different age groups and in both sexes report evidence of the benefits of exercise on the prevention and treatment of several diseases related to the cardiovascular systems (5–9), respiratory (10, 11), immune (12), diabetes (13, 14), neurogenic diseases (15, 16), cancer (17), obesity (18), and many other diseases.

Similarly, in human psychology, numerous studies have confirmed strong associations between physical inactivity and various negative behaviors and psychological parameters such as stress, depression and anxiety (19–22). Moreover, in contemporary sociology, a plethora of work has established links and explanatory models for the benefits of physical activity with several social factors (23–25).

As a result, findings have been reported by physicians, biologists, psychologists, and sociologists on the need to promote exercise and regular physical activity. Many researchers cite sedentary behavior and physical inactivity as a major risk factor that increases lethality rates in contemporary societies.

Despite all of these substantial changes, lifestyles across countries vary and physical inactivity in many countries is likely to persist to become an international pandemic in 2012. Globally, physical inactivity is presented as the greatest public health problem of the twentyfirst century (26) and the fourth leading cause of death (27), its economic consequences are also severe (27). Physical inactivity is currently considered a pandemic that has become a major concern for several international organizations, such as the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC). Sustained physical inactivity and sedentary behavior are generally associated with poor physical and mental health and increased risk of mortality (6, 7, 28–30).

Physical inactivity across multiple populations and countries is increasingly worsening, particularly during the COVID-19 pandemic, which was a particular global experience characterized by specific measures that imposed containment, restrictions on travel between countries, and even habitual travel within cities of the same country (31, 32). Indeed, during the COVID-19 pandemic, several studies have reported a significant increase in physical inactivity would be evident due to the requirements of self-isolation and quarantine in addition to the curfews. In other words, in several countries, the rapid growth of the COVID-19 pandemic has forced governments to put in place a curfew (33), stoppages, or restrictions on movement.

Abbreviations: CF-19, COVID 19 Fear; IPAQ, International Physical Activity Questionnaire; IPAQ-C, International Physical Activity Questionnaire (short, last 7 days); PSS10, Perceived Stress Scale 10 items; MET, Metabolic Equivalent Tasks; PIPE S, Physical Inactivity Perceived Experience Scale; PIPES1, Physical Inactivity Perceived Experience Scale (Factor1); PIPES2, Physical Inactivity Perceived Experience Scale (Factor1).

These government decisions were accompanied by a decrease in physical loads at work, the cessation of schooling, the suspension of all sports activities and competitions, in addition to the closure of several places of physical activities such as sports centers, sports halls, amusement parks, municipal stadiums and private fields (31).

Under these specific conditions often accompanied by fear of COVID-19, stress, anxiety, and depression (34–37), physical inactivity could significantly increase mortality rates in several populations (38–40) and particularly in patients and vulnerable groups such as obese, diabetic, hypertensive, and cancer patients. In this regard, Stanton et al. (41) reported during the pandemic an increase in physical inactivity associated with increased depression, anxiety, and stress.

This increase in inactivity can be dramatic in many populations and deserves a measurement tool specific to this environment. Indeed, several physical activity measurement tools have been developed over time to target the perception of physical activity (42). As an example, Fox and Corbin (43) developed the physical self-perception profile based on self-esteem theories. In another work, Kerner and Kalinski (44) developed a measure for young people through attitudes, beliefs, perception of control, and intention to engage in leisure-time physical activity. And Salvador et al. (45) study who develops the "Perception of the environment and leisure-time physical activity in the elderly". However, these scales were not general (for example, focused on specific physical activities such as leisure activities), never considered physical inactivity, and were mostly developed for specific populations. To the best of our knowledge, there is no measurement scale which attempted to measure the perception of the experience of physical inactivity in relation to a pandemic environment and adjacent specific measures. It is therefore very important to construct a standard tool that can assess this, especially in a phase of awareness of the importance of having a healthy body with strict measures such as movement restriction and containment. The objective of this paper is to develop a self-administered questionnaire that measures the perception of the experience of physical inactivity, to test its psychometric properties and to confirm the relationships between the perception of the experience of physical inactivity with the fear of COVID-19, and the perceived stress during the pandemic.

MATERIALS AND METHODS

Instruments

The questionnaire items were developed based on an in-depth analysis of specific literature and expert feedback. Before making decisions about scale development, we considered several models and theories in the context of physical exercise, such as the behavioral epidemiological framework advocated, which looks at the link between behaviors and health and disease (46), the theory of planned behavior which has been dominant for years (47) and the Health Belief Model (48). After examining and criticizing the first two theories [e.g., (49)], we are committed to exploiting the latter model for those overarching considerations

that could classify attitudes toward activity and physical inactivity at my time.

Indeed, current research based on the Health Belief Model considers that verbal responses regarding attitudes toward physical activity must include expressions about the intention to be physically active or not (50).

As a result, a self-reported measure of attitudes applied to physical activity must include two constructs: one construct centered on expressions that promote physical activity, while the second construct is interested in evaluating a positive attitude with regard to physical inactivity.

In the process, the theoretical design of the first concept of perceived experience of physical inactivity (PIPES1) avoided conceptualizing the construct from a perspective that considers the specific effects of physical activity on physical health factors, mental health or social interactions. This allows for a general conceptualization that can encompass all the factors mentioned without detailing the perceived benefits that are detailed in the non-verbal model of attitudes.

For the second concept, which is also the negative perception of physical inactivity, a general construct was established. This construct was generally related to barriers to practice without detailing the reasons for physical activity inability, such as time required, lack of adequate infrastructure, lack of safety, physical disability. This choice made it possible to measure the concept in a global way. As a result, the cognitive and affective response categories of the Health Belief Model (50, 51). Non-response to long-form questionnaires in the health context [see: (52–54)], the cost and time of administration [for example, (55)], led us to limit ourselves to a reduced number of items.An initial 12-item instrument was generated to measure the two constructs with 6 items for each. Next, the tool was subjected to a review by two experts in physical activity behavior and two university professors specializing in Arabic and English. The thorough review by the panel of experts recommended the elimination of two items that could present ambiguities in the responses (their link with the time factor). The two items "I consider that doing physical activity is a waste of time" and "I consider that the moment of doing physical activity is essential" were eliminated.

The final version led to the generation of 10 items that were retained to measure two orthogonal constructs.

The two factors Positive and Negative perceptions of physical inactivity were then measured with five-items for each of them. A five-point Lickert scale was favored for collecting responses as follows: strongly disagree (1 point), disagree (2 points), neutral (3 points) agree (4 points), totally agree (5 points).

Physical Activity Level

The level of physical activity was assessed by the official Arabic abbreviated version of the IPAQ (56).

This measure of physical activity has established good psychometric properties in several populations (57–59).

The seven-item IPAQ-C records self-reported physical activity over the past seven days. Responses were converted into minutes of metabolic equivalent tasks per week (MET-min/week) according to the IPAQ scoring protocol: the total number of minutes in the last seven days spent in vigorous activity, moderate-intensity activity, and walking was multiplied by 8.0, 4.0, and 3.3, respectively, to create MET scores for each activity level. MET scores in the three sub-components were added to indicate overall physical activity. Levels of physical activity were also categorized into three categories: small, moderate, and high, according to the scoring system provided by the IPAQ. In this research, we consider this classification of three categories to make a judgment on practicing physical activity.

COVID-19 Fear Scale

An adapted Arabic version of the COVID-19 scale was applied to illustrate the fear of COVID-19 (60). Reliability and validity were inspected through 693 Saudi participants and confirmed the unique construct of the tool. The internal Arabic consistency was satisfactory ($\alpha = 0.88$), with a healthy concomitant validity indicated by significant and positive correlations with the HADS anxiety scale ($r = 0.66$).

The initial scale was examined with 717 Iranian participants. After evaluation, using both the classic test theory and the Rasch model, the properties of the scale were satisfactory: internal consistency ($\alpha = 0.82$) and test-retest reliability (ICC = 0.72) were acceptable.

Good psychometric properties similar to the original instrument have been proven in a Turkish version, an Italian adaptation, and a model built in Bangladesh.

The Turkish version reveals its robustness of measurement and the one-dimensional nature of the tool in 1,304 participants, aged 18 to 64, in 75 cities across confirmatory factor analysis, Item Response Theory, convergent validity, and internal consistency (Cronbach's α, McDonald's ω, Guttmann's λ6, and composite reliability). Likewise, Cronbach's alpha of the Italian version was 0.871 and displayed high-quality reliability. The results of the confirmatory factor analysis of the Bangladeshi version confirmed the unidimensional factor structure of the scale and very good internal reliability.

Perceived Stress Scale

To assess perceived stress, the version of 10 items in Arabic validated by Almadi et al. (61) was used. The instrument is adapted from the initial scale of Cohen et al. (62), which is the most widely used scale in the world to assess perceived stress as two first-order components, assessed on a Lickert scale of 5 points.

The psychometric properties of the initial scale and the different adaptations have confirmed their measurement robustness in several studies for different populations (63–65).

Data Collection

Data were collected with a total of 481 subjects aged between 16 and 67 years old with a mean age (M = 32.48, SD = 9.46), over a three month period (March, April, May 2020) in two ways: (1) on work sites, shops, and administrations in several Tunisian cities ($n = 257$, 53.4%) and (2) by a questionnaire sent by email to several contacts ($n = 224$, 46.6%).

Study participants consist of males ($n = 249$, 51.8%) and females ($n = 232$, 48.2%). The distribution of the study level was (34.7%) subjects who had a basic study level (<10 years; $n = 167$),

34.5% who had completed their secondary school studies (n = 166), and 30.8% who had a higher level (n = 148). No significant difference in the χ^2 test was demonstrated according to the three variables: age (p = 0.44), method of administration (p = 0.13) and level of study (p = 0.49).

Statistical Analysis

Preliminary data analysis was performed to examine the quality of the data collected and to inspect if there are any anomalies or missing boxes. Missing data were excluded from the analysis. Subsequently, tests for univariate (Skewness and Kurtosis) and multivariate normality by the Mardia coefficient, were performed. Also, descriptive statistics for each variable were done.

Exploratory factor analysis was performed by the Unweighted Least Squares method with Direct-Oblimin rotation and Kaiser Normalization.

The reliability of the instrument was examined simultaneously by Cronbach's α coefficient, McDonald's ω coefficient, and the composite reliability coefficient CR calculated from the Factor Loading set and the error variances.

The questionnaire structure of the entire population was carried out by confirmatory factor analysis (CFA). Several indices of the CFA were retained to examine the model: (1) the χ2; (2) χ^2/DF, (3) the comparative fit index (CFI); (4) Tucker-Lewis index (TLI); and (5) the Root Mean Square Error of Approximation (RMSEA).

The recommendations of Hu and Bentler (66) suggested values >0.95 for CFI and TLI and RMSEA values of<0.08 for reasonable fits. The equivalence of the two-factor and 10-item model across the three variables gender, study level, and the method of administration was achieved through confirmatory multi-group factor analysis for four models of invariance tested successively.

The first invariance tested is the Configural Invariance. This step is designed to test whether the indicators have the same free and fixed load pattern across groups.

Once the Configural invariance is confirmed, the increasing comparisons from one model to the next, by imposing a more restrictive level of invariance between the samples of nested model configuration, are tested according to a complexity hierarchy with constraints.

The second step, called the metric invariance test, is to ensure that the different groups answer the questions similarly or equivalently. The technical examination of metric invariance consists of showing that factor loadings are similar to the factors of the measurement scale in the groups.If the metric invariance is assured, the next step is to evaluate the scale invariance. Scalar invariance means that the item interceptions are equivalent between the groups, which means that the group differences in the item mean should give differences in the means of the factors constructed by these indicators. In other words, this implies that subjects with the same value in a factor should have equal values of the indicators.

The last step is to test the residual invariance or the similarity of errors across groups. Residual invariance means that the sum of the specific variance (variance of the item that is not shared with the factor) and the measurement error variance is similar for the different groups.

The Chi-square difference between models was performed to test for invariance in structural equation models. Also, the difference in CFI which must be <0.01 was retained as a criterion to establish the factorial invariance.

Concurrent validity was tested by examining the association between the two instrument factors and the three scales: the IPAQ scale, the COVID-19 Fear scale, and the Perceived Stress Scale *via* a Pearson correlation.

Statistical analyzes were performed using IBM SPSS Software version 26.0 for Windows. While the examination of the different factor structures was carried out by IBM SPSS Amos Software for Windows version 23 (See **Table 1**) .

We retained the significance levels for a value of $p < 0.05$ for all statistical analysis.

Ethics Statement

This work has received approval from the ethics committee of the "Research Unit, Sportive Performance, and Physical Rehabilitation, High Institute of Sports and Physical Education, Kef, University of Jendouba, Jendouba, Tunisia" and received ethical clearance from the UNESCO Chair "Health Anthropology Biosphere and Healing Systems," "University of Genoa, Genoa (Italy)," the "Higher Institute of Sport and Physical Education of Kef, Kef (Tunisia)," and the "Higher Institute of Sport and Physical Education of Sfax, Sfax (Tunisia)." The proposal has been also approved by the "Jendouba University" Ethics Committee and was undertaken following the legal standards of the Helsinki declaration in 1964 and its corresponding amendments.

RESULTS

The statistical analysis began by calculating descriptive statistics (means and standard deviations) and inspecting the distributions of the 10 items of the questionnaire. The normality of each item was considered through the examination of Kurtosis and Skewness.

The results of the exploratory factor analysis by the Unweighted Least Squares method using a Direct-Oblimin rotation with Kaiser Normalization resulted in the extraction of two factors that explain 72.17% of the total variance.

The 10 items were subjected to exploratory factor analysis using the Unweighted Least Squares method. The adequacy of the sampling is supported by the index KMO = 0.92 (Kaiser-Meyer-Olkin which measures the quality of the sampling and the quality of the correlation matrices by the significant Bartlett test (x^2 = 607,132, p <0.001).

Internal Consistency

Instrument reliability was examined by both Cronbach's α coefficient, McDonald's ω coefficient, and the composite reliability coefficient CR calculated from a Factor Loading set and the error variable (derived from the initial model output of AMOS Software for the whole population).

Table 2 denotes the reliability coefficients for the two instrument factors.

To test the factorial invariance of the designed tool, several successive models were tested. The specification of the links, variances, and covariances of these models gradually becomes more severe until the complete invariance of the model is demonstrated (67, 68).

The results of the configuration invariance by gender indicated that the model fit was adequate, χ^2 (66) = 137.28; p <0.001; CFI = 0.9842; TLI = 0.975; and RMSEA = 0.047. These values demonstrate that women and men conceptualize the two perception constructs of physical activity similarly (See **Table 3**).

For the metric invariance tests, a non-significant statistical difference χ^2 was demonstrated [$\Delta\chi^2$ (8) = 9.10; p = 0.334]. As a result, participants from different groups respond to items in the same way, that is, the strengths of the relationships between specific scale items and their constructed factors are the same from group to group.

The scalar invariance provided a non-significant statistical difference χ^2 [$\Delta\chi^2$ (12) = 9.37; p = 0.670]. As such, the results indicated that the equal interception constraints kept the solution fit. Assuming the equivalence of the item intersections, we were able to compare the latent means. This implies that the factor loads and their means are equivalent to women and men (See **Table 3**).

To test for strict factor invariance, equal constraints were imposed on the factor loads, the intersections, residuals, variances, and covariances. The results for Strict invariance across the three variables, the gender, the level of study, and the methods of administration showed non-significant Δdf with ΔCFI that are <0.01. This demonstrates the strict invariance of the tool for the different groups.

For the strict factorial invariance, a statistical difference χ^2 [$\Delta\chi^2$ (12) = 20.22; p = 0.063] and a ΔCFI = −0.002 were highlighted. This result indicates that our model is gender invariant (See **Table 3**).

The tests of configural invariance according to the study level and the method of administration of the questionnaire proved the robustness of the factorial structure through the two models M5 and M9 respectively. Indeed, the results of the configural invariance for the M5 model presented a value of X^2 (99) = 174.89, CFI = 0.981, TLI = 0.973 and RMSEA = 0.040. While for the M9 model, the value of X^2 (99) = 174.89, CFI = 0.983, TLI = 0.977 and RMSEA = 0.046, which shows good adjustment indices (See **Table 3**).

The metric invariance for the level of education and the method of administration of the questionnaire proved through the comparisons M6-M5 and M10-M9 respectively. The comparisons yielded ΔX^2 = 18.05 (Δdf = 20; p = 0.584) and ΔCFI = 0.000 for the variance according to the level of education. While for the method of administration of the questionnaire, the comparisons generated ΔX^2 = 2.38 (Δdf = 8; p = 0.967) and ΔCFI = 0.002 (See **Table 3**).

The scalar invariance for the level of education and the method of administration of the questionnaire proved through the comparisons M7-M6 and M11-M10 respectively. The comparisons yielded ΔX^2 = 27.58 (Δdf = 20; p = 0.12) and ΔCFI = −0.002 for the scalar variance according to the level of education. While the comparison M11-M10 generated ΔX^2 = 6.38 (Δdf = 12; p = 0.90) and ΔCFI = 0.001 (See **Table 3**).

Strict invariance across study level (M8-M7) and according to the administration of the questionnaire method (M12-M11)

TABLE 1 | Mean (M), SD, confidence interval 95%, skewness (S), kurtosis (K), and factor loadings (λ) by item.

Items	Mean	SD	Skewness	Kurtosis	Lamda
Item1	2.88	1.36	0.09	−1.14	0.903
Item3	2.98	1.39	0.01	−1.26	0.829
Item5	3.02	1.39	−0.02	−1.24	0.797
Item7	2.99	1.41	0.03	−1.28	0.853
Item9	2.99	1.36	−0.02	−1.21	0.896
Item2	2.65	1.24	0.24	−0.97	0.831
Item4	2.63	1.25	0.28	−0.98	0.845
Item6	2.63	1.24	0.28	−0.89	0.847
Item8	2.60	1.28	0.37	−0.92	0.831
Item10	2.62	1.28	0.24	−1.01	0.842

TABLE 2 | Reliabilities of the PIPES-10.

English items	Factors	McDonald's ω	Cronbach's α	Composite reliability
1. The lack of physical and sports activities is understandable to me.	PIPES1	0.933	0.933	0.887
2. Reducing or discontinuing my physical and athletic activity is worrying to me.				
3. Not being physically active or exercising is something I do not easily accept.				
4. The lack of physical and sports activities has several negative repercussions.				
5. I consider the decision not to engage in physical and sports activities to be completely unsatisfactory.				
6. I canceled many of my physical moves and activities with complete conviction		0.906	0.905	0.881
7. Physical and sporting activities should be discontinued.				
8. I find that reducing physical and athletic activity is necessary.				
9. I am fully convinced that I should not be physically or physically active.				
10. Not doing sports and physical activities has a negative repercussion.				

TABLE 3 | Factorial invariance comparison.

Invariance	X^2(df)	df	CFI	TLI	RMSEA	Δ	ΔX^2	Δdf	p	ΔCFI
M.0	91.3	33	0.985	0.980	0.061					
Gender										
Configural (M1)	137.28	66	0.982	0.975	0.047					
Metric (M2)	146.38	74	0.983	0.979	0.043	M2-M1	9.10	8	0.334	0.001
Scalar (M3)	155.75	86	0.982	0.981	0.045	M3-M2	9.37	12	0.670	−0.001
Strict (M4)	175.97	98	0.980	0.982	0.041	M4-M3	20.22	12	0.063	−0.002
Study Level										
Configural (M5)	174.89	99	0.981	0.973	0.040					
Metric (M6)	192.94	119	0.981	0.978	0.036	M6-M5	18.05	20	0.584	0.000
Scalar (M7)	220.52	139	0.979	0.980	0.035	M7-M6	27.58	20	0.120	−0.002
Strict (M8)	234.71	163	0.982	0.985	0.031	M8-M7	14.19	24	0.942	0.003
Administration of the Questionnaire										
Configural (M9)	131.47	66	0.983	0.977	0.046					
Metric (M10)	133.85	74	0.985	0.981	0.041	M10-M9	2.38	8	0.967	0.002
Scalar (M11)	140.23	86	0.986	0.985	0.036	M11-M10	6.38	12	0.90	0.001
Strict (M12)	154.54	98	0.985	0.987	0.035	M12-M11	14.31	12	0.281	−0.001

All values of X^2 were significant at $p < 0.001$.

TABLE 4 | Pearson's correlation between the two dimensions of PIPES, the IPAQ, the CF-19 fear, and the PSS-10.

	IPAQ	PIPES1	PIPES2	CF-19	Stress1	Stress2
IPAQ	–					
PIPES1	0.328**	–				
PIPES2	−0.380**	−0.579**	–			
CF-19	−0.223**	−0.378**	0.331**	–		
Distress	−0.209**	−0.219**	0.226**	0.600**	—	
Coping	0.119**	0.008	−0.012	0.059	0.063	–

***P < 0.01.*

demonstrated a value of $\Delta X^2 = 14.19$ ($\Delta df = 24$ at $p = 0.942$) and $\Delta CFI = -0.002$ for the first invariance and $\Delta X^2 = 14.31$ ($\Delta df = 12$ at $p = 0.281$) and $\Delta CFI = -0.001$ for the second invariance (See **Table 3**).

As a conclusion, the factorial invariance of the measuring instrument was confirmed across the gender, the study level, and also the method of administration of the questionnaire.

Table 4 shows the results of correlations between the two dimensions of the PIPES scale with the measures of the IPAQ scale, the COVID-19 fear scale, and the two dimensions of the PSS10 scale.

A positive association between PIPES1 with IPAQ was demonstrated by a value of r = 0.328. While a negative correlation was found between the PIPES2 scale and the IPAQ scale. The IPAQ was able to explain 38% of the variance in the internal factor and 32.8% of the variance in the environmental factor of the PIPES.

Likewise, the results demonstrated a significant negative correlation between fear of COVID-19 and the PIPES1 scale ($r = -0.378$) and a moderate correlation with distress ($r = -0.219$). However, no link has been demonstrated between PIPES1 and the PSS-10 coping subscale.

For the link of PIPES2 with fear of COVID-19 and stress, the results showed a moderate positive correlation, on the one hand between PIPES2 and CF-19 ($r = 0.331$) and on the other hand between PIPES2 and general distress ($r = 0.226$).

DISCUSSION

The purpose of the present study was to develop and examine the psychometric properties of an instrument originally developed to measure perceived physical activity.

The reliability of the instrument examined in three ways showed that the two factors selected were consistent.

The results of the exploratory and confirmatory factor analysis and the factor invariance tests showed the robustness of the structure. The examination of configurational, metric, scalar and strict invariance confirmed the equivalence of the structure according to gender, level of education and mode of administration of the questionnaire.

Concurrent validity was tested by examining the association between the two factors of the instrument with the three scales: the IPAQ, COVID-19 fear, and perceived stress measured in two components.

The results showed that a negative perception of physical inactivity was positively associated with the IPAQ scale, and negatively associated with COVID-19 fear scores and perceived stress measured by Cohen's scale. Whereas positive perception of environment-related physical inactivity in COVID-19 was negatively associated with the IPAQ and positively associated with fear of COVID-19 and perceived stress. However, no association was found between coping strategies and the two components of the PIPES-10 scale.

To explain physical activity/physical inactivity, the two main models that have been put forward are the personality trait-based model and the ecological model.

The first model focuses on personality and will explain physical activity/inactivity by specific personality traits. For example, another study by Hoyt et al. (69) attempted to explain physical activity adherence through personality trait theory. They suggested that the traits of extraversion and activity awareness were associated with exercise behavior.

From the same perspective, Sutin et al. (70) studied the relationships between personality traits and physical inactivity in both sexes in several age groups. The results of their study concluded that lower neuroticism and elevated consciousness were linked to more physical activity and less physical inactivity. Furthermore, extraversion and openness were also associated with more physical activity and less inactivity.

Individuals who are rich in neuroticism (the tendency to feel negative emotions and stress) tend to avoid physical activity, while individuals who are rich in extroversion (the tendency to feel positive emotions and be outgoing) and conscience (the tendency to be organized and disciplined) tend to be more physically active (71). Openness to traits (the tendency to be open-minded and creative) has recently been associated with greater physical activity (72).

The second model addresses this issue in a system that integrates external factors to the individual, such as the environment, culture, politics, and society. Indeed, several studies have been able to establish the evidence of a great impact of the environment on personal choices in several contexts, such as participation in physical activity. Another parameter that favors the ecological approach is that it is possible to act on internal and external factors for the promotion of physical activity (73) while the personality traits are unchangeable in nature.

Several studies have supported the relationship between environmental characteristics and physical exercise. The results highlighted the relationship between physical practice such as infrastructure, adequate pedestrian walks, easy access to stores and services, access to recreational parks and public open spaces, and pedestrian accessible infrastructure, greenery and aesthetic landscapes, low crime rate, and sense of personal safety. Similarly, Liu et al. (74) linked access to physical activity infrastructure at work and home time spent on physical activity.

The ecological model attempts to explain participation in physical activity through the combination of internal individual factors such as beliefs, attitudes, and behavior (intra-individual) and individual factors such as environment, society, and culture (extra-individual) at the same time.

Moreover, on the one hand, there is a gap between perception and adherence to physical activity.

Much more, the perception of health itself can influence the perception of physical activity. As an example, in an exploratory work by Martinez-Harvell et al. (75) which aimed to identify predictors of adherence to physical activity in patients, the results showed that subjects with poor health, daily smoking, obesity, or kidney disease did not follow recommendations for physical activity.

On the other hand, in another study, Tuakli-WosorRowan and Gittelsohn (76) explored the links between perceptions of physical activity and physical activity behaviors with health factors among Ghanaian women using both qualitative and quantitative analysis. They concluded that physical activity barriers were associated with the time load that leaves no time for activity, family, and work obligations, as well as the absence of sports facilities. While the correct perception was related to weight loss, health issues and the top motivational factors for physical activity were "weight loss," and "increased energy."

However, specific interventions can affect the perception of physical activity. In this context, West et al. (77) explored the effects of a focus group session on behavior change in physical activity across subjects with a high risk for diabetes. They showed that the chat session helped improve the maintenance of physical activity.

During the COVID-19 pandemic, physically inactive people were considered by several authors to be at higher risk and the impact of the disease would be more severe.

Therefore, several global scientific recommendations have emphasized the major importance of maintaining optimal physical activity despite the security measures of quarantine and social distancing. In this regard, Hall et al. (38) classified physical inactivity and sedentary lifestyle as a persistent pandemic and aggravated by the containment measures taken during the COVID-19 pandemic period. Other researchers such as (78) even proposed physical activity as both a physical and mental therapeutic tool to withstand the negative consequences of quarantine during the pandemic.

Similarly, Jakobsson et al. (79) recommended that individuals maintain regular physical activity during self-isolation to prevent future chronic health problems due to sedentary behavior. They emphasized maintaining a minimum threshold of 150 min of moderate-intensity physical activity or 75 min of vigorous physical activity per week, as recommended by the World Health Organization as a health support solution (80).

This study makes some recommendations regarding physical activity practice.

Conclusion and Recommendations

The present study developed an instrument to measure the perception of physical activity through two factors that have proven to be robust. The developed scale can be used as a tool for the perception of physical inactivity.

Examination of associations between PIPES scores with different background variables should be considered in future research. For example, the ease of access to physical activity and sports facilities, the safety of these structures in residential and professional areas can be linked to the perception of physical activity.

Also, future research must establish the links between daily time management and the time devoted to physical activity on the one hand, and the perception of PIPES physical activity and inactivity. Difficulty in time management, especially for people who have a job that requires a lot of time, can lead to a negative attitude toward physical activity.

Further person-centered studies could be conducted to categorize populations according to their perceptions of physical

activity. this can lead to effective awareness campaigns that target vulnerable and at-risk people.

In future research, it is interesting to build measurement scales centered on both the perception of physical activity and the environment. Such an ecological approach can make it possible for us to measure the perception of physical activity that takes into account cultural and social specificities. This will facilitate the intervention for the promotion of physical activity.

Limits of the Study

The first limitation concerns the study of the temporal stability of the two factors of the instrument, which could not be implemented in the present study.

Similarly, factorial invariance across different ages was not investigated, and it is very important to do so, especially for the elderly.

Although this study offers very interesting avenues for measuring perceived physical activity from an ecological perspective that takes into account the COVID-19 pandemic situation, it would be appropriate to expand the population and examine the psychometric properties of the instrument and its factorial invariance in other populations as well as to test for cultural differences.

It is important to note that examining the tool in specific populations such as those with chronic illnesses may contribute to the sensitivity of the instrument.

Finally, another limitation is the need to implement a review that addresses the relationship between perceived physical inactivity and environmental factors such as culture, policy and infrastructure specific to physical activity, and life safety.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

This work has received approval from the Ethics Committee of the Research Unit, Sportive Performance, and Physical Rehabilitation, High Institute of Sports and Physical Education, Kef, University of Jendouba, Jendouba, Tunisia and received ethical clearance from the UNESCO Chair Health Anthropology Biosphere and Healing Systems, University of Genoa, Genoa (Italy), the Higher Institute of Sport and Physical Education of Kef, Kef (Tunisia), and the Higher Institute of Sport and Physical Education of Sfax, Sfax (Tunisia). The proposal has been also approved by the Jendouba University Ethics Committee and was undertaken following the legal standards of the Helsinki declaration in 1964 and its corresponding amendments. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

NG and NB conceived the experiment. NG, NC, and NB collected and analyzed data. NG, NC, AT, LP, FA, and NB drafted and critically revised the paper. All authors contributed to the article and approved the submitted version.

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The Associations Between Parental Burnout and Mental Health Symptoms Among Chinese Parents With Young Children During the COVID-19 Pandemic

Minglong Chen[1†], Yashuang Bai[1†], Mingqi Fu[2], Ning Huang[1], Farooq Ahmed[3], Muhammad Shahid[4], Xiaohua Wang[5], Chengbin Liu[6], Xing Lin Feng[1] and Jing Guo[1*]*

[1] Department of Health Policy and Management, School of Public Health, Peking University, Beijing, China, [2] Center for Social Security Studies, Wuhan University, Wuhan, China, [3] Department of Anthropology, Quaid-I-Azam University Islamabad, Islamabad, Pakistan, [4] School of Insurance and Economics, University of International Business and Economics, Beijing, China, [5] School of Social Development and Public Policy, Beijing Normal University, Beijing, China, [6] School of Sociology, Huazhong University of Science and Technology, Wuhan, China

The Coronavirus Disease 2019 (COVID-19) pandemic has caused numerous unexpected changes for families and societies, which have likely contributed to higher amounts of stress for most parents. This study aimed to examine the relationship between burnout and mental health among parents during the COVID-19. Pandemic exposure and household factors (e.g., family structure, family function) were examined as moderators. An online cross-sectional survey recruiting 1,209 adults was conducted from April 21st to April 28th, 2020 during the COVID-19 lockdown in China. The multivariable linear regression analysis was employed to test the association between burnout, household factors, and mental health among parents. Findings suggested that for parents with a young child, poorer mental health was related to a higher level of burnout ($\beta = 0.220$, $P < 0.001$) and greater exposure to the pandemic. Mothers of a single and/or young child had considerably poorer mental health. Moreover, the relationship between mental health and burnout among parents was significantly moderated by epidemic exposure ($\beta = 2.561$, $P < 0.001$), family structure (number of children: $\beta = -1.257$, $P < 0.001$; first child age: β =-1.116, $P < 0.001$) and family function ($\beta = -0.574$, $P < 0.05$). This study indicated that burnout symptoms were significantly associated with worse mental health among parents in China. Besides, exposure to the pandemic, family structure, and family function was found to moderate the association between burnout and mental health among parents. Therefore, the present study stressed enhanced access to mental health resources and emotional supports for parents during a public crisis to reduce the deleterious effects of burnout.

Keywords: parental burnout, mental health symptoms, family structure, family function, Chinese parents, COVID-19

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Michele Giannotti, University of Trento, Italy

***Correspondence:**
Jing Guo
jing624218@163.com
Xing Lin Feng
fxl@bjmu.edu.cn

†These authors have contributed equally to this work and share first authorship

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INTRODUCTION

The coronavirus disease 2019 (COVID-19) outbreak spread rapidly throughout the country and quickly attracted global attention (1). To contain the infection spread, the Chinese government has issued nationwide emergency policies, with strict quarantine measures, including shutting down schools and non-essential businesses, and home quarantine. Those strict containment measures, severe economic loss, and great concerns regarding the virus infection all disrupted families' daily routines and stimulated overwhelmed pressures among families and society. A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic found that almost 35% of the respondents experienced psychological distress (2). In particular, during a prevalent pandemic lockdown, parents may experience extra pressures from family unemployment, income deduction, or the inability to work from home (3), as well as from home-schooling and parental communications (4).

Pressures from work and family are associated with an increased risk of parental burnout and push parents to be more vulnerable to mental health disorders during the pandemic (5). It should be noted that parental burnout differs from daily parenting stress because it is a prolonged response to chronic and overwhelming parental stress, with high risks and limited resources, and possibly followed by parental neglect and violent behaviors (5, 6). Existing studies pointed out that chronic stresses would deplete individuals' resources and lead to burnout symptoms if they last too long (7). Though gained little attention until recent years (8, 9), burnout was found to have significant impacts on mental wellbeing among parents (10, 11). An existing study has revealed that burnout was associated with higher levels of depressive symptoms, sleep disorders, as well as addictive behaviors among parents (12). In particular, unemployment, low levels of social support, and financial insecurity during the COVID-19 pandemic were found to place parents at a greater risk of burnout (13). For example, results from a survey conducted in Italy showed that the prevalence of parenting-related exhaustion (the main symptom of parental burnout) during the COVID-19 lockdown was as high as 17%, and greater parenting-related exhaustion was predicted by lower parental resilience, motherhood, having a child with special needs, and having younger children (14). Quasi-longitudinal research also revealed a higher parental burnout level during the pandemic lockdown than before including emotional distancing, exhaustion, and contrast (15). However, little was known about the relationship between burnout and mental health among Chinese parents during the COVID-19 pandemic. Moreover, these associations might vary between genders. According to the gender role theory (16), mother's mental health is more vulnerable to parenting issues than that of fathers, as they took more responsibilities in taking care of children. Simultaneously, mothers spent more time on primary childcare than fathers, and this gender inequality in the distribution of parental responsibilities and associated strains were linked to greater distress among mothers than fathers (17, 18). Indeed, mothers are more likely to regard the caregiving role as part of their social identity than fathers do and tend to ignore their own needs to meet society's expectations, therefore, are at an increased risk of becoming overwhelmed (19). As showed in recent research on the psychological wellbeing of parents, mothers had higher parental burnout and lower psychological wellbeing than the fathers during the prevalence of COVID-19 in Iran (20). Thus, burnout among mothers is likely to associate with higher mental health risks as compared to male caregivers.

Besides exploring the relationship between burnout and mental health among parents, this study further hypothesizes that several factors may work as moderators in this relationship. This first goes to the COVID-19 exposure. As noted by a cumulative risk model (21), the impact of burnout on mental health may be larger while the individuals are exposed to greater threats like the perceived impact of the pandemic. Meanwhile, the second one goes to family structure and functional factors (22). Regarding family structure, parents with more than two kids undoubtedly have to pay more time and energy to meet the extra parenting demands. A recent study in China indicated that mothers from two-kids families had higher parenting stress than their one-child counterparts (23), while Krieg (24) found that mothers in both one-child and two-child families reported equivalent levels of stress. Besides, age interval between siblings also accounts. One previous study proposed that mothers experienced greater stress during their kids' early childhood and their parenting stress would decrease as the kids became older (25). In addition, recent research found an increasing level of emotional symptoms such as frustration and sadness among mothers with pre-school children (from 2 to 5 years) during the pandemic (26). Another study conducted among Italian parents showed that parents of younger children experienced a higher level of parental stress as these children require continuative supervision and greater parental involvement (27). Thus, extra pressures in parenting more and younger kids may underdress parent's vulnerability in coping with burnout symptoms, and put them at higher risks of mental health disorders. Thirdly, the family functional factor might be a third moderator in the relationship between parental burnout and mental health. Impaired family functioning could contribute to decreased resources for the parental job (11), making parents more vulnerable to the consequence of burnout which occurs when resources are limited (6), thus leading to deteriorating mental health.

To date, emerging studies have investigated the effects of the COVID-19 crisis on parenting stress and the mental health of parents in China (28, 29). However, to our knowledge, no investigation has explored parental burnout, which differs from daily parental stress, and its relationship with psychological wellbeing among Chinese parents under this special background. In the present study, we administered a web-based survey of Chinese parents promptly to examine the relationship between burnout and parent mental health during the COVID-19 outbreak. Furthermore, prior research on burnout among parents have mainly focused on the risk factors analysis (10). For example, parents are at increased risk of burnout when they have prior psychiatric disorders, have lower emotional capabilities (30), have part-time work or off-work (10, 30), and lack social support (11). One existing study explored the consequence of burnout and found higher levels of escape, suicidal ideation, and other negative psychopathologies among parents with substantial

burnout (5). This study tries to extend the post-burnout studies into traumatic context, and give a new perspective to evaluate the mental health burden of the COVID-19 pandemic on families and society.

Aims and Hypothesis

The main objective of this study is to examine the relationship between burnout and mental health among parents in China. Then, we aim to explore the differences of this association between different genders. Finally, we want to further test if this association is moderated by pandemic exposure, family structure, and functional factor. On basis of the above-mentioned literature, three hypotheses were proposed. The first hypothesis is that parents with a higher level of burnout might be at greater mental health symptoms than their lower-leveled counterparts. The second hypothesis suggests that burnout among mothers is likely to associate with higher mental health risks, compared to fathers. Lastly, we assume that parents with higher traumatic exposure, having more and younger kids, and living with unhealthy family functions have higher levels of mental health disorders once they experienced levels of burnout.

METHODS

Study Design and Participants

Data in this study were drawn from an online survey in April 2020, in China. During this time frame, governmental pandemic measures included: working remotely, keeping social distance, and closing schools and daycare centers. The questionnaires were distributed and retrieved through a web-based platform (https://www.wjx.cn/app/survey.aspx). A two-stage cluster sampling method was used to choose participants. In the first stage, three primary schools in Henan, Hubei, and Guangdong were selected. These schools were selected from the ordinary schools instead of special education schools, with the parents of children with special needs (e.g., developmental disabilities or physical illnesses) excluded. In the second stage, all students and their parents in selected schools contributed to a survey pool of this study. Headteachers helped to process the survey. Only parents with kid(s) aged 0 to 10 years were included in this study since they would experience a higher level of parenting stress due to the more parental assistance younger children often require. Participants were excluded if (1) they were unwilling to give informed consent; (2) The time to complete the questionnaire was <5 min; (3) We added quality control questions into the questionnaire. We excluded the questionnaires with obvious logical errors. According to a previous study, the incidence of various mental health problems among Chinese citizens during the epidemic was 20∼35% (1). A sample size of 400 participants was required to achieve sufficient power to detect moderately sized associations (power $= 0.80$, $r = 0.20$, $\alpha = 0.05$). The online survey required respondents to answer every question, so there was no missing data in our study. The final study sample consists of 1,286 participants. Participants received a small gift (e.g., 1–3 RMB) as a token of appreciation at the end of the session.

All participants joined the study voluntarily and gave written consent after being informed about the aim of the survey. This study was approved by the Ethics Committee of Peking University Medical Center and conducted in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

MEASURES

Dependent Variables

Mental health was accessed by the Brief Symptom Inventory 18 (BSI-18, omitting suicidality) measuring somatization (6 items), depression (5 items), and anxiety (6 items), and a subset of 10 questions of the posttraumatic stress disorder (PTSD) checklist for DSM-5. All the questions were rated as "1 = never," "2 = occasionally," "3 = sometimes," "4 = often," "5 = Very often." Since the four dimensions of mental health symptoms were highly correlated (ranging from 0.776 to 0.961), the total score of this scale was computed by averaging all 27 item scores. The higher the score, the poorer the mental health was. Confirmatory factor analysis supported this decision by indicating that one general psychopathology factor explained the correlational structure of the four latent psychopathology factors (RMSEA = 0.06; CFI = 0.974; SRMR = 0.043). The Cronbach's alpha of the scale in this study was 0.96.

Independent Variables

Burnout among parents is assessed by the Parental Burnout Assessment (31). This scale includes 23 items in four dimensions (exhaustion, contrast with previous parental self, feelings of being fed up, and emotional distancing). All the items referred to general parenting. Specifically, in the case of multiple children, the questions referred to all their offspring (e.g., "I feel completely run down by my role as a parent," "I don't think I'm the good father/mother that I used to be," and "I can't stand my role as father/mother anymore"). Response options for each question are based on a 7-point Likert scale ranging from "never" to "every day." Items were summed for a total score, with higher scores indicating a higher level of parental burnout. In this study, internal consistency for the total scale was 0.89, and for the four subscales were 0.91, 0.88, 0.84, and 0.63.

Exposure to COVID-19 was assessed with a question to describe if the subjects, family members, neighbors, or friend's exposure to COVID-19 pandemic, with "0" refers to "no," while "1" denotes "yes." Then, a total score was obtained by summing the scores of these items.

The family function was measured by the General Functioning 12-items (GF12) of The McMaster Family Assessment Device (FAD) (32), which has been validated as a single index measure to assess family functioning. The GF12 subscale is made up of 12 items, six items that reflect healthy family functioning and the other six items reflecting unhealthy functioning (33). Respondents could mark the level to which they agree with the statements with 1 to 4 points: 1 for completely disagree; 2 for disagree; 3 for agree; and 4 for completely agree. We calculated the score with inverse unhealthy item scores and the total score was the sum of these 12 items, with higher scores indicating fewer problems in a family's functioning. The internal consistency for this scale was 0.84.

Socio-Demographic and the Family Structure

Based on previous related studies (34, 35), this study took the following demographic and socioeconomic characteristics into consideration: gender (male/female), age, province (Hubei/Henan/Guangdong/Else), occupation (manager/professional staff/individual/else), education level (high school and below/ college/undergraduate/master and above), marital status (married/others), family annual income (<100,000¥/100,000∼200,000¥/>200,000¥), first child age, number of children (one/two/more than two).

Statistical Analysis

Data in this study were analyzed with the SPSS version 24.0. Descriptive statistics were calculated to describe the parental burnout, mental health of parents, exposure to COVID-19, family function, family structure (including the number of children and first child age), and other covariates. Means and standard deviations were used for continuous variables, and frequencies and percentages were computed for categorical variables. Main analyses included several multivariable linear regressions on mental health were conducted in three steps, with the same covariates used in each step: gender, age, province, occupation, family income level, and parental education level. In the first step, we examined the specific associations between parental burnout and mental health. Model 0 included every predictor separately to estimate its "raw" contribution to the mental health of parents. Model 1 put all the predictors into the model to determine the relationship between parental burnout and mental health. In the second step, the whole sample was divided into 2 groups by gender to examine gender differences in the effects of parental burnout on mental health. In the final step, interactions between parental burnout and the other three predictors (exposure to COVID-19, family structure, and family function) were examined in each model. Specifically, in Model 2 the interaction between parental burnout and COVID-19 exposure was included to examine its effect on parent mental health. Whereas, Model 3 included the interaction between parental burnout and number of children, Model 4 included the interaction between parental burnout and first child age, and Model 5 included the interaction between parental burnout and family function.

RESULTS

The socio-demographic characteristics of the study are presented in **Table 1**. Among the 1,286 participants, 74.2% of the surveyed parents were female. Nearly 22.4% were from Hubei, 14.6% from Henan, 42.0% from Guangzhou, and the remaining were from other provinces. In terms of the number of children, 46.2% of the parents had one child, 47.6% had two children, and 6.2% had three or more. Regarding the exposure to COVID-19, 18.2% reported that someone in their family, neighborhood, and friends had suffered from COVID-19. The average parental burnout score was 48.03 (SD = 21.60), and the mean overall family function score was 22.56 (SD = 5.42). The mean parental mental health score was 33.97 (SD = 11.44). More details are listed in **Table 1**.

TABLE 1 | Parental burnout, family exposure, socio-demographic characteristics, and its binary relationship with mental health score among Chinese parents (N = 1,286).

Variable	Frequency (*N*)	Percent (%)	B	Std.Err	β
Parent gender					
Male	332	25.8			
Female	954	74.2	0.544	0.729	0.021
Province					
Hubei	288	22.4	−0.583	0.765	−0.021
Henan	188	14.6	0.986	0.903	0.030
Guangdong	540	42.0	−2.694	0.642	−0.116***
Else	270	21.0			
Types of professionals					
Manager	207	16.1	0.880	0.868	0.028
Professionals & technical	466	36.2	1.614	0.662	0.068*
Individual	194	15.1	−2.692	0.888	−0.084**
Else	419	32.6			
Education level					
High school and below	371	28.8	−3.385	0.698	−0.134***
college	237	18.4	−0.838	0.823	−0.028
undergraduate	460	35.8	1.206	0.665	0.051
Master and above	218	17.0			
Marital status					
Living with a partner	1,217	94.6	−2.731	1.414	−0.054
Others	69	5.4			
Annual income					
<100,000¥	790	61.4	−0.947	0.655	−0.040
100,000∼200,000¥	266	20.7	1.203	0.787	0.043
>200,000¥	230	17.9			
COVID-19 exposure					
None	1,052	81.8			
Yes	234	18.2	7.005	0.804	0.236***
Number of children					
One	594	46.2	3.325	0.633	0.145***
Two	612	47.6	−2.611	0.635	−0.114***
More than two	80	6.2			
	Mean	**SD**			
Parental burnout scores	48.03	21.60	0.230	0.013	0.434***
Parent age	35.99	5.504	−0.158	0.062	−0.071*
First child age	6.791	2.368	−0.535	0.137	−0.110***
Family function (10–47)	22.599	1.041	−0.456	0.057	−0.216***
Mental health scores (27∼135)	33.97	11.44			

*B, coefficient; Std.Err, standard error; β, beta; SD, standard deviation; ***p < 0.001, **p < 0.01, *p < 0.05.*

Table 2 shows the results of the multivariable linear regression analysis for the relationship between parental burnout and mental health. In model 0, parental burnout, exposure to COVID-19, and family function were all significantly associated

TABLE 2 | Multivariable linear regression analysis for the relationship between parental burnout and mental health score among Chinese parents ($N = 1,286$).

Variable	Model 0			Model 1		
	B	Std.Err.	β	B	Std.Err.	β
Burnout	0.227	0.013	0.429***	0.220	0.015	0.414***
Exposure	6.143	0.830	0.207***	5.322	0.781	0.179***
Number of children (ref: > 2)						
One child	3.353	1.372	0.146*	3.202	1.246	0.138*
Two children	0.947	1.345	0.041	1.658	1.212	0.072
First child age	−0.303	0.146	−0.062*	−0.364	0.130	−0.075**
Family function	−0.484	0.057	−0.229***	−0.090	0.059	−0.043*

*B, coefficient; Std.Err, standard error; ß, beta; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; Control variables: Gender, age, province, occupation, marital status, family income level.*

TABLE 3 | Multivariable linear regression analysis for the relationship between parental burnout and mental health score among Chinese parents by gender.

Variable	Male			Female		
	B	Std.Err.	β	B	Std.Err.	β
Parental Burnout	0.192	0.032	0.329***	0.233	0.017	0.453***
COVID1-9 Exposure	7.823	1.639	0.246***	4.427	0.890	0.152***
Number of children (ref:>2)						
One child	3.269	3.134	0.130	3.288	1.347	0.147*
Two children	1.817	3.115	0.072	1.473	1.307	0.066
First child age	−0.470	0.280	−0.090	−0.364	0.147	−0.077*
Family function	−0.210	0.126	−0.090	−0.033	0.067	−0.016*

*B, coefficient; Std.Err, standard error; ß, beta; *$p < 0.05$, ***$p < 0.001$; Control variables: Gender, age, province, job, marital status, annual income.*

TABLE 4 | Multiple linear regressions for interaction effects of family exposure, demographic factors, and family function predicting parents' mental health.

	Model 2			Model 3			Model 4			Model 5		
	B	Std.Err.	β	B	Std.Err.	β	B	Std.Err.	β	B	Std.Err.	β
Parental Burnout	0.210	0.014	0.395***	0.219	0.015	0.411***	0.222	0.015	0.418***	0.207	0.016	0.389***
COVID-19 Exposure	4.938	0.748	0.166***	5.409	0.771	0.181***	5.297	0.772	0.178***	5.274	0.777	0.177***
Number of children	−1.695	0.488	−0.089***	−1.489	0.504	−0.078***	−1.554	0.505	−0.081***	−1.551	0.508	−0.081***
First child age	−0.369	0.124	−0.076***	−0.348	0.128	−0.072***	−0.342	0.128	−0.070***	−0.373	0.129	−0.077***
Family function	−0.082	0.057	−0.039	−0.095	0.058	−0.045	−0.094	0.059	−0.044	−0.109	0.060	−0.051
Parental Burnout*COVID-19 exposure	2.561	0.253	0.240***									
Parental Burnout*number of children				−1.257	0.267	−0.114***						
Parental Burnout*first child age							−1.116	0.276	−0.099***			
Parental Burnout*family function										−0.574	0.293	−0.053*

*B, coefficient; Std.Err, standard error; ß, beta; *$p < 0.05$, ***$p < 0.001$; Control variables: Gender, age, province, job, marital status, annual income.*

with mental health. In model 1, the family function became marginal significant to parents' mental health. Parents with younger children ($\beta = -0.075$, $P < 0.01$) have more mental health symptoms than their counterparts. Compared to parents with more children, parents with one child ($\beta = 0.138$, $P < 0.05$) have more mental health problems. Details can be found in **Table 2**.

Table 3 displays gender differences in the relationship between parental burnout and mental health. Parental burnout (Male: $\beta = 0.329$, $P < 0.001$; Female: $\beta = 0.453$, $P < 0.001$) and epidemic exposure (Male: $\beta = 0.246$, $P < 0.001$; Female: $\beta = 0.152$, $P < 0.001$) are significantly associated with mental health for both males and females.

Table 4 reveals the relationships between four interactions and mental health (model 2–5). Participants who reported greater exposure to the COVID-19 and higher parental burnout showed elevated levels of mental health symptoms, while those who experienced higher parental burnout and parenting younger showed less mental health symptoms. Parents with more children and

high family function would decrease the likelihood of developing mental health symptoms among parents with burnout symptoms.

DISCUSSION

This study examined the relationship between burnout and mental health among Chinese parents during the COVID-19 pandemic. In this relationship, we further tested the moderating role of exposure to the COVID-19, family structure, and family function. Our findings suggested that experiencing burnout, having greater exposure to the pandemic were related to worse mental health symptoms among parents. Mothers with one child or young children had worse mental health symptoms. Besides, the relationship between burnout and mental health among parents was significantly moderated by the level of epidemic exposure, the family structure, and the wellbeing of family function. Greater exposure to the pandemic enhanced the relationship between burnout and more mental health symptoms. On the contrary, parents with older-aged and/or more than one kid, and/or reported healthy family function are less likely to develop mental health symptoms despite burnout.

Firstly, burnout is significantly associated with mental health among parents, which is in line with previous studies (10, 36). These studies have indicated a high level of stress and low mental wellbeing among parents who experienced parental burnout caused by prolonged exhaustion from parenting tasks (6, 36). According to the transactional model of stress, a sense of burnout among parents might evolve into one specific chronic stress (37), while overburden pressure could lead to poor psychological adjustments and more mental health problems (38). Meanwhile, the Job Demand-Resources (JD-R) model (39) posits that job burnout occurs when job demands are high and job resources are limited. Alike, parental burnout develops when more parenting needs are not compensated by enough resources (40). Poor access to parental resources might cause frustration and disengagement among parents, and result in exhaustion and other mental health impairments potentially (6). Moreover, in Chinese society, families generally outsource care resorting to after-school training institutions and grandparents that can help with the education and caring of their children. However, during the lockdown, all these external supports were limited and parents had to run childcare tasks and newly acquired family issues themselves, which made them exhausted from parenting tasks and reduced their mental health (28). Taken together, burnout among parents could be either a factor of acute mental health disorders during the pandemic or a signal of long-term mental health problems after the trauma. We urge that more attention should be paid to burnout symptoms among parents in China.

Secondly, the correlations between parental burnout and mental health are significant in both father and mother groups. In agreement with previous studies (20, 41), we found that mothers were more vulnerable to mental distress than fathers owing to parenting issues, which reflects that female takes most of the home care responsibilities in China. In addition, these results are in line with other studies that highlight COVID-19 could bring additional gender burdens, with women experiencing increased vulnerability and low psychological wellbeing (42, 43). Thus, we propose that more services in mental health protection should be delivered to females in a household context.

Besides, this study reveals that having a younger and only one child was associated with an elevated level of mental health symptoms among mothers, yet healthier family function played an inverse connection. It is obvious that younger kids compared with their older counterparts need more intensive family care, and produce greater parenting stress among parents (25). However, it is counterintuitive that parents with only one child are with more mental health problems than those parenting more kids. Possibly, parents in China still hold a traditional belief that "more children indicate more happiness," thus a greater number of kids in their family are helping to shape a sense of happiness and resilience (44). In Guangdong province, in particular, the number of kids often indicates the level of life satisfaction under the local "Zongci" culture. Parents could obtain more emotional support from their children in multi-children family (45). When it comes to a family function, an existing study found that an unhealthy family function may lead to marital conflicts and eventually to depression among family members (46). A healthy family function, on the contrary, would work with a sense of life satisfaction and hopefulness, and serve to protect mental health (47).

Thirdly, this study suggests that the relationship between burnout and mental health was significantly moderated by epidemic exposure, family structure, and family function. Previous studies also showed a high level of traumatic exposure forced parents into a more frightened and fragile condition, which lowers their threshold of burdening the burnout sensation (14, 15). On the other hand, burnout, as a sense of exhaustion or a result of long-term stress, makes parents more vulnerable to the following negative life events and exacerbates their capabilities to cope with the potential negative affections. Meanwhile, family structure with more and older children reduced the risk of mental health problems among parents with burnout. A possible explanation is that children being older-aged and with a sibling(s) are more probable to care for others, and more likely to provide social support inversely to the parents once burnout emotions existed (25, 48). Thus, this study proposes that reducing the level of traumatic exposure and/or giving voice to a healthy family function might be the interesting starting point in mental health protection among parents in China.

LIMITATIONS AND STRENGTHS

Several limitations of this study should be acknowledged. First, apart from the covariates mentioned in this study, there are yet many other factors such as living arrangements that have not been controlled in this study. In addition, the measure of COVID-19 exposure is not detailed and important information (e.g., severity and duration of symptoms) are overlooked. Moreover, gender differences are addressed but

parents in the study were not couples and dyadic processes (co-parenting, coping, division of labor, the degree of caregiving involvement) are not addressed. Second, the parents of children with special needs (e.g., developmental disabilities or serious physical illnesses) were excluded in our study, whose mental health might be worse due to a higher level of parental burden. The samples including parents of children with developmental disabilities or physical illnesses are expected in future research to examine the child-related predictors on parents' mental health. Third, the sampling methods used in our study were not based on a random selection, which might constrain the generalizability of our findings. Finally, with the cross-sectional design of the current research, it is hard to ensure the direction of causal relationships among the major variables tested in the model, though the theoretical framework has provided full support for these hypotheses. Longitudinal data are expected in future research to help clarify the relationship patterns.

Despite these limitations, there are several implications for practitioners that can support the parents during the COVID-19 difficulties. First of all, urgent consideration should be given to how additional support can be provided to Chinese parents experiencing burnout during the COVID-19 pandemic context. Applicable and proactive interventions, and family education programs, for example, can be proposed. Meanwhile, given the direct and moderating effect of family function in mental health inflammation, community service to help to facilitate better family communications and increase life satisfaction should be encouraged. Last but not the least, it is vital to identify what advice and support could help parents most according to their different situations during the COVID-19 lockdown. In detail, for those women who have only one child or parenting younger children, more effective strategies to prevent burnout and more support of childcare may effectively reduce mother's parenting stress and therefore be beneficial to their mental health.

CONCLUSION

This study indicates that burnout symptoms are significantly associated with worse mental health among parents in China. It also finds out the relationships between parental burnout and mental health differs across gender. Females are more vulnerable to parenting-related pressures than their male counterparts. Besides, exposure to the pandemic, family structure, and family function is found to moderate the association between burnout and mental health among parents. This study urges that community services and target interventions with a healthy family structure and function might be beneficial to improve parent's mental health.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Peking University. The patients/participants provided their electronic informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JG designed the study. MC and YB drafted the manuscript and analyzed the data. MF, NH, FA, MS, XW, CL, and XLF were involved in revising the manuscript. All authors were involved in writing the manuscript and approve of its final version.

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Investigating Anxiety and Fear of COVID-19 as Predictors of Internet Addiction With the Mediating Role of Self-Compassion and Cognitive Emotion Regulation

Reihaneh Moniri†, Kimia Pahlevani Nezhad*† and Fahimeh Fathali Lavasani*

Deputy of Behavioral Sciences and Mental Health, Tehran Psychiatric Institute, Iran University of Medical Sciences, Tehran, Iran

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Daria Smirnova, Samara State Medical University, Russia

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Marianna Mazza, Agostino Gemelli University Polyclinic (IRCCS), Italy
Lucia Romo, Université Paris Nanterre, France

***Correspondence:**
Reihaneh Moniri
reihaneh1996@yahoo.com

†ORCID:
Reihaneh Moniri
orcid.org/0000-0002-2725-2174
Kimia Pahlevani Nezhad
Orcid.org/0000-0002-7039-0142

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Background: In addition to many deaths due to the Coronavirus pandemic, many psychological issues and problems are affecting people's health. Including the constant anxiety and fear of infecting themselves and their families, COVID-19 has led to excessive spending of time in cyberspace and the Internet.

Methods: In this study, the role of fear and anxiety of COVID-19 in predicting Internet addiction among 1,008 students was investigated. The mediating role of the two components of self-compassion and cognitive emotion regulation has also been measured. Data collection was done online due to the outbreak of the disease and a modeling method was used to analyze the data.

Results: The results shows that anxiety and fear of COVID-19 has a positive and significant relationship with both Internet addiction ($r = 0.32$) and maladaptive cognitive emotion regulation strategies ($r = 0.17$), and it has a negative relationship with self-compassion ($r = -0.25$).

Conclusions: The findings suggest that self-compassion can play a protective role against internet addiction at the time of COVID-19 pandemic while maladaptive strategies for emotion regulation can be risk factors for anxiety and fear of the virus.

Keywords: anxiety, COVID-19, internet addiction, self-compassion, cognitive emotion regulation

INTRODUCTION

In December 2019, a virus of unknown origin entangled the world called SARS-CoV-2, or more commonly referred to as the COVID-19 virus. The virus began to spread from China and the city of Wuhan, which spread widely around the world despite China's rapid quarantine efforts (1). According to the World Health Organization (WHO), the coronavirus pandemic has become a global concern and measures such as social distancing, regular hand washing, and in a case of infection, house quarantining for 7 to 14 days is necessary (2). Based on WHO, the number of confirmed cases worldwide is more than 373 million and the number of deaths is about 5.65 million

people as of January 2022, and is on an ascending path. In particular, Iran has reported about 6.34 million confirmed cases and more than 132 thousand deaths (3). The pandemic has effected almost every part of human life (4) such as: socializing, working, planning and even shopping. Also the social isolation which is one of the consequences of the pandemic, has not only changed the lifestyles of the people all over the world, such as the quantity of physical activities and sleep patterns, it has also influenced mental health and emotional responses of the people (5). Even it is studied that less physical activity, sleep problems related to the quarantine, and internet usage can be the risk factors for increased anxiety at the time of pandemic (6). Some psychological impacts of the disease have been investigated with the onset of the prevalence but the solutions in order to reduce the damage have been somehow neglected (7). Fear and anxiety caused by little knowledge about the virus (8), fear of disease and death (2), spreading false news (9), reduced social contacts (1), restrictions on the use of public transportations (10), economic problems (11) and excessive use of social media (12) are among the problems of this period of time. Dr. David Murphy (president of the British Psychological Society) introduced fear and anxiety as one of the basic variables that should be investigated during COVID-19 pandemic (13). Besides that, fear and anxiety as consequences of COVID-19 can lead to disorders such as depression and anxiety among adolescents (14).

An unavoidable requirement of the coronavirus pandemic is observing physical and social distancing. Physical distancing means staying 6 feet away from others while social distancing is home-staying and prohibition of outdoor activities, which has encouraged the use of virtual ways of communication. By returning people to the routine of social life, the importance of practicing physical distancing is being more emphasized. People who are infected by the coronavirus need to self-quarantine for at least 14 days and in this period of time they should stay at home, wash their hands regularly, not share items such as towels and utensils, and not having visitors. In severe cases, hospitalization and intensive care may be required. At the end of the illness, when subjects have no symptoms, with doctor's diagnosis, they can return to normal life. Quarantine has many psychological impacts such as PTSD, anxiety and irritability, insomnia, depression and anger. Also due to the fact that people spend most of their time at home, the risk of intimate partner violence (IPV) in multiple domains of abuse has increased (15–19), however its benefits typically outweigh these health issues when setting public policy. Another important impact of staying at home is increasing the usage of Internet both for telecommuting and browsing for information on outbreaks and other news related to the disease such as the mortality rate (20); which can also be a trigger to the fear of COVID-19 and obtaining incorrect information (9). Besides the concern of the COVID-19 pandemic, Internet, social media and games have become an integral part of individual's lives; which has added a disorder called Internet addiction into the list of problems and psychiatric disorders (21). Addiction is defined as a high dependency on something and the inability to control the consumption that can involve some kinds of substance, behavior and process (22) such as gambling, excessive sexual behavior, compulsive buying, Internet use, or stealing (23). According to the recent statistics, about 4.66 billion people are active internet users as of February 2021, where 3.96 billion people are also active social media users (24). As of April 2019, Iran ranks first in the Middle East with 62.7 million internet users (25) and according to the report of Internet World Stats, it is the 17th country with the greatest number of internet users worldwide.

Over the last decade, increasing population size and the frequency of internet use has become a concern of the possible negative consequences of overuse (26). This concern has increased during the time of the COVID-19 pandemic due to social contact restrictions and the reduction of non-virtual communications and outdoor activities (12). There are some psychological factors which can predict addiction to the internet; such as loneliness, self-esteem and life satisfaction (27), shyness and locus of control (28), depression (29), emotional regulation (30), and self-compassion (31).

The concept of self-compassion was created in response to criticisms of the concept of self-esteem as a component of psychological health. As self-esteem is based on the performance of others, kind of social judgment and comparison, self-efficacy, true self-esteem, self-respect, and self-compassion have been identified as components that provide a better explanation for mental health. Self-compassion is a concept that consists of three parts: (a) kindness toward oneself rather than self-blaming and being self-judgmental during times of difficulty, (b) having human commonalities instead of a sense of isolation and (c) mindfulness vs. over-identification or avoidance toward painful feelings. Being self-compassionate is being used for one who understands his/her condition in a non-evaluative manner and keeps being empathic instead of over criticizing. The person interprets the situation as an experience which may occur to everyone during their lifetime, acknowledging that suffering and he is not the only person in pain in the world. Furthermore, he can keep thoughts and emotions in balanced awareness instead of attaching to one and avoiding the others (32). The relationship between self-compassion and anxiety, depression and self-criticism are negatively significant, while the positive association between self-compassion and wellbeing, optimism and happiness are proven. There is a negative relationship between internet addiction and depression and lower self-esteem thus self-compassion can play a protective role against this psychopathology (33).

Another factor that can predict internet addiction is cognitive emotion regulation which is a general term that is defined as the human's ability to manage and modulate emotions in every difficult situation of life, consciously or unconsciously (34). According to Gross' model, emotion regulation includes 5 stages: (1) situation selection, (2) situation modification, (3) attention deployment, (4) cognitive change and (5) response modulation (34). Moreover, various studies have introduced different emotion regulation strategies that fall into two categories: adaptive and maladaptive. Maladaptive strategies include repression, avoidance, and mental rumination; which are associated with a variety of disorders such as anxiety and depression. Adaptive strategies include problem solving

(ability to change conditions that create undesirable emotions), acceptance (accepting emotions and feelings as they are) and reappraisal (positive interpretation of stressful situations as a way of anxiety reduction) (34, 35). Inability to use healthy strategies to moderate negative emotions may lead to many mental disorders such as affective and anxiety disorders; while adaptive ways of emotion regulation are linked to psychological and physical wellbeing (35). Additionally, some research shows that students with severe internet addiction have greater difficulties in emotion regulation (36) and it may be an important variable in understanding the relationship between mental health problems and improper use of social media (37). Other research suggests that activation of maladaptive coping strategies such as rumination, may increase the likelihood of using the Internet as a means of cognitive-emotional self-regulation. Thus, using the Internet may become a strategy for controlling unwanted negative emotions (38).

In general, the pandemic of COVID-19 has affected every part of our lives, on top our psychological health which can be influenced by some non-mental components and some interpersonal issues. Besides that, people are constantly worried about getting infected, whether themselves or their loved ones, so this fear and anxiety has become an integral part of their lives. People may cope with this pressure in different ways; some by exercising at home, some through learning new skills, and some people may spend most of their time in cyberspace, computer games, and more generally, on the Internet. In order to help with the current situation, this work intends to investigate the relationship between anxiety and fear caused by the COVID-19 disease, and Internet addiction with the mediating role of self-compassion and cognitive emotion regulation.

METHODS

Samples

The target sample in this research was students from different academic levels which were selected using the convenience sampling method. They were invited to participate in this research through popular social media pages and groups. Due to the prevalence of the coronavirus and the need to follow health protocols, online methods were used to collect data in this study. Questionnaires were sent to the target population, through programs such as WhatsApp, Telegram and Instagram. The survey was started in January 2020 and the data collection was done after 2 months. Inclusive criteria are students and those who have access to the internet in order to fill out a questionnaire online. If a questionnaire was not completely done, or only one option had been selected in all questions, the person was excluded from the sample. The questuionnaire was sent to more than 1,200 students and 1,008 of them filled the inclucive criterias. Participation or non-participation in the study was not beneficial or harmful for individuals and all of them answered the questionnaires based on personal satisfaction.

In this study, 12 samples for each subscale were collected. This number of samples required is based on the book of multivariate regression in behavioral research written by Kerlinger (39), which indicates the need for 12 or 15 samples per subscale in this method of analysis. With a total of 18 subscales, there was a requirement to collect data from at least 216 students.

MATERIALS

Corona Disease Anxiety Scale

The CDAS has recently been developed and validated to measure anxiety caused by the outbreak of coronavirus in Iran. The final version of this questionnaire has 18 items and 2 components. Items 1 to 9 measure psychological symptoms and items 10 to 18 measure physical symptoms. This tool is scored in a 4-point Likert scale (never = 0, sometimes = 1, most times = 2 and always = 3). High scores in this questionnaire indicate higher levels of anxiety in the individuals. The reliability of this tool was obtained using Cronbach's alpha method for the psychological symptom $\alpha = 0.879$, the physical symptom $\alpha = 0.861$, and the whole questionnaire $\alpha = 0.919$ (40).

Young Internet Addiction Test (IAT)

The IAT is a 20-item questionnaire that assesses the person's performance at work, school and home (3 questions), social behaviors (3 questions), emotional communication and response via the Internet (7 questions), and general patterns of Internet use (7 questions) (41). Respondents answer on a 5-point Likert measure ("does not apply" to "always"), which people score from 0 to 100. Those who get <49 will be in the "average users"' category, participants scoring between 50 and 79 are "problematic internet users," and those scoring 80 and above be categorized as "severely problematic users." In the study of Widyanto et al. (42), the internal validity of the questionnaire was higher than 0.92 and the validity of the retest was also reported to be significant. It also shows good to moderate internal consistency and, alpha coefficients of 0.82 (42). In a Persian psychometric survey of the test, the validity of the retest was 0.82 and internal consistency, where the alpha coefficient was 0.88 (43).

Self-Compassion Scale Short-Form

The Self-Compassion Scale (SCS) is a 26-item questionnaire with six subscales consist of self-kindness, self-judgment, common humanity, isolation, mindfulness and over-identification; which is a valid and reliable test (44). The Self-Compassion Scale Short-Form (SCSSF) is a shorter 12-item questionnaire and with a 5-point Likert measure that is a reliable and valid alternative to the full version with a high correlation ($r \geq 0.97$). The internal consistencies for the SCS–SF subscales were 0.54 and 0.75 for the English version of SCS–SF. Reliabilities for all but one subscale (self-kindness) were above 0.60, and Cronbach's alphas of 0.60 and above are acceptable (45). In the Persian version of the test, Cronbach's alphas of 0.91 for the whole scale and 0.77 to 0.92 for the six subscales were calculated. Validity coefficient with the general health questionnaire was−0.45 and for the subscales from−0.28 to−0.48 (46).

Cognitive Emotion Regulation Questionnaire

The CERQ is a 36-item multidimensional questionnaire designed to identify cognitive emotion regulation strategies that people use in stressful, threatening or traumatic life events; which is a valuable and reliable tool. This questionnaire examines 9 cognitive strategies for emotion regulation (self-blame, blaming others, acceptance, refocusing on planning, positive refocusing, rumination, positive reappraisal, putting into perspective, and catastrophizing) (47). Moreover, the short-form of cognitive emotional regulation (CERQ-short) is an 18-item questionnaire with high alpha reliabilities. Self-blame has the lowest alpha in this questionnaire between the subscale (0.67) and the rest of the alphas were in a range of 0.73 to 0.81 (48). Based on the standardization done in Iran, this questionnaire with Cronbach's alpha between 0.68 and 0.82 (for 9 subscales) has a good validity in the Iranian society (49).

RESULT

The research is a cross-sectional and modeling method using SPSS Statistics v22 and AMOS v22 has been applied to analyze the data. Also a description of the demographic information of the participants is given in **Table 1**.

Descriptive indicators such as mean, standard deviation, range of values, and correlation matrix of the studied variables are reported in **Table 2**. As can be seen, anxiety and fear of COVID-19 has a positive and significant relationship with both Internet addiction ($r = 0.32$) and maladaptive cognitive emotion regulation strategies ($r = 0.17$) and it has a negative relationship with self-compassion ($r =$ -0.25).

Considering the significant relationships between research variables, the results of path analysis are summarized in **Table 3** to investigate the mediating role of self-compassion and cognitive emotion regulation strategies as the role of mediators. The results show that the relationship between all pathways in the mediation model except anxiety and fear of COVID-19 pathway with adaptive cognitive emotion regulation strategies were statistically significant ($p < 0.0001$). Therefore, the findings support the mediating role of self-compassion and maladaptive cognitive emotion regulation strategies in the relationship between anxiety and fear of COVID-19 and Internet addiction. The results are summarized in **Figure 1** below. In other words, these findings suggest that people with high anxiety and fear of COVID-19 use maladaptive emotion regulation strategies, which in turn increase their susceptibility to Internet addiction. Also, people with high anxiety and fear of COVID-19 with low levels of self-compassion, are more vulnerable in the path of Internet addiction.

TABLE 1 | Demographic characteristics of study sample ($n = 1,008$).

Variable	Frequency	Percentage (%)
Gender		
Male	284	28
Female	724	72
Education		
Diploma	360	35
Bachelor	340	34
Masters	236	24
Doctorate	72	7
Marital status		
Single	857	85
Married	137	13.5
Divorced	13	1.5
Widowed	1	0.1
Employment status		
Physical presence at work	185	18
Teleworking	217	22
Unemployed	606	60
Type of employment		
Unemployed	630	62.5
Part-time	249	25
Full-time	129	12.5
Income		
Low	75	7.5
Middle	755	75
Good	178	17.5
Have you been infected by COVID-19?		
Yes	189	19
No	819	81
Has any of your family members or friends been infected by COVID-19?		
Yes	556	55
No	452	45
Social distance		
<2 months	120	12
Between 2 and 5 months	187	18.5
More than 5 months	701	69.5

DISCUSSION

The aim of this study was to investigate anxiety and fear of COVID-19 as predictors of Internet addiction with the mediating role of self-compassion and cognitive emotion regulation. From the results, it is concluded that in the days when the world is widely affected by COVID-19, there is an association between the fear and anxiety of the virus and the misuse of the Internet. Although the level of anxiety may not indicate that one is suffering from an anxiety disorder, it still requires awareness and, if necessary, intervention. Also, due to the continuing epidemic and its other consequences, people's fear and anxiety may increase in severity to the extent of psychiatric diagnosis. Various factors can be effective in this regard. For example, it seems that limitations related to social distancing, the need to commit to health protocols and high mortality rates, can cause a significant rise in anxiety and fear, which leads to obsessive behaviors such as spending time in cyberspace.

Our findings show that a high level of compassion can be effective in reducing the effect of COVID-19 anxiety on Internet addiction. Since the compassionate person scores higher in the three main indicators of this component, namely self-kindness, human commonalities and mindfulness, it can be inferred as a

TABLE 2 | Descriptive statistics and the correlation matrix ($n = 1,008$).

Variable	Mean	SD	Range	1	2	3	4	5
1. COVID-19 anxiety	14.09	9.11	1–54	-				
2. Internet addiction	44.20	14.90	20–100	0.32**	-			
3. Self-compassion	36.98	7.82	14–57	−0.25**	−0.43**	-		
4. Maladaptive strategies	25.19	4.72	8–40	0.17**	0.11**	0.11**	-	
5. Adaptive strategies	29.45	5.98	10–49	0.04	0.04	0.23**	0.47**	

*r, Pearson's correlation coefficient; **$p < 0.01$; *$p < 0.05$.*

TABLE 3 | Summary of mediation analyses on direct and indirect effects of Corona Disease Anxiety on internet addiction ($n = 1,008$).

Mediator	Direct effect	Indirect effect via mediator		
		Indirect effect	Indirect lower CI	Indirect upper CI
Self-compassion	0.36***	0.15***	0.114	0.206
Maladaptive strategies	0.08***	0.03***	0.015	0.059
Adaptive strategies	0.03	0.000	0.000	0.000

*CI, 95% confidence interval derived based on 5,000 bootstrapped samples; ***$p < 0.0001$.*

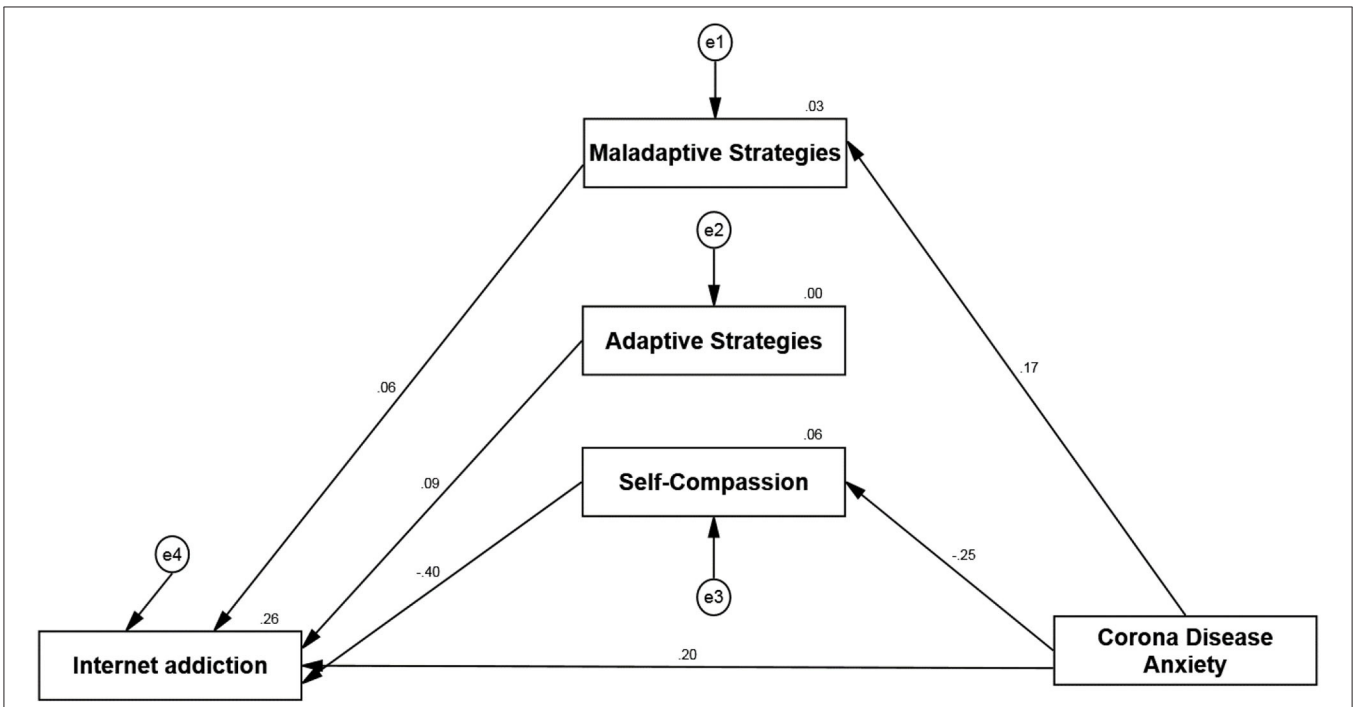

FIGURE 1 | Examining the indirect effect of corona disease anxiety on internet addiction through self-compassion and emotion regulation.

protective variable, which is congruent with the study of Muris et al. (50, 51). Constantly blaming oneself for the possibility that the individual's actions will put himself or his family members at the risk of infection, as well as feeling responsible for the health of people with whom they are in contact, can cause great anxiety, which is contrary to the constructive effects of self-kindness. Another effect of self-blame is that it leads to the application of maladaptive coping strategies, which is followed by decreased self-esteem, the feeling of helplessness, and social isolation (52). The feeling of common humanity, especially during the coronavirus pandemic, can create this perception that people all around the world are involved in an unavoidable condition, which has imposed many deaths and major limitations in the way of normal life. This factor creates a feeling of closeness to other human beings. Therefore, the less one considers themself a member of human society, the more one will experience anxiety

and separation (52, 53). In addition, lack of self-awareness about the present and the constant mental conflict with the issue of coronavirus and fear of death (of themselves and/or their loved ones), and over-identification with these thoughts also increases the level of anxiety. All of these factors explain people turning to virtual networks and the Internet as an inefficient way to deal with this fear and anxiety (12, 54).

Cognitive emotion regulation plays an important role in coping with stressful situations, as it determines the effect of these situations on our mental health. The use of adaptive strategies can help a person cope with stressors such as coronavirus pandemic more efficiently. According to the results, there is a positive relationship between anxiety and fear of coronavirus and the use of maladaptive strategies of cognitive emotion regulation such as avoidance, suppression and rumination, which is consistent with Jungmann and Witthoft (55). Most of people have ruminating thoughts with anxious content such as risk of infection and death of themselves or their loved ones. Moreover, daily exposure to the news of death rates cause people to experience high levels of anxiety. Obsessive use of internet is an avoiding strategy in order to feel less anxious during the pandemic. The negative reinforcing effect of using the Internet turns this behavior into an addiction. Some other reasons for the pathological use of internet could be some dissociative symptoms which are found in their neural pathways (56). It is also proven that social media users have much more social and emotional impairments in comparison with the non-users (57). All these descriptions explain the positive and significant relationship between anxiety and fear of COVID-19 and Internet addiction.

CONCLUSIONS

Due to the increase in addictive behaviors during COVID-19 pandemic (58), self-compassion can play a protective role while maladaptive strategies for emotion regulation such as self-blame, blaming others, and rumination can be risk factors for anxiety and fear of the virus which leads to more obsessive use of internet.

Suggestions

Self-compassion can be enhanced with treatments such as Mindful Self Compassion (MSC), Compassion Focused Therapy (CFT), Mindfulness-Based Stress Reduction (MBSR), Acceptance and Commitment Therapy (ACT), Dialectical Behavior Therapy (DBT) and Mindfulness Based Cognitive Therapy (MBCT) (59). Also, training emotional regulation skills in limited sessions can help control the level of experienced anxiety. It can also improve adaptive strategies and reduce the use of maladaptive strategies at the time of stress (60). In addition internet is not only the cause of addiction but also due to the extreme relation between anxiety and stress and the use of it, Internet-based interventions could be used to promote wellbeing and manage psychological distress during Covid-19 pandemic (61).

LIMITATIONS

This study was performed on a student population, and precautions should be taken in generalizing the results to other individuals. Also, due to the prevalence of coronavirus, data collection has been done online and by the convenience sampling method, which may bias the results.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

All the data collecting, analyzing, and writing the whole research has been done with the efforts of RM and KP, under the supervision of FL. All authors have read and approved the final manuscript.

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This research has been written with the efforts of the authors of the article.

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Characterizing the Relationship Between the COVID-19 Pandemic and U.S. Classical Musicians' Wellbeing

Grace Wang[1], *Noah R. Fram*[2], *Laura L. Carstensen*[3,4] *and Jonathan Berger*[2]*

[1] Department of Biology, Stanford University, Stanford, CA, United States, [2] Center for Computer Research in Music and Acoustics, Stanford University, Stanford, CA, United States, [3] Department of Psychology, Stanford University, Stanford, CA, United States, [4] Stanford Center on Longevity, Stanford University, Stanford, CA, United States

The COVID-19 pandemic has devastated the economic and social wellbeing of communities worldwide. Certain groups have been disproportionately impacted by the strain of the pandemic, such as classical musicians. The COVID-19 pandemic has greatly harmed the classical music industry, silencing the world's concert halls and theaters. In an industry characterized by instability, a shock as great as COVID-19 may bring negative effects that far outlast the pandemic itself. This study investigates the wellbeing of classical musicians during the COVID-19 pandemic. 68 professional classical musicians completed a questionnaire composed of validated measures of future time horizons, emotional experience, social relationships, and life satisfaction. Findings show that feelings of loneliness had a significant negative association with other measures of wellbeing and were significantly mediated by increased social integration and perceived social support from colleagues, friends, and family. These findings help to characterize the present psychological, emotional, and social wellness of classical musicians in the United States, the first step toward mitigating the hazardous impacts of COVID-19 on this vulnerable group's mental health and wellness.

Keywords: COVID-19, mental wellbeing, social isolation, SARS-CoV-2, musicians

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***Correspondence:**
Jonathan Berger
brg@ccrma.stanford.edu

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INTRODUCTION

On March 17, 2020, health authorities in the San Francisco Bay Area imposed the United States' first COVID-19 stay-at-home order (Allday, 2020). By the end of May 2020, 42 states and territories in the U.S. had enacted similar closures, dramatically disrupting the country's performing arts sector (A Timeline of COVID-19 Developments in 2020., 2021). As concert halls closed, performers faced heightened uncertainty about their careers. Particularly affected were classical musicians, who earn most of their income from live concerts and view performing as integral to their careers and identities (DiCola, 2013). The onset of COVID-19 closures required musicians to adapt creatively, moving performances from the concert hall to places ranging from porches, balconies, and the streets, to the internet (Gelt, 2021).

As concert halls shuttered, musicians faced both professional and personal challenges—as was the case for much of the world, social distancing guidelines greatly isolated individuals, raising concerns for increased loneliness and mental health deficits. For musicians who usually performed with others in an ensemble, such solitude did not only result in loneliness—a key aspect of their music was inhibited.

Even prior to the pandemic, classical musicians faced intense competition and financial insecurity (Macnamara et al., 2014; Pecen et al., 2016; Ascenso et al., 2018), two intense occupational stressors that categorize the occupation as precarious work. Precarious work is defined as employment that is uncertain and unpredictable from the point of view of the worker (Kalleberg, 2009), causing far-reaching consequences to individuals' mental health and social outcomes (Kalleberg, 2011, 2018; Benach et al., 2014; Kelly et al., 2014; Schneider and Harknett, 2019). Indeed, such occupational challenges may contribute to a higher prevalence of mental health disorders in classical musicians than in the general population (Kegelaers et al., 2020). However, despite these occupational stressors, classical musicians tend nonetheless to maintain relatively high levels of satisfaction with their jobs and lives (Bonneville-Roussy et al., 2011; Brodsky, 2011). Many have even described performing as a lifestyle, rather than simply a means of earning a living (Oakland et al., 2012). This appears to hold true for the pandemic's disruptions as well; in recent interviews, classical musicians have described these disruptions to their career as bringing about "existential questions," ranging from "how do we find meaning?" to "do we even continue to play music?" (Gelt, 2021).

The COVID-19 stay-at-home orders found many successful classical musicians unable to perform or earn a living from musical work, raising financial, social, and mental health concerns. A prior study of the pandemic and classical musicians analyzed the UK performing arts community, finding that classical orchestral musicians have been severely impacted by the closures enacted due to COVID-19 (Cohen and Ginsborg, 2021). The current study is, to our knowledge, the first analysis of how the COVID-19 pandemic has affected United States classical musicians' emotional experience, and how factors such as social relationships and loneliness mediate this experience. Given the intense social isolation brought by the pandemic, we frame our study around the important connections between social relationships and mental wellbeing (House et al., 1988; Turner and Marino, 1994; Thoits, 1995; Kawachi and Berkman, 2001; Schnittker, 2008; Wang et al., 2018), which are found to be important mediators to emotional and financial stress (Whelan, 1993; Wang et al., 2014).

From a sociological perspective, social relationships can be understood through three classes of phenomena: social integration, relational content, and social network structure (House et al., 1988). The present study focuses on the first two classes: social integration, defined as the quantity and type (e.g., kin/nonkin) of social ties, and relational content, defined as the functional quality of social relationships. An important aspect of relational content is social support, the positive, potentially stress-buffering aspects of relationships (Hall and Wellman, 1985). Given that the COVID-19 pandemic is a significant stressor to the global community (Bridgland et al., 2021; Whitehead, 2021), we position our study under Cohen and Wills' stress-buffering model of social support, wherein social support is hypothesized to prevent or modulate responses to stressful events that are damaging to health (Cohen and Wills, 1985). Under this model, social support may act on several points in the pathway between stressful events and harm to mental wellbeing, such as influencing an individuals' appraisal of the stressful situation or reducing a negative emotional reaction to stress (Cohen and Wills, 1985; Bailey et al., 1994; Kawachi and Berkman, 2001).

Given the existing literature, we hypothesized that increased measures of social integration and perceived social support would correlate with more positive measures of wellbeing in our study sample. We use validated measures of wellbeing to empirically analyze U.S. classical musicians' outlook on the future, emotional affect, and life satisfaction during the pandemic, focusing on the connections between social relationships and wellbeing.

MATERIALS AND METHODS

Participants

Participants were recruited by email using the listservs of U.S. professional classical musician organizations such as small ensembles, orchestras, composers' associations, and chamber music groups. Inclusion criteria for the study were that participants must: (i) be a professional classical musician, defined as someone who makes the majority of their salary from classical music performances (U.S. Government., 1949), (ii) reside in the United States, and (iii) be over the age of 18. There was no specification of musical instrument detailed in participant criteria. Of the participants recruited for the study ($n = 68$), 32 identified as White, 10 identified as Black or African American, 16 identified as Asian or Asian American, 2 identified as Hispanic or Latinx, 2 identified as mixed-race or "other," and 7 declined to report their race. Given previous data on the racial makeup of the classical music field, our data is mostly racially representative, though slightly overrepresents minority races (Doeser, 2016). 31 of the participants had completed a four-year college or conservatory program, 7 had started but not completed a four-year college or conservatory, 12 had completed a graduate or professional degree, 11 had graduated from high school or obtained a GED, and 8 declined to report their education. The median participant 2020 fiscal year total household income was $70,000. 52% of participants were married, 24% had living children, and 67% had other living immediate family. Upon survey completion, participants had the choice to enter their email address for an optional $10 Amazon gift card raffle.

Measures

The survey was administered in March through May of 2021 using Qualtrics. This survey was comprised of validated measures of wellbeing designed to assess participants' time horizons, subjective wellbeing, social relationships, and a range of emotional experiences.

Time Horizons

Time horizons are defined as individual temporal strategies and orientations toward the past, present, and future (Lundqvist, 2020). We assessed time horizons with a modified version of the Future Time Perspective (FTP) scale (Carstensen and Lang, 1996). The original FTP scale consists of 10 statements about subjective time perception (e.g., "I could do anything I want in the future"), where participants rate how true each statement is for them on a 7-point scale from 1, *very untrue*, to 7, *very true*. This scale has been further adapted to occupational time horizons (Zacher and Frese, 2009; Henry et al., 2017), with prior findings suggesting that FTP at work mediates the relationship between occupational well-being and behavioral or motivational outcomes. In the present study, we adapted the occupational FTP model for classical musicians by altering the statements to pertain specifically to a musical career (e.g., changing "Many opportunities await me in the future" to "In my musical career, many opportunities await me in the future"). Additionally, we added three questions that concerned classical musicians' future planning, such as "I will challenge myself with new repertoire in the future."

Subjective Wellbeing and Life Satisfaction

Subjective wellbeing refers to how individuals experience and evaluate their lives (Stone and Mackie, 2013). We assessed subjective wellbeing through the Diener Satisfaction with Life Scale (Diener et al., 1985, 2006, 2010). This scale assesses participants' satisfaction with their lives holistically, rather than with specific life domains (e.g., health or finances). It is a 5-statement survey, where participants indicate the degree to which they agree with each statement on a 7-point scale, with 1 being *strongly disagree* and 7 being *strongly agree*.

Social Integration and Relational Content

To assess participants' degree of social integration and perceived quality of relational content, we adapted previously validated questionnaires (Schuster et al., 1990; Turner and Marino, 1994), asking about both the quantity and quality of social ties through questions such as "How many musician colleagues do you regularly interact with professionally?" and "How close is your relationship with your musician colleagues?" For questions regarding the number of social or professional ties, several answer categories were presented, such as 0, 1–5, 6–10, 11–15, and 15+. For questions regarding the quality of social or professional ties, participants rated the closeness of their relationships on a four-point scale, where 1 indicated *very close* and 4 indicated *not at all close*. We further investigated the amount and degree of contact participants had with their social network, using the question "On average, how often do you communicate with musician friends and colleagues in the following ways?" with follow-up statements such as "rehearse or jam on-line" or "write or email." For these questions about quantity of contact, participants answered each statement on a 6-point scale, with 1 indicating three *or more times a week* and 6 indicating *less than once a year or never*. Lastly, we further assessed participants' degree of social connectedness using the Social Support Convoy Model, which classifies participants' social connections as a network of social ties that provides protection and support (Kahn and Antonucci, 1980; Antonucci and Akiyama, 1987). This model asks participants to envision their social relationships as three separate levels of closeness and list the first names of people they believe fit into each level.

Positive and Negative Affect

Emotional experience was assessed with queries about the frequency of 29 emotions, 16 of which were positive and 13 of which were negative. We adapted this list of emotions from Carstensen et al. (2020), which measured the valence and arousal level of emotions of the general population during the COVID-19 pandemic. Participants were asked to rate how often they experienced each emotion during the past week on a 5-point scale, with 1 indicating *all or nearly all the time*, and 5 indicating *never*.

Effect on Employment

Participants were asked to indicate the extent to which their employment in a musical career had been impacted during the COVID-19 pandemic through one question, responding on a four-point scale, with 1 indicating *not at all* and 4 indicating *a great deal.*

Ethical Considerations

All study procedures and analyses were approved by Stanford University's Institutional Review Board (IRB #59654), and informed consent was obtained from all participants. Other than the optional email address for the Amazon gift card, no identifying information was collected through the course of the study.

Data Analysis

Statistical analyses were first conducted using R Core Team (2020). First, basic descriptive statistics (means, standard deviations, and frequencies) were calculated for all variables. After verifying assumptions of ordinarily and monotonicity (Wissler, 1905), Spearman's rank correlation coefficients (Savicky, 2014) were calculated to explore the direction and strength of potential relationships between emotional affect, FTP, life satisfaction, social relationships, and career effects. Then, after verifying that our observations were independent and have non-perfect separations, but are not normal, linear, or homoscedastic (Stoltzfus, 2011), we employed single and multivariate logistic regression analyses (R Stats Package, 2020; Wickham et al., 2021) to assess the relationship among loneliness, FTP, life satisfaction, and social relationships, controlling for potential demographic confounding variables such as race, socioeconomic status, and education level. Finally, to assess potential common variance bias, we used Harman's Single Factor Test in SPSS Version 28 (IBM Corp, 2021) (SPSS Statistics for MacOS, 2021).

TABLE 1 | Logistic regression between the question "how many musician colleagues do you regularly interact with professionally?" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	3.1317	0.3653	0.1673	3.159	0.00267**
FTP 2	3.4821	0.3732	0.1809	3.356	0.00150**
FTP 3	3.3856	0.4470	0.1099	2.510	0.0153*
FTP 4	3.1209	0.4351	0.0920	2.274	0.0272*
FTP 5	3.2221	0.4384	0.0650	1.884	0.0653
FTP 6	3.1789	0.4562	0.1096	2.505	0.0155*
FTP 7	5.7758	0.4438	0.2756	4.405	0.0000544***
FTP 8	5.1145	0.4734	0.1210	2.263	0.0115*
FTP 9	3.8798	0.3812	0.1949	3.153	0.000937***
Multivariate FTP	2.35377	1.15565	0.3895	2.037	0.007841**
Life satisfaction 1	3.5219	0.4382	0.0936	2.295	0.0259*
Life satisfaction 2	3.3916	0.4228	0.2151	3.738	0.000469***
Life satisfaction 3	3.3282	0.4861	0.1305	2.766	0.00788**
Life satisfaction 4	3.8366	0.3951	0.1677	3.174	0.00257**
Life satisfaction 5	3.6833	0.4516	0.1126	2.544	0.0140*
Multivariate life satisfaction	3.516	0.9338	0.2765	2.574	0.00895**
Career satisfaction	1.7718	0.42230	0.0467	1.581	0.120

*Both single variable and multivariate logistic regression analyses were conducted. * indicates $p < 0.05$, ** indicates $p < 0.01$, and *** indicates $p < 0.001$.*

RESULTS

Emotional Affect

Participants' most commonly reported emotions were anxiety/worry, loneliness, and concern. These negative emotions were more common than any of the positive emotions. This is notable, given that surveys of the general population during COVID-19 find that participants report more positive than negative emotions (Carstensen et al., 2020). In our study, positive emotions were strongly positively correlated to other positive emotions, while negative emotions were weakly positively correlated to other negative emotions. Generally, positive emotions and negative emotions were negatively correlated. Of all 29 emotions assessed, the emotion of loneliness had the strongest negative correlation to positive emotions. Additionally, loneliness had the strongest negative correlation to measures of life satisfaction and shorter FTP.

Social Integration and Relational Content

There is substantial evidence that low social integration and low degrees of perceived social are related to loneliness (Wang et al., 2018). To explore the emotion of loneliness further, we first examined the relationship between social integration as an independent variable and FTP, career, and life satisfaction as dependent variables using multivariate logistic regression. The question, "How many musician colleagues do you regularly interact with professionally?" was significantly related to all FTP questions, with the exception of the statement, "I could do anything I want in the future." It was also significantly related to all life satisfaction questions, with increased musician colleague interaction associated with more positive life satisfaction. The number of musician colleagues was not associated with career satisfaction (**Table 1**). The question, "How many friends (musician or non-musician) do you have?" was significantly related to all FTP questions, with an increased quantity of friends correlating with a more positive FTP and increased life satisfaction. We were unable to interpret the relationship between "How many friends would you say you have a close relationship with?" and FTP or life satisfaction due to the ambiguity of participants' given answers (e.g., "many," "few"). Quantity of friends was also significantly associated with career satisfaction (**Table 2**).

We further analyzed the relational content of participants' social relationships through multivariate logistic regression using questions examining relationship quality and closeness as the independent variable and questions assessing FTP, life, and career satisfaction as dependent variables. The question, "How close is your relationship with your musician colleagues?" was significantly correlated with higher FTP scores but did not correlate with life satisfaction. However, the perceived quality of relationships with musician colleagues was significantly correlated with career satisfaction (**Table 3**). Answers to "How close is your relationship with your friends?" were significantly associated with FTP and life satisfaction, with closer relationships correlated with more positive scores on both. The quality of friendship was also correlated with career satisfaction (**Table 4**). Relationship quality with kin, as assessed with the question, "How close is your relationship with your family members?" was significantly correlated with all FTP questions, except for FTP8, which states "there are only limited possibilities in my future musical career." Kin relationships were also correlated with career satisfaction (**Table 5**). However, in multivariate logistic regression analyses, family relationships were not correlated with life satisfaction.

TABLE 2 | Logistic regression between the question "how many friends do you have?" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	3.42975	0.27022	0.1962	3.528	0.000897***
FTP 2	3.85573	0.28026	0.1884	3.441	0.00116**
FTP 3	3.23837	0.28556	0.3620	5.379	0.00000189***
FTP 4	3.09697	0.30023	0.2406	4.020	0.000192***
FTP 5	3.12205	0.30404	0.2099	3.681	0.000560***
FTP 6	3.17234	0.31070	0.2745	4.393	0.0000566***
FTP 7	5.0280	0.3505	0.2062	3.640	0.000636***
FTP 8	4.6992	0.3595	0.1099	2.484	0.0164*
FTP 9	4.08969	0.26424	0.3205	4.905	0.00000995***
Multivariate FTP	1.43030	0.95200	0.4327	3.559	0.00233**
Life satisfaction 1	3.60788	0.31311	0.1872	3.428	0.001212**
Life satisfaction 2	3.87624	0.31852	0.2174	3.764	0.000433***
Life satisfaction 3	3.42375	0.33586	0.2708	4.352	0.0000649***
Life satisfaction 4	4.25102	0.30054	0.1547	3.025	0.003924**
Life satisfaction 5	3.80499	0.32084	0.2133	11.869	0.0004933***
Multivariate life satisfaction	2.0147	0.9029	0.3144	4.219	0.00307**
Career satisfaction	1.58897	0.26836	0.4237	5.176	0.000008776***

** indicates p < 0.05, ** indicates p < 0.01, and *** indicates p < 0.001.*

TABLE 3 | Logistic regression between the question "how close is your relationship with your musician colleagues?" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	2.5489	0.1855	0.2179	3.695	0.000555***
FTP 2	2.9046	0.1932	0.2192	3.709	0.000531***
FTP 3	2.6516	0.2343	0.1661	3.124	0.00230**
FTP 4	1.6855	0.2114	0.2961	4.540	0.0000367***
FTP 5	1.9450	0.2145	0.2406	3.941	0.000268***
FTP 6	2.1156	0.2307	0.2159	3.673	0.000592***
FTP 7	6.4058	0.6324	0.2554	4.099	0.000156***
FTP 8	6.0704	0.2485	0.1954	3.415	0.00131**
FTP 9	3.5934	0.2074	0.1572	3.023	0.000937***
Multivariate FTP	1.5474	0.8851	0.3514	1.322	0.0274*
Life satisfaction 1	3.3444	0.2432	0.1671	5.250	0.00297**
Life satisfaction 2	3.3581	0.2334	0.0125	2.652	0.111
Life satisfaction 3	3.1908	0.2713	0.0817	2.089	0.0673
Life satisfaction 4	3.3584	0.2123	0.5331	5.354	0.0107*
Life satisfaction 5	3.6386	0.2594	0.51626	3.053	0.0419*
Multivariate life satisfaction	1.1553	0.9419	0.1922	1.074	0.0841
Career satisfaction	1.4713	0.2331	0.05111	1.625	0.1107

** indicates p < 0.05, ** indicates p < 0.01, and *** indicates p < 0.001.*

Future Planning

We assessed the extent of participants' future planning with two questions: "I have an idea of what I will be doing musically 1 month from now" and "I have an idea of what I will be doing musically 6 months from now." Most participants agreed with the first statement (M = 5.15, SD = 1.99, seven-point scale, with 7 indicating *very true* and 1 indicating *very untrue*) but disagreed with the second statement (M = 3.64, SD = 2.28, seven-point scale, with 7 indicating *very true* and 1 indicating *very untrue*). We further examined participants' degree of future planning with multivariate logistic regression, using 1-month and 6-months future planning as the independent variable and FTP, career, and life satisfaction as dependent variables. Both degrees of future planning were highly correlated with FTP scores. Additionally, future planning at both time points was highly correlated with degree of life satisfaction (**Tables 6**, **7**). Interestingly, compared

TABLE 4 | Logistic regression between the question "how close is your relationship with your friends?" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	2.1948	0.1800	0.2182	3.736	0.000481***
FTP 2	2.4357	0.1867	0.2363	3.933	0.000259***
FTP 3	2.2596	0.2259	0.1698	3.198	0.00240**
FTP 4	1.1991	0.2020	0.3047	4.680	0.0000222***
FTP 5	1.6684	0.2143	0.2065	3.607	0.000715***
FTP 6	1.4783	0.2209	0.2477	4.058	0.000174***
FTP 7	6.4987	0.7618	0.1866	3.387	0.00138**
FTP 8	6.2435	0.7462	0.1687	3.154	0.00275**
FTP 9	2.9316	0.1977	0.2108	3.655	0.000617***
Multivariate FTP	2.1948	0.1800	0.2182	3.736	0.00477**
Life satisfaction 1	1.5515	0.2012	0.3172	4.819	0.0166*
Life satisfaction 2	1.6491	0.1970	0.3697	5.416	0.0000138***
Life satisfaction 3	1.2020	0.2217	0.3409	5.085	0.00000176***
Life satisfaction 4	2.2851	0.1886	0.3090	4.681	0.00000554***
Life satisfaction 5	1.9825	0.2203	0.2535	4.121	0.0000229***
Multivariate life satisfaction	1.0762	0.3846	0.4286	2.798	0.0000903***
Career satisfaction	1.6917	0.2263	0.02006	1.012	0.020

** indicates p < 0.05, ** indicates p < 0.01, and *** indicates p < 0.001.*

TABLE 5 | Logistic regression between the question "how close is your relationship with your family members?" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	2.5692	0.1741	0.2106	3.503	0.00104**
FTP 2	2.9735	0.1775	0.2066	3.461	0.00117**
FTP 3	2.0786	0.2026	0.2861	4.294	0.0000898***
FTP 4	2.2186	0.2100	0.1781	3.157	0.00281**
FTP 5	2.3725	0.2104	0.156	2.916	0.00547**
FTP 6	2.1680	0.2161	0.2082	3.478	0.00112**
FTP 7	5.5942	0.2481	0.1054	2.328	0.0243*
FTP 8	4.9835	0.2507	0.0473	1.495	0.142
FTP 9					0.00000827***
Multivariate FTP	0.2456	0.2308	0.4340	3.153	0.00639**
Life satisfaction 1	3.0951	0.2252	0.1077	2.356	0.00637**
Life satisfaction 2	3.4393	0.2250	0.1120	2.408	0.0228*
Life satisfaction 3	2.8638	0.2526	0.1224	2.533	0.0201*
Life satisfaction 4	3.7143	0.2060	0.1075	2.328	0.0148*
Life satisfaction 5	3.2371	0.2405	0.0987	2.244	0.0245*
Multivariate life satisfaction	1.4992	0.2505	0.1551	0.771	0.2093
Career satisfaction	0.8316	0.2117	0.1508	2.859	0.0297*

** indicates p < 0.05, ** indicates p < 0.01, and *** indicates p < 0.001.*

to 6-month future planning, 1-month future planning was less strongly correlated with the question, "compared to this time last year, I am more fulfilled by my career."

Impacts on Employment

We assessed participants' employment during the pandemic using the question, "what describes your current employment status?" 87% of participants were currently working for pay (part time or full time), while the rest were currently unemployed. We also assessed the impact of COVID-19 on participants' employment with the question, "to what extent has your employment or retirement status been affected by the coronavirus pandemic?" using a five-point scale, with 1 indicating *not at all* and 5 indicating *a great deal*. The majority (67.3%) of participants answered *a great deal*. On average, participants' employment statuses were strongly affected by the

TABLE 6 | Logistic regression between responses to the statement "I have an idea of what I will be doing musically one month from now" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	2.7785	0.1004	0.1204	2.668	0.0102*
FTP 2	2.8475	0.0988	0.1823	3.405	0.00128**
FTP 3	2.2312	0.1112	0.2121	3.741	0.000458***
FTP 4	2.3765	0.1135	0.1302	2.790	0.00736**
FTP 5	2.0182	0.1060	0.1909	3.502	0.000956***
FTP 6	2.2215	0.1143	0.1717	3.283	0.00184**
FTP 7	6.3160	0.1221	0.1866	3.453	0.00111**
FTP 8	5.4046	0.1272	0.2082	2.135	0.0376*
FTP 9	2.8898	0.0955	0.2691	4.375	0.0000586***
Multivariate FTP	2.0867	0.3733	0.3283	2.523	0.00132**
Life satisfaction 1	2.3769	0.1078	0.2017	3.590	0.000742***
Life satisfaction 2	2.5955	0.1108	0.2148	3.736	0.000473***
Life satisfaction 3	1.8621	0.1169	0.2677	4.317	0.0000728***
Life satisfaction 4	2.9716	0.09916	0.2223	3.781	0.000418***
Life satisfaction 5	2.5763	0.1123	0.2018	3.591	0.000740***
Multivariate life satisfaction	5.0061	0.3934	0.4440	2.424	0.00203**
Career satisfaction	1.1301	0.1085	0.0835	2.156	0.0358*

** indicates $p < 0.05$, ** indicates $p < 0.01$, and *** indicates $p < 0.001$.*

TABLE 7 | Logistic regression between the statement "I have an idea of what I will be doing musically six months from now" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	2.7089	0.3301	0.3408	5.185	0.00000360***
FTP 2	3.1857	0.0801	0.3046	4.773	0.0000152***
FTP 3	2.8809	0.0943	0.2659	4.340	0.0000659***
FTP 4	2.5410	0.0913	0.2705	4.391	0.0000556***
FTP 5	2.4970	0.0881	0.2757	4.460	0.0000441***
FTP 6	2.8018	0.0976	0.2170	3.796	0.000385***
FTP 7	5.4808	0.1075	0.1829	3.411	0.00126**
FTP 8	5.4583	0.1034	0.2273	3.874	0.000307***
FTP 9	3.5299	0.0795	0.3428	5.208	0.00000332***
Multivariate FTP	0.8988	0.2383	0.4534	3.964	0.000975***
Life satisfaction 1	2.5422	0.0802	0.4363	6.282	0.0000000738***
Life satisfaction 2	2.9299	0.0863	0.3931	5.747	0.000000510***
Life satisfaction 3	2.5858	0.0967	0.3592	5.347	0.00000212***
Life satisfaction 4	3.3659	0.0802	0.3624	5.331	0.00000235***
Life satisfaction 5	3.4088	0.1003	0.1870	3.426	0.00122**
Multivariate life satisfaction	5.0061	0.3934	0.4440	2.424	0.00000923***
Career satisfaction	1.0760	0.0878	0.2343	3.950	0.000240***

** indicates $p < 0.05$, ** indicates $p < 0.01$, and *** indicates $p < 0.001$.*

coronavirus pandemic (M = 4.46, SD = 0.93). Surprisingly, neither 1-month nor 6-month future musical planning as an independent variable was correlated with employment status nor the impact of COVID-19 on employment status as dependent variables. Additionally, multivariate regression analysis of the impact of the pandemic on employment did not correlate to any measure of life satisfaction or FTP. However, it did have a significant relationship to career satisfaction (**Table 8**).

DISCUSSION

This cross-sectional study revealed that the COVID-19 pandemic is negatively associated with the time horizons, life satisfaction, emotional experience, and overall wellbeing of professional classical musicians. The majority of musicians surveyed stated that the pandemic had affected their musical employment status a great deal, reporting that their careers during the pandemic

TABLE 8 | Logistic regression between the question "to what extent has your employment or retirement status been affected by the coronavirus pandemic" and measures of future time perspective (FTP), life satisfaction, and career satisfaction.

	B	*SE* B	β	*T*	*p*
FTP 1	3.7540	0.2199	0.0277	1.183	0.243
FTP 2	4.3071	0.2363	0.0051	0.500	0.619
FTP 3	3.8084	0.2654	0.0235	1.086	0.283
FTP 4	3.8959	0.2582	0.0014	0.260	0.796
FTP 5	3.5409	0.2536	0.0227	1.069	0.290
FTP 6	3.8462	0.2750	0.0071	0.591	0.557
FTP 7	4.5712	0.2941	0.0233	1.082	0.285
FTP 8	4.1760	0.2855	0.0032	0.395	0.695
FTP 9	4.4328	0.2362	0.0379	1.389	0.171
Multivariate FTP	1.7053	0.1482	0.1881	0.9485	0.434
Life satisfaction 1	4.2258	0.2581	0.0054	0.514	0.610
Life satisfaction 2	4.5053	0.2647	0.0094	0.681	0.499
Life satisfaction 3	3.9521	0.2994	0.0231	1.076	0.287
Life satisfaction 4	4.6561	0.2456	0.0071	0.584	0.562
Life satisfaction 5	4.8902	0.2777	0.0075	0.611	0.544
Multivariate life satisfaction	1.5297	0.1202	0.1324	1.440	0.264
Career satisfaction	1.1301	0.1085	0.0835	2.156	0.036*

** indicates $p < 0.05$.*

were significantly less fulfilling than their careers prior to the pandemic.

Of the 29 emotions we assessed, the emotion negatively correlated to the greatest number of indicators for wellbeing was loneliness. Three general types of loneliness exist: situational loneliness, developmental loneliness, and internal loneliness. Situational loneliness refers to loneliness resulting from environmental factors and disasters, developmental loneliness results from personal inadequacies, developmental deficits, or poverty, and internal loneliness results from personality factors, mental distress, low self-esteem, and poor coping strategies with stress (Tiwari, 2013). While the loneliness experienced by participants may be classified under any one or multiple of these categories, the current COVID-19 pandemic is a significant environmental stressor that has affected every aspect of the world. Thus, it is not surprising that loneliness has been a defining characteristic of the COVID-19 pandemic, especially given the implementation of social distancing and "stay-at-home" orders for public health (Li and Wang, 2020; Luchetti et al., 2020).

Studies of the general population have found that not only has loneliness significantly surged during the pandemic (Killgore et al., 2020), it has also been associated with a breadth of mental health concerns, such as elevated rates of depression and higher suicidal ideation (Ingram et al., 2020). Even prior to the pandemic, loneliness has been linked to significant psychological health problems and found to increase the risk of distress, depression, anxiety, and suicidal ideation (Beutel et al., 2017). Beyond its mental health impacts, loneliness has also been known to have damaging effects on physical health, negatively affecting health behaviors, health care utilization, cardiovascular activation, cortisol levels, and sleep (Cacioppo et al., 2002). These physical health impacts can lead to disorders such as rheumatoid arthritis, lupus, cardiovascular disease, obesity, physiological aging, and cancer (Mushtaq et al., 2014). These negative mental and physical health effects of loneliness make our results especially concerning.

Though loneliness may be attributed to any number of causes, we posited that it may be related to the musicians' social relationships. Our findings supported this hypothesis, indicating that greater amounts of social integration and perceived quality of social support, whether it be from musician colleagues, friends, or family were negatively correlated with the emotion of loneliness. Both increased quantity and quality of social relationships appeared to yield this benefit, as well as correlate with higher scores on the FTP scale and greater life satisfaction. However, only perceived quality of kin relationships was correlated with career satisfaction, indicating that career and life satisfaction may be influenced by different variables.

Although the relationship between social support and mental wellbeing has been well-established in the sociological literature, we were surprised to find that while the quantity of musician colleague interaction was correlated with career satisfaction, the quality of these relationships was not. This may indicate that the mere presence of musical colleagues plays a vital role in the lives of musicians, even if these colleague relationships are not close. These results support prior work that found relational content to only partially mediate the impact of social integration on psychological wellbeing and mortality (Blazer, 1982). Additional research has also indicated that social integration is more consequential for health than is the perceived quality of relationships (House, 1984; House et al., 1988).

The next two most indicated surveyed emotions were anxiety/worry and concern. Anxiety during COVID-19

pandemic has been well characterized in multiple countries throughout the span of the pandemic. Even early on, social distancing greatly affected individuals' levels of anxiety: surveys of people quarantined in Wuhan, China during the first 2 weeks of lockdown (the first COVID-19 related lockdown in the world) found that the vast majority of respondents (70.78%) reported symptoms of anxiety (Cao et al., 2020). A similar phenomenon was seen in the U.S. at the onset of the pandemic, with anxiety levels significantly increasing compared to pre-pandemic times. However, in the general U.S. population, anxiety/worry has decreased in the most recent stages of the pandemic (spring and summer 2021), reverting to pre-pandemic levels (Li et al., 2021). Thus, it is interesting that the classical musicians surveyed in our study still report high levels of anxiety/worry and concern.

Our findings are in line with prior studies of classical musicians' anxiety, which have found that even pre-pandemic, anxiety is more prevalent in performing classical musicians than the general population (Barbar et al., 2014; Vaag et al., 2016; Kegelaers et al., 2020). This may be due to the precarious nature of the work, caused by occupation-specific stressors such as employment instability and performance anxiety (Ascenso et al., 2018). Our study finds that the COVID-19 pandemic has worsened employment stability for classical musicians, with the vast majority of respondents stating that their employment status has been affected *a great deal* by the pandemic. Job insecurity is linked to multiple aspects of mental health, including anxiety and worry (Menéndez-Espina et al., 2019). Thus, it is possible that pre-pandemic levels of anxiety/worry in classical musicians have been exacerbated by the addition of pandemic-specific occupational stressors.

Prior studies of COVID-19 and musicians have found that during the pandemic, classical orchestral musicians were overwhelmingly concerned about the future of their careers (Cohen and Ginsborg, 2021). Our investigation of musicians' time horizons through the FTP scale aligns with such findings. However, we also hypothesized that participants' time horizons may be moderated by their extent of future planning. Our results found that both 1-month and 6-month musical future planning were correlated with all measures of FTP and life satisfaction, indicating that both short- and long-term plans are related to musicians' wellbeing. Interestingly, only 6-month planning was correlated to career satisfaction, suggesting that long-term planning may have a unique relationship with a musical career. A potential explanation for this is the open-endedness of the question—we asked respondents their level of agreement with the questions, "I have an idea of what I will be doing musically one/six month(s) from now," not limiting participants to musical plans within their employment. Thus, it is possible that participants referred to personal musical projects outside the scope of their primary employment. This may also explain the difference between 1-month and 6-month planning: it is more likely that musicians have scheduled performances 6 months in the future than 1-month in the future, given the present ongoing disruptions of the pandemic. Therefore, 6-month future planning may refer more directly to participants' primary careers, explaining the significant correlations between 6-month planning, positive FTP, and life satisfaction.

Interestingly, even though participants largely indicated that the pandemic had affected their employment status a great deal, most participants were actively employed at the time of survey. This indicates that participants' understanding of "affected employment status" may encompass more than layoffs. Throughout the pandemic, numerous U.S. orchestras and small ensembles furloughed their musicians. A prominent example is New York's Metropolitan Opera orchestra, whose members were furloughed without pay for months. Even after the furlough period ended, musicians were subjected to significant salary reductions (Jacobs, 2021). Numerous other ensemble groups around the country enacted similar pay-cuts to musicians, many of which are substantial and long-lasting, suggesting that employment disruptions will continue long after the pandemic has ended (Jacobs, 2020).

The results of our study find that the effects of the COVID-19 pandemic are significantly associated with classical musicians' views of their careers, time horizons, and wellbeing. At the time of writing, the pandemic continues to pose an ongoing threat to human health and society, even as vaccinations have become widely available in the United States. Fortunately, as social-distancing guidelines decrease, the performing arts sector has begun to return. However, the mere return of music to concert halls does not signify a solution to many classical musicians' challenges. The economic ramifications of the pandemic on the performing arts will be long-lasting, directly impacting musicians' livelihoods and careers. Thus, the challenges classical musicians are currently facing may outlast the pandemic, raising the question, "how do we best support this vulnerable group?"

One answer: help musicians cultivate resilience. Resilience is defined as the ability to withstand setbacks, adapt positively, and bounce back from adversity, all of which are vitally important in the face of increased stressors during the pandemic (Luthar and Cicchetti, 2000). Prior studies of classical musicians have found that increased psychological resilience is negatively correlated with mental health issues (Kegelaers et al., 2020), indicating its importance in our study population. Though studies of resilience in musicians are limited, prior findings suggest that resilience may be promoted by goal setting, increasing social connectedness, and creating a facilitative environment that reduces mental health stigma, increases mental health literacy, and encourages help-seeking behaviors (Polizzi et al., 2020; Wu et al., 2021). Our study finds that participants with increased goal setting (as measured through FTP), social integration, and perceived support demonstrated lower levels of negative emotions and higher levels of life satisfaction and wellbeing. Thus, it may be beneficial for classical musicians to employ goal-setting behaviors and increase social connectedness to increase psychological resilience. Likewise, ensemble groups and other musical organizations might consider implementing mental health resources and wellbeing workshops for their musicians.

Study Strengths

The present study examines a vulnerable, yet greatly understudied population that is particularly positioned to

be negatively affected by the COVID-19 pandemic. Using well-validated measures of wellbeing and social relationships, we draw important connections between social integration and support to time horizons, career satisfaction, and life satisfaction. Such findings reinforce prior sociological and psychological theory, emphasizing the great importance of social relationships in this unprecedented and uniquely stressful time.

Limitations and Future Directions

Potential limitations of this study include our relatively small sample size, which reduces the external validity of the statistical findings. In general survey research, common method bias is a concern. However, we evaluated this possibility *post hoc,* employing Harman's single factor test using exploratory factor analysis. The total variance explained by a single factor was less than 41%, which falls below the threshold of 50%. Thus, while common method bias cannot be ruled out as a contributing factor in the present study, it does not appear to be a significant factor (Podsakoff et al., 2003). Since all data were self-reported, response bias may be a limitation to construct validity, given the potential influence of social desirability bias, recall bias, and demand characteristics. To reduce such bias, we ensured participants their responses would remain anonymous, asked only about events that took place within the last year, and did not reveal the goals nor hypotheses of the study during participant recruitment. In addition, though the COVID-19 pandemic presents a significant stressor to our study population, it is possible that participants may have had very different experiences during the pandemic. For instance, we did not ask musicians to specify their specific employer: it is possible that gig musicians had significantly less economic stability than ensemble musicians during the pandemic. Moreover, the cross-sectional design of our study precludes us from making a causal claim and reduces internal validity. Future studies could investigate the ramifications of COVID-19 on the classical musician population through increased sample size and longitudinal observations.

In conclusion, our study finds that the COVID-19 pandemic is associated with changes in nearly every aspect of U.S. classical musicians' lives, whether it be their careers, view of the future, emotional affect, life satisfaction, or overall wellbeing. Participants' most reported emotions were loneliness and anxiety, which have been defining emotional characteristics of the pandemic. Our results highlight the power of future planning and social connectedness to help benefit the emotional status, life satisfaction, and wellbeing of classical musicians, suggesting that psychological resilience may be an important and necessary protective factor against the stressors of COVID-19 and the classical music industry.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Stanford University Institutional Review Board (Protocol #59654). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

GW conceived the study and drafted the original manuscript, with revisions from JB, NF, and LC. All authors approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsoc.2022.848098/full#supplementary-material

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Obsessive-Compulsive Disorder During the COVID-19 Pandemic—A Systematic Review

Elisabeth S. Linde†, *Tibor V. Varga**† and *Amy Clotworthy**†

Section of Epidemiology, Department of Public Health, University of Copenhagen, Copenhagen, Denmark

Background: The COVID-19 pandemic and its associated restrictions may contribute to a deterioration in mental health; individuals with obsessive-compulsive disorder (OCD) may be particularly affected. This systematic review aimed to investigate the effects of the current pandemic on people diagnosed with OCD, and whether pandemics may affect the development of OCD symptoms.

Methods: We conducted a systematic search using NCBI PubMed, SCOPUS, and Google Scholar on February 9, 2021. Research articles related to OCD and COVID-19 or other pandemics were attempted to be identified using pre-defined search terms. Case reports, clinical guidelines, letters, and clinical research articles including ≥100 participants were included; reviews were excluded. The systematic review adheres to PRISMA guidelines and the Newcastle-Ottawa Scale was used to assess the quality of the included clinical research articles.

Results: A total of 79 articles were included in the full-text assessment. Of these, 59 were clinical research articles, two were clinical guidelines, six were case reports, and 12 were letters. The research articles examined OCD symptoms in adult patients with diagnosed OCD, the general population, pregnant women, healthcare workers, students, and young adults, children, and adolescents. Only one study on OCD in previous pandemics was identified.

Conclusion: This systematic review found that people both with and without diagnosed OCD prior to the pandemic generally experienced a worsened landscape of symptoms of OCD during the COVID-19 pandemic. However, the responses are heterogeneous and many factors other than the pandemic seemed to affect the development of OCD symptoms. To prevent the impairment of symptoms and the development of new cases, close monitoring of patients with OCD and education of the general public is essential. Literature is still limited; thus, multinational and cross-cultural, longitudinal studies are warranted to gain further insights on this topic.

Keywords: obsessive-compulsive disorder, OCD, COVID-19, Coronavirus, obsession, pandemic, systematic review, mental health

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****Correspondence:***
Tibor V. Varga
Tibor.Varga@sund.ku.dk
Amy Clotworthy
amy@sund.ku.dk

†These authors have contributed equally to this work

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INTRODUCTION

Throughout history, pandemics have struck human societies and caused millions of deaths, economic depressions, and even the fall of empires (1). While *epidemic* describes a disease that infects large groups of people within a population or region, the word *pandemic* refers to an epidemic that spreads worldwide and is difficult to contain (2). Pandemics have the ability to shape cultures, politics, religion, health care, and people's mental health for many generations to come (1). Research into pandemics from recent decades also indicates an immediate and long-term negative psychosocial impact on large numbers of individuals (3).

The Coronavirus disease 2019 (COVID-19) pandemic—which was caused by the SARS-CoV-2 virus originating in Wuhan, China, in December 2019—has increased mortality worldwide (4). As of 16 February 2022, there were over 414 million confirmed cases and over 5.8 million deaths worldwide due to infection from the virus and its complications (5). The virus presents with a wide range of symptoms: from milder symptoms like fever, dry cough, and fatigue to severe symptoms like difficulty to breathe, fever, and chest pain (6). About one in six individuals experience complications of COVID-19, some of which are life-threatening (7).

Since the World Health Organization (WHO) declared a pandemic in March 2020 (8), rigorous strategies have been imposed worldwide to limit the spread of SARS-CoV-2. At times, these strategies have included quarantines, physical distancing, and national campaigns on the importance of hand hygiene and wearing protective facemasks (9). It has been reported that fear of the virus and various strategies to limit the virus' spread might have a synergistic effect in exerting a negative impact on the mental health of populations worldwide (10). Quarantines, in particular, may contribute to negative psychological effects (11). According to recent literature, individuals who had been diagnosed with obsessive-compulsive disorder (OCD) prior to the current pandemic may be the group most affected by the pandemic among those with mental disorders (10).

To date, it remains unknown to what extent and through which mechanisms pandemics affect the mental health of people with OCD (12). OCD is a severe anxiety disorder involving uncontrollable obsessions and repetitive compulsions (9). Obsessions are defined as repeated, unwanted thoughts that generate anxiety, whereas compulsions are defined as behaviors subsequent to an obsessive thought (9). OCD is an extremely heterogeneous and idiosyncratic disorder. However, Rajkumar et al. (13) suggest that at least four distinctions can be identified in patients: (a) fear of contamination and cleaning/washing compulsion; (b) obsessive taboo thoughts and checking compulsions; (c) obsessions and compulsions regarding symmetry; and (d) hoarding.

The etiology of OCD is largely unknown but probably consists of a complex combination of both genetic, biological, and environmental factors (14, 15). Evolutionarily, OCD symptoms like contamination fear, handwashing, and hoarding may have developed to protect our ancestors from infectious diseases and from starvation during times of limited resources (13). General risk factors that are known to cause or trigger OCD are stressful life events, comorbid mental-health disorders, a family history of OCD, and/or personality traits like perfectionism, intolerance of uncertainty, and threat overestimation (15–17). High-risk groups include OCD patients in remission/recovery, geriatrics (i.e., people over age 65), pregnant women, children and adolescents, and healthcare professionals (18–20). OCD is associated with reduced quality of life, various comorbid mental disorders and, with severe OCD, an increased risk of suicide attempts (21, 22). The lifetime prevalence of OCD is estimated to be 1.9–2.5% globally (23). Mild symptoms are reported to occur in up to 14–29% of populations, which means that a sizeable proportion of individuals experience symptoms during their lifetime (24).

About 50% of individuals living with OCD worldwide experience symptoms such as a fear of contamination, excessive handwashing, and a fear of dirt (25). Based on current COVID-19 recommendations from WHO, individuals with OCD are encouraged to engage in cleaning habits that were previously considered irrational. Symptoms such as irritability, anxiety, and sadness—which were once restricted to patients with OCD when they came into contact with objects considered contaminated—are now observed in individuals without previous mental disorders (12, 26, 27). This has raised concerns about how to separate rational fears and behaviors exhibited during the COVID-19 pandemic from obsessive fears and compulsions typical of individuals with OCD. Aardema et al. (12) argue that one aspect separating the two groups is the psychological meaning attached to "contamination." The authors suggest that individuals with contamination fear typically attribute personifications to viruses and germs, which thereby threatens their identity and causes inner corruption (i.e., a threat to the self). The authors explain that OCD is not only characterized by an increased fear of certain threats but also whether these threats target the individual's vulnerable self-theme; i.e., the fear of becoming a certain type of person and/or the areas where the person feels vulnerable and wrong (12, 28).

It has been hypothesized that, during a pandemic, individuals with OCD might believe that their fears of contamination are verified or even encouraged, or they might demonstrate a disproportionate concern about getting infected by the disease (10). During the current pandemic, these phenomena might occur as some of the measures to prevent COVID-19 transmission are similar to behaviors demonstrated by people with OCD, especially those with symptoms like contamination fear and compulsive handwashing (10). Although the emergent crisis of the management of OCD during pandemics is evident, literature is still limited. Thus, an investigation is warranted to learn more about the etiology of OCD and the possible consequences of pandemics on mental health. The goals of this systematic review were to analyze the available evidence in order to gain knowledge about: (1) whether the COVID-19 pandemic has increased the prevalence of OCD symptoms; (2) which specific demographic groups are the most susceptible and which personal characteristics contributed to the worsening of OCD symptoms; and (3) whether there are recommendations on how to improve the management of OCD during the current and future pandemics.

This systematic review of the literature includes both articles that report on people with diagnosed OCD and articles that describe people who display OCD-related (self-reported) symptoms in order to obtain a nuanced understanding of the putative effects of pandemics.

Previous research has indicated that OCD may result in significant impaired psychosocial and occupational functionality and reduced quality of life (29). Therefore, it is important to investigate whether pandemics and their associated lockdowns—as well as other restrictive interventions such as quarantines—may worsen the symptoms of OCD in people with a previous diagnosis, and/or even cause OCD in the general population. Our review has produced unique, important findings that contribute to medical knowledge about OCD, and the results of our study have the potential to inform public-health policies that impact the lives of people with OCD.

METHODS

This systematic review follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines (**Figure 1**) (30). The EndNote reference manager was used to organize references. The systematic review was not registered prior to publication.

Eligibility Criteria

We aimed to include studies concerning the following themes, and generated our search terms accordingly:

1. Studies measuring changes in OCD-related symptoms in patients or populations during pandemics.
2. Studies investigating the mental health of patients or populations during pandemics, with a focus on OCD symptoms.

To increase the robustness of our findings, only research articles including $\geq$100 participants were selected (except for case reports, which were also considered to introduce a case-based qualitative aspect of the research area). Only non-review articles, published in the English language, were selected. No restrictions were set based on publication dates or study design.

Information Sources

We conducted searches using NCBI PubMed, SCOPUS, and Google Scholar on February 9, 2021.

Search Strategy

We searched SCOPUS with the search term: *("Obsessive-compulsive disorder" OR "Obsessive compulsive disorder" OR ocd) AND (covid-19 OR "SARS-CoV-19" OR pandemic OR "coronavirus disease 2019")*

We searched PubMed with the search term:

("SARS-CoV-2"[Mesh] OR "COVID-19"[Mesh] OR "Pandemics"[Mesh] OR pandemic[Text Word] OR covid*[Text Word] OR coronavirus [Text Word] OR "corona virus"[Text Word]) AND ("Obsessive-compulsive Disorder"[Mesh] OR "OCD"[Text Word] OR "Obsessive-compulsive disorder"[Text Word] OR "obsessive"[Text Word] OR "compulsive"[Text Word] OR "obsessive compulsive disorder"[Text Word]).*

Study Selection

After removing duplicates, the initial search resulted in 194 articles and 41 additional publications were identified through other sources, including the revision of all articles included in a recent systematic review by Guzick et al. on the topic of OCD and the COVID-19 pandemic (31). The identified publications were categorized as research articles, clinical guidelines, correspondences, case reports, and comments. We examined the abstracts of the 235 potentially eligible articles and used reference tracking for reviews to search for additional potentially eligible articles. After the exclusion of reviews and non-relevant articles based on the abstracts, 115 articles were included for full text assessment. Of these, 79 articles were included in this qualitative synthesis (**Figure 1**). Of the 79 articles, 59 were original research articles, which are summarized in **Table 1**.

Data Collection

The screening of titles and abstracts was conducted by two co-authors (ESL and TVV) independently, and conflicts in this screening process were resolved by including any articles co-authors selected for full-text assessment. Quality assessment was undertaken by TVV.

Data Extraction

We extracted the following data from the full-text clinical research articles: study design, method of exposure and outcome ascertainment, demographic characteristics (mean age and percent female), sample size, country, period of data collection, and main findings. The Newcastle-Ottawa Scale was used to assess the overall quality of the included clinical research articles based on nine aspects related to study selection, comparability, and outcome assessment (88).

RESULTS AND DISCUSSION

We analyzed a total of 79 articles on OCD and pandemics. From these, 59 were research articles (**Table 1**), six were case reports, and 14 articles were communications or clinical guidelines. Of the 59 research articles, 16 examined individuals diagnosed with OCD prior to the pandemic. Twenty-one articles examined the general population of a specific country. Two articles investigated how pregnant women are affected by the pandemic, six studied healthcare workers, nine focused on students and young adults, and four articles investigated COVID-19 in children and adolescents. Only one study was identified on OCD during previous pandemics. Six articles were case reports of individuals with OCD during COVID-19. An additional 12 articles were letters, editorials, and comments with relevant discussion points, and two articles were clinical guidelines on how medical consultations and treatments were being modified during the COVID-19 pandemic. The quality assessment of the 59 original research articles is presented in **Supplementary Table 1**.

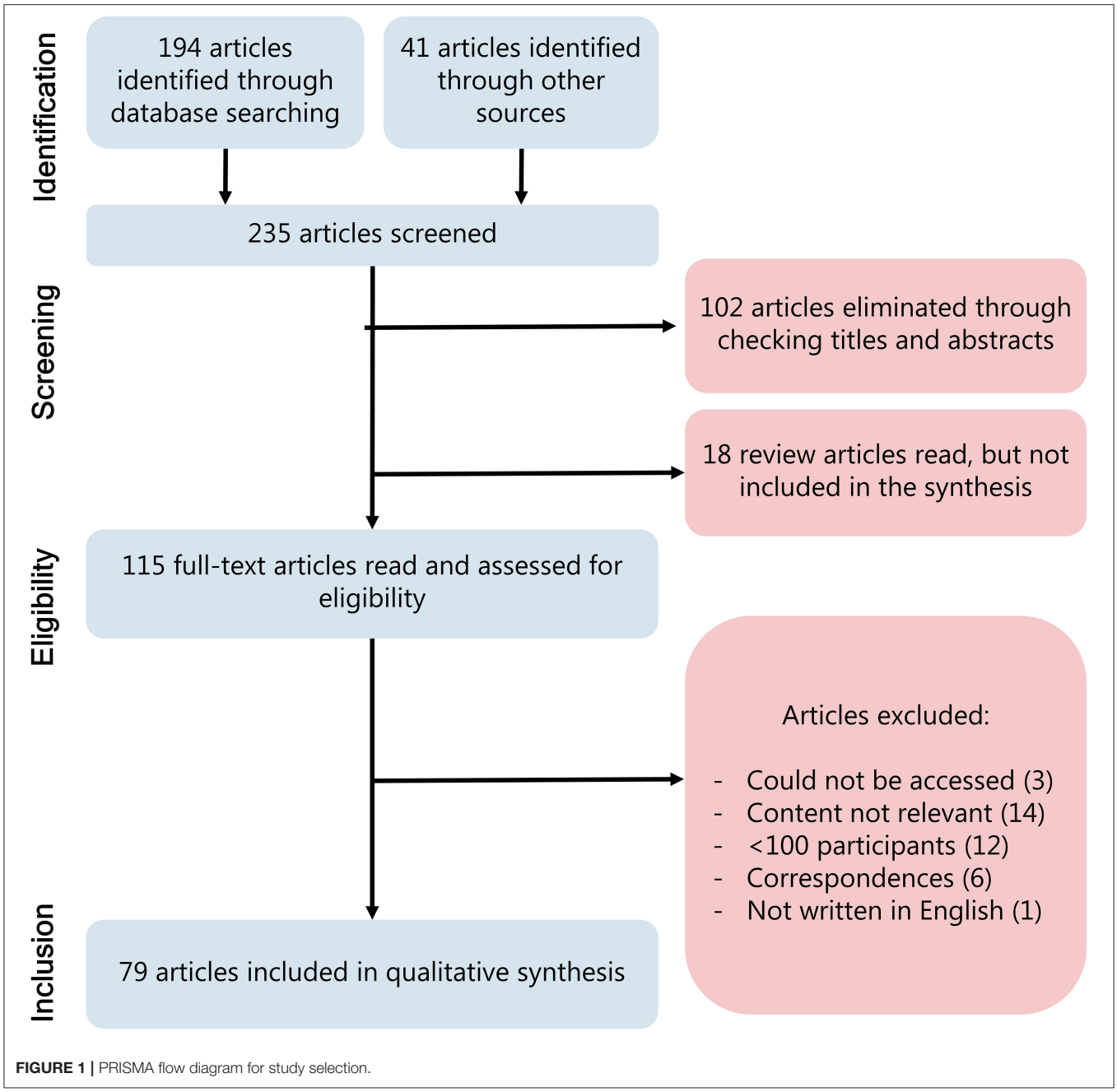

FIGURE 1 | PRISMA flow diagram for study selection.

Overall, the 59 research articles on various demographic groups indicated that the populations studied experienced a worsening of their OCD symptoms as well as increased symptoms of other mental-health disorders and a reduced quality of life. The six case reports provided examples of how the clinical impairments might look among individuals with OCD. The 12 letters reported a more varied picture, arguing that some individuals may be experiencing worsening symptoms during the pandemic, while others were not significantly affected; some may even experience improved mental health. The two clinical guidelines provided information on how to engage with and treat individuals with OCD during this period. We used the data collected from the various articles to answer our three main questions presented in the introduction.

The Prevalence of OCD and Its Symptoms Before and During the COVID-19 Pandemic

The estimated lifetime prevalence of OCD is around 2–3% globally (66). According to a study from 2003, the estimated prevalence of OCD was 1.2% among the adult U.S. population

TABLE 1 | Original research articles related to the COVID-19 pandemic and OCD.

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Individuals with OCD								
Alonso et al. (32)	*Cross-sectional, case-cohort study*. Structured interviews, online, self-report survey (VAS, HDRS, DSM-5, Y-BOCS).	364	Patients: 53.5% Controls: 57.6%	Patients: 42.0 Controls: 40.8	Spain	April 27– May 25, 2020	Patients with OCD and controls from the general population	*Individuals with OCD had more internalizing symptoms, suicidal thoughts, and sleep/appetite changes. OCD symptoms increased to a clinically significant degree in 40% of patients. Contamination symptoms predicted more COVID-focused symptoms and increases in OCD severity. Pre-pandemic OCD severity, depression, and social support predicted increase in OCD severity*.*
Benatti et al. (33)	*Cross-sectional study.* Telephone (94%) and in-person (6%) interview.	123	44.9%	40.0	Italy	N/A (at least 3 months after the initial outbreak)	Patients with OCD	35.3% of patients experienced clinical worsening of OCD. The group with worsening OCD were characterized by the development of new obsession and/or the reoccurrence of past obsessions. The most frequent symptoms were excessive washing and cleaning in the total population.
Carmi et al. (34)	*Longitudinal study, clinical trial.* Clinical evaluation, self-report survey (CGI-I).	113	50%	33.8	Israel	April–May 2020 Reevaluation: September, 2020	Patients with OCD enrolled in a clinical trial	The majority of OCD patients with active therapy and pharmacological intervention did not report a worsening of symptoms during the COVID-19 pandemic. The majority of patients reported that COVID-19 did not impact their OCD.
Højgaard et al. (35)	*Cross-sectional study.* Self-report survey (Y-BOCS)	201	65.7%	39.7	Denmark	April 6–29, 2020	Patients with OCD	61.2% of participants reported a worsening of OCD symptoms. Being female, demonstrating contamination symptoms, and psychiatric comorbidities were associated with increased OCD severity.
Jelinek et al. (36)	*Cross-sectional study.* Online, self-report survey (PHQ-9, OCI-R)	394	73.9%	37.8	Germany	March 23–May 18, 2020	Patients with OCD	72% of the participants experienced a worsening in OCD symptoms. This deterioration was the most prominent in patients with washing compulsions. The worsening of symptoms was associated with reduced mobility and interpersonal conflicts.
Kaveladze et al. (37)	*Cross-sectional study.* Self-report survey (Dimensional Obsessive-Compulsive Scale)	196	71.4%	24.8	USA	June 28–August 10, 2020	Patients with OCD	*Among a sample of adults who participated in online OCD support communities, 93% experienced symptom worsening and 96% stated having OCD made dealing with the pandemic more difficult. Rates of worsening were higher in unacceptable thought, harm, and contamination domains compared with symmetry/completeness*.*

(Continued)

TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Khosravani et al. (27)	*Longitudinal study.* Online, telephone or in-person survey (DOCS, Y-BOCS, CSS)	270	57.4%	36	Iran	Before outbreak. Reevaluation: May –July, 2020	Patients with OCD	Statistically significant increase in OCD severity in all OCD dimensions during the COVID-19 pandemic compared with pre-pandemic levels. COVID-19 related stress associated with increased OCD severity.
Khosravani et al. (38)	*Cross-sectional study.* Self-report survey (CSS, PHQ-4, FCV−19S, C19P–S, SHAI, VOCI, XS, HCQ-54, OCI-R, OCS).	300	58.7%	35.8	Iran	June 1–August 15, 2020	Patients with OCD	*Contamination and checking obsessive-compulsive symptoms were significantly associated with all domains of COVID-19 stress responses, including danger/contamination fears, socio-economic consequences, traumatic stress, xenophobia, and compulsive checking. Patients with OCD had significantly more COVID-related stress in all domains than patients with social anxiety and specific phobias*.*
Khosravani et al. (39)	*Cross-sectional study.* Self-report survey (DOCS, Y-BOCS, CSS, PHQ-4, BSS).	304	58.6%	35.8	Iran	June 5–October 30, 2020	Patients with OCD	*COVID-19-related compulsive checking and traumatic stress mediated the relationships between harm and unacceptable thought symptoms and suicidal ideation. COVID-19-related compulsive checking mediated the relationship between overall OCD severity and suicidal ideation*.*
Pan et al. (40)	*Longitudinal (case-cohort) study.* Online, self-report survey (QIDS, BAI, PSWQ, DJGLS)	1,517	64%	56.1	Netherlands	Before outbreak. Reevaluation: Apr-May, 2020	Patients with OCD, anxiety or depression and controls from the general population	Individuals with OCD, anxiety and depression scored higher on the four-symptom scales compared to healthy controls from the general population both before and during the pandemic. Greater increase in symptoms was observed in healthy individuals.
Rosa-Alcázar et al. (41)	*Cross-sectional, case-control study.* Online, self-report survey (Y-BOCS, HADS, COPE-28)	237	55.7%	33.5	Spain	April 2020	Patients with OCD, and controls from the general population	*Individuals with OCD reported greater use of the following: instrumental support and religion. Individuals with OCD scored higher for self-blame. Within the OCD group, presence of comorbidities was associated with denial, substance use, and self-blame. Overall, results suggest patients living with OCD could benefit from adaptive coping strategies during COVID*.*
Sharma et al. (42)	*Longitudinal study.* Telephone interview (Y-BOCS, MINI, CGI-S, CTS, DSM-5, WSAS)	447	Patients with OCD before the pandemic: 35% Patients with OCD before the pandemic:37%	Patients with OCD before the pandemic: 33.0 Patients with OCD before the pandemic:32.3	India	April 26–May 12, 2020	Patients with OCD before and during the pandemic	No influence of the pandemic was observed on OCD symptoms when comparing patients with OCD during the pandemic with an independent sample of OCD patients before the pandemic. Remission rates among those with OCD were similar before and during the COVID-19 pandemic.

(Continued)

TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Storch et al. (43)	*Cross-sectional study.* Online survey filled by clinicians about their patients. (NIMH-GOCS, Y-BOCS)	232	51%	28.5	USA	July 19–August 2, 2020	Patients with OCD (data reported by their clinicians)	According to clinicians treating OCD patients with ERP before and during the pandemic, 38% of the patients had worsened symptoms, 47% stayed the same, and 10% had improved symptoms. The pandemic likely attenuated the efficacy of ERP therapy.
Toh et al. (44)	*Longitudinal case-control study.* Online, self-report survey (DASS-21, EUROHIS-QoL, OCI-R)	264	89.4%	32.9	Australia	Baseline: April 2020 Follow-up: May 2020	Patients with OCD and controls from the general population	The OCD group reported increased rates of severe depression, anxiety, reduced quality of life, and stress compared to control group between April and May 2020. Obsessive washing and checking did not increase between the two timepoints.
Tundo et al. (45)	*Cross-sectional study.* Self-report survey (SCID-5, HDRS, Y-MANIA-RS, Y-BOCS, PAAAS, BSPS)	386	59.3%	52.0	Italy	March 10–June 30, 2020	Patients with OCD, and patients suffering from other mental illness	*Patients living with OCD, compared to other patients with depression, had a greater worsening of symptoms as a result of the pandemic. Differences were not found compared to other disorders*.*
Wheaton et al. (46)	*Cross-sectional, case-control study.* Self-report survey (CTS, DOCS, DASS-21)	548	Patients: 79.2% Controls: 41.5%	Patients: 32.2 Controls: 38.2	USA	April 1–August 12, 2020	Patients with OCD and controls from the general population	76.2% of patients reported worsening of symptoms, and 58.3% reported COVID-19 becoming a point of their obsession. Concerns about COVID-19 were associated with OCD severity. 59.1% of patients reported COVID-19 interfering with their treatment.
General population samples								
Abba-Aji et al. (47)	*Cross-sectional study.* Online, self-report survey (BOCS, PSS, GAD-7, PHQ-9).	6,041	86.6%	42	Canada	March 23–30, 2020	General population	60.3% developed OCD symptoms during COVID-19 (fear of germs and viruses). Hand-washing compulsions developed in 53.8% of the population. OCD symptoms were associated with moderate/high stress, generalized anxiety disorder, and major depressive disorder.
Albertella et al. (48)	*Cross-sectional study.* Online, self-report survey (mYFAS2.0, IAT, PPCS-6, PGSI, AUDIT, OCI-R).	878	53%	32.0	Australia	May–June, 2020	General population	*Younger age, greater COVID-19-related disruptions, greater psychological distress, and greater pre-COVID OCD were associated with obsessive-compulsive symptom severity*.*
AlHusseini et al. (49)	*Cross-sectional study.* Online, self-report survey (PHQ-9, OCI-R)	2,187	60.5%	N/A (50% aged <35)	Saudi Arabia	N/A (during lockdown)	General population	62.4% of the respondents are likely to have OCD based on the OCI-R questionnaire. Older age, being male, being married, and having higher income were associated with increased OCD symptoms.

(Continued)

TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Cox et al. (50)	*Longitudinal study.* Online, self-report survey. (DASS, ISI, OCI-R)	369	89.1%	47.0	USA	Baseline: 2016 Follow-up: April 1–8, 2020	General public	Increase in washing and hoarding symptoms during COVID-19 pandemic compared to 2016 levels. Other OCD symptoms like ordering, neutralizing, and obsession symptoms did not change. Pre-COVID-19 insomnia was associated with an increased COVID-19 incidence of OCD symptoms.
Damirchi et al. (51)	*Cross-sectional study.* Self-report survey (STS, TDAS, MOCI, Folkman and Lazarus Coping Strategies Inventory)	300	N/A (∼72–79%)	N/A (range 18–54 years)	Iran	January 21–March 19, 2020	General public	*Positive correlations were found between self-talk and problem-centered coping. Inverse relationships between self-talk and emotional coping, death anxiety, and OCD symptoms were also found*.*
De Pietri et al. (52)	*Cross-sectional study.* Self-report survey (HAQ, SAI, CES-D, OCI, BAI)	660	86.2%	31.1	Italy	March 26–April 9, 2020	General public	*Retrospectively rated pre-pandemic obsessing and hoarding factors of the Obsessive-Compulsive Index predicted increased anxiety during the quarantine period*.*
El Othman et al. (53)	*Cross-sectional study.* Self-report survey (PHQ-9, PSS-4, LAS, Y-BOCS)	386	75.9%	31.3	Lebanon	March 29–April 6, 2020	General public	*Higher Y-BOCS compulsion scores were associated with more adherence to recommended hygienic practices, and higher Y-BOCS obsession scores were associated with information avoidance*.*
Fontenelle et al. (54)	*Cross-sectional study.* Online, self-report survey (COROTRAS, DOCS, VOCI-MC, AAI, HRS-SR, MGHHS, SPS-R, DASS-21, WHODAS 2.0, Q-LES-Q-SF, CHIT, BIS)	829	52.6%	38.5	USA	July 29–30, 2020	General public	Statistically significant increase in OCD and related disorders, including body dysmorphic disorder and hoarding disorder compared to before pandemic levels. Based on the DOCS scale, 38.6% of respondents demonstrate severe symptoms of OCD during COVID-19, compared to 15.3% before the pandemic.
Karagöz et al. (55)	*Longitudinal study.* Interviews, self-report survey (BDI, BAI, PI-WSUR)	139	31.7%	55	Turkey	March 20–June 20, 2020	Patients with ST-Elevation Myocardial Infactrion (STEMI)	*Higher contamination-related OCD was associated with delays of 120+ minutes going to the hospital for acute ST-Elevation Myocardial Infarction. Statistically significantly higher OCD subscale scores observed in March-April compared to April-June*.*
Loosen et al. (56)	*Longitudinal study.* Online, self-report survey (PI-WSUR, HADS)	406	57.3%	34	United Kingdom	Baseline: April 24–May 7, 2020 Follow-up: July 15–August 15, 2020	General public	*Contamination OCD symptoms in the general population appeared at similar levels as in previously reported clinical samples. Obsessive-compulsive symptoms increased across the timepoints. Information-seeking predicted increased OCD symptoms*.*

(Continued)

TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Mansfield et al. (57)	*Medical record review (longitudinal design).* Electronic health records (Clinical Research Practice Datalink Aurum).	13% of UK population (~10 M/year)	50%	N/A (aged >11)	United Kingdom	Jan 1, 2017–July 18, 2020	General public	*There were statistically significantly fewer visits for OCD (and all other mental-health conditions) in July 2020, compared with January 2017*.*
Mazza et al. (58)	*Cross-sectional study.* Clinical interview, self-report survey (IES-R, PCL-5, ZSDS, STAI-Y, MOS-SS, WHIIRS, OCI)	402	34.1%	57.8	Italy	April 6–June 9, 2020	COVID-19 survivors from the general public	*20% of COVID-19 survivors reported symptoms of OCD. Duration of hospitalization inversely correlated with the OCI-R*.*
Moreira et al. (59)	*Cross-sectional study.* Online, self-report survey (DASS-21, OCI-R)	1,280	79.8	37.1	Portugal	March 23–31, 2020	General public	*Elevated self-reported OCD was reported in 12% of the sample using the OCI-R. Younger age and education were predictors of obsessive compulsive symptoms. Presence of housemates, pets, or continuing work were not*.*
Mrklas et al. (60)	*Cross-sectional study.* Online, self-report survey (PSS, GAD-7, PHQ-9, BOCS)	8,267	86.2%	N/A (>90% aged >26)	Canada	March 23–May 4, 2020	General public	Self-reported prevalence rates of moderate or high stress, anxiety, and depression were 85.6, 47.0, and 44.0%, respectively. Non-healthcare workers reported higher rates of OCD symptoms compared to healthcare workers.
Munk et al. (61)	Cross-sectional study. Online, self-report survey. (BCI, BDI, SHAI, PHQ, OCI-R, WHO-5, COPE, BRS)	949	79.5%	28.9	Germany	March 27–April 3, 2020	General public	Prevalence of at least one mental-health disorder in the sample was 50.6%. 21.4% of the surveyed population reported OCD symptoms.
Ojalehto et al. (62)	*Cross-sectional study.* Online, self-report survey (CAS, DASS-21, ASI3, DOCS, CSS, BVS).	438	75.3%	30.3	USA	August 27–November 5, 2020	General public	Contamination-related OCD symptoms (DOCS contamination subscale) are statistically significant univariate predictors of COVID-19-related severe anxiety.
Quittkat et al. (63)	*Cross-sectional study.* Online, self-report survey (BDSI, DASS-D, EDE-Q, PHQ, PSWQ-d, SIAS, SPS, WI, Y-BOCS)	2,233	80.7	33.2	Germany	April 2–May 6, 2020	General public	*2.1% of the population self-identified as suffering from OCD. No statistically significant changes in the level of OCD symptoms were found from November 2019 during COVID-19 (rated retrospectively). 36% of those with OCD reported worsening mental health*.*

(Continued)

TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Robillard et al. (64)	*Cross-sectional study.* Online, self-report survey (PSS, DOCS, BRCS)	6,040	70.3%	51.8	Canada	April 3–May 15, 2020	General public	*Obsessive-compulsive symptoms related to germs and contamination were significantly associated with increased stress levels during the outbreak*.*
Samuels et al. (65)	*Cross-sectional study.* Online, self-report survey (Coronavirus Impact Scale, DY-BOCS, SMSPA, OCI-R, PHQ-4)	2,117	54%	46	USA	September 17–30, 2020	General public	COVID-19-related preventive behaviors were associated with contamination obsessions and phobias and an increase in OCD symptoms. 22.2% of responders reported high levels of contamination obsessions and 20.3% reported high levels of contamination phobias.
Wheaton et al. (17)	*Cross-sectional study.* Online, self-report survey (IUS-12, DOCS, SHAI, CTS)	720	50.3%	36.9	USA	March 2–11, 2020	General public.	Positive correlation between OCD symptoms, intolerance of uncertainty, health anxiety, and concerns about COVID-19. DOCS is a statistically significant univariate predictor of intolerance of uncertainty.
Zheng et al. (66)	*Cross-sectional study.* Online, self-report survey (Y-BOCS, SSRS, PSQI)	541	57.5%	N/A (>85% aged <45)	China	July 9–19, 2020	General public	Prevalence of demonstrating OCD symptoms was 18%. 89% of OCD patients had both obsessions and compulsions. Being unmarried, being a student, having a family history of OCD and other mental-health disorders, presence of psychiatric comorbidities, and sleep latency were risk factors for OCD.
Pregnant women								
Xie et al. (67)	*Cross-sectional case-control study.* Self-report survey (SCL90-R, PSQI, FES).	3,346	100%	Before pandemic cohort: 28.9 During pandemic cohort: 29.0	China	Before pandemic cohort: March 1–December 31, 2019 During pandemic cohort: January 1–August 31, 2020	Pregnant women before the pandemic, and pregnant women during the pandemic	*Conflict with family was positively associated with OCD symptoms. No increases in OCD severity were noted among women who were pregnant before vs. during the pandemic*.*
Yassa et al. (19)	*Longitudinal case-control study.* Self-report survey (STAI, MOCI)	304	100%	27.5	Turkey	April, 2020	Pregnant and non-pregnant women	Increased prevalence of OCD (based on high MOCI scores) in 60% of the pregnant women and in 30% of the non-pregnant women during the COVID-19 pandemic. Non-pregnant women demonstrated higher levels of anxiety during the pandemic.
Healthcare workers								
Ahmed et al. (68)	*Cross-sectional study.* Online, self-report survey (BAI, Y-BOCS, BDI-2)	524	57.4%	N/A (>50% aged 31–40 years)	Egypt	May 1–June 1, 2020	Healthcare workers and non-healthcare workers	*7% of healthcare workers self-reported moderate to severe OCD, whereas 3% of non-healthcare workers reported moderate-to-severe OCD. OCD severity was associated with female sex, urban residency, and chronic-disease history*.*

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TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Cai et al. (69)	*Cross-sectional study.* Online, self-report survey (SCL-30, Y-BOCS, SCSQ).	616	63.8%	N/A (~90% aged 19–39 years)	China	February 5–25, 2020	Healthcare workers and non-healthcare workers	*Non-healthcare workers reported statistically significantly more compulsions than healthcare workers*.*
Ergenc et al. (70)	*Cross-sectional study.* Self-report survey (Obsessive-Compulsive Disorders Scale)	198	72%	COVID-group: 35.6 Non-COVID: 33.7	Turkey	N/A	Healthcare workers	Healthcare workers in the COVID-19-section scored higher on OCD, depression, and anxiety scales compared to healthcare workers in other sections.
Juan et al. (71)	*Cross-sectional study.* Online, self-report survey (IES-R, GAD-7, PHQ-9, Y-BOCS, PHQ-15)	456	70.6%	30.7	China	February 1–14, 2020.	Healthcare workers	37.5% of hospital staff experienced symptoms of OCD. Women, those with lower income, and those working on isolation wards had higher rates and more severe OCD symptoms.
Zhang et al. (72)	*Cross-sectional study.* Online, self-report survey (ISI, SCL-90-R, PHQ-4, PHQ-2, GAD-2)	2,182	64.2%	N/A (96.3% aged 18–60)	China	February 19–March 6, 2020	Healthcare workers	Medical health workers had a higher prevalence of insomnia, anxiety, depression, somatization, and OCD symptoms compared to non-medical health workers. Living in rural areas, being at risk of contact with COVID-19 patients, and having organic diseases were risk factors for OCD symptoms.
Zheng et al. (73)	*Cross-sectional study.* Online, self-report survey (PSQI, SCL-90)	207	84.5%	N/A (>60% aged >30)	China	March 1–15, 2020	Healthcare workers	*25.6% of the responding medical workers reported elevated OCD symptoms*.*
Students and young adults								
Abuhmaidan et al. (74)	*Cross-sectional study.* Online, self-report survey (SCL-90-R)	258	76.4%	N/A (91% >20 years)	United Arab Emirates	March, 2020	University students (humanities and science)	The population was characterized by low levels of mental illness. Compared to the other mental health-related dimensions (e.g., depression, anxiety), OCD symptoms were the most severe. Female students and those younger than 20 showed the poorest mental health.
Bahçecioglu et al. (75)	*Cross-sectional study.* Online, self-report survey (OCS, WCI)	628	76.4%	21	Turkey	October 4–17, 2020	University students (nursing)	Nursing students had low levels of obsession with COVID-19, and demonstrated moderate coping skills. On average, female students were more stressed than male students.
Chen et al. (76)	*Cross-sectional study.* Online, self-report survey (CCMD-3, Brief Response Questionnaire)	992	52.8%	19.3	China	March 27, 2020	University students	From a population of young people living in isolation for two months, 6% were categorized as high-risk, 63% were medium-risk, and 31% were low-risk of developing a mental illness. Unhealthy behaviors (e.g., smoking, alcohol consumption) increased the risk for psychological problems. Negative pandemic information increased anxiety, controllability, and vulnerability.

(Continued)

TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Darvishi et al. (77)	*Cross-sectional study.* Self-report survey (MOCI, CEQ)	150	64.7%	16.7	Iran	N/A (before July 2020)	High-school and pre-university students	67% of subjects may have demonstrated OCD symptoms. Prevalence in women is higher than in men (72.1 vs. 60.3%). Washing compulsion is the most common symptom.
Ji et al. (78)	*Longitudinal study.* Online, self-report survey (Y-BOCS, SAS)	13,478	65.4%	21.3	China	Survey 1: February 8, 2020 Survey 2: March 15, 2020 Survey 3: April 30, 2020	University students (medical and non-medical)	Higher prevalence of OCD and anxiety levels in March (11.3%) compared to April (3.6%) and May (3.5%). Male students had higher prevalence of OCD symptoms compared to female students at all timepoints.
Jiang (79)	*Cross-sectional study.* Online, self-report survey (SCL-90)	Participants: 472 Population norm: 12,160	51.9%	N/A (aged 17–22 years)	China	February 10, 2020	University students	Students had increased levels of obsessive behaviors compared with the general population. Students had insufficient knowledge about COVID-19 and demonstrate high-risk perceptions (i.e., high levels of fear of the virus and getting infected).
Knowles et al. (80)	*Longitudinal study.* Self-report survey (PI, OCI-R, CAI, CSBS, IAI, ISBS)	108	75%	19.6	USA	Baseline: January 2020 Follow-up: February 27–March 26, 2020	University students	COVID-19 anxiety and precautionary behaviors were higher than for influenza. Mean levels of OCD washing symptoms increased between January 2020 and March 2020.
Meda et al. (81)	*Longitudinal study.* Self-report survey (BDI-2, BAI, OCI-R, EHQ, EDI-3).	358	79.9%	21.3	Italy	Baseline: October–December, 2019 Follow-up: April–June, 2020	University students	*Scores on the OCI-R were reduced over the course of the pandemic, independent of history of mental-health disorder or the participant's sex. 86% of the students did not experience a worsening of symptoms.**
Wheaton et al. (82)	*Cross-sectional study.* Online, self-report survey (ECS, CTS, DASS-21, OCI-R)	603	87.6%	22.9	USA	April 5–May 13, 2020	University students	*Greater susceptibility to emotion contagion was associated with concerns about COVID-19, depression, anxiety, stress, and OCD symptoms. Emotion contagion moderated relationship between COVID-19-related media consumption and OCD symptoms.**
Children and adolescents								
Cho et al. (83)	*Longitudinal study.* Self-report survey (SHAPS, DTS, CASI, UPPS Impulsive Behavioral Scale, RCADS)	2,120	61.2%	21.2 (at follow-up)	USA	Baseline: 2016 Follow-up: May–August, 2020	Adolescents	*High school students completed substance use assessments in 2016 and again in May-August 2020. Substance use in adolescence did not predict OCD severity in young adulthood during the pandemic.**
McKune et al. (84)	*Cross-sectional study.* Self-report survey.	280	51.8%	N/A (range 5-18)	USA	April 2020	School-age children	*32.1% of the population were at risk and 8.9% at high risk of OCD. OCD symptoms were associated with loss of household income, female sex, and younger age.**

(Continued)

TABLE 1 | Continued

References	Design	Sample size	Females (%)	Mean age	Country	Period	Population	Main findings
Nissen et al. (85)	*Cross-sectional study.* Patient records, self-report survey (Y-BOCS)	102	Clinical group (CG): 63.1% Survey group (SG): 66.7%	Clinical group (CG): 14.9 Survey group (SG): 14.1	Denmark	April–May 2020	Children newly diagnosed with OCD (CG), and children diagnosed with OCD years ago (SG)	Children newly diagnosed or long-term diagnosed with OCD both experienced worsening of OCD, anxiety, depression, and avoidance behavior. Changes in the total OCD severity scores correlated with worsening levels of anxiety and depression. These findings were the most pronounced in children with early onset of ADHD and family history of ADHD.
Seçer et al. (86)	*Cross-sectional study.* Online, self-report survey (OCI-CV, ERS, Depression and Anxiety Scale for Children, Fear of COVID-19 Scale)	598	61.1%	16.4	Turkey	N/A	Adolescents	Increased OCD symptoms in adolescents. Fear of COVID-19 is associated with the development of OCD symptoms and is a predictor of depression- and anxiety-related symptoms. Experiential avoidance mediates the relationship between fear of COVID-19 and OCD symptoms.
Previous pandemics and OCD								
Brand et al. (87)	*Cross-sectional study.* Self-report survey (OCI-R, ASI3, Swine Flu inventory, OBQ-44, DS-R)	393	68%	20.1	USA	November 2009–March 2011	University students	OCD symptoms predicted Swine Flu-related fears. Disgust sensitivity mediated the relationship between both OCD beliefs and OCD symptoms and Swine Flu-related fears.

**Summary extracted or adapted from the systematic review: A.G. Guzick, A. Candelari, A.D. Wiese, S.C. Schneider, W.K. Goodman, and E.A. Storch, Obsessive–Compulsive Disorder During the COVID-19 Pandemic: a Systematic Review. Current psychiatry reports 23 (2021) 1-10.*

AAI, Appearance Anxiety Inventory; ASI3, Anxiety Sensitivity Index-3; AUDIT, Alcohol Use Disorders Identification Test; BAI, Beck Anxiety Inventory; BCI, Behavioral Item Regarding Corona; BDI, Beck-Depression-Inventory; BDSI, Body Dysmorphic Symptoms Inventory; BIS, Barratt Impulsivity Scale; BOCS, Brief Obsessive-Compulsive Scale; BRCS, Brief Resilient Coping Scale; BRS, Brief Resilience Scale; BSPS, Brief Social Phobia Scale; BSS, Beck Scale for Suicidal Ideation; BVS, Body Vigilance Scale; C19P–S, COVID-19 Phobia Scale; CAHSA, Continuum of Auditory Hallucinations – State Assessment; CAI, Coronavirus Anxiety Inventory; CAS, Coronavirus Anxiety Scale; CASI, Childhood Anxiety Sensitivity Index; CCMD-3, Chinese Classification of Mental Disorders; CEQ, Cognitive Errors Questionnaire; CES-D, Center for Epidemiologic Studies Depression Scale; CGI, Clinical Global Impressions; CGI-I, Global Clinical Impression–Improvement; CGI-S, Clinical Global Impression–Severity; CHIT, Cambridge-Chicago Compulsivity Trait Scale; COPE, Coping Survey; COROTRAS, Coronavirus Traumatic and Stressful Life Events Scale; CSBS, Coronavirus Safety Behaviors Scale; CSS, Contamination Cognitions Scale; CSS, COVID Stress Scale; CTS, COVID-19 Threat Scale; DASS, Depression Anxiety Stress Scales; DASS-D, Depression Anxiety Stress Scales – Depression Subscale; DJGLS, De Jong Gierveld Loneliness Scale; DOCS, Dimensional Obsessive Compulsive Scale; DSM-5, The Diagnostic and Statistical Manual of Mental Disorders; DS-R, Disgust Scale-Revised; DTS, Distress Tolerance Scale; DY-BOCS, Dimensional Yale-Brown Obsessive-Compulsive Scale; ECS, Emotion Contagion Scale; EDE-Q, Eating Disorder Examination-Questionnaire – 2nd Edition; EDI-3, Eating Disorder Inventory – 3; EHQ, Eating Habits Questionnaire; ERS, Emotion Reactivity Scale; EUROHIS-QoL, European Health Interview Surveys-Quality of Life; FCV−19S, Fear of COVID-19 Scale; FES, Family Environment Scale; GAD-7/GAD-2, Generalized Anxiety Disorder Assessment; HADS, Hospital Anxiety and Depression Scale; HAQ, Health Anxiety questionnaire; HCQ-54, Health Concerns Questionnaire-54; HDRS, Hamilton Depression Rating Scale; HRS-SR, Hoarding Rating Scale-Self Report; IAI, Influenza Anxiety Inventory; IAT, Young's Internet Addiction Test; IES-R, Impact of Events Scale-Revised; ISBS, Influenza Safety Behavior Scale; ISI, Insomnia Severity Index; IUS-12, Intolerance of Uncertainty Scale; LAS, Lebanese Anxiety Scale; MGHHS, Massachusetts General Hospital Hairpulling Scale; MINI, Mini International Neuropsychiatric Interview; MOCI, Maudsley Obsessive-Compulsive Inventory; MOS-SS, Medical Outcomes Study Sleep Scale; mYFAS2.0, Modified Yale Food Addiction Scale 2.0; N/A, Not available information; NIMH-GOCS, National Institute of Mental Health Global Obsessive Compulsive Scale; OBQ-44, Obsessional Beliefs Questionnaire-44; OCI-CV, Obsessive Compulsive Inventory – Child Version; OCI-CV, Obsessive Compulsive Inventory–Child Version; OCI-R, Obsessive-Compulsive Inventory-Revised; OCS, Obsession with COVID-19 Scale; PAAAS, Panic Attack and Anticipatory Anxiety Scale; PCL-5, PTSD Checklist for DSM-5; PGSI, Problem Gambling Severity Index; PHQ-2/PHQ-4/PHQ-9/PHQ-15, Patient Health Questionnaire; PI, Padua Inventory; PI-WSUR, Padua Inventory-Washington State University Revision; PPCS-6, Short Version of the Problematic Pornography Consumption Scale; PSQI, Pittsburgh Sleep Quality Index; PSS, Perceived Stress Scale; PSWQ/ PSWQ-d, Penn State Worry Questionnaire; QIDS, Quick Inventory of Depressive Symptoms; Q-LES-Q-SF, Quality of Life, Enjoyment, and Satisfaction Questionnaire-Short Form; RCADS, Revised Children's Anxiety and Depression Scales; SAI, Social Anxiety Inventory; SAS, Zung Self-Rating Anxiety Scale; SCID-5, Structured Clinical Interview for DSM-5; SCL-30, Symptom Check List-30; SCL90-R, Symptom Checklist-90 Revised; SCSQ, Simplified Coping Style Questionnaire; SHAI, Short Health Anxiety Inventory; SHAPS, Snaith Hamilton Pleasure Capacity Scale; SIAS, Social Interaction Anxiety Scale; SMSPA, Severity Measure for Specific Phobia–Adult; SPS, Social Phobia Scale; SPS-R, Skin Picking Scale-Revised; SSRS, Social Support Rating Scale; STAI/ STAI-Y, The State-Trait Anxiety Inventory; STS, Self-Talk Scale; TDAS, Templer Death Anxiety Scale; UPPS, UPPS Impulsive Behavioral Scale; VAS, Visual Analog Scale; VOCI-MC, Vancouver Obsessional Compulsive Inventory – Mental Contamination; VOCI-MC, Vancouver Obsessional Compulsive Inventory; WCI, Ways of Coping Inventory; WHIIRS, Women's Health Initiative Insomnia Rating Scale; WHO-5, Well-being Index; WHODAS 2.0, World Health Organization Disability Assessment Schedule 2.0; WI, Whitely Index; WSAS, Work and Social Adjustment Scale; XS, xenophobia scale; Y-BOCS, Yale-Brown Obsessive-Compulsive Scale; Y-MANIA, Y-MANIA Rating Scales; Y-MANIA-RS, Y-MANIA Rating Scales; ZSDS, Zung Self-Rating Depression Scale.

(89). We were unable to identify comprehensive studies on the prevalence of OCD globally or nationwide since the pandemic started. Only the prevalence of OCD (or its symptoms) in specific demographic groups and specific nationalities has been investigated so far and, as it is discussed in the following section, research shows a tendency towards increased OCD symptoms in all investigated demographic groups.

In 2020, Zheng et al. (66) investigated the prevalence of OCD symptoms in Wuhan, China. In July, three months after reopening after lockdown, 17.93% of the investigated population had symptoms of OCD, but unfortunately there was no pre-pandemic statistic for comparison. While this figure is certainly higher compared to the estimated 1.2% OCD prevalence in the U.S. population, a significantly larger percentage of populations (14–29%) has been shown to demonstrate mild symptoms of OCD even prior to the pandemic (24). The study found that being single, student, having comorbid mental disorders, family history of OCD, and sleep latency were all associated with OCD.

In Iran, Khosravani et al. (27) found increased levels of OCD severity when comparing pre-pandemic and pandemic levels in patients diagnosed with OCD prior to the pandemic. The results of the study indicated that the increased severity of OCD symptoms was primarily was primarily due to stress induced by the current pandemic.

A study by Munk et al. (61) found a higher prevalence of OCD symptoms in Germany during the first weeks of the pandemic (March, 2020) compared to the reported prevalence pre-pandemic; 21.4% of the participants expressed clinically-significant OCD symptoms during the pandemic compared to 3.6% reported in the general population. Prevalence of depression and general anxiety disorder were also significantly higher than what was reported in the general population, which again indicates an overall initial stress response to the pandemic.

In India, Sharma et al. investigated relapse rates in individuals diagnosed with OCD prior to the pandemic compared to a control group (42). The authors did not find worsening in severity of illness nor did they find increased relapse rates. Also, very few patients developed COVID-19-related OCD symptoms. They argue that this might be because data collection was conducted relatively early in the pandemic (April-May, 2020), that patients were already on medication, and/or that the lockdown and various restrictions and recommendations might have limited their exposure to COVID-19 (42).

With regards to the etiology of OCD during COVID-19, many articles in our review report various risk factors that triggered OCD symptoms during the current pandemic (16, 71, 74, 75, 77). Banerjee (16) lists seven factors that may play a role in the worsening of OCD symptoms: 1. an increased demand for hand-washing; 2. recommended hand-washing steps that may reinforce ritualistic patterns; 3. recommended hand-washing after suspected exposures, which may provide cognitive justification; 4. the prompting of family to ensure strict hygiene measures; 5. the media's regular reporting of possible sources of contamination; 6. increased ruminations and repeated washing, which can become normalized during the pandemic; and 7. stocking protective equipment and disinfectants, which may increase hoarding symptoms (16).

An interesting point by Banerjee is that in previous pandemics like Severe Acute Respiratory Syndrome (SARS), Middle Eastern Respiratory Syndrome (MERS), and influenza, the worsening of OCD symptoms has advanced up to 6–12 months *after* the end of the outbreak. They argue that symptoms might not be evident during a pandemic due to under-detection and alternate public-health priorities. As several studies in our review suggested, some patients with OCD may not seek treatment and follow-up meetings because of fear of contamination, stigma, or lack of knowledge about what is excessive cleaning/washing; this is a possible explanation for an increase in their symptoms (27, 90). The largest study identified in our review by Mansfield et al. (57), which investigated electronic health records of millions of individuals from the United Kingdom before and during the pandemic, also observed fewer visits related to OCD during the pandemic compared to the years before. Thus, it is important that clinicians follow up with patients who have been previously diagnosed with OCD but who are not in active treatment. As the COVID-19 pandemic is still active, it is quite possible that we will see an increase in OCD incidence once the pandemic has ceased.

Worsening of OCD in Specific Demographic Groups and Personal Characteristics

Two letters (10, 91) report that responses from patients with OCD have been varied; some people experience increased anxiety while others feel validated in their concerns and/or reassured by the strict guidelines (10). Based on such findings, Perkes et al. argue that the recommended measures may be more stressful to those without OCD compared to individuals who are already accustomed to these practices (91).

In the 16 research articles on the effects of COVID-19 on *patients diagnosed with OCD prior to the pandemic*, the clinical landscape has been more homogenous; most of these articles found a clinically significant increase in OCD symptomatology in patients suffering from OCD (27, 32, 33, 35–38, 45, 46). However, some articles did not, or reported mixed results (34, 40, 42–44). The findings from these studies suggest that the COVID-19 pandemic represents a stressor for many individuals with OCD resulting in increased OCD symptoms, although not all of the studies identified in our search fully support this notion. For example, in some patients with clinical worsening of OCD symptoms, their symptoms were only a part of a larger clinical impairment (33). Of all the previously characterized subgroups of individuals with OCD, *those with washing and cleaning compulsions* have had the most severe impairment during the current pandemic (33, 36, 47, 77, 79, 80). Research indicates that COVID-19-related stress was also associated with increased OCD severity (27) and that, compared to the general population, individuals with OCD were more likely to have moderate/high stress, general anxiety disorder, and depression (47, 78).

When investigating OCD symptoms among the general population, some studies (17, 50, 61, 66) found a small increase in OCD symptoms after the pandemic's initial outbreak, with hand-washing symptoms and contamination obsessions being predominant. The results of these studies indicate that many

aspects of OCD remain unaffected by the COVID-19 pandemic, at least among the general population. However, there may also be an increased prevalence of other mental-health disorders; this indicates that not only are certain at-risk groups under psychological distress but also that the pandemic is affecting all groups of society (61, 66). This is supported by the majority of studies of students and young adults, which generally showed a complex influence of COVID-19 on mental health. Although not all of these studies indicated an increase in OCD symptoms, they generally indicated that the young adults' mental health did in fact decline (74–80).

Several studies found that *pregnant women and medical workers* are more susceptible to OCD symptoms compared to the general public (71, 72, 92). A number of studies found an increase in obsessive-compulsive symptoms and anxiety levels among pregnant women and healthcare workers (19, 70–72). These results highlight the necessity of adequate working conditions and recovery programs so that medical workers may progress toward improved psychological wellbeing as well as an increased focus on the mental health of pregnant women (70–72).

Children and adolescents were also identified as a risk group. Research indicates an association between negative and traumatic childhood experiences and OCD symptoms in adulthood (93). The adverse experiences during the current pandemic may have an immediate negative impact on children and adolescents both with and without OCD, especially among those with early age of onset and a family history of psychiatric disorders (85, 86). Reactions seemed to be more severe if the child did not have access to a psychiatric facility. These effects carry a high risk of long-term consequences for the individuals affected (93); hence, we believe that this at-risk group needs closer attention and further research.

Even though good hand hygiene was one of the first precautionary behaviors consistently recommended by multiple national governments, none of the studies we identified examined the physical consequences of OCD with regards to *compulsive hand-washing*. Nor did any studies examine the physical consequences of excessive *hand sanitizing*. Studies published prior to the COVID-19 pandemic have shown that compulsive hand-washing often induces severe skin damage and hand eczema (94, 95). As such, there is often a high burden in the field of dermatology due to patients with obsessive hand-washing and fear of contamination. Some of the research suggests that recommendations for good hygiene provide patients with cognitive justification, which consequently results in cases of hand eczema (16, 95). Moreover, Xerfan et al. (94) suggest an interaction between hand eczema, sleep disturbances, and OCD. Research prior to the current pandemic has also reported a link between sleep disturbances and OCD, either directly or indirectly via other mental-health disorders. These findings align with our findings from the literature during the current pandemic, in which sleep disturbances may also be associated with OCD symptoms (50, 66).

The six case reports included in our review provide examples of how individuals with OCD may react to their circumstances during the current pandemic; we chose to include these reports in our systematic review to exemplify how the pandemic might have impacted individuals living with OCD. Several of these reports (4, 96–98) reported an exacerbation of symptoms in patients diagnosed with OCD. The main symptoms were self-isolation, avoidance of certain foods, and excessive hand-washing, and cleaning. In the most severe cases (4, 96), individuals reported panic symptoms and suicidal ideation or attempts. Previous studies have suggested that, of all OCD symptoms, patients with predominant contamination obsessions and compulsive cleaning tend to exhibit the highest rates of suicidality (99). In all of the case reports, patients benefitted from a combination of pharmaceutical and psychological treatment in healthcare facilities. Nevertheless, these reports are a warning that patients with OCD should be more closely monitored to prevent severe mental-health consequences from the pandemic.

Two of the case reports described possible improvements of OCD symptoms during the pandemic; in the case report by Conrad et al. (40), five adolescent female patients diagnosed with OCD attended an experiment without a control group consisting of cognitive-behavioral group therapy for a period of 12 weeks in the U.S. With social support, education about OCD symptoms, coping, and adaptions during lockdown, these patients recovered and improved their outcomes during the therapy. In the report by Kuckertz et al. (47), eight OCD patients in a residential treatment program reported various experiences. None of them had a significant decline in their quality of life during the pandemic; in fact, most patients experienced an improvement of their symptoms.

It is worth noting that, in these small interventions, patients with close, continuing contact with healthcare providers seemed to be more resilient and more equipped to meet the challenges posed by the pandemic. In contrast, those patients who experienced an acute exacerbation of their OCD symptoms were typically those who had been diagnosed prior to the pandemic or those who did not receive regular follow-ups and support from healthcare professionals.

Only one study from a previous pandemic (the H1N1 "Swine Flu" pandemic) examined the effects of pandemics on OCD symptomatology. Brand et al. (87) found a relationship between OCD symptoms and a fear of the Swine Flu. However, the authors did not specifically evaluate the effects of the pandemic on the worsening of symptoms in individuals with OCD, nor the rates of OCD.

The Management of OCD During Pandemics

Fontenelle et al. (100) hypothesize that cognitive behavior therapy (CBT) with Exposure and Response Prevention (ERP) may clash with the public-health recommendations regarding hygiene and protective equipment during the current pandemic, as an active element of ERP is to expose patients to feared objects. Storch et al. (43) oppose this, stating that empirical support for the abovementioned standpoint is lacking, and that there are no negative consequences of ERP during COVID-19; however, the authors acknowledge that ERP treatment needs to be adjusted to the current situation. They suggest that clinicians should continue to assess compulsions and obsessions, and that exposures should target *excessive* rituals from core obsessions, which are most often not COVID-19-related (43). Some clinicians have advised that ERP therapy should be

conducted online, although the effects of such interventions are yet to be examined (10, 43, 100). In cases of a fear of COVID-19 itself, when planning treatment, clinicians will likely need to weigh the risks of contracting COVID-19 vs. the benefits of overcoming OCD (101). To educate patients on common symptoms and to prevent obsessions and compulsions, Farhan et al. (22) proposed the utilization of an innovative online chatbot. Many clinicians encourage educating both individuals with OCD and the general public in stress management (10, 61, 66).

Various other treatment strategies have been investigated and/or proposed. Chen et al. (66) proposed a six-step intervention strategy, namely: 1. Deliver positive information about the pandemic in order to reduce the abnormally increased risk perception among individuals with OCD; 2. Reduce negative behavioral responses to stress that may worsen OCD symptoms (e.g., smoking, drinking, over-eating, and taking medications); 3. Educate individuals at-risk of OCD about stress management; 4. Improve family relationships and community support; 5. Increase positive behaviors like being active, working, or studying; and 6. Adjust expectations to relieve stress. Treatment should be individually tailored; i.e., when treating individuals with OCD, some—or all—of these steps could be implemented, depending on the severity of symptoms.

When it comes to treatment, many articles advise following the clinical guidelines proposed by Fineberg et al. (10). These guidelines were written by a working group of clinical experts based on empirical evidence, and they emphasize the importance of focusing on resilience and interventions that maintain a calm attitude, build community, and sustain hope (**Figure 2**). However, Farhan et al. (22) were skeptical of these guidelines, arguing that they are of little help in reality due to limited resources, high cost, and a lack of therapists in many countries worldwide. According to these authors, some of the public-health recommendations and preventive measures implemented during the pandemic have been mostly targeted at healthy people, and ambiguous terminology may worsen symptoms in individuals with OCD. They also provide an example: "*The US Centers for Disease Control and Prevention recommends washing hands for at least 20 seconds and disinfecting surfaces daily, whereas WHO suggests cleaning hands regularly and thoroughly.*" As individuals with OCD often overestimate risks, recommendations on hygiene should be precise and with limits.

Several studies in our review warn about the aftermath of the current pandemic. As there is often latency in diagnosis, consecutively worsening prognosis, and resistance to treatment, early identification and prevention of OCD symptoms is of the utmost importance (18). Pozza et al. suggest that early intervention may be especially helpful for individuals with sub-threshold OCD symptoms (18). People at-risk need to receive education about the COVID-19 virus as well as information that the public-health authorities' recommendations are *sufficient* and that excessive behaviors do not further reduce risk (102). While no current evidence suggests that there will be an increase in OCD patients after the pandemic, helping the general population to identify warning signs of OCD (e.g., in close relatives and friends) might be useful for prevention (101).

Limitations and Knowledge Gaps

The literature on changes in OCD symptoms during the COVID-19 pandemic is still limited, and the studies included in our review have several limitations as revealed by the quality assessment (**Supplementary Table 1**).

First, the majority of the identified studies (76%, 45/59) are cross-sectional in nature and data were collected during the first months of the pandemic. Due to cross-sectional designs, most of the studies revealed statistical associations that are unable to demonstrate causal relationships (70, 74, 86). Of note, several studies are planning longitudinal follow-ups of their populations. Further longitudinal studies are warranted to examine the long-term effects of public-health recommendations related to the COVID-19 pandemic on OCD symptoms.

Second, apart from one article, most studies (98%, 58/59) included self-reported questionnaires as the means to assess outcomes; this data-collection method reduces accuracy and likely biases the results compared to data collection *via*, e.g., structural clinical interviews. As one study stated, it is possible that individuals with OCD were more likely to participate in some of the studies during the pandemic, potentially overestimating their own symptoms (36). Furthermore, an increase in OCD symptoms likely reflects the real threat of the SARS-CoV-2 virus, and not necessarily obsessive-compulsive trends in the populations (47).

Third, there is a lack of comprehensive and comparative assessments of incidence rates of OCD in populations before and during the COVID-19 pandemic. We were unable to identify recent statistics on the prevalence or incidence of OCD globally. Furthermore, most of the current research studies on the prevalence of OCD or its symptoms after the COVID-19 outbreak in certain demographic groups do not report pre-pandemic statistics for comparison. Hence, it is difficult to reach conclusions on the effect of the pandemic on the incidence of OCD cases in populations.

Fourth, enrollment in some of the studies (42, 80, 85) occurred over a longer period, resulting in heterogeneous study populations. While these populations allow for a wider generalizability of results, more focused studies are needed to gain a complete understanding about key aspects of OCD pathophysiology during the current pandemic. Related to this point, further studies will need to include a broad variety of demographic groups—cross-cultural and multinational—in order to gain more extensive and generalizable knowledge on general populations and OCD during the COVID-19 pandemic. Only three out of all articles analyzed representative samples or took measures to ensure representative samples of the underlying populations; conversely, most studies (95%, 56/59) did not utilize representative samples. This review has examined studies focusing on several at-risk subpopulations during the pandemic: patients with pre-existing OCD, children, adolescents, and pregnant women. However, we did not identify any articles that investigated OCD symptomatology specifically in older populations, another key high-risk group.

Last, most articles reviewed in this study investigate contamination-related OCD symptoms and were less focused on other types of OCD. Further research is warranted on less studied clinical manifestations.

Clinical guidelines according to Fineberg, N. A. *et al., Comprehensive Psychiatry (2020)*

1. Use a compassionate, calming approach. Use telemedicine in areas where it is possible.
2. Careful history taking. Confirm diagnosis. Clarify the extent to which symptoms represent rational or exaggerated relations. Establish level of insight from patient. The concerns are often idiosyncratic. Assess comorbidities.
3. Assess suicidal risk.
4. Provide psychoeducation with balanced information about know risks and impact of COVID-19 on physical and mental health.
5. Enquire about media consumption. Offer a balanced approach and suggest trusted sources.
6. If OCD symptoms are the main problem: Review medication status, review and risk assess the CBT plan, help with social and occupational care, provide career support. Have regular follow-ups by the therapists. Establish a daily routine.

FIGURE 2 | Clinical guidelines for the treatment of obsessive-compulsive disorder during the COVID-19 pandemic.

As with most systematic reviews, there is a risk that relevant articles were missed. To mitigate this risk, two authors (ESL and TVV) scanned the literature and read all titles and abstracts to narrow down the search results to those articles that were read in full. During the drafting phase, another systematic review on OCD and COVID-19 was published (31); we incorporated all of the original research articles identified by these authors and their key findings in this report. We also acknowledge that scientific literature related to the COVID-19 pandemic is rapidly accumulating; thus, since conducting our final search, it is likely that additional research has been published that might nuance our findings or address the knowledge gaps we identified above.

CONCLUSIONS

Despite increased focus on OCD during this pandemic, literature is still limited. A recently released systematic review on various aspects of OCD during the COVID-19 pandemic highlights the exacerbation of OCD-related symptoms and the emergence of new symptoms during the pandemic. Most important, it emphasizes the importance of continuing established evidence-based therapies during the pandemic (31). We add to this body of evidence by our review of the literature; current evidence from research articles suggests that both people with and without OCD prior to the pandemic show increased symptoms of OCD during the COVID-19 pandemic. High-risk groups include OCD patients in remission/recovery, geriatrics, pregnant women, children and adolescents, and healthcare professionals. Of all demographic groups included in the articles, individuals with diagnosed OCD prior to the pandemic with hand-washing and cleaning compulsions have had the most severe impairment during the pandemic.

To prevent worsening of symptoms in OCD patients, clinicians are encouraged to check in with their patients and adjust treatment based on the specific needs of the patient. As early intervention is key to prevent new cases, the articles suggest the need for sufficient education of the general population on both stress management, OCD symptoms, and on the COVID-19 pandemic.

OCD is an extremely heterogeneous and complex disorder. While not all individuals are affected negatively by the current conditions, most of our results show a worsening of OCD symptoms in the examined populations. The time frame makes any conclusion even more complex, since OCD develops and presents itself slowly. Due to the acute nature of COVID-19, and because the pandemic is still ongoing, we do not yet have long term data on the putative effects of the pandemic and its associated lockdowns. Multinational and cross-cultural, longitudinal studies are warranted to address the extensive remaining knowledge gaps.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

EL drafted the article. EL and TV conducted the article search. TV conducted the quality assessment. TV and AC provided supervision and edited the article. All authors approved the final version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.806872/full#supplementary-material

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The Right to Health: COVID-19 Pandemic and the Opportunity to Transform Mental Health Inequalities in Indonesia

Gina Anindyajati[1†], Diashati Ramadhani Mardiasmo[2†], Laras Sekarasih[3], Damar Susilaradeya[2,4], Bagus Takwin[3], Dicky C. Pelupessy[3] and Hervita Diatri[1]*

[1] Department of Psychiatry, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia, [2] Medical Technology Cluster, Indonesia Medical Education and Research Institute, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia, [3] Faculty of Psychology, Universitas Indonesia, Depok, Indonesia, [4] Department of Physiology and Biophysics, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia

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***Correspondence:**
Diashati Ramadhani Mardiasmo
diashati.ramadhani.mardiasmo@gmail.com

[†]These authors share first authorship

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The COVID-19 pandemic has caused major catastrophes worldwide. In Indonesia, the pandemic has caused greater barriers for individuals to access mental health services. This article aims to capture the state of public mental health in Indonesia using data from various national surveys. Four main problems were identified: the increase in depression, loneliness, and distress in the general population, disruption in accessing mental health services, mental health problems among vulnerable populations, and the limited scope of available mental health services and facilities in the community. This article provided practical recommendations for the Indonesian government that focuses on preparing a resilient mental healthcare system for future crises, reducing barriers to access mental health services, and expanding the available resources and programs to ensure equal and sustainable access to mental health services in the community.

Keywords: COVID-19, pandemic, Indonesia, mental health service, psychosocial support

INTRODUCTION

As the largest diverse archipelagic country and the fourth most populous country in the world, Indonesia faces unique challenges in controlling the COVID-19 pandemic (1). First, as a low-level resource country in the southeast Asia region, tremendous efforts are required to keep the number of active cases and virus transmission low. Before the pandemic, the physician to population ratio was lower than the internationally recommended ratio. Moreover, the ratio of hospital beds to population remained below WHO standards and trails behind neighboring countries (2). The archipelago also requires connectivity to distribute medical supplies and the COVID-19 vaccines to different parts of Indonesia. The country's geographical position has also put Indonesia at risk for natural disasters, 2,059 natural disasters were recorded between January and September 2020, creating another layer of complexity in managing the COVID-19 pandemic (3). Second, the pandemic has shown to throttle Indonesia's economic growth as Indonesia went from upper-middle income to lower-middle income status and the national unemployment rate has remained at a high 6.49% percent in August 2021 (1, 4). The uncertainty the pandemic poses with the rise and fall of cases, changes in restriction policies as well as the economic stress, not only has introduced risks at the societal level, but also at the individual level.

One of the challenges that seems to be less overt than the physical and financial stress among Indonesians is mental health problems (5, 6). The requirement for physical distancing and limited spatial mobility during the pandemic, while crucial in slowing down the virus transmission, have created some constraints for individuals to maintain their psychological wellbeing. The third phase of COVID-19 vaccination rollout included people with mental illnesses and the Indonesian government even provided door-to-door vaccination services to people who were severely mentally ill however, this was still insufficient in facilitating routine access for their recovery (7, 8). Unfortunately, equal and affordable access to mental health facilities remains one of the issues in many parts of Indonesia, even among individuals residing in the country's major cities.

This perspective is written based on a collaborative work between mental health professionals, academics, and administrators with broad expertise on mental health and public health. The objective of this perspective is to identify priority issues in mental health and provide specific recommendation to anticipate the effect of COVID-19 pandemic toward Indonesia's mental health system.

MAIN ISSUES

This section provides our report on priority issues regarding the burden of mental health problems in Indonesia during COVID-19 pandemic.

High Proportion of Depression, Distress, and Loneliness

Proportion of depressive symptoms between March and May 2020 during the pandemic reached 35%, 5–6x higher than the current incidence of depression in Indonesia and 1.5x higher than depression rates seen in other (non-pandemic) disasters (9–11). Periods of quarantine and self-isolation causes loneliness and a sense of deprivation which can lead to suicidal thoughts. According to Indonesian Psychiatric Association (May 2020), mental health issues was observed highest among 17–29 years old and >60 years old (12). They observed suicidal thoughts in 49% of respondents who showed depressive symptoms. A year later, numbers were still reportedly high (39.3%) (13). Fluctuations in social restriction policies may also contribute to anxiety and loneliness. A nationwide survey in November 2020 by Universitas Indonesia Big Data Synergy Against COVID-9 Team found 42.4% of participants felt lonelier since the pandemic (14). In Mei 2021, Into the Light Indonesia reported almost double the number (13), 98% of participants experienced loneliness within the past month.

The pandemic has taken a mental toll on HCWs. Moderate-severe burnout syndrome was found in 83% of Indonesian HCWs, 41% had moderate-severe emotional fatigue, 22% had moderate-severe loss of empathy, and 52% had moderate-severe loss of confidence (15). Compared to pre-pandemic, these numbers have doubled (16–18). Data regarding prevalence of burnout among HCWs pre-pandemic is very limited. A survey by KOMPAS (local newspaper) identified financial stress as the highest (57.6%) type of distress caused by the pandemic, most likely due to a surge in unemployment and a decrease in income (14, 19). In addition, sleeping difficulties are common during the pandemic and a high prevalence was observed in COVID-19 patients (57%) (20). The pandemic has limited opportunities to engage in physical activities due to the state-mandated requirement to stay at home. Both sleeping difficulties and lack of physical activity were associated with depression and anxiety (20, 21). Dynamic changes in living circumstances, policy fluctuations, health uncertainties, and financial burden brought on by the pandemic has resulted in high levels of depression, distress, and loneliness.

Disruption of Mental Health Services

During the COVID-19 pandemic, a series of mental, neurological, and substance (MNS) related services such as psychotherapy, counseling, mental health interventions, suicide prevention programs, and many others have been completely or partially disrupted in 93% of countries worldwide (22). In Indonesia, one of the main issues is difficulty in accessing healthcare facilities for mentally ill people. Data from 2018 showed a shortage of mental health facilities. Of 9,000 primary-care facilities throughout Indonesia, only 40% have operational mental health programs (23). Only 60% of all hospitals have mental health programs and 6 out of 34 provinces in Indonesia do not have a psychiatric hospital (24). At Dr. Cipto Mangunkusumo General Hospital, a national referral tertiary hospital, quota for psychiatry ward and psychiatry outpatient clinic were significantly reduced during COVID-19 surge e.g., in the psychiatry ward, 24 beds were reduced to 2 and in the outpatient clinic, only 20 patients/day were allowed (adult and geriatric patients combined). This was done to maintain physical distance and as a result of resource allocation to COVID-19 unit (beds, nurses, and resident doctors). At primary-care facilities, general practitioners, and community leaders have not been able to conduct home-visits, consequently severely mentally ill patients who relied on these home-visits for routine check-ups and monthly prescriptions, have had their treatments halted.

People with mental illnesses are at a higher risk for transmitting COVID-19 due to numerous factors such as: (1) self-care limitations (poor hygiene and unhealthy lifestyle); (2) co-morbidities e.g., diabetes; (3) densely populated living environment poses social distancing challenges. One study showed that people with depression and schizophrenia were 7 times more likely to be infected with COVID-19 (25). Those with mental disorders were also associated with an increased risk of hospitalization and COVID-19 mortality (26, 27). On top of all this, mental-illness related stigmatization acts as a barrier to mental health as well as healthcare services in general (28, 29). Thus, these disruptions are disastrous as the need for mental health services during the pandemic is higher than ever.

Increased Mental Health Issues Among the Diverse Vulnerable Population

Sandwich generation refers to a group of people (usually working population) who simultaneously care for their children and aging parents, causing immense emotional distress during the

COVID-19 pandemic, thereby rendering them vulnerable to mental health problems. The pandemic increases the risk of domestic conflict, divorce, elderly, and child abuse. Victims of abuse may feel unsafe at home so they desperately opt to "escape" their homes despite the risk of COVID-19 transmission. Children and adolescents are vulnerable to mental health issues as the pandemic has caused significant learning as well as social changes, since it now heavily relies on technology. Marginalized young people are a community of young adults who are usually homeless, LGBTQ+, disabled, and/or HIV positive. They live in such poor conditions and are already prone to mental health issues, therefore the pandemic only exacerbates their problems. More than half of Indonesian marginalized youths from sexual minority groups (intersex, transgender, non-binary, non-heterosexual) were reported have suicidal and self-harm thoughts (13). One Indonesian study found particular individuals were more vulnerable to anxiety, including those younger in age, of the female sex, suspected COVID-19 infection, and lack adequate social support (30). Lastly, within the geriatric population, apart from feelings of loneliness and abandonment, periods of quarantine can also worsen cognitive function (31). Those among the vulnerable population are already susceptible to mental health problems and the pandemic has amplified their susceptibility.

Limited Scope of Mental Health Services Within the Community

In Indonesia, identification of mental health issues does not reach all varying layers of society due to lack of access to independent mental health assessment. Current mental health assessment utilizes psychological self-assessment online questionnaire which is not equipped with an adequate referral system (http://pdskji.org/home). Moreover, current healthcare services have failed to integrate both mental and physical aspects of health as well as community-based mental health services, contributing to the limited scope of mental health services in Indonesia.

During the COVID-19 pandemic, the dynamic of mental health services has shifted from in person counseling to e-counseling (telemedicine) due to social restrictions. As of May 2021, 68% of people access mental health services through a phone application or via website (13). Although the new norm of voice and video call consultation is deemed acceptable, its practical use is limited. Those who are digitally illiterate, have no stable internet connection and/or a smartphone, are at a disadvantage. Another important issue is telemedicine services not covered by JKN (National Health Insurance), therefore patients may be discouraged from using telemedicine. Other issues include shorter consultation period, lack of physical examination (e.g., examinations to assess anti-psychotic side effects) and troubles with tele-pharmacy (i.e., inter-province prescription writing is prohibited). A survey by Department of Psychiatry, Universitas Indonesia (32) revealed these mental health service changes were perceived as "less convenient" for patients.

Moreover, misperceptions and poor knowledge regarding mental health issues are common among Indonesian. Into the Light Indonesia found 7 out of 10 respondents admitted to not knowing that mental health expenses were covered by BPJS (Healthcare Social Security Agency) and 3 out of 5 respondents did not know there were mental health facilities within their sub-district (13). Additionally, none of the respondent was able to correctly answer questions regarding suicide facts and myths. All of these key points contribute to the limited scope of mental health services in Indonesia.

RECOMMENDATIONS

In this section we outline recommendations to improve access to mental health services and ensuring its continuity for people who need it the most.

Preventing a Mental Health Crisis During and After COVID-19 Pandemic

Prevention of mental health crisis is not solely the responsibility of Ministry of Health. Mental health service is bigger than just healthcare, therefore to deal with such concerns, it will need collaboration between COVID-19 taskforce, Ministry of Health, Coordinating Ministry for Economic Affairs, Ministry of Communication and Information Technology, Coordinating Ministry for Human Development and Cultural Affairs, and BPJS (Healthcare Social Security Agency). Based on the problems listed above, it is recommended to:

- Conduct periodic surveillance on the impact of COVID-19 on mental health issues and its effects toward productivity, work performance, economic wellbeing and social security.
- Conduct surveillance on mental health resources within all types of healthcare facilities.
- Provide digital access to those self-isolating both at home or at a healthcare facility (33, 34) so they have access to relevant information and can continue to communicate with family and friends as well as consult with healthcare professionals online.
- Increase the number of primary-care facilities with operational mental health programs.
- Develop a "Psychosocial and Mental Health Support Team" which includes trained personnel and medical professionals that creates and assists with long term support programs (35, 36); inclusive for the general population and HCWs, easily accessible and inter-connected from sub-district to provincial level.

Ensuring Continued Services to Mentally Ill Patients

Lack of access during the pandemic has caused disruption of mental health services. Continuity of care is especially critical for mentally ill patients as it prevents decompensation and other consequences (37). Therefore, it is essential to ensure that people with mental illness can access mental health services (38). COVID-19 taskforce and Ministry of Health should collaborate to:

- Provide telemedicine and hotline crisis services (39, 40).

- Ensure stable patients receive enough medication for 2–3 months.
- Provide a system in place for patients who were lost to follow up so they still receive medication.
- Ensure availability of medication in accordance with national formulary standard.

As for COVID-19 prevention, it is crucial ensure that each patient with severe mental illnesses, receive the standard of care by providing them with information on COVID-19 health precautions, educating them on the importance of family and community support to prevent COVID-19 infection, and having community leaders and/or HCWs reach out to them directly.

Providing Psychosocial and Mental Health Support to the Working Population and Other Vulnerable Population

It is important to ensure the provision of psychosocial and mental health support to all during COVID-19 pandemic (41). It is considered particularly important to provide such support for the working population, people living with HIV/AIDS, children and adolescents, elderly, women, and marginalized young people due to their high exposure to stress (26, 42). Collaboration between COVID-19 taskforce, Coordinating Ministry for Economic Affairs, and Coordinating Ministry for Human Development and Cultural Affairs is required in order to:

- Ensure social security networks are active and working effectively.
- Provide psychosocial support to those who struggle to adapt with working from home/online school and evaluate its effect on their mental wellbeing.
- Develop a guidebook that focuses on how to develop better interpersonal, self-regulation, and communication skills to facilitate the challenges of quarantine.

Expanding the Scope of Mental Health Services Within the Community

Considering the shortage of mental health facilities, unequal distribution of competent resources, failure to integrate both mental and physical aspects of health as well as community-based mental health services, it is necessary to develop strategies to expand the scope of mental health services within the community. Several recommendations include:

- Provide access to integrate both physical and mental health services, which consists of assessment for anxiety and depression. This access should be in accordance with clinical practice guidelines and should utilize professional and competent human resource. This access should also facilitate online and offline referral systems.
- Provide psychological and emotional support that is integrated with COVID-19 health services available for patients, patient family and healthcare professionals.
- Develop a guidebook that provides information on where to seek help for those suffering from mental health issues/symptoms. Ensure guidebook are readily accessible at primary-care facilities and are disseminated to target populations.
- Conduct routine community outreach activities (43), especially to those isolated from technology.

To achieve these objectives, it will be crucial for COVID-19 taskforce, Coordinating Ministry for Human Development and Cultural Affairs, and Ministry of Health to all work together.

CONCLUSION

We identify four priority mental health issues, including high proportion of common mental disorders, service disruption, increased risk among the vulnerable population, and limited service within the community. Therefore, we recommend collaboration between multi-sector government bodies involved in the COVID-19 response and beyond to anticipate the effect of COVID-19 pandemic toward Indonesia's mental health system. The aforementioned bodies include but are not limited to healthcare regulators, funders and providers, such as the COVID-19 taskforce, Ministry of Health, Coordinating Ministry for Economic Affairs, Ministry of Communication and Information Technology, Coordinating Ministry for Human Development and Cultural Affairs, and BPJS (Healthcare Social Security Agency). It is important to optimize utilization of established infrastructure in order to prevent mental health crises due to the pandemic. We also suggest the government provide mental health and psychosocial support, emphasizing on the need of working and other vulnerable populations. For mentally ill patients, we must ensure they receive continuous treatment. Furthermore, with the available resources, we should start to integrate mental health services into current health programs in the community to expand its reach. Other pandemic-related issues such as, effectivity, restriction policy challenges, virus mutations, changes in values and culture, are important areas that would be interesting to study for future evidence-based policies.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

GA, DM, LS, DS, BT, DP, and HD: conception and design of the article and writing. All authors read and approved the final version of the article.

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Stress Experience of COVID-19 Patients as Reported by Psychological Supporters in South Korea: A Qualitative Study

Hyein Park[1†], *Nabin Lee*[2†], *Jung Hyun Lee*[1], *Dayoung Lee*[1], *Kyoung Ae Kim*[1], *Hyun-Seung Kim*[1], *Eunhye Oh*[1], *Ji Hyun Ha*[1], *So Yoen Hyun*[1], *Juyeon Lee*[1], *Jiae Kim*[1], *Kyoungsun Jeon*[1], *Hyeong Taek Kim*[3] *and Minyoung Sim*[1*]

[1] National Center for Disaster Trauma, National Center for Mental Health, Seoul, South Korea, [2] Korea Trauma Research & Education Institute, Seoul, South Korea, [3] Department of Psychiatry, Yongin Severance Hospital, Yongin, South Korea

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***Correspondence:**
Minyoung Sim
mdsim@hanmail.net

[†] These authors have contributed equally to this work and share first authorship

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Background: COVID-19 patients experience various stressors during the quarantine period and after release from quarantine. However, stressors experienced during each period remain unclear.

Methods: A total of 15 mental health experts from the integrated psychological support group for COVID-19participated in this study. Psychological support was provided for the total 932 confirmed COVID-19 patients and their families. Qualitative data were collected using Focus Group Interview (FGI). The participants were divided into two groups and semi-structured questions were used to allow participants to speak their minds.

Results: During the quarantine period, difficulties of being diagnosed with COVID-19, concerns about recovery from COVID-19, stress related to quarantine, issues related to the treatment environment, and limited information about COVID-19 and communication were frequently reported. After release from quarantine, the reported main stressors include reinfection or reactivation, concerns about complications, and financial difficulties. Confusion as vectors and victims, stigma and discrimination, and conflicts within a family were observed during both periods.

Conclusions: COVID-19 patients suffered various stressors during the quarantine period and after release from quarantine. Moreover, returning to their daily life required timely psychosocial support, intervention, and treatment for COVID-19 infection.

Keywords: COVID-19, quarantine, stigma, psychological support, stress

BACKGROUND

COVID-19 has become the worst pandemic in this century since the WHO reported its first case in December 2019 in China. The pandemic has continued for more than a year, steadily increasing the number of infected persons. During this period, there has been a considerable amount of interest in the mental health of COVID-19 patients (1, 2). Contracting COVID-19 could be traumatic in terms of threatened death or serious physical injury and accompany with shame and guilt, which can lead to social withdrawal, negative intrusive thought, post-traumatic stress disorder, and depression (3, 4).

Patients with infectious diseases suffer from various stressors such as longer quarantine duration, fear, boredom, inadequate supplies and information, financial loss, and stigma about the infection (5). Preventive measures, including social distancing, cross-border movement restrictions, lockdown, and self-quarantine, has impacted mental health globally. Moreover, emerging infectious diseases such as COVID-19 induce a lack of factual information, uncertainty about the epidemic trend, and continuity of the chain of events (6).

Furthermore, based on observation from previous outbreaks of Severe Acute Respiratory Syndrome (SARS) and the Middle East Respiratory Syndrome (MERS), providing psychological support for the confirmed patients was heavily emphasized during the pandemic. In addition, for effective intervention, it is necessary to identify the psychological problems of patients over the course of the disease (7). However, previous studies on stressors experienced by COVID-19 patients mainly focused on the contagious period (8–10).

National Center for Disaster Trauma (NCT) provided psychological support services for COVID-19 patients, quarantined individuals, and their families in South Korea. In this study, we aimed to find out stressors experienced by COVID-19 patients by analyzing the interviews of mental health experts who provided counseling to them. These experts provided psychological support and observed the patients during the quarantine period right after diagnosing COVID-19 and after release from quarantine. We hypothesized that the types of stressors would differ depending on under quarantine or after release from quarantine. Specifically, health and quarantine related issues would be prominent during the quarantine and secondary stressors such as financial difficulties would intensify after release from quarantine.

METHODS

Participants

The integrated psychological support group for COVID-19 was established under the Ministry of Health and Welfare in January 2020. They provided mental health services, including 24-h hotline service and tele-counseling by mental health experts. They sent text messages containing information on mental health services and a self-rated screening tool to a list of COVID-19 patients given by the government. Psychological First Aid was provided through tele-counseling to those who called back to hotline service and for the high-risk group identified from mental health screening. For those who needed continuous counseling, psychological support was given from the quarantine period after diagnosing COVID-19 till after release from quarantine. A total of 15 mental health experts, including two psychiatrists, five psychologists, and seven social workers, provided tele-counseling to 932 COVID-19 patients and their families. All participants gave informed consent. They participated in psychological support for more than 3 months at the time of the interview.

Data Collection

Qualitative data were collected using Focus Group Interview (FGI). The FGI is a method of interviewing a group of individuals at the same time, in which questions are freely discussed together and structured for research purposes. In the FGI, a moderator can also ask questions depending upon the situation (11).

Generally, to provide sufficient opportunity for participants to report, the size of FGI group is maintained as a minimum of 4 and a maximum of 12 individuals per group (12). We divided 15 participants into two groups and two mental health specialists oversaw each group and semi-structured questions were used to allow participants to speak their minds. The FGI was conducted once for each group and lasted 1 h. The questions included 10 open-ended ones (**Table 1**).

The moderators played an active role in initiating interactions and discussions within the group. They familiarized themselves with the procedure and planned what to ask before the interview.

Analysis Method

The analysis was carried out by two psychiatrists and one psychologist who had experience in conducting qualitative research. They had more than 2 years of work experience in disaster mental health and participated in providing psychological support for COVID-19 patients. The qualitative data were analyzed using content analysis. The content analysis classifies, abbreviates, and forms meaningful description of data collected to identify the phenomena of researchers' interest (13). The content analysis uses systematic procedures to increase objectivity, and to flexibly use deductive methods for constructing coding frames based on prior knowledge or theory and inductive methods for deriving categories and concepts from data (14).

Accordingly, we constructed a coding framework based on the existing literature on the mental health of COVID-19 patients and reconstructed the existing coding frameworks by categorizing relevant concepts from qualitative data. After pilot coding, triangular verification of coding was done and the process of recoding the review results and triangular verification was repeated. Triangular verification was conducted with the unanimous agreement of all the analysts and when anyone of the three analysts exhibited disagreement, we discussed to reach a consensus.

RESULT

The results are summarized in **Table 2**.

The Quarantine Period due to COVID-19 Infection

Being Diagnosed With COVID-19

The confirmation of COVID-19 could be experienced as psychological trauma. Some patients had difficulty accepting the confirmation and expressed mistrust of testing results. They were pessimistic, pondering why they were infected out of all people, and showed anger toward the unidentified person who infected them.

"The most common responses were, 'I am so unlucky', 'Why does this happen to me?' etc." (Participant 3).

Concerns About Recovery From COVID-19

Depression and anxiety escalated when quarantine release was delayed for 2–3 weeks. The patients were eager for recovery,

TABLE 1 | Focus Group Interview (FGI) questions.

Category	Question
COVID-19 patients general	Was the COVID-19 patient cooperative with the counseling?
	Was the COVID-19 patient under quarantine at the time of counseling or after being completely cured?
Stressors of COVID-19 patients	What were stressors or difficulties reported by COVID-19 patients?
	When did COVID-19 patients report those stressors?; During or after quarantine
	Was the stressors reported during quarantine relieved after release from quarantine?
	Was there a change of stressors over time?
Psychological support	What helped with COVID-19 patients in terms of psychological support?
	Was there a change in the need for psychological support of COVID-19 patients over time?
	Did you experience the difficulties during psychological support activities?
	How did you cope with above difficulties?

TABLE 2 | COVID-19 related stress divided by period.

Period	Common stressors	
During the quarantine	Being diagnosed with COVID-19	
	Concerns about recovery from COVID-19	
	Stress related to quarantine	
	Treatment environment issues	Confusion as vectors and victims
	Limited information and communication	Stigma and discrimination
After release from the quarantine	Reinfection or reactivation	Conflicts within the family
	Concerns about complications	
	Financial difficulties	

sometimes despairing and even fearing death. In wards, the recovery level and release order were compared among patients. This made the patients more impatient.

"Patients considered hospitalization for 2 weeks as common, but after 3–4 weeks, they started to get worried about things like, 'Is there something really wrong with me?' 'Is it just me?' 'Everyone else is getting discharged and will I be the only one who will not?' Patients who have been hospitalized for more than 3 weeks were worried about things like 'What if I will not recover …' etc." (Participant 5).

Stress Related to Quarantine

Patients suffered from loneliness, helplessness, and frustration during the quarantine period. They expressed utter helplessness since they were unable to do anything independently in the isolation ward and it was difficult to spend time meaningfully. Patients with pre-existing psychiatric illness showed fear of not receiving timely assistance due to quarantine and the exacerbation of symptoms. Prolonged quarantine often led to severe suffering.

According to the quarantine policy at the time of the interview, even asymptomatic COVID-19 patients were required to test negative for two consecutive PCR test to be released from quarantine. Therefore, the patients often continued quarantine for more than 20 days.

"The patient had been already in self-quarantine for 1 month due to close contact with another confirmed patient, and additional quarantine continued for 2 months after his confirmation… the patient said that 'I'm so tired, I want to die, I want to kill myself, Should I jump out the window, I think I can only get out of here if I die"' (Participant 11).

Treatment Environment Issues

The change in the daily living environment was a stressor for COVID-19 patients. Staying in a decrepit facility for a long time and frequent transferring to different quarantine facilities intensified the stress even more. Further, one of the most common stressors in the treatment environment was the feeling of being watched, and the patients in hospital facilities experienced discomfort due to healthcare providers' frequent visits and observations.

"The facility is so old… it was suffocating enough…but there is no sunlight at all and the facility is so aged and I am being confined so it is so depressing… The nurse and healthcare providers keep coming and going and checking, so I could not sleep well and it was uncomfortable…" (Participant 5).

Limited Information and Communication

In the early days of the pandemic, the epidemiological characteristics of COVID-19 were unknown and response guidelines were not detailed. There was no accurate information about the process after the diagnosis. Increasing demand made it hard to contact the authorities for acquiring necessary information.

"The patient had to be transported after the confirmation but I think he was not given a detailed explanation. They did not say

that they would come in the protective gear, so the patient said that he was so flustered when they showed up like that. They came in too suddenly and he was not prepared and conscious of how others would think about that, but they just came in and took him, so he was really flustered…" (Participant 5).

After Release From the Quarantine

Reinfection or Reactivation

Concerns about COVID-19 infection continued even after complete recovery. Many patients regarded getting infected with COVID-19 as their vulnerability, which led to concern about reinfection of COVID-19. Some patients were worried that the virus would remain in their bodies for a long time and this anxiety was intensified as they were exposed to the press release on reinfection cases.

"As soon as the patient returned (to work), he started to show severe agitation. His hands were shaking and his heart was pounding on the day before going to work and in the morning, his hands were all sweaty and he was out of breath. He felt suffocated even at work so he had to get some air frequently. Similar symptoms appeared when using public transportation. I think his anxiety was closely related to worry about reinfection" (Participant 7).

Anxiety about reinfection or reactivation thwarted their daily lives. Some patients purchased all types of thermometers on the market and checked their body temperature often. Other patients avoided using public transportation or meeting people. They were concerned that they might spread the infection to other people, and because of this, they refrained from going outside or decided to go out only when neighbors were not around.

"Even after being cured, the patient repeatedly checked body temperature and was highly sensitive to the normal range. If it was any close to that threshold, anxiety level soared further …" (Participant 15).

Concerns About Complications

Various sequelae related to COVID-19 infection were reported, which ranged from physical symptoms such as fatigue and shortness of breath to vague somatic symptoms. Many patients became highly sensitive to all physical symptoms after COVID-19 infection.

"They were nervous that their health might suddenly take a downturn in an unexpected way and they might die suddenly. Some patients urged their family members to go to the emergency room in the middle of the night. They were easily overwhelmed by even minor physical symptoms. 'Is there something wrong with my body?' 'My lung seems to be damaged.' Hypochondriacal concerns have been commonly reported in many recovered patients" (Participant 11).

Financial Difficulties

Many patients were stressed out by financial difficulties as quarantine was prolonged. Patients who were daily employees, under temporary positions, and the sole breadwinners of their families, the quarantine caused severe financial difficulties.

"The patient returned to work for a week after the quarantine release, but his family tested positive again, so he had to undergo quarantine again. He lost all his business contacts and clients and did not know how to continue running the business…" (Participant 6).

Over the Entire Period

Confusion as Vectors and Victims

Guilt feeling was commonly observed among the patients and they thought that they caused trouble and might have spread the infection to others. They felt sorry for those who underwent disinfection and self-quarantine because of them. However, they felt anger for being overly criticized since they were also victims who caught the virus unwittingly.

"The patient talked about a neighbor with a child living across her unit. She was worried that she might spread the infection to the kid, so she would listen to the sounds coming from outside and only go out cautiously when it is quiet…" (Participant 3).

"Patients were often hurt by the online malicious comments and were directly criticized by colleagues or close ones… On the one hand, they felt sorry for causing trouble to others, but on the other hand, they were resentful to those who were criticizing them without consideration of the unintended and unavoidable situation… They felt as if their whole life was degraded and considered relationships as meaningless…" (Participant 11).

Stigma and Discrimination

Patients were concerned that people would avoid or reject them if they disclose COVID-19 confirmation. For example, one patient who visited a hospital for non-COVID-19 symptoms was refused treatment due to the previous history of COVID-19 confirmation. Some patients experienced avoidance from their acquaintances and neighbors.

"After the treatment was over, I went to a community treatment center to submit an application for support payment, and someone said something like, 'Hey, there comes a COVID-19 patient,' and I felt like being treated like a plague. Since then, I could not go to a community treatment center…" (Participant 14).

Discrimination and rejection were experienced even within close relations. The negative social attitude toward confirmed patients gave them a sense of self as a virus, bacterium, corpse, etc. They felt as if they were a toxic being to be avoided and such self-stigmatization harmed their self-esteem and self-efficacy.

"After being discharged, the patient wanted to visit an acquaintance, but the acquaintance kind of sounded like he was unwelcomed… So, he once again felt like he is treated like a bacterium by other people" (Participant 2).

Moreover, forced disclosure of personal information such as their paths and companions served as an excuse for criticism. In the case of mass infection involving religious facilities, gay bars, and mental hospitals, consequent stigma and discrimination were severely experienced.

"When public attention was focused on a particular group through media or online, patients were extremely anxious about being identified, and that was also evident in the counseling. They were afraid that the counselor would have a negative prejudice against them. It took them time to reveal their personal information and situation honestly…" (Participant 15).

Conflicts Within the Family

Furthermore, conflicts within the family increased due to infection and transmission, causing substantial damage and disruption to their daily life. The patients had mixed feelings toward their family, they felt sorry and were worried about their family and, at the same time, they felt lonely because the family members did not understand their difficulties.

"The patient quickly recovered from COVID-19 infection and seemed to be okay. Family members could not understand that patient would have some psychological difficulties. They would react like, 'Why is it hard to return to work?' You only had minor symptoms but why do you keep complaining that you are having a hard time and need counseling?" (Participant 3).

"Some families were too sensitive to the patient. The family dissuaded him from returning to work to rest a little longer, and that just sounded annoying. They fought often. They realized that COVID-19 infection had taken a heavy toll on the whole family…" (Participant 7).

DISCUSSION

This study explored the psychological distress experienced by COVID-19 patients. As we hypothesized, during the quarantine, traumatic stressor, concerns about recovery, and the quarantine related difficulties were noticeable. Stressful treatment environment and limited information about COVID-19 and communication were also observed during this period. After release from quarantine, secondary stressors such as financial difficulties were remarkable as expected. It was noteworthy that concerns about the physical condition still continued after the release from quarantine. Consistent with previous studies of infectious diseases, 'vector or victim' issue and suffering from stigma were reported over entire period (15).

Fear About Health Deterioration

Patients with COVID-19 reported concerns about the exacerbation of the disease, recurrence, unpredictable complications, and even death (9). The daily lives of confirmed patients were greatly affected by preoccupied concerns and anxiety to the extent that the term "COVID-19 health anxiety" is coined (16). They repeatedly checked their body temperature and were reluctant to use public transportation or meet people. This is consistent with previous findings that patients with infectious diseases show health behavior changes such as excessive hand washing and avoiding closed places even after recovery (17, 18).

Moreover, COVID-19 patients suffer from long-lasting symptoms, such as fatigue, headache, loss of smell, and shortness of breath even after recovery (19). Some patients became sensitive to small body symptoms because of their worry about complications (20).

Stress Related to Quarantine

Quarantine or isolation causes psychological difficulties such as loneliness and helplessness (5, 21). Several studies have shown that quarantined persons are more likely to develop depression, irritability, insomnia, post-traumatic stress symptoms, and emotional exhaustion than those who were not quarantined (5, 22).

The psychological disturbance became prominent as the quarantine period was prolonged (9, 10, 23). According to prior study of COVID-19 patients admitted to a community treatment center (CTC) in Korea, only 4.3% of COVID-19 patients had depression at the beginning of quarantine, which increased to 15.6% after 4 weeks (24). A longer quarantine period was related to more emotional and psychological distress (5, 24). It was also a risk factor for post-traumatic stress disorder (25).

In South Korea, quarantine release criteria were changed from test-based to symptom-based, and the average quarantine period was shortened by 10 days. Accordingly, the reports of quarantine stress among patients decreased. The reduction of the unnecessary quarantine period is necessary for maintaining good mental health (5).

Vector or Victim

Being treated as a vector and a victim is a unique feature of infectious diseases (15). A considerable number of COVID-19 patients expressed guilt that they might have spread the infection to their families or others and at the same time, they showed resentment at being criticized without being considered as victims (15, 26). Another qualitative study has also shown that COVID-19 patients suffered from guilt that they were infected and infected others due to their carelessness (26). Given that it is difficult to identify the source of the infection and that asymptomatic infection of COVID-19 is frequent, attributing it to one's own responsibility would be improper in many cases.

Patients feel ashamed of themselves as if they were defective, which is exacerbated by the stigma of COVID-19 (27). Some patients faced disadvantages at work. They were criticized by the people around them. Moreover, they faced difficulty returning to work and society even after recovery, leading them to financial difficulties. Previous studies showed that financial problems, stigma, and discrimination caused stress even after release from quarantine (22).

As well as the impact of maladaptive guilt and shame on mental health (3, 27), the stigma of infected persons caused barriers in testing and diagnosing, which lead to the spread of COVID-19 (28). It also interrupted proper follow-up treatment.

Stress caused by stigmatization cannot be improved by psychological counseling, and it requires accurate government policies to prevent them. A national community-based anti-stigma and advocacy activity could significantly decrease mental health and public health problems, including violence, self-harm, and suicide (29). Reducing the social stigma of patients will help them to return to their daily life without any psychological problems and adjust to their daily life.

Information Delivery

Recognizing and responding to infodemic was one of the most important strategies used for managing COVID-19 pandemic (30).The fear of an unknown illness leads to increased anxiety and sharing of misinformation with unknown sources (31). Therefore, providing information about diagnosis and treatment

procedures, psychological education including stress management, and hotline services to the public could have been helpful.

Furthermore, less knowledge of diseases has a strong link to discrimination and stigma. Hence, efforts should be taken to protect the public from fake news and provide accurate information to control stigma and fear of infection (32–35).

Moreover, factual and transparent information should be provided through official narratives, online news, social media, and local government to the public (36). In addition, since information can be interpreted differently depending on the political orientation, it is necessary to provide accurate information separately from political communication (37).

Practical Implication

Advice for Mental Health Professionals

Immediately after confirmation of an infectious disease, it is easy to be mentally overwhelmed because several stressors occur at once, such as fear of death, deterioration of health, infection with others, and difficulties caused by quarantine, etc. They are often confused whether they are vectors or victim, and it might be hard to report psychological difficulties because they are guilty and ashamed. Therefore, clinicians should be able to fully understand the difficulties that patients with infectious disease face at the beginning of confirmation and actively provide psychological support (38, 39). In addition, normalization that anxiety of re-infection or complication may continue for a while even after quarantine could promote their psychological recovery.

Advice for Policy Maker

WHO emphasized the management of mental health among essential health services to be guaranteed during COVID-19 public health emergencies (40).

As can be seen from the results of this study, COVID-19 patients suffer a lot even after release from quarantine and return to daily life. The long-term effects of infectious diseases has been found as high levels of depression, anxiety, and post-traumatic stress disorder a year after SARS pandemic (41). Disaster-related suicides are said to be on the rise over the next 2–3 years after the disaster (42, 43). In addition to taking mid- to long-term mental health recovery plans, funding for mental health is required (44).

Limitations and Suggestions

This study has several limitations that need to be addressed. In this study, the stress experience of patients was examined through the report of mental health professionals who provided psychological support to them. This is delivered in the language of an experts who provided psychological support rather than directly translating the words of patients. Hence, there might be a bias in the classification system because the stress experience of patients might differ from the practitioner's point of view. However, the problem was reported objectively and accurately since practitioners had prior knowledge of disaster stress experience. Furthermore, psychosocial support was given through telephone counseling, instead of face-to-face counseling. Previous study reported that there is no significant difference in effectiveness between face-to-face and telephone counseling (45), but non-verbal communication restrictions can make it difficult to track the problems of patients in depth. Moreover, in this study, the stress level of patients was not periodically traced in a detailed manner. A longitudinal study of patients' experiences in the future may help us understand the long-lasting stressors of patients with infectious diseases. In addition, our data were collected and analyzed in the early stages of COVID-19. Considering that the quarantine guidelines were frequently changed and the quarantine period was longer, the level of anxiety and stress might have increased at a later stage. In addition, the issue of personal information disclosure and stigma of patients was severe. The pattern of early outbreaks and current trends differ in many aspects. Hence, stress experiences must be analyzed periodically for identifying and responding to the long-term effects of the epidemic.

CONCLUSION

COVID-19 patients experienced various stressors from the moment they were confirmed. The stressors continued even after recovery. Patients had a confusing experience of being treated as both vectors and victims after being confirmed with COVID-19.Stigma and discrimination were important issues over the entire period. During the quarantine period, thoughts about the infection and isolation mainly caused stress. After their release from quarantine, the patients were troubled with concerns about sequelae and reinfection, and financial difficulties.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institutional Review Board of National Center for Mental Health. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

NL, JHL, MS, and DL conceived and designed the study. NL, HK, SH, KK, H-SK, EO, JH, and JL collected the data. NL, JHL, and HP analyzed and interpreted the data. HP, JHL, and MS drafted and wrote the manuscript. MS, JHL, DL, JK, and KJ contributed to critical revision of the article. All authors read and approved the final manuscript.

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The COVID-19 Pandemic and Posttraumatic Stress Disorder: Emotional Impact on Healthcare Professions

Concetta De Pasquale[1,2], *Daniela Conti*[3]*, *Carmela Dinaro*[4], *Rosa Alessia D'Antoni*[2], *Elena La Delfa*[2] and *Santo Di Nuovo*[2]

[1] Vascular Surgery and Organ Transplant Unit, University Hospital of Catania, Catania, Italy, [2] Department of Educational Sciences, University of Catania, Catania, Italy, [3] Department of Humanities, University of Catania, Catania, Italy, [4] Drug Addiction Health Service, SER.T-ASP3, Catania, Italy

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University of Murcia, Spain
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City College of New York (CUNY), United States

***Correspondence:**
Daniela Conti
danielaconti@unict.it

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The COVID-19 pandemic, which began in March 2020, has resulted in the deaths of hundreds of thousands of people around the world in just a few months, putting at great risk the commitment of healthcare workers unprepared to manage a worldwide phenomenon at great risk. In the early stages especially, medical staff had to deal with the pandemic at the expense of their physical and mental health, putting them particularly at risk for experiencing posttraumatic stress disorder (PTSD). The study aims to analyze the psychopathological aspects associated with PTSD, focusing on the emotional impact caused by the COVID-19 pandemic on healthcare professionals compared with a control group. The sample analyzed over 2 months, from March to May 2021, included 214 participants into two groups, i.e., healthcare professionals ($N = 107$) and a control group ($N = 107$). The online assessment instrument used consisted of an anonymous questionnaire, assembled *ad hoc* with demographic information and different standardized assessment scales (e.g., Fear of COVID-19 scale, Profile of Mood States, and Maslach Burnout Inventory-Human Services Survey), while a further section of the survey used the DSM-5 criteria to investigate Posttraumatic stress disorder (e.g., COVID-19—PTSD). The results reported that healthcare professionals had a consistent perception of stress (mean = 26.18, $SD = 14.60$), but not at a level significantly higher than other categories of workers (mean = 25.75, $SD = 14.65$; $t = 0.20$, $p = 0.84$). However, they showed less emotional disturbance than the control sample, better anxiety management skills, and lower levels of depressive disorder and mental confusion. Specifically, the healthcare professionals showed a condition of emotional exhaustion (T = 0.64, D = 0.74, A = 0.62, S = 0.75, C = 0.64) and depersonalization (T = 0.41, D = 0.52, A = 0.49, S = 0.60, C = 0.40), which is common in the burnout syndrome. In conclusion, the results obtained are useful in understanding the determinants of the emotional involvement of healthcare professions and the risk of burnout syndrome and, therefore, for planning activities and support paths for these workers who are particularly at risk during prolonged and pervasive crises, such as the pandemic.

Keywords: COVID-19 pandemic, Fear of COVID-19 scale, posttraumatic stress disorder (PTSD), emotional disorders, burnout syndrome (BS), healthcare workers

INTRODUCTION

On March 11, 2020, the WHO declared the coronavirus pandemic and SARS-CoV-2 as the causative agent of the COVID-19 respiratory syndrome. The COVID-19 pandemic has attracted worldwide attention for its rapid diffusion: In fact, the highly contagious nature of SARS-CoV-2 has been a major reason for the increasing number of deaths due to COVID-19. Social distancing, confinement, and quarantine were adopted by many countries to contain the diffusion of the infection (1). The literature on the psychological effects of quarantine indicates that the perception of the traumatic event can concern both the fear of contracting the virus and the measures adopted to counter the spread of infection (2).

These extreme measures taken to limit the spread of COVID-19, as well as the fear of contracting the virus, have impacted on people's lifestyles, generating high levels of psychological distress, anxiety, and mood alterations (3, 4). Consequently, they can represent risk factors for many mental health issues and can potentially generate posttraumatic stress disorder (PTSD) symptoms (1, 5).

The DSM-5 (6) indicates that "experiencing repeated or extreme exposure to aversive details of the traumatic event(s)" can be considered as potentially traumatic events. The clinical characteristics required by DSM-5 to define the diagnosis of PTSD provide for the fulfillment of Criterion A, concerning exposure to trauma; moreover, in PTSD, the trauma resurfaces in an intrusive, invasive way, in the subject's memories through flashbacks, vivid images and nightmares, associating with avoidance behaviors of thoughts, places, objects, and situations that recall the traumatic event, with symptoms of affective dulling, negative alterations in cognition and mood, as well as persistent symptoms of increased arousal (Criteria B, C, D, and E of the DSM-5). In addition, a further Criterion F is defined, concerning the significant impairment of social function, work, or other important areas for the individual. In accordance with the criteria expressed in the DSM-5, several studies have been conducted relating to posttraumatic stress disorder.

Although most of the epidemiological studies on PTSD have been conducted in the United States [e.g., (7)], there are some concerning the general European population (8), in particular, the Italian one (9, 10).

An important study was conducted by the European Study of the Epidemiology of Mental Disorders, which analyzed the population of Western Europe, within the WHO World Mental Health Survey Initiative (ESEMeD-WMH); this is a worldwide epidemiological study aimed at estimating the prevalence of PTSD and its association with various traumatic events in the adult population (11). There is evidence of a gender difference in PTSD, with females being more at risk of developing the condition than males (12). Regarding age, some authors have reported that exposure to trauma decreases over the years (13), and other studies show that young age is globally a risk factor for the development of PTSD (14). The pandemic outbreak of an unrecognized infection, such as COVID-19, could be defined as a traumatic experience for its acute and chronic implications at individual and community levels (1). Specifically, the healthcare workers in emergency care settings are particularly at risk of PTSD because of the highly stressful work-related situations they are exposed to, which include: management of critical medical situations, caring for severely traumatized people, frequent witnessing of death and trauma, operating in crowded settings, and interrupted circadian rhythms due to shift work (15). Consequently, investigating the psychological impact of the COVID-19 pandemic on healthcare workers including physicians and nurses has become increasingly important (15, 16).

Aims and Hypotheses

Currently, given the enormous burden of distress and potentially traumatic events experienced by people who work in healthcare, it is important to document the prevalence of mental health problems in this population group (17). In this framework, the purpose of the current study was to investigate the emotional impact and the prevalence of self-reported PTSD symptoms caused by the COVID-19 pandemic by comparing Italian healthcare professionals to a control group of the general population. Specifically, the main hypothesis was to compare the perception of stress between the two groups and its psychological and clinical effects on the lives of participants.

MATERIALS AND METHODS

Participants and Procedure

The inclusion criteria for volunteers were (i) Italian-speaking citizens, (ii) at least 20 years old, (iii) with at least 13 years of education, and (iv) carrying out work in the healthcare sector or not employed (for the control group). Respondents who did not complete the questionnaire on demographic characteristics and who reported psychological distress before the pandemic were preliminarily excluded. We randomly selected, among the 371 initial respondents, those suitable to balance the groups of health workers and control workers by number, age, and gender. The final sample analyzed in the study included 214 participants into two groups, i.e., healthcare workers ($N = 107$) and control group ($N = 107$). Specifically, each group was composed of 29 men (27%) and 78 women (73%), all aged between 20 and 60 ($M = 26.75$, $SD = 3.86$). Also, age ranges were matched in the two groups: ages 20–30, $n = 23$; ages 31–40, $n = 29$; ages 41–50, $n = 24$; age > 51, $n = 31$. However, considering the small number of the general sample, it is only representative of the population investigated. Specifically, the two groups had the following characteristics: the healthcare workers (HCWs) included nurses ($N = 63$), doctors ($N = 19$), healthcare assistants ($N = 9$), and medical and nursing students trainees in hospitals ($N = 14$).

The hospitals involved in the study were the University Hospital "Policlinico—San Marco" and the Drug Addiction Health Service, SER.T-ASP3, of Catania. The control group included employed, self-employed, casual employees, housewives, and not employed.

The volunteer participants were informed of the research via email and subsequently gave online written informed consent and answered the questionnaire anonymously. The

administration time of the instrument used was ∼20–30 min. In the research presentation platform, it was reported that the volunteer participant could leave the completion of the questionnaire at any time of administration.

Data collection occurred from March 14, 2021 to May 30, 2021, namely, 1 year after the onset of the pandemic. In Italy, during this time, the first dose of vaccine and medical treatments were available for the population. Also, the data were collected in aggregate form, and individual users were not identified.

This study was conducted according to the Declaration of Helsinki and was approved by the Ethics Committee of the Department of Educational Sciences at the University of Catania (Italy), which guarantees the confidentiality and anonymity.

The research design was of a correlational type as the objective of the study was to investigate the relationship between the variables used without the researcher controlling or manipulating any of them.

Measures

The online instrument with 112 items consisted of an anonymous questionnaire, assembled *ad hoc* including demographic information and different standardized assessment scales.

The first part of the questionnaire was on sociodemographic parameters (e.g., gender, age and profession), while the second part consisted of standardized scales, i.e., the Fear of COVID-19 scale (FCV19S) (18), the COVID-19—Post Traumatic Stress Disorder (COVID-19-PTSD) (1, 19), the Profile of Mood States (POMS) (20), and the Maslach Burnout Inventory—Human Services Survey (MBI-HSS) (21).

The final part of the questionnaire was a debriefing. The volunteer participants were thanked for their availability, and contact references were given for any questions about the purpose of the research. Also, the online system did not guarantee the possibility of saving the questionnaire without having definitively concluded it.

For our sample, the results indicate that the instruments used has really good internal consistency. Specifically, $\alpha = 0.82$ was for FCV19S, $\alpha = 0.92$ for COVID-19-PTSD test, $\alpha = 0.97$ for POMS, and $\alpha = 0.89$ for the BMI-HSS.

Fear of COVID-19 Scale

The Fear of COVID-19 scale (FCV19S) (18) represents a standardized tool in assessing the generalized fear of COVID-19 among individuals, fear often associated with the transmission speed, and the high mortality rate related to the virus. The scale showed good reliability ($\alpha = 0.87$) and is a one-dimensional questionnaire composed of seven items (e.g., "I'm very afraid of coronavirus-19"; "It makes me uncomfortable to think about coronavirus-19"; "I can't sleep because I worry about getting coronavirus-19"), with a five-point response scale (1 = strongly disagree to 5 = strongly agree), which assesses fear of COVID-19 and its consequences. The score is obtained by adding the scores to the questions.

COVID-19—Posttraumatic Stress Disorder

A section of the questionnaire used the COVID-19—PTSD (1, 19) to investigate posttraumatic stress disorder (F43.10). This questionnaire includes 19 items (e.g., "Having repeated, disturbing and unwanted thoughts related to this stressful experience," "To have difficulty in falling asleep"), requiring a response on a five-point Likert scale, from 0 (not at all) to 4 (extremely), and is developed, thanks to the modification of the PCL-5 (22) in order to focus the attention on a prolonged and current stressor. A COVID-19—PTSD cutoff score of 26 was deemed to correctly categorize a participant as having or not having significant PTSD symptoms.

The COVID-19—PTSD demonstrated a good internal consistency (Cronbach's $\alpha = 0.94$) and a robust convergent validity.

Profile of Mood States

The Profile of Mood States (POMS) scale is a widespread psychological instrument used to measure mood and identify problematic affective states. The scale, developed by McNair et al. (20) is composed of a list of adjectives that measure six aspects or scales of emotions. The POMS scale showed good reliability ($\alpha = 0.85$) and consists of a questionnaire of 58 adjectives (e.g., "Tense," "Energetic," "Fatigued"), is particularly useful in evaluating subjects with stress disorders, and is structured on the basis of six mood states: tension–anxiety (T), which describes an increase in somatic tension that may not be observable from the outside or may concern visible psychomotor manifestations; depression (D), which indicates a state of depression accompanied by a sense of personal inadequacy, the uselessness of effort, a sense of emotional isolation, melancholy, and guilt; aggression–anger (A), which describes anger and dislike toward others; vigor–activity (V), a positive factor including exuberance, energy, euphoria, and optimism; tiredness–indolence (TI), which represents boredom, low energy, and physical fatigue; and confusion (C), characterized by a sense of disturbance and linked to the organization–disorganization dimension, anxiety, and the feeling of cognitive inefficiency. The intensity of the mood is measured on a five-point Likert scale (0 = not at all, 1 = a little bit, 2 = moderately, 3 = quite a bit, and 4 = extremely). Total scoring for the scale [Total Mood Disturbance (TMD)] can be calculated by adding the scores for tension, depression, anger, tiredness, confusion, and then subtracting the score for vigor.

Maslach Burnout Inventory—Human Services Survey

Burnout is a syndrome of high emotional exhaustion and high depersonalization in the presence of a lack of personal accomplishment. The Maslach Burnout Inventory—Human Services Survey (MBI-HSS) is a questionnaire of 22 items, each of which with 7 degrees of response on the Likert scale (0 = never, 1 = a few times a year or less, 2 = once a month or less, 3 = a few times a month, 4 = once a week, 5 = a few times a week, 6 = every day). This questionnaire was designed for professionals in human service employees and is appropriate for respondents working in a diverse array of occupations, including nurses, and other fields focused on helping people live better lives by offering guidance, preventing harm, and ameliorating physical, emotional, or cognitive problems. The questionnaire was developed by Maslach and Jackson (23) and investigates three

TABLE 1 | Means, *t*-test, and *p*-value for the comparison between groups in the factors and total score of Profile of Mood States (POMS).

POMS	Group	Mean	SD	*t*	*p* (df = 212)
T—Tension	Healthcare workers (HCWs)	11.77	7.78	−2.03	0.04*
	Control	14.08	8.86		
D—Depression	HCWs	15.50	11.90	−2.34	0.02*
	Control	19.79	14.83		
A—Anger	HCWs	11.51	9.98	−3.64	<0.01**
	Control	17.07	12.25		
V—Vigor	HCWs	17.90	5.49	1.32	0.19
	Control	16.73	7.34		
TI—Tiredness	HCWs	10.80	6.05	−1.46	0.14
	Control	12.09	6.82		
C—Confusion	HCWs	8.29	5.81	−3.47	<0.01**
	Control	11.15	6.26		
TMD—Total Mood Disturbance	HCWs	39.97	40.04	−2.87	<0.01**
	Control	57.46	48.79		

*The symbol **indicates the value of $p < 0.01$ and symbol *indicates the value of $p < 0.05$.*

TABLE 2 | Mean, *t*-test, and *p*-value for the comparison between groups in the Maslach Burnout Inventory—Human Services Survey (MBI-HSS) (only working respondents were considered: $N = 96$).

MBI-HSS	Group	Mean	SD	*t*	*p* (df = 201)
EE—Emotional Exhaustion	HCWs	19.81	10.10	1.96	0.05*
	Control	16.68	12.72		
DP—Depersonalization	HCWs	12.63	5.39	6.42	<0.01**
	Control	7.06	6.93		
PA—Personal Accomplishment	HCWs	28.18	7.64	1.58	0.12
	Control	26.27	9.57		

*The symbol **indicates the value of $p < 0.01$ and symbol **indicates the value of $p < 0.05$.*

different subscales: emotional exhaustion (EE—nine items—e.g., "I feel burned out from my work"), depersonalization (DP—five items—e.g., "I worry that this job is hardening me emotionally"), and personal accomplishment (PA—eight items—e.g., "In my work, I deal with emotional problems very calmly"). Scales are scored such that higher scores indicate more of each construct. Higher scores on the EE and DP subscales indicate a higher burnout symptom burden; lower scores on the PA subscale indicate a higher burnout symptom burden (21). The reliability of all items measured by Cronbach's index was 0.80 for the Italian version used (24). This scale was not considered for unemployed respondents.

Data Analysis

The SPSS version no. 26 was used for the statistical analyses. We analyzed the data using parametric techniques when the data satisfied the assumptions of normality of the distribution, i.e., Student's *t* and discriminant analysis for detecting significant groups differences, Pearson's *r*, and multiple regression for correlational analyses. In analyzing the compared groups based on criterial variables, we used chi-square statistic.

RESULTS

The fear of COVID is not significantly different in the two groups considered in the study: in healthcare professionals, mean 15.08, *SD* 4.95; in the controls, mean 14.66, *SD* 4.82 ($t = 0.63$, df = 212, $p = 0.53$).

Instead, in the two groups, both POMS factors and the Total Mood Disturbance (TMD) significant differences have been found, with higher scores in the controls. However, the factors vigor and tiredness are not significant (**Table 1**).

Table 2 shows that in two out of three MBI-HSS factors, the scores are significantly higher in the healthcare professionals group than in the control group (excluding the not employee respondents).

Emotional exhaustion and depersonalization are higher in the professionals, while personal accomplishment at work is higher too, but not at a significant level.

PTSD values are high in both groups, higher—but not in a significant level—in healthcare professionals ($n = 107$, mean = 26.18, $SD = 14.60$) compared vs. controls, excluding nonprofessional participants ($n = 85$, mean = 25.75, $SD = 14.65$; $t = 0.20$, $p = 0.84$).

Also, considering the participants with COVID-19—PTSD scores higher than the cutoff (25), the differences between the two groups are not significant: 52.34% ($N = 54$) among health professionals vs. 47.06% ($N = 52$) of controls ($\chi^2 = 0.53$, $p = 0.47$).

Given that the two groups are not significantly different in PTSD scores, we have computed the correlations between the level of stress and the other variables in the whole sample. In the

TABLE 3 | Pearson correlation of COVID-19—Posttraumatic Stress Disorder (PTSD) with Fear of COVID-19 scale (FCV19S), POMS—TMD and subscale, and MBI-HSS scores.

	COVID-19-PTSD
FCV19S—Fear of COVID-19	0.76**
POMS—T (Tension)	0.68**
POMS—D (Depression)	0.59**
POMS—A (Anger)	0.57**
POMS—V (Vigor)	−0.16
POMS—S (Tiredness)	0.67**
POMS—C (Confusion)	0.50**
POMS—TMD (Total Mood Disturbance)	0.63**
EE—Emotional Exhaustion	0.44**
DP—Depersonalization	0.36**
PA—Personal Accomplishment	0.07

*The symbol **indicates the value of $p < 0.01$.*

TABLE 4 | Results of discriminant analysis (Wilks' $\Lambda = 0.67$, $\chi^2 = 20.05$, $p < 0.001$).

Variables	F-to-remove	Coefficient
POMS—TMD (Total Mood Disturbance)	24.79	0.49
DP—Depersonalization	54.88	0.34
PA—Personal Accomplishment	4.34	0.74
FCV19S—Fear of COVID-19	1.51	0.81
EE—Emotional Exhaustion	2.16	0.29

study, all the correlations are highly significant, except for vigor and personal accomplishment at work (**Table 3**).

Posttraumatic stress is significantly correlated with the fear of COVID-19 and other negative emotions (mostly with tension, tiredness, anger, and confusion). Also, emotional exhaustion and depersonalization at work are connected with general stress due to the pandemic event.

To better differentiate the two groups based on the scores in the standardized tests, a discriminant analysis was performed (**Table 4**), using a predictor of the POMS—Total Mood Disturbance score, the Fear of COVID-19, and the three factors of MBI-HSS scores.

Total mood disturbance and depersonalization are the most discriminating variables.

The classification results confirm that the discriminant function based on the test variables can distinguish the two groups with a percent of correct of a medium-high level (77%), more for controls (80%) than for healthcare professionals (74%).

After analyzing the difference between groups, other analyses were addressed to the study of the relations within the target group, i.e., the healthcare professionals. The correlations among the MBI-HSS and POMS factors in healthcare professionals are shown in the **Table 5**. Emotional exhaustion and depersonalization are correlated with all POMS factors except with vigor. Also, the personal accomplishment factor (scored in the positive direction) correlates only with vigor (also positive factor), not significantly with other variables.

Moreover, fear of COVID measured by FCV19S test significantly ($p < 0.01$) correlates with POMS—Total Mood Disturbance (0.49), with factors Tension (0.52), Depression (0.47), Anger (0.33), Tiredness (0.57), Confusion (0.38), and not with Vigor (−0.16).

Table 6 shows the results of a series of multiple regression analyses performed in healthcare professional samples separately for the three variables of the MBI-HSS.

Results demonstrate that depression and tiredness are the best predictors of emotional exhaustion; tiredness is the best predictor also of depersonalization, together with anger and negation of tension. Vigor and tiredness, conjointly with reduced anger, predict personal accomplishment in healthcare professionals.

DISCUSSION AND CONCLUSIONS

Anxiety, depression, burnout, and suicide risk among healthcare workers (HCWs) were considered as critical health issues even before the COVID-19 pandemic (26). However, the coronavirus disease-19 (COVID-19) has brought about a period of world emergency and highlighted the need to focus on the impact caused by the pandemic situation both in the subjects directly involved in the management of this emergency and in the general population. Recent cross-sectional studies reported that increased workload and burnout were especially pronounced among frontline HCWs who volunteered as members of the COVID-19 outbreak response team (25, 27–30). Previous studies of frontline health workers during the SARS and Ebola outbreaks showed that frontline workers suffer significant risks of burnout, anxiety, and PTSD (31–33). However, the psychological suffering that follows exposure to a traumatic and stressful event is highly variable. For this reason, it is not uncommon for the clinical picture to include some combinations of symptoms (e.g., anhedonia, dysphoria, anger, and dissociation) with the presence or absence of anxiety and fear. A recent systematic review (34) showed that 29 studies reported the prevalence of mental health disorders in HCWs. Specifically, the percentage of healthcare workers with anxiety ranged from 9 to 90% with a median of 24%, while the percentage with depression ranged from 5 to 51%, with a median of 21%.

This cross-sectional online study intended to examine the prevalence of PTSD symptomatology and the emotional impact in Italian healthcare workers and the general population during the phases immediately following the possibility of administering vaccines and medical treatment for COVID-19 (over 2 months, from March to May 2021).

The results of the study have indicated that both the groups of our sample show a high level of posttraumatic stress derived from working during a pandemic, with nearly half of the professionals exceeding the cutoff (>26) in accordance with the Italian standardization of the COVID-19—PTSD test (1, 19). Comparing the two groups, we found that healthcare professionals have a consistent perception of stress, but not at a level significantly higher than other categories of workers. However, probably as a result of their specific training and supervision, they showed less emotional disturbance than the

TABLE 5 | Person correlations among the MBI-HSS and POMS factors in healthcare professionals' group.

MBI—Factors	POMS—Factors					
	Tension	Depression	Anger	Vigor	Tiredness	Confusion
EE—Emotional Exhaustion	0.64**	0.74**	0.62**	−0.17	0.75**	0.64**
DP—Depersonalization	0.41**	0.52**	0.49**	−0.20	0.60**	0.40**
PA—Personal Accomplishment	0.19	0.16	0.10	0.37**	0.21	0.04

*The symbol **indicates the value of $p < 0.01$.*

control sample, as they are familiar with, and capable of, dealing with more stress, have better anxiety management skills, and display lower values of depressive disorder and mental confusion. Instead, the healthcare professionals showed a condition of emotional exhaustion and depersonalization, which is common in the burnout syndrome. These symptoms, in the group of healthcare professions, are predicted by specific emotional variables: e.g., Tiredness together with Depression due to Emotional Exhaustion, Tension, Anger, and Depersonalization.

It is, therefore, recommended that the HCWs are provided with a safe and secure environment that promotes their psychological wellbeing to facilitate adequate service delivery during the COVID-19 pandemic and future events of disease outbreak (35). As suggested by Tucci et al. (32), whereas HCWs are not sufficiently capable of managing their individual health while caring for other ill persons, this supports the need for national and local healthcare agencies to place a premium on the psychological and mental health status of HCWs (35). Intervening professionally on the outcomes found on the emotional sphere in times of crisis, as the epidemiological situation in the grip of the COVID-19 pandemic demonstrates, means learning to manage emergency situations and also dealing with them on the psychic side.

Some limitations of this study need to be acknowledged. First, the number of healthcare professionals and controls were not high enough to make differentiation among the jobs. Second, as the sample was not representative of the healthcare workers population, the study should be considered a correlational one. Furthermore, the use of self-report instruments and the lack of data about COVID-19 infection or other variables related to the pandemic (death of a loved one, etc.) may be considered limitations.

In conclusion, the results obtained are useful in understanding the determinants of the emotional involvement of healthcare professions and the risk of burnout syndrome and, therefore, for planning activities and support paths for these workers who are particularly at risk during prolonged and pervasive crises, such as the pandemic. As suggested by Chirico et al. (35), social activities, such as sharing one's experience with colleagues and family members, would help reduce subthreshold syndromes before they evolve to complex conditions. Scientific literature confirms the positive effect of practicing oriental disciplines as Judo, Tai Chi, yoga, or meditation on health and self-control to recover our balance (36). Furthermore, psychological support interventions for healthcare workers should not be limited to a set period of time (e.g., lockdown), but should be constantly monitored and guaranteed regardless of the crisis events. However, further research could be needed to comprehend their cost effectiveness for individuals and health organizations and their sustainability over time.

TABLE 6 | Multiple regressions for the three variables of the MBI-HSS in healthcare professional samples.

Predictors:	EE Emotional exhaustion	DEP Depersonalization	PA Personal accomplishment
	Std. coeff.	Std. coeff.	Std. coeff.
	$r^2 = 0.61$	$r^2 = 0.44$	$r^2 = 0.28$
FCV19S—Fear of COVID-19	0.07	0.00	−0.03
POMS—T (Tension)	−0.21	−0.45*	0.11
POMS—D (Depression)	0.48**	0.10	0.19
POMS—A (Anger)	−0.07	0.44*	−0.49*
POMS—V (Vigor)	0.04	−0.12	0.49***
POMS—S (Tiredness)	0.45***	0.74***	0.48*
POMS—C (Confusion)	0.10	−0.28	−0.03

*Predictors are the scores on the Fear of COVID-19 scale and POMS subscales. The symbol ***indicates the value of $p < 0.001$, the symbol **indicates the value of $p < 0.01$, and symbol *indicates the value of $p < 0.05$.*

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Department of Educational Sciences of the University of Catania (Italy). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CDe, DC, and SD: conceptualization and methodology. DC: validation. DC and SD: formal analysis. RD'A and EL: investigation. SD: data curation and supervision. DC and

RD'A: writing—original draft preparation. CDe, DC, CDi, and SD: writing—review and editing. CDe: funding acquisition. All authors contributed to the article and approved the submitted version.

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Knowledge, Attitudes, and Practices Toward Coronavirus and Associated Anxiety Symptoms Among University Students: A Cross-Sectional Study During the Early Stages of the COVID-19 Pandemic in Bangladesh

Muhammad Mainuddin Patwary[1,2], Asma Safia Disha[1,2], Mondira Bardhan[1,2], Md. Zahidul Haque[1,2], Md. Pervez Kabir[1,2], Sharif Mutasim Billah[1,2], Md. Riad Hossain[3], Md. Ashraful Alam[4], Matthew H. E. M. Browning[5], Faysal Kabir Shuvo[6], Awais Piracha[7], Bo Zhao[8], Sarya Swed[9], Jaffer Shah[10]* and Sheikh Shoib[11]*

[1] Environment and Sustainability Research Initiative, Khulna, Bangladesh, [2] Environmental Science Discipline, Life Science School, Khulna University, Khulna, Bangladesh, [3] Institute of Disaster Management, Khulna University of Engineering & Technology, Khulna, Bangladesh, [4] Department of Global Health Policy, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan, [5] Department of Parks, Recreation and Tourism Management, Clemson University, Clemson, SC, United States, [6] Centre for Urban Transitions, Swinburne University of Technology, Melbourne, VIC, Australia, [7] Geography, Tourism and Urban Planning, Western Sydney University, Penrith, NSW, Australia, [8] Department of Health Administration, Graduate School, Yonsei University, Wonju, South Korea, [9] Faculty of Human Medicine, Aleppo University, Aleppo, Syria, [10] Medical Research Center, Kateb University, Kabul, Afghanistan, [11] Department of Psychiatry, Jawahar Lal Nehru Memorial Hospital (JLNMH), Srinagar, India

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Daria Smirnova,
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COMSATS University, Islamabad Campus, Pakistan

***Correspondence:**
Muhammad Mainuddin Patwary
raju.es111012@gmail.com
Jaffer Shah
jaffer.shah@kateb.edu.af

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Background: University students' knowledge, attitude, and practice (KAP) toward COVID-19 are vital to prevent the spread of the virus, especially in the context of developing countries. Consequently, the present study aimed to determine the KAP levels of university students and associated anxiety during the earlier stage of the pandemic in Bangladesh.

Methods: A cross-sectional, online study with 544 university students was conducted during April 17–May 1, 2020. The questionnaire incorporated several KAP-related test items aligned with the World Health Organization (WHO) guidelines. Anxiety was measured with the 2-item Generalized Anxiety Disorder scale (GAD-2). Multivariable logistic regression analysis was performed to determine the association between KAP levels and anxiety adjusting for sociodemographic variables. Subgroup analyses included rerunning models stratified by gender and quarantine status.

Results: Approximately 50% of students showed high levels of knowledge about COVID-19 guidelines, 59% reported behavioral practices that aligned with COVID-19 guidelines, and 39% had negative attitudes toward COVID-19 guidelines. Attitudes differed by anxiety (χ^2 = 23.55, $p < 0.001$); specifically, negative attitudes were associated with higher anxiety (OR: 2.40, 95% CI = 1.66–3.46, $p < 0.001$). Associations were significant for male (OR = 2.36; 95% CI = 1.45–3.84, $p < 0.001$) and female (OR = 2.45; 95% CI = 1.3–4.34; $p < 0.001$) students. Stratified analyses found non-quarantined students with negative attitudes had three times the chance of experiencing

anxiety (OR = 3.14, 95% CI: 1.98–4.98, $p < 0.001$). Non-quarantined students with low levels of knowledge had half the chance of developing anxiety (OR = 0.49, 95% CI: 0.31–0.78, $p < 0.01$).

Conclusion: Based on these findings, it is recommended that university authorities continue to prioritize proactive and effective measures to develop higher levels of knowledge, more positive attitudes and better behavioral practices regarding COVID-19 for the mental health of their students.

Keywords: KAP, anxiety, COVID-19, cross-sectional, knowledge, university student, Bangladesh

INTRODUCTION

The rapidly spreading coronavirus disease 2019 (COVID-19) has been recognized as a worldwide public health concern. The World Health Organization (WHO) declared COVID-19 a public health emergency of international concern on 30 January 2020 and urged all nations to work together to halt the epidemic (1). In response, countries around the world implemented a variety of containment measures, including the closure of educational and other government and non-government institutions, prohibition of large-scale social gatherings, restrictions on local, national, and international travel, and complete lockdowns to prevent viral transmission (2, 3). Despite these precautions, the world has recorded a massive number of infected cases, about 262 million, with 5.2 million deaths to-date because of the highly contagious nature of the coronavirus (4).

The first COVID-19 case in Bangladesh was reported on March 08, 2020 (5). As one of the most densely populated countries, Bangladesh faced particularly demanding challenges to manage the knowledge, attitudes, and behavior practices regarding COVID-19 in its massive population (6, 7). As of August 14, 2021, Bangladesh reported COVID-19 cases surpassed 1.4 million, and COVID-19-related deaths exceeded 23,600 (5). To control the spread of the virus, the Bangladesh government has taken several precautionary measures, including educational institution shutdowns, ceasing all social gatherings, closing government and non-government entities except emergency services, restricting tourism, and limiting intra-country travel (7–9). Besides, several organizations voluntarily promoted massive advertisements regarding COVID-19 on awareness-raising, proper handwashing practices, wearing facemask appropriately, and maintaining social distancing, among other measures (10).

For Bangladesh to further control the virus, each citizen must be informed, maintain attitudes that support adherence to behavioral practices, and practice measures that reduce health risks and viral transmission (11). Therefore, appropriate knowledge, attitude, and practice (KAP) levels toward this infectious disease are cognitive keys to this public health emergency (12). KAP entails a variety of ideas regarding the disease's etiology and exacerbating variables, and the identification of symptoms, treatment options, and repercussions (13). Studies during the Severe Acute Respiratory Syndrome (SARS) pandemic showed poor level of KAP concerning contagious diseases was an obstacle to containment (14). During the COVID-19 pandemic, some scholars believe that poor knowledge and orthodox religious beliefs may be responsible for negative attitudes and ineffective containment strategies (6).

Knowledge, attitude, and practice surrounding health-related habits, along with environmental and financial factors, status of quarantine, lockdown measures and fear of COVID-19 may influence anxiety levels during the pandemic (15, 16). According to a previous study on Brazilian people, respondents experienced fear and mental distress due to multi-level coping strategies (17). Another study conducted in Latvia found that poor health conditions, fear of contracting COVID-19, having family members contract COVID-19, family conflicts, lack of religiosity and caring for a vulnerable person were associated with depression and anxiety (18). Several studies on infectious diseases found that knowledge and attitude toward these diseases were related to serious psychological distress, fear, and stigma among people that challenged efforts to prevent disease spread (19–21). In the 2003 SARS outbreak, lower levels of anxiety were associated with higher levels of knowledge and positive attitudes toward infectious disease transmission (22). A cross-sectional study of Chinese college students during COVID-19 found that knowledge and attitudes were protective against mental distress (21). Another study in Latvia reported that preventive behaviors during COVID-19 were associated with COVID-19 threat appraisal, trust in information sources, and fear (23). Another study identified protective factors of COVID-19 including disbelief in the effectiveness of precautionary behavior were associated with lockdown-induced anxiety (24). A global analysis of 40 countries reported that physical inactivity, excessive use of the internet, tendency to stay up late, sleeping pills and dreams of being trapped contributed to anxiety during the COVID-19 lockdown (25). Ding et al. (26) conducted a study of 817 pregnant women and reported that high knowledge scores were associated with less anxiety. Alaloul et al. (27) reported high levels of anxiety were associated with preventive measures in Oman during the pandemic. Other studies in Singapore, China and Italy found that self-efficacy and information sufficiency was associated with lower anxiety levels, while higher anxiety levels were catalysts to adopt preventive behaviors (28). Another study in Indonesia found that individuals with correct responses to knowledge tests had significantly lower anxiety scores. That study also found individuals reporting practices that conflicted with WHO guidance, such as attending crowded places, showed higher anxiety scores (29). Collectively, these studies suggest KAP level are associated with anxiety during the pandemic. However,

some contradictory evidence also exists; high anxiety levels in India (30) and China (31) were found even in respondents with reasonably good levels of knowledge about the virus. Chowdhury et al. (32) reported anxiety due to COVID-19 was negatively associated with risky behavior during COVID-19 outbreaks. Based on this literature and the emerging COVID-19 situation, it remains important to determine level of KAP surrounding the coronavirus and its associations with anxiety. Such knowledge would provide further insight into how Bangladesh can prevent the further spread of the contagion and downstream impacts of its citizens' mental health.

At present in Bangladesh, the literacy rate of current status stands for 74.9%, while the Net Enrollment Rate (NER) on primary education is almost 97.94% and over 1.3 million students receive tertiary level of education, of which 74% were male, and 26% were female (33, 34). In the present study, we studied KAP surrounding COVID-19 and anxiety among university students. This sample was chosen because we expected they would be motivated and insightful regarding positive attitudes toward COVID-19 containment measures. In Bangladesh, there have been several studies on the KAP of students and young adults (35–39). Further, Hossain and his research team investigated Bangladeshi general people's KAP toward COVID-19 and their underlying fear levels in relation to sociodemographic factors (40). However, the KAP of university students and their association with mental distress has yet to be investigated. Based on this research gap, the present study aimed to determine KAP toward COVID-19 and associated anxiety of university students during the earlier stage of the pandemic in Bangladesh. More specifically, this study aimed to:

a. Determine Knowledge, Attitude, and Practice (KAP) levels of university students toward COVID-19.
b. Test associations between KAP levels and anxiety during the COVID-19 lockdown period.
c. Explore gender-based differences in associations between KAP levels and anxiety.
d. Examine quarantine status-based differences in KAP levels and anxiety associations.

MATERIALS AND METHODS

Study Participants and Sampling Procedure

A cross-sectional study was conducted during the first wave of the pandemic among university students of Bangladesh to understand their KAP levels and anxiety during the COVID-19 pandemic. Inclusion criteria included current enrollment as a university student and the decision to participate in our study. The questionnaire was prepared in English and then translated to the local language (Bangla). A snowball sampling procedure was used to collect the data. First, we distributed a web-based structured questionnaire through attainable social networks (e.g., Facebook, WhatsApp, and Instagram). Then, we requested our social network communities to provide their responses and asked them to share the questionnaire with their networks. The questionnaire was prepared following the World Health Organization (1) guidelines. It was divided into the following sections: (a) demographic information, (b) knowledge toward the COVID-19 pandemic, (c) attitudes toward the spread of COVID-19, (d) related practices to control the spread of COVID-19, and (e) anxiety.

The questionnaire's relevance was determined by consulting a panel of experts. A relevance analysis was used to determine the content validity of each questionnaire block. Experts offered constructive feedback on readability, general relevance, and specific relevance to the study's aims. The questionnaire was then piloted with 25 participants to gather additional feedback. The questionnaire was modified based on this feedback and made more understandable. Cronbach's alpha values were used to determine the reliability index of both the pilot and final questionnaires. All values were more than 0.75, suggesting that the reliability was satisfactory (41).

Previous studies using our suite of measures were unavailable; therefore, we used an online calculator to estimate our necessary sample size (42). We followed the recommended conservative value (50%) for the proportion of our sample displaying our factor of interest. Thus, we calculated the minimum required number of respondents using an online sample size calculator,[1] which was determined at 427 based on a 10% non-response rate, 5% precision, and 50% proportion, with a 95% confidence range for the overall population size of 3.2 million of tertiary level students in Bangladesh (43).

We gathered 744 responses between April 17 and May 01, 2020. As our target population was university students, we cross-checked our data and found that among the respondents, 544 students from different universities of Bangladesh responded. Thus, a total of 544 responses were used for the final analysis. All survey items were answered by all participants, so missing data analysis was not required. Electronic consent was obtained from all participants prior to their completion of the survey. The participant could opt out at any time. Additionally, the survey did not ask participants to provide their names or email addresses, ensuring that the participant could not be identified. Accordingly, the research ethical clearance board of the Institute of Disaster Management, Khulna University of Engineering & Technology, Khulna, Bangladesh waived the approval for this study.

Measures

The survey gathered information on the independent (KAP levels) and dependent variable (anxiety) as well as basic information on university students. This basic information included their gender, age, degree of education, residential status, living status, quarantine status, and sources of information during the COVID-19 epidemic.

- Participants' knowledge of the COVID-19 pandemic was assessed using 24 yes/no questions about the illness type, mode of transmission, and likelihood of exposure to transmission risk. Respondents were asked to answer questions as true or false, with the option of "don't know." Correct responses received a score of one, while incorrect

[1] https://statulator.com/

or unsure (don't know) responses received a score of zero. The overall score for knowledge was between 0 and 24. Scores greater than the sample mean were classified as having good knowledge while scores having less than the sample mean were classified as having poor knowledge. This differentiation between good and poor knowledge levels is in line with past research, improved the interpretability of the results, and was responsive to differences in information sources between populations (44). Cronbach's alpha value of 0.78 suggested a high degree of internal consistency.

- Attitudes toward COVID-19 were captured with five questions divided into two categories. Three questions captured negative attitudes toward COVID-19: (1) worry about the personal financial condition, (2) worry about academic delays, and (3) worry about social stigma. Two items captured positive attitudes toward COVID-19: (4) daily life returning to normal soon, and (5) social support during the pandemic. To determine the extent of these attitudes, a five-point Likert-type scale was used with responses ranging from 1 (not at all) to 5 (very high). The total attitude score ranged from 5 to 25, with negative attitude items recoded to align with the directionality of the response scale of the positive attitude items. Individuals who scored higher on the attitude scale than the mean were categorized as having a positive attitude, while those who scored lower than the mean on the attitude scale were labeled as having a negative attitude. This categorization also aligned with past research, assisted with the interpretability of the results, and was responsive to population differences (44). The Cronbach's alpha was 0.80, indicating a high degree of internal consistency.
- To capture preventive measures, respondents were asked ten questions about their precautionary behaviors during the COVID-19 pandemic. Each item was answered as 1 (yes) or 0 (no). The total score ranged from 0 to 10. Once again, this score was classified into two levels for the same reasons as the knowledge and attitude classifications (44). A score higher than the mean indicated good practices and a score less than the mean indicated poor practices.
- Anxiety was assessed with the 2-item Generalized Anxiety Disorder scale (GAD-2). GAD-2 is a shortened version of the GAD-7 that has been reported in numerous studies to assess anxiety disorders (45, 46). The GAD-2 evaluates how participants were bothered over the last 2 weeks by "feeling nervous, anxious, or edge" and "not being able to stop or control worrying" (47). Participants responded on a 4-point Likert scale: 0 (not at all) to 3 (almost every day). The total score ranges from 0 to 6 with scores ≥ 3 indicating a higher level of anxiety (47).

Statistical Analysis

Descriptive statistics were calculated to analyze the characteristics of the respondents. Levels of KAPs were reported as frequency distributions. Categorical data were presented as numbers (N) and frequencies (%), while continuous data were displayed as means and standard deviations (SD). Associations between KAP levels and anxiety were tested with Pearson chi-square tests and Student's t-tests. To determine associations between KAP levels and anxiety while adjusting for other factors, multivariable logistic regression models were run. Controls included gender, age, education, place of residence, living status, quarantine status, and information sources. Stratified analyses were conducted to examine associations between KAP levels and anxiety in men vs. women and in students under vs. outside of quarantine. The significance of associations was determined with odds ratios (OR) and 95% confidence intervals (CI). A two-tailed test with a significance level of $p < 0.05$ was considered statistically significant. The R Statistical Package (version 4.0), developed by R Core Team released on 2021 and IBM SPSS Statistics, Version 26.0. IBM Corp., Armonk, NY, United States were used to analyze the data.

RESULTS

Sample Demographics

Demographic characteristics of students are displayed in **Table 1**. Of the total, 56.99% were men, and 43.01% were women. The majority (72.43%) were 25 years old or less. Most were undergraduate students (66.54%), followed by graduate (27.21%) and post-graduate (6.25%) students. A total of 84.74% were urban residents, and 78.86% lived with family members. Approximately one-third (32.17%) were in quarantine during the survey period. The largest share of respondents used social media to collect information about the pandemic (89.34%), followed by traditional media (77.57%), governmental agencies (77.21%), online media (60.85%), and healthcare staff (31.43%). Females ($\chi 2 = 12.34$, $p < 0.05$), participants over the age of 25 ($\chi 2 = 19.32$, $p < 0.05$), graduate students ($\chi 2 = 18.34$, $p < 0.05$), and non-quarantined students ($\chi 2 = 4.56$, $p < 0.05$) were more likely to show high anxiety relative to their counterparts.

Knowledge, Attitudes, Practices, and Anxiety Levels

Frequencies of correct and incorrect answers to knowledge-related questions are provided in **Supplementary Table 1**. Almost all students (91.91%) agreed with the statement, "COVID-19 is an infectious disease." About 94.67% of students answered correctly for droplets as one of the transmission routes of the virus, followed by a face-to-face talk (77.39%), handshaking (97.06%), fecal-oral transmission (66.36%), mosquito bites (72.06%), and touching of objects used by an infected person (96.32%). Most students responded incorrectly that food, air, and pets could transmit COVID-19. More than nine-in-ten respondents knew the common symptoms of COVID-19 such as fever (95.77%), dry cough (90.81%), sore throat (91.91%), and difficulty breathing (93.93%). Most students provided incorrect answers for nose bleeds (95.77%) and aches and pains (60.29%). Another 87.50% of students gave the correct answer for the incubation period as understood at the time of this study (1–14 days). When respondents were asked about individuals at most risk of COVID-19, most students correctly answered

TABLE 1 | Demographic characteristics of respondents for the total sample and among students without vs. with anxiety, and significance tests for differences between each characteristic and anxiety (*N* = 544).

Characteristics	*N* (%)			χ 2	*P*-value[a]
	Total (*N* = 544)	Without anxiety (*N* = 295)	With anxiety (*N* = 249)		
Gender				12.34	0.03*
Male	310 (56.99)	180 (61.02)	130 (52.21)		
Female	234 (43.01)	115 (38.98)	119 (47.79)		
Age				19.32	0.01*
≤25	394 (72.43)	226 (76.61)	168 (67.46)		
>25	150 (27.57)	69 (23.39)	81 (32.54)		
Education status				18.34	0.01*
Undergraduate student	362 (66.54)	210 (71.19)	152 (61.05)		
Graduate student	148 (27.21)	71 (24.07)	77 (30.92)		
Post-graduate student	34 (6.25)	14 (4.75)	20 (8.03)		
Place of residence				1.45	0.34
Urban	461 (84.74)	246 (83.39)	215 (86.35)		
Rural	83 (15.26)	49 (16.61)	34 (13.65)		
Living status				1.02	0.31
Alone	26 (4.78)	15 (5.08)	11 (4.42)		
With family members	429 (78.86)	236 (80.00)	193 (77.51)		
With non-family members	89 (16.36)	44 (14.92)	45 (18.07)		
Quarantine status				4.56	0.04*
Yes	175 (32.17)	94 (31.86)	81 (32.53)		
No	369 (67.83)	201 (68.24)	168 (67.47)		
Information source for COVID-19				0.35	0.96
Government agency	420 (77.21)	228 (77.29)	192 (77.11)		
International agency	347 (63.79)	186 (63.05)	161 (64.66)		
Healthcare staff	171 (31.43)	96 (32.54)	75 (30.12)		
Social media	486 (89.34)	257 (87.12)	229 (91.97)		
Traditional media	422 (77.57)	224 (75.93)	198 (79.52)		
Online media	331 (60.85)	177 (60.00)	154 (61.85)		

[a]*Kruskal–Wallis Test, *p < 0.05.*

that people over 60 years old (97.61%), people with chronic illness (92.28%), healthcare professionals (91.36%), and pregnant women (54.23%) were at increased risk of COVID-19. On the other hand, 71.14% of participants believed that young people were not at high risk of COVID-19. One exception was noticed for children, where more than half provided the incorrect answer.

Supplementary Table 2 shows the positive and negative attitudes students held toward COVID-19 during the lockdown. Nearly half of the respondents believed that life would be back to normal soon. However, 29.41% were not optimistic and reported being undecided about this statement. Approximately 70% believed in the necessity of social support during the pandemic. In contrast, more than half were worried about their economic condition being at risk. Another 39.89% consented that they were worried about their academic routine while almost one-third were undecided about this. Besides, 31.25% were undecided about infected people facing stigma in the society.

Regarding practices toward COVID-19, 56.86% of respondents reported that they were staying at home (**Supplementary Table 3**). The vast majority did not wash their hands more frequently with soap and water (91.36%) or avoid social gatherings (92.83%) and public transports (86.21%).

Table 2 shows the KAP scores of students with and without anxiety during COVID-19. Of the total, 50.55% (N = 275) demonstrated a high level of knowledge, 38.61% showed a negative attitude, and 59.01% maintained good practices regarding the COVID-19 pandemic. Students with anxiety had significantly higher negative attitudes about COVID-19 (52.85%, $\chi 2 = 23.55$, $p < 0.001$). There were no statistically significant differences in knowledge and practice scores between students with and without high anxiety.

Associations Between Knowledge, Attitude, and Practice Levels and Anxiety

Bivariate correlations between KAP levels and anxiety are reported in **Table 3**. Knowledge was positively correlated with attitudes ($r = 0.156$, $p < 0.01$) and practices ($r = 0.227$, $p < 0.01$). Attitudes were also positively correlated with practices ($r = 0.178$, $p < 0.01$). Anxiety was positively correlated with attitudes ($r = 0.287$, $p < 0.01$) but not with knowledge or practices ($p > 0.05$).

Table 4 presents the results of a logistic regression model used to determine fully adjusted associations between KAP

TABLE 2 | Knowledge, attitude, and practice (KAP) levels toward COVID-19 among students with and without anxiety, and significant tests between each level and anxiety.

KAP score	*N* (%)			χ 2	*p*-value
	Total	Without anxiety	With anxiety		
Knowledge				1.836	0.192
High	275 (50.55)	157 (57.09)	118 (42.91)		
Low	269 (49.45)	138 (51.30)	131 (48.70)		
Attitudes				23.55	0.000***
Positive	334 (61.39)	186 (55.20)	151 (44.80)		
Negative	210 (38.61)	99 (47.14)	111 (52.85)		
Practices				0.035	0.853
Good	321 (59.01)	173 (53.89)	148 (46.11)		
Bad	223 (40.99)	122 (54.71)	101 (45.29)		

*Chi-square test was conducted to identify significance difference. ***$p < 0.001$ (2-tailed).*

TABLE 3 | Correlations between knowledge, attitude, and practice (KAP) levels toward COVID-19 and anxiety among university students in Bangladesh during the early phases of the pandemic (*N* = 544).

	Knowledge	Attitudes	Practices	Anxiety
Knowledge	1			
Attitudes	0.156**	1		
Practices	0.227**	0.178**	1	
Anxiety	0.007	0.287**	0.081	1

$^{**}p < 0.01$ (2-tailed).

TABLE 4 | Multivariate logistic regression models to determine associations between knowledge, attitude, and practice (KAP) levels toward COVID-19 and anxiety among university students in Bangladesh during the early phases of the pandemic (*N* = 544).

KAP levels	Crude model		Fully adjusted model[a]	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Knowledge				
Low	0.72 (0.51–1.03)	0.06	0.71 (0.50–1.02)	0.06
High	1.00 (ref.)		1.00 (ref.)	
Attitudes				
Negative	2.43 (1.71–3.45)	0.000***	2.40 (1.66–3.46)	0.000***
Positive	1.00 (ref.)		1.00 (ref.)	
Practices				
Bad	0.95 (0.66–1.35)	0.78	0.90 (0.62–1.32)	0.60
Good	1.00 (ref.)		1.00 (ref.)	

*Abbreviations: OR, odds ratio; CI, confidence interval; ref, reference. [a]Adjusted for gender, age, education, place of residence, living status, quarantine status, and information sources. ***$p < 0.001$ (2-tailed).*

levels and anxiety. After accounting for co-variables (gender, age, education, place of residence, living status, quarantine status, and information sources), participants with negative attitudes toward COVID-19 expressed 2.4 times higher risk of anxiety (95% CI: 1.66–3.46, $p = 0.000$). Associations between practices and anxiety were not statistically significant, whereas associations between knowledge and anxiety were negative and approached significance (OR = 0.71, 95% CI: 0.50–1.02, $p = 0.06$). However, none of adjusted variables were found significant (**Supplementary Table 4**).

Adjusted associations between KAP and anxiety levels stratified by gender and quarantine status are displayed in **Figures 1**, **2** and **Supplementary Tables 5, 6**. Both men and women who had negative attitudes toward COVID-19 were at greater risk of anxiety (Male: OR = 2.36; 95% CI: 1.45–3.84; Female: OR = 2.45; 95% CI: 1.3–4.34; $p < 0.001$) (**Figure 1** and **Supplementary Table 5**). Non-quarantined students showing negative attitudes had over three times the chance of experiencing anxiety (OR = 3.14, 95% CI: 1.98–4.98, $p < 0.001$), and non-quarantined students with a low level of knowledge had half the risk of experiencing anxiety (OR = 0.49, 95% CI: 0.31–0.78, $p < 0.01$). In the case of quarantined students, no significant associations between KAP levels and anxiety were observed (**Figure 2** and **Supplementary Table 6**).

DISCUSSION

Summary of the Findings

As one of the densely populated countries in the world, Bangladesh has faced challenges to implementing non-therapeutic measures such as avoiding social gatherings and public transport, wearing masks, washing hands frequently, and other practices. In this catastrophic condition, higher education is one of the worst affected sectors of society. However, past research suggests that adequate knowledge, positive attitudes, and good behavioral practices of students not only supports health and safety but also prevents mental distress. Thus, our study investigated KAP levels toward COVID-19 and associated anxiety in university students during the early stage of the pandemic.

Our results show that approximately half of the students had sufficient levels of knowledge and more than half adhered to COVID-19 precautionary practices. These findings corroborate a previous study with over 10,000 Bangladeshi adults that reported high levels of knowledge regarding COVID-19 preventative behaviors (48). Such findings speak to the effectiveness of delivering massive online public health education during lockdown (49). However, more than half of the students gave incorrect answers regarding the transmission of COVID-19 by food, air, and pets. Also, a few students incorrectly did not think that aches and pains were symptoms of the disease and half of respondents incorrectly associated the occurrence of COVID-19 with nasal congestion. The latter belief could be attributed to mistakes of linking the common fever with cold symptoms (50). The origin of the other incorrect beliefs is unclear but indicates that additional education and research are needed.

Less than half of the students showed negative attitudes toward COVID-19. Mostly, students were unclear about whether their economic conditions and academic careers would be disrupted due to the pandemic. This ambiguity can negatively affect mental health and decision-making ability (51). Similar to other studies (52, 53), half of students realized the importance of social support during the pandemic. Furthermore, nearly one-third of students

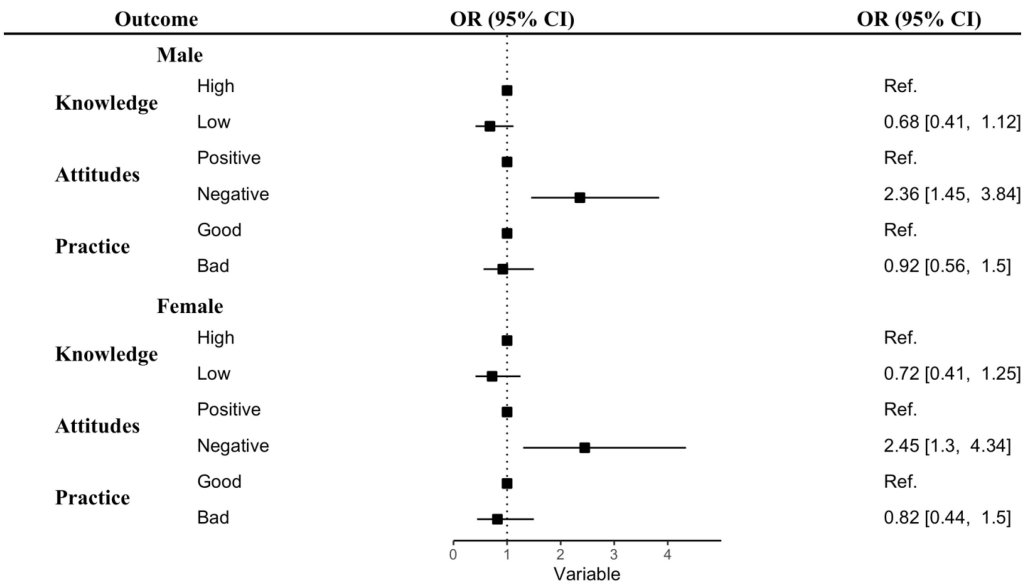

FIGURE 1 | Associations between KAP levels and anxiety during the COVID-19 lockdown by gender. Abbreviations: OR, odds ratio; CI, confidence interval; ref, reference. Adjusted for age, education, place of residence, living status, quarantine status, and information sources.

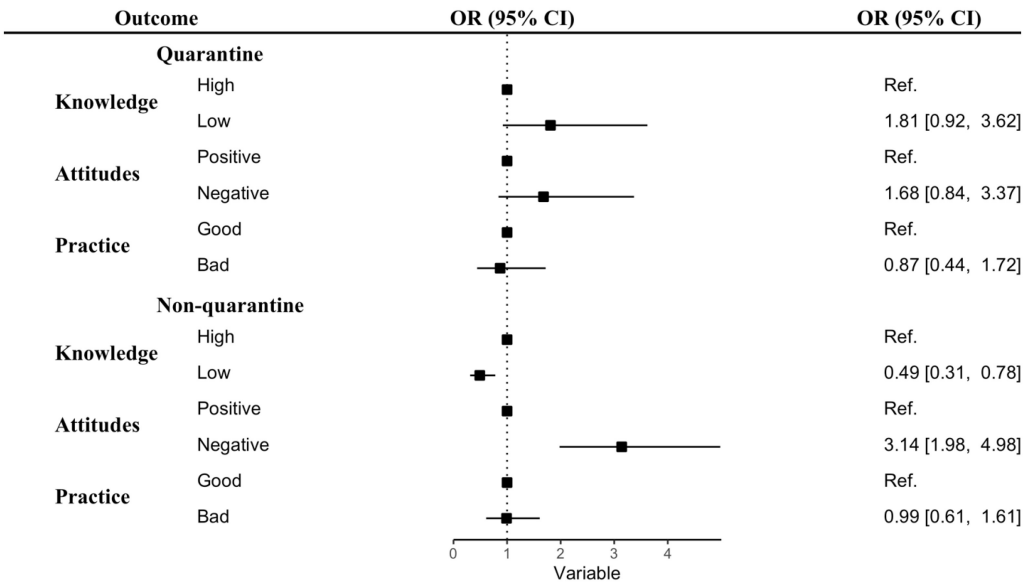

FIGURE 2 | Association between KAP levels and anxiety during the COVID-19 lockdown by quarantine status. Abbreviations: OR, odds ratio; CI, confidence interval; ref, reference. Adjusted for age, gender, education, place of residence, living status, and information sources.

believed that COVID-19 contributed to societal stigma. These findings highlight the importance of social factors on KAP and mental health among university students during the lockdown, which requires the attention of relevant departments.

Compared to other studies (i.e., 54, 55), our study showed a reduced rate of precautionary behaviors toward COVID-19. Despite having sufficient knowledge, half of students did not adhere to such measures, which was similar to the finding reported by Ferdous et al. (56). Such avoidance can stem from lack of clarity in recommended behavioral measures as well as uncertainty regarding their effectiveness against COVID-19 (57). The percentage of students not adhering to these behaviors was much higher than in some past research (22). One explanation may be the educational gap, which reflects a lack of understanding about public health information. Since our study participants were students, they returned to their homes during

lockdown in areas with limited access to information, particularly in rural areas. In addition, people in low-middle income countries, like Bangladesh, generally have poor personal hygiene practices and are less conscious about their health; for instance, only 40% of people have access to facilities to wash their hands with soap and water (58, 59). These factors might contribute to a lack of understanding of COVID-19 protective measures. Although a good knowledge level on infection transmission was found among the students, there was still opportunity to improve these levels. It is widely accepted that a population that is more informed about the disease would adhere to preventative and treatment measures more effectively (56).

Many surveyed students experienced anxiety, including 52% of males and 48% of females. In the early stage of COVID-19, the prevalence of moderate to severe psychiatric symptoms has been documented in several studies (60–63). Prior to the pandemic, the prevalence rate of anxiety was 4.1%, which is approximately five times lower than the present situation (64). Reasons for the higher rates in our sample could be explained by the large share of students (78%) living with their families; one of the reasons for anxiety comes from the fear of spreading the virus between family members through thyself (65). In addition, over 90% of students experiencing anxiety in our sample used social media, such as Twitter and Facebook to update and get information about COVID-19. Past research has found that indirect exposure to mass trauma *via* the media may result in anxiety disorder (66). A recent study conducted in mainland China discovered that increased exposure to social media increased the risk of experiencing anxiety (67).

Our study found that negative attitudes toward COVID-19 were potential risk factors for developing anxiety during the lockdown. In other words, anxiety was comparatively lower among participants who showed positive attitudes toward COVID-19. According to previous research among college students, scholars denoted that positive attitudes were protective against anxiety (OR = 0.822, 95% CI = 0.762–0.887) (21). They mentioned that if people could increase their confidence in resisting COVID-19, it would be advantageous to their mental wellbeing. Another study indicated that young adults intending to gather information about COVID-19 were less likely to develop anxiety (28). As stated in the literature, certain behaviors and responses vary by age and gender (54). One of the reasons for developing anxiety among university students could relate to their academic disruptions. The lockdown caused considerable disruptions that created learning gaps among many students. Such disruptions may have impacted students' mental health since they were more likely to graduate later than expected (68). To comply with strict precautions, educational institutions had to transfer in-person learning to virtual online classes that created extra burdens among many students (69, 70). Additionally, disruptions in academic activities may have led to uncertainty about future career prospects and therefore increased anxiety (71). Finally, the increasing case counts, lack of proper treatment, absence of available vaccine during the time of this study, media speculation and sensational news could have made students more vulnerable to develop psychological distress during early stage of the COVID-19 pandemic (72–75).

Regarding our stratified analyses, showing negative attitudes was significantly associated with anxiety for males, females, and non-quarantined students. Females indicated stronger effects than males as well. Similar findings were reported elsewhere (21); female students with negative attitudes were more likely to develop anxiety. Usually females are more vulnerable to anxiety and depression because of their social expectations. The situations may be exacerbated during the time of a crisis. An extensive review conducted in 30 countries found a greater prevalence of depression among women (76). Studies have also reported that women are 1.6 times more likely to develop mental disorders than men (77, 78). It is important to mention that women must multitask in household duties while providing caregiving roles. In addition, the closing of educational institutions might have put additional pressures on women. To balance such overloads, women appear to be at particular risk of developing higher disorders (79). When stratified by quarantine status, respondents having negative attitudes and not being in quarantine tended to show higher risks of anxiety. This finding is contrary to an earlier study that showed students in quarantine were more anxious than non-quarantined students (80). This contradictory finding may be explained by the possibility of non-quarantine students being less aware of the impacts of COVID-19 during the early stages of the pandemic. An earlier study (81) reported that two-thirds of student participants had confidence that COVID-19 wouldn't be a problem in Bangladesh. Despite the government holiday, students could not communicate with their friends in person due to COVID-19 restrictions, which would could have triggered depression and anxiety (82). The prolonged lockdown restricted students from going outdoors and having family outings, and forced to students to remain in the house idly. Consequently, students appear to have more provision to internet access, social media and news exposure and missed out on the salutatory benefits of physical activity and exposure to restorative environments (i.e., green spaces) (83). Furthermore, many news outlets prioritized sensational news and people frequently shared false and negative news that may have sparked mental stress among young adults, particularly students (84).

Implications

The findings of this study have theoretical and practical implications. Our study is the first of its kind in Bangladeshi university students to examine associations between KAP levels and anxiety. This study therefore expands our understanding about the roles of knowledge, attitudes, and behavioral practices on the mental health of young adults during the COVID-19 pandemic. Even though our study had some limitations, its findings could be relevant for university authorities and policymakers adopting public health interventions in effective and timely manners. Our study suggests that KAPs required to protect students from COVID-19 during the study period were at only moderate levels. Public health education programs should specific target behavioral practices regarding COVID-19 at universities, given the low levels of this dimension of KAPs in our sample. Such programs can be coordinated the Ministry of Education and Ministry of Health and Family Welfare in collaboration with universities. Also, given our notable finding

that negative attitudes and less knowledge were associated with anxiety, teachers can play an important role in improving mental health through education and reinforcing positive outlooks toward the COVID-19 situation.

While a wealth of data has been collected on student's mental health since March 2020, investigations on the psychological and behavioral consequences of lockdowns should continue to be conducted as the pandemic wanes. Simultaneously, interventions should be introduced at universities to alleviate the negative lingering effects of the pandemic on students. Internet based cognitive therapy (CBT) could be an effective way to treat anxiety that works through stress management and relaxation techniques and is convenient for students to complete. Strategies for public policy could also include greater availability of mental health clinicians and psychosocial support interventions. Ultimately, we hope the behavioral data gathered in the current study might serve as a reference for other COVID-19 researchers working on this important and critical area.

Limitations of the Study

There are some limitations to this research. First, our study was cross-sectional, which was insufficient to explain casual relationships between KAP levels and anxiety. To evaluate these hypothesized causal links, longitudinal investigations may be necessary. Secondly, response biases may have existed in the online and self-reported questionnaires. Without internet connections, respondents could not provide their opinions so our study could not reach these populations. In addition, there could be selection bias due to our use of a non-probability sampling method. Finally, we considered only the early stage of the COVID-19 pandemic, which was a short period of time relative to the entire pandemic. Consequently, our results may not apply to different times of the COVID-19, which means ongoing research should be conducted during the pandemic.

CONCLUSION

This is one of the first studies to examine knowledge, attitudes, and behavioral practices knowledge, attitude, and behavioral practice (KAP) levels toward COVID-19 and associated anxiety levels in university students during the first phase of the pandemic. The results provide insights into KAP levels and anxiety rates at this first phase. More than half of students showed high levels of knowledge and good behavioral practices; however, a significant portion of students also held negative attitudes toward COVID-19. Low knowledge levels and negative attitudes were risk factors for anxiety. Consequently, proactive interventions, such as economic and academic security and social support, might be necessary to encourage positive attitudes and psychological welfare. Social support to reduce social stigma is another recommendation. Simultaneously, authentic information sources should be ensured to expand virus-related knowledge and adopt good behavioral practices. The abovementioned suggestions would ultimately support the psychological wellbeing of university students during the ongoing pandemic.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Institute of Disaster Management, Khulna University of Engineering & Technology, Khulna, Bangladesh. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MP: conceptualization, methodology, formal analysis, writing-original draft, review, and editing. AD and MB: conceptualization and writing-original draft. MHa: conceptualization, data curation, and writing-original draft. SB, MHo, MA, MHB, FS, AP, BZ, SaS, JS, and ShS: writing-review and editing. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.856202/full#supplementary-material

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Perceptions of Telemental Health Care Delivery During COVID-19: A Cross-Sectional Study With Providers, February-March 2021

Hattie Wilczewski[1], Samantha R. Paige[1], Triton Ong[1], Janelle F. Barrera[1,2], Hiral Soni[1], Brandon M. Welch[1,3] and Brian E. Bunnell[1,2]*

[1] Doxy.me Research, Doxy.me Inc., Rochester, NY, United States, [2] Department of Psychiatry and Behavioral Neurosciences, University of South Florida, Tampa, FL, United States, [3] Biomedical Informatics Center, Medical University of South Carolina, Charleston, SC, United States

The COVID-19 pandemic accelerated adoption of telemental health (TMH). Providers with limited TMH experience faced challenges during the rapid switch to remote patient care. We investigated TMH providers' perceptions about remote care one year into the pandemic according to *when* providers adopted telemedicine (i.e., before *vs.* after March 2020) and *how much* of their caseloads were served remotely (i.e., $< 50\%$ *vs.* $\geq 50\%$). Between February–March 2021, 472 TMH providers completed a cross-sectional, web-based survey that measured perceived benefits and satisfaction with telemedicine, therapeutic alliance, patient-centered communication, eHealth literacy, multicultural counseling self-efficacy, and facilitating factors of using telemedicine. Providers who began using telemedicine before the pandemic reported having better training, task-related therapeutic alliance with patients, and ability to conduct multicultural interventions, assessments, and session management. Providers who served $\geq 50\%$ of their caseload remotely reported greater satisfaction with their practice, stronger beliefs about the benefits of telemedicine, and greater perceived effects of telemedicine on alleviating the impact of COVID-19. There were no differences in reports of patient-centered communication nor eHealth literacy. In conclusion, providers who adopted TMH more recently may require additional training and support to successfully establish a working alliance with their patients, especially with multicultural aspects of care.

Keywords: telemedicine, telemental health, mental health, quality of care, COVID-19

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****Correspondence:***
Hattie Wilczewski
hattie.wilczewski@doxy.me

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INTRODUCTION

Coronavirus Disease 2019 (COVID-19) ignited a shift in mental health care from in-person to remote delivery. In response to the pandemic, studies estimate over 97% of mental health providers have adopted telemental health (TMH) to supplement or replace in-person care (1, 2). Some mental health providers' caseloads increased by 25–50% during the pandemic with patient surges as high as

Abbreviations: COVID-19, Coronavirus Disease 2019; eHEALS, eHealth Literacy Scale; IRB, Institutional Review Board; MCSE-RD, Multicultural Counseling Self-Efficacy Scale – Racial Diversity; MH, Mental Health; TMH, Telemental Health; US, United States; WAI-SR-T, Working Alliance Inventory - Short Revised – Therapist.

6,558% (1, 3). Telemedicine revolutionized the delivery of evidence-based mental health care (4), and proved to be a dependable solution that 90% of providers surveyed intend to use beyond the resolution of COVID-19 (5). It is imperative to understand how mental health providers deliver remote services to inform and sustain post-pandemic TMH care models.

Mental health providers were highly satisfied with telemedicine before the pandemic, despite its slow uptake (2, 6). High satisfaction and benefits of TMH have been attributed to its convenience, the ability to reach more patients, and the opportunity for a better work-life balance (7). The COVID-19 pandemic led to an abrupt transition from in-person care to TMH for most providers, making TMH less of a choice and more of a requirement to continue practicing (8). In a study conducted during the initial months of the pandemic, mental health providers practicing in the state of Florida believed they were still delivering high-quality care and communicating effectively with their patients despite the transition to TMH care (2). We are now years into the pandemic and it is unknown whether TMH providers remain satisfied with their capacity to conduct high-quality care. The purpose of this study is therefore to further explore perceptions of delivering high-quality healthcare remotely among a nationally representative United States sample of TMH providers.

High-quality healthcare is effective, safe, and equitable and delivered by a provider who clearly communicates and involves patients in health decisions (9). Therapeutic alliance–the relationship and tasks to achieve mutually established health goals–is reliably among the strongest predictors of mental health treatment success, making strategies and tactics for building a strong patient-provider relationship paramount to high-quality care (10–14). Consistent with high-quality care, therapeutic alliance thrives in patient-centered environments where providers elicit the "true" wishes of patients to recognize and respond to their needs and values (15). For in-person healthcare settings, patient-centered communication is commonly described as asking and welcoming questions to understand patients' beliefs and needs to ensure that healthcare is concordant with their values (16). The capacity to practice patient-centered communication requires providers to practice cultural competencies, or multicultural counseling self-efficacy (17). Patient-centeredness is integral to the capacity of providers to recognize and become responsive to the diverse backgrounds of patients and integrate their values into clinical decision-making (18). In TMH settings, patient-centered communication occurs when providers help patients navigate the telemedicine platform, which includes facilitating an environment where they can access, evaluate, and discuss online resources as partners in care (i.e., eHealth literacy) (19). Therapeutic alliance, eHealth literacy, and multicultural competence in a patient-centered environment are vital for success in mental health care, but it is unclear how these indicators of high-quality care have fared throughout the pandemic.

Delivering high-quality TMH care is also attributed to organizational factors that facilitate or support providers in using telemedicine. A recent study found that having strong organizational capabilities, such as sufficient information technology infrastructure, is integral to successful telemedicine adoption in healthcare systems (20). However, healthcare providers must also feel supported in using telemedicine to practice their specialty with fidelity and to effectively provide care to their patients (21). This includes feeling confident that the overarching healthcare system is supportive of telemedicine utilization (e.g., timely reimbursement processes), as well as having enough training or resources available to help them most effectively practice their specialty remotely. Harst et al. (22) found that perceptions of organizational factors which impact telemedicine use has most often been explored among patients rather than providers. This is a significant gap in the literature that our study aims to address.

Telemental health providers' perceptions about the quality of care they provide to patients remotely may vary according to when they adopted telemedicine and how frequently they use it. For example, Zhu et al. (1) found that TMH providers were more comfortable with telemedicine during the pandemic than before it began. Other than this finding, little empirical attention has been paid to examining how the temporal aspects of TMH uptake affect perceptions of TMH care delivery. The decision whether to use telemedicine largely depends on the healthcare provider, making them gatekeepers of telemedicine (23, 24). Therefore, it is imperative to understand how perceptions of TMH care vary according to when it was adopted and the frequency of its use.

The purpose of this study was to investigate TMH providers' perceptions about TMH care delivery during the pandemic. Participants were surveyed about their perceptions of TMH satisfaction, benefits, therapeutic alliance, patient-centered communication, eHealth literacy, cultural competence, and organizational factors that facilitate TMH use. A secondary purpose of the study was to examine how perceptions of TMH care vary depending on when telemedicine was adopted (before or after the onset of COVID-19) and the proportion of caseload served remotely ($<$50% or $\geq$50%). Our investigation occurred in Spring 2021, approximately one year after global leaders announced the COVID-19 pandemic.

MATERIALS AND METHODS

Sample and Procedures

Telemental health providers (N = 472) completed a cross-sectional, web-based survey between February and March 2021. Emails were sent to TMH providers who used the Doxy.me telemedicine platform, sampling from which has shown to be consistent with mental health industry demographics (1, 2, 7, 25, 26). After providing electronic informed consent, providers completed a series of screening questions. English-speaking adults (i.e., $\geq$ 18 years) who identified as practicing mental and/or behavioral health providers were eligible to participate. Providers were compensated with a free 1-month Doxy.me professional membership. Study procedures were approved by the Institutional Review Board of the University of South Florida (IRB#002053).

Survey and Measures

The survey was iteratively developed and refined based on prior studies exploring TMH practice (1, 2, 7). The survey included a variety of items selected from validated scales, questions adapted from validated scales, and novel questions related to TMH practice during COVID-19. See **Table 1** for Cronbach's alpha reliabilities for each measure.

Personal and Professional Characteristics of Telemental Health Providers

We collected demographic (e.g., age, gender, race, ethnicity, rurality) and professional characteristics (e.g., professional title, theoretical orientation, disorders treated, age group primarily treated, change in overhead costs).

Beliefs About the Satisfaction and Benefits of Telemedicine Experience

Perception of providers' satisfaction with telemedicine experience was measured using several items reported in Slone et al. (2). These items were linearly rescaled to create a unidimensional satisfaction measure. Each item was anchored on a 5-point Likert scale from *Extremely Dissatisfied* to *Extremely Satisfied*. Benefits of telemedicine (general) was measured using 3 items anchored on a scale from 1 = *Not at all* to 5 = *Extremely*. Benefits of telemedicine specific to COVID-19 was similarly measured using 3 items anchored on a scale from 1 = *Not at all* to 5 = *Extremely*.

Therapeutic Alliance

Therapeutic alliance with patients *via* telemedicine was captured using the Working Alliance Inventory - Short Revised – Therapist version (WAI-SR-T) (27). This measure consists of three subscales: goals, tasks, and bonds. Responses ranged from 1 = *Seldom* to 5 = *Always*.

Patient-Centered Communication

Patient-centered communication *via* telemedicine was measured with an 11-item instrument. Based on best practices in patient-centered communication (28, 29), we identified four subscales: encourage expression, increase confidence in ability, support patients outside the session, and help patients overcome technology issues. Responses ranged from 1 = *Very difficult* to 5 = *Very easy*.

Electronic Health Literacy

Electronic health (eHealth) literacy was measured based off items from the eHealth Literacy Scale (eHEALS) (30) adapted to fit the therapist perspective. For example, "I know what health resources are available on the internet" was rephrased as "I know what health resources are available on the Internet for my clients." We identified three subscales adapted from a prior eHEALS 3-factor model study (31): information awareness, information seeking, and information evaluation. Responses were anchored on a 5-point Likert scale from 1 = *Strongly disagree* to 5 = *Strongly agree*.

TABLE 1 | Perceptions of care by telemedicine adoption and caseload.

Construct and Measure	Telemedicine Adoption		Telemedicine Caseload	
	<March 2020 M(*SD*)	≥March 2020 M(*SD*)	<50% M(*SD*)	≥50% M(*SD*)
Benefits of Telemedicine				
Satisfaction with Practice (0.86)	4.19 (0.79)	4.15 (0.68)	3.93 (0.86)	4.21 (0.66)**
Protects Against COVID-19 (0.81)	4.49 (0.68)	4.51 (0.70)	4.13 (0.99)	4.59 (0.57)***
Improves Practice (0.70)	3.13 (1.17)	3.02 (1.06)	2.50 (1.08)	3.18 (1.06)***
Therapeutic Alliance				
Goals (0.78)	4.07 (0.65)	3.99 (0.66)	3.92 (0.71)	4.03 (0.64)
Tasks (0.81)	4.22 (0.52)**	4.05 (0.60)	4.07 (0.63)	4.11 (0.57)
Bonds (0.81)	4.49 (0.48)	4.41 (0.50)	4.44 (0.44)	4.44 (0.51)
Patient-Centered Communication				
Encourage Open Communication (0.88)	4.19 (0.85)	4.09 (0.85)	3.97 (0.88)	4.16 (0.83)†
Confidence in Providers' Ability (0.88)	4.34 (0.90)	4.23 (0.78)	4.15 (0.83)	4.29 (0.82)
Support Patients After/Outside of the Session (0.91)	4.06 (0.91)	3.97 (0.82)	3.88 (0.90)	4.03 (0.84)
Improve Comfort with the Technology (0.67)	3.69 (0.94)	3.59 (0.80)	3.47 (0.88)	3.65 (0.83)†
eHealth Literacy				
Information Awareness (0.83)	3.88 (0.84)	3.75 (0.83)	3.73 (0.88)	3.81 (0.82)
Information Seeking (0.81)	3.96 (0.79)	3.84 (0.83)	3.83 (0.82)	3.88 (0.81)
Information Evaluation (0.84)	4.04 (0.90)	3.90 (0.88)	3.93 (0.84)	3.95 (0.90)
Multicultural Counseling Self-Efficacy				
Intervention (0.91)	3.98 (0.61)*	3.85 (0.54)	3.85 (0.56)	3.90 (0.57)
Assessment (0.86)	3.39 (0.86)**	3.11 (0.77)	3.31 (0.75)	3.17 (0.82)
Session Management (0.90)	4.07 (0.55)*	3.92 (0.53)	3.97 (0.52)	3.96 (0.55)
Facilitating Factors				
Feeling supported to practice *via* telemedicine (0.78)	4.00 (0.67)	4.13 (0.76)	4.25 (0.71)*	4.05 (0.75)

*Cronbach's alpha reliabilities are in parentheses next to the construct or measure name. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; †$p < 0.10$.*

Multicultural Counseling Self-Efficacy

Multicultural counseling competence was measured with the Multicultural Counseling Self-Efficacy Scale – Racial Diversity Form (MCSE-RD) (17). The measure focuses on MH providers' confidence in multicultural counseling skills with racially diverse clients, a central aspect of multicultural competence. We measured three subscales: multicultural intervention, multicultural assessment, and multicultural counseling session management. The 60 items in the MCSE-RD were reduced to 22 by consulting two clinical content experts. Criteria for inclusion included eliminating redundancies in scale items and item relevance to TMH practice. Each subscale displayed adequate internal reliability. Responses were anchored on a 5-point Likert scale from 1 = *No confidence at all* to 5 = *Complete confidence*.

Facilitating Factors

Finally, we measured the degree that providers receive organizational support to use telemedicine (e.g., training, resources) using a 4-item measure with response ranging from 1 = *Strongly disagree* to 5 = *Strongly agree*.

Data Analysis

SPSS v28 (IBM Corp.) was used for all analyses. Descriptive and frequency statistics were computed to describe the sample and responses to survey items. A series of χ^2 tests were conducted to examine how demographic factors varied according to our two independent variables (IVs), which included when providers began using telemedicine (0 = before March 2020; 1 = March 2020 or later) and how much of their caseload was served remotely ($0 \leq 50\%$; $1 \geq 50\%$). A series of independent samples *t*-tests were also conducted to examine how perceptions of care quality varied by both IVs. Statistical significance was set at $p < 0.05$.

RESULTS

Table 2 shows that TMH providers in this study were, on average, 53.19 years old (*SD* = 13.16) and predominantly female (81.36%), white (80.51%), and non-Hispanic (91.10%). Most (72.68%) providers lived in a Metropolitan area, with either a moderate or strong urban influence.

Table 3 shows the professional characteristics of the providers. Most identified as mental health counselors (47.46%), psychologists (31.14%), and social workers (14.19%). Nearly three-quarters of providers (75.42%) reported working in an individual practice and 18.43% in a network of providers or a small clinic. Over half of providers primarily treated anxiety and mood related disorders (i.e., anxiety, 43.01%; mood, 21.82%; trauma- and stressor-related disorders, 24.79%), followed the cognitive-behavioral treatment paradigm (54.24%), and served adults (18-64 years old; 83.90%). Private health insurance was the most common form of reimbursement for telemedicine services. About half (45.34%) of providers said their overhead costs (including rent, supplies) had not changed because of providing telehealth services. Over half (67.58%) of providers (n = 319) started using telemedicine March 2020 or later, and 79.66% (n = 376) reported seeing at least 50% of their patients *via* telemedicine. There was no statistically significant association between percent of caseload served *via* telemedicine and whether telemedicine was adopted before or during the pandemic ($p = 0.20$).

TABLE 2 | Personal characteristics of TMH providers (*N* = 472).

Personal Characteristics	*n*	(%)
Age (years), *M (SD)*	53.19	13.16
Sex		
Female	384	81.36
Male	79	16.74
Other	3	0.64
Missing	6	1.27
Race		
White	380	80.51
Black or African American	30	6.36
American Indian/Alaska Native	6	1.27
Asian	8	1.69
Native Hawaiian or Pacific Islander	2	0.42
Multiracial	20	4.24
Other	18	3.81
Missing	8	1.69
Ethnicity		
Hispanic, Latinx, or Spanish origin	37	7.84
Not Hispanic/Latino	430	91.10
Missing	5	1.06

Personal and Professional Characteristics of Telemental Health Providers

Most providers who used telemedicine, regardless of onset, were women; however, the proportion of women who used telemedicine was significantly greater during the COVID-19 pandemic (85.48%) than before it (77.46%), χ^2 (1, N = 459) = 4.48, $p < 0.05$. No other statistically significant relations existed for personal demographics.

Providers who used telemedicine to treat the majority (50% or more) of their caseload were more likely to treat adults (18 + years old) rather than children and adolescents (0-17 years old), χ^2 (1, N = 463) = 11.10, $p < 0.05$. There were no statistically significant differences in changes to overhead costs because of adopting telemedicine technology. However, providers who served less than 50% of their caseload reported that overhead costs "haven't changed" (M = 2.91; SD = 0.60) whereas providers who served more than 50% of their caseload *via* telehealth reported that overhead costs have "decreased some" (M = 2.57; SD = 0.99), t (461) = 3.07, $p < 0.01$. This difference should be noted as having a moderate effect (Cohen's d = 0.42). No other statistically significant relationships existed for professional characteristics and telemedicine use.

Beliefs About the Satisfaction and Benefits of Telemental Health Care

Table 1 includes the responses to general satisfaction of using telemedicine and the benefits (i.e., general to telemedicine and specific to protecting against COVID-19 transmission). Providers

TABLE 3 | Professional characteristics of TMH providers (*N* = 472).

Professional Characteristics	*n*	(%)
Professional Title		
Mental Health Counselor	224	47.46
Psychologist	147	31.14
Social Worker	67	14.19
Marriage and Family Therapist	33	6.99
Missing	1	0.21
Type of Mental Health Practice		
Individual Practice	356	75.42
Small clinic or network of providers	87	18.43
Health organization (i.e., hospital, large clinic, gov't agency)	15	3.18
Educational setting (i.e., school, college, university)	5	1.06
Missing	9	1.91
Primary Age Group Treated		
Children (0-10 yrs old)	13	2.75
Adolescents (11-17 yrs old)	47	9.96
Adults (18-64 yrs old)	396	83.90
Older adults (65 + yrs old)	7	1.48
Missing	9	1.91
Most Common Mental Health Disorder Treated		
Anxiety	203	43.01
Mood	103	21.82
Trauma- and stressor-related	117	24.79
Other	40	8.47
Missing	9	1.91
Primary Treatment Paradigm		
Behavioral	11	2.33
Cognitive-Behavioral	256	54.24
Existential/Humanistic	46	9.75
Family Systems	24	5.08
Interpersonal	61	12.92
Psychodynamic/analytic	61	12.92
Social Learning	4	0.85
Missing	9	1.91
Geographical Region		
Metropolitan/City (Urban center)	110	23.31
Strong urban influence	68	14.41
Moderate urban influence	165	34.96
Weak urban influence	62	13.14
Rural/Small Town (Remote - no urban influence)	62	13.14
Missing	5	1.06
Primary Health Insurance Reimbursement		
Public Insurance (Medicare, Medicaid)	68	14.41
Private Insurance	312	66.10
Client out-of-pocket	83	17.58
Other	9	1.91
Change in Overhead Costs		
Greatly decreased	63	13.35
Decreased some	120	25.42
No change	214	45.34
Increased some	56	11.86
Greatly increased	10	2.12
Missing	9	1.91

reported feeling somewhat satisfied with their TMH practice (M = 4.16; SD = 0.71). They believed that telemedicine services moderately benefitted their practice (M = 3.05; SD = 1.09) but that it had been very-to-extremely beneficial in protecting against the spread of COVID-19 while supporting continuity of care (M = 4.50; SD = 0.69). The timing of telemedicine adoption (before or after March 2020) was not associated with providers' satisfaction using telemedicine or its perceived benefits. However, compared with their counterparts who served fewer patients remotely, providers who served 50% or more of their caseload remotely reported greater satisfaction with their telemedicine practice (M = 4.22 SD = 0.66 vs. M = 3.93 SD = 0.86), t (371) = −3.14; 95% CI = −0.47, −0.11; $p < 0.01$. Providers who served most of their caseload remotely also reported stronger beliefs about the benefits of telemedicine to support their practice (M = 3.18 SD = 1.06 vs. M = 2.50 SD = 1.08), t (421) = −5.50; 95% CI = −0.94, −0.42; $p < 0.001$). They were also more likely to report that telemedicine helped to alleviate the impacts of COVID-19 (M = 4.59 SD = 0.57 vs. M = 4.13 SD = 0.99), t (421) = −5.13; 95% CI = −0.62, −0.20; $p < 0.001$.

Therapeutic Alliance

Table 1 shows that providers reported very often agreeing with their patients on the therapeutic goals (M = 4.01; SD = 0.65) and tasks to achieve those goals (M = 4.10; SD = 0.58) *via* telemedicine. Providers also felt they very often-to-always established a meaningful bond with the patients they served remotely (M = 4.44; SD = 0.50). Compared with providers who started using telemedicine during the pandemic, providers who used telemedicine before the pandemic reported having a greater task-related alliance with their patients (M = 4.22 SD = 0.52 vs. M = 4.05 SD = 0.60), t (357) = 2.62; 95% CI = 0.04, 0.31; $p < 0.01$. There were no other statistically significant differences in therapeutic alliance sub-scores based on when providers began using telemedicine or the proportion of caseload served remotely.

Patient-Centered Communication

Table 1 also shows that providers generally felt that it was somewhat easy to encourage patients to openly communicate *via* telemedicine (M = 4.12; SD = 0.85), to increase patients' confidence in their ability as a healthcare professional (M = 4.26; SD = 0.82), and to stay engaged with them outside the telemedicine session (M = 4.00; SD = 0.85). They reported it was "neither easy nor difficult" to help patients feel more comfortable using telemedicine (M = 3.62; SD = 0.84). There were no statistically significant differences in patient-centered communication based on when providers began using telemedicine or how much of their caseload is served remotely. However, two subscales approached statistical significance based on the percent of patients seen *via* telemedicine; providers who served more than 50% of their caseload remotely felt it was easier to encourage their patients to openly communicate (p = 0.06) and help them feel more comfortable to use telemedicine (p = 0.07).

eHealth Literacy

In **Table 1**, providers somewhat agreed that they were knowledgeable about where to find health information on the Internet to benefit their patients (M = 3.79; SD = 0.83), how

to help their patients find health information on the Internet (M = 3.87; SD = 0.81), and how to help their patients evaluate the quality of health information they find on the Internet (M = 3.94; SD = 0.89). There were no statistically significant differences in online health information awareness, seeking, and evaluation skills according to when providers began using telemedicine and the percentage of caseload they served remotely.

Multicultural Counseling Self-Efficacy

Table 1 includes the responses to providers' multicultural counseling self-efficacy. Providers reported some confidence in their ability to conduct multicultural assessment (M = 3.19; SD = 0.81) and some-to-a lot of confidence in their ability to conduct multicultural interventions (M = 3.89; SD = 0.56) and multicultural counseling session management (M = 3.96; SD = 0.54). Compared to providers who began using telemedicine March 2020 or later, providers who used telemedicine before the COVID-19 pandemic reported a statistically significant higher ability to conduct: (a) multicultural interventions (M = 3.98 SD = 0.61 vs. M = 3.85 SD = 0.54), t (344) = 2.00; 95% CI = 0.00, 0.26; $p < 0.05$, (b) multicultural assessments (M = 3.39 SD = 0.86 vs. M = 3.11 SD = 0.77), t (344) = 3.07; 95% CI = 0.10, 0.47; $p < 0.01$, and (c) multicultural counseling session management (M = 4.07 SD = 0.55 vs. M = 3.92 SD = 0.53), t (344) = 2.35; 95% CI = 0.02, 0.27; $p < 0.05$. There was no statistically significant difference in multicultural counseling self-efficacy based on the percentage of their caseload served remotely.

Facilitating Factors

Table 1 shows that providers somewhat agreed they were adequately trained and supported to provide services *via* telemedicine (M = 4.11; SD = 0.74). This perception was stronger among providers who began using telemedicine before rather than during the COVID-19 pandemic (M = 4.25 SD = 0.71 vs. M = 4.05 SD = 0.75), t (409) = 2.54; 95% CI = 0.05, 0.36; $p < 0.05$. Perceptions about facilitating factors did not vary according to percentage of patients served remotely.

DISCUSSION

The current study aimed to investigate TMH providers' perceptions about remote healthcare delivery one year into the pandemic. A secondary aim was to examine the variability in these perceptions according to when TMH providers adopted telemedicine (i.e., before or during the pandemic) and how much of their caseload was served remotely (i.e., less than 50%; 50% or more). Approximately 80% of providers in this study, regardless of whether they adopted telemedicine before or during the pandemic, reported treating at least half of their patient caseload *via* telemedicine. Findings demonstrate heterogeneity in TMH providers' perceptions of delivering care *via* telemedicine.

Principal Results

Telemental health providers generally reported being satisfied with using telemedicine to deliver care one year into the COVID-19 pandemic. Providers believed that telemedicine was beneficial to their practice and to the safety of themselves and their patients during the COVID-19 pandemic. Positive beliefs were consistent among providers who adopted telemedicine before or during pandemic. However, they were strongest among providers who used telemedicine to treat 50% or more of their caseload. In previous research, TMH providers have cited telemedicine as a convenient and considerably low-cost approach to reach patients who otherwise would not have access to care (7). Although TMH providers were generally satisfied with their telemedicine experience, positive beliefs about using telemedicine to deliver care were cultivated when the technology was regularly integrated into their practice.

TMH providers generally felt confident in their ability to establish a therapeutic alliance with their patients. This is a positive finding, as a therapeutic alliance is an integral component of effective mental health care (14). TMH providers reported establishing treatment goals with their patients, despite the challenges of cultivating task-related alliances. Specifically, TMH providers who began using telemedicine during the pandemic reported the weakest task-oriented alliances with their patients. There are several barriers that may impede the ability of providers to achieve mutual understanding and agreement on exercises to help their patients achieve treatment goals. Some examples include poor internet connection, challenges using devices and software, limited knowledge about how to engage patients remotely, and believing that patients are unreceptive to telemedicine (32). In a study conducted prior to the pandemic (26), TMH providers commonly assigned patients exercises that involved coping and emotional regulation, problem solving, mindfulness, interpersonal skills, and modifying and addressing core beliefs. Future research is needed to examine if and how these exercises are conducted by mental health providers who began using telemedicine during the pandemic. Such inquiry would be useful to inform instructional efforts to help providers new to telemedicine to succeed in cultivating therapeutic alliances.

The strongest therapeutic alliances are cultivated within patient-centered environments, meaning that care is discussed and coordinated with the patients' needs, preferences, and values in mind (18). Telemedicine can challenge the patient-centeredness and therapeutic alliances of healthcare appointments, as self-expression and relational connections among other considerations may manifest differently than in-person appointments (33, 34). As a result, telemedicine has a reputation for being provider-centered, as observational analyses of clinical encounters have found that providers exhibit verbal and information dominance (35, 36). And although there is enthusiasm for telemedicine as a patient-centered healthcare delivery solution (37), a study conducted in the early phases of the pandemic found that disparities in patient-centered communication exist *via* telemedicine (e.g., limited opportunities for open-ended communication and poorly expressed empathy) (38). Future research is needed to capture both patient and provider assessments of therapeutic alliance following telehealth appointments.

There are two important findings related to patient-centered care and communication in this study. First, TMH providers believed it was somewhat easy to encourage their patients to openly communicate about their feelings, values, and needs *via* telemedicine. This positive perception about facilitating open communication was consistent regardless of when providers began using telemedicine and how frequently it is used to serve their caseload. Second, providers also felt it was somewhat easy to help patients feel confident in their abilities as a remote healthcare professional. Patients are more likely to ask for providers to repeat information *via* telemedicine than in-person consultations (35). As a result, providers may perceive patients' expressions of perceptual difficulty as engagement, giving them greater opportunity to exhibit their knowledge about subject matter. Future research examining remote patient-centered communication and investigating its effect on how care is delivered by providers and received by patients is a fruitful area.

Another aspect of patient-centered communication is helping patients feel comfortable receiving and navigating health care. In this study, TMH providers in this study felt it was neither easy nor difficult to help their patients feel comfortable receiving care *via* telemedicine. Further, they felt somewhat knowledgeable about where to find online health information and how to help their patients evaluate its quality to support their health-related goals. Nearly 60% of healthcare providers have shared and recommended online health information to their patients (39), and this proportion is expected to be higher now that the internet has penetrated the daily lives of most people worldwide. Future research is needed to explore what online health information is discussed during telemedicine appointments. Understanding what content is introduced during these appointments and exploring the process by which the information is shared and navigated will inform future interventions to support providers in this endeavor.

To appropriately establish patient-centered care and cultivate therapeutic alliance among racially/ethnically diverse patients, TMH providers must be capable of providing culturally sensitive treatments. TMH providers reported some confidence in their ability to apply multicultural competencies in mental health assessment, intervention, and session management. Multicultural counseling self-efficacy was strongest among providers who reported using telemedicine before the pandemic. This difference may be due to differences in the amount of experience using telemedicine to deliver culturally sensitive care, or perhaps the availability of cultural competence training. Despite a great deal of heterogeneity in workforce cultural competence trainings, common strategies include increasing providers' knowledge and skills to facilitate culturally competent care (40). Future research might focus on patients demographics and include observational studies of multicultural counseling competencies in practice *via* telemedicine. Overall, findings of this study echo the need for training to support TMH providers in serving culturally diverse patient caseloads, especially those residing in medically underserved communities who are disproportionately at-risk for mental health concerns (31).

Although not specific to cultural competence, TMH providers reported being trained and feeling supported by their professional organization in using telemedicine to practice their specialty. Providers who felt supported in using telemedicine were more likely to have started using telemedicine before the pandemic rather than during it. Weaker perceptions of support among novice telemedicine users may be due to the abrupt, and sometimes mandated shifts from in-person to remote care in March 2020. Harst et al. (22) report that positive attitudes toward telemedicine and its acceptability (e.g., perceived usefulness and ease-of-use) are some of the most important predictors for its personal decision to adopt the technology. However, social policies and organizational infrastructure are also important predictors of telemedicine acceptance, and they are also crucial in considering the long-term adoption and sustainability of telemedicine. In this study, we operationalized facilitating factors as providers' beliefs about whether they are supported to use telemedicine and adequately trained and provided resources to practice their specialty remotely. Future research is needed to explore the interpersonal, organizational, and policy-oriented factors that facilitate mental health providers' telemedicine use. Several social and organizational factors have been found to affect providers' adoption of mobile health solutions in their practice (e.g., workflow, patient, policy/regulation, social influence, monetary factors, evidence-base, awareness, and user engagement) (41). Similar research conducted among TMH providers will begin to inform policy and future procedural practices of telemedicine.

Limitations

This study was cross-sectional, and it is limited to a single time-point during the COVID-19 pandemic. Surveillance efforts are needed to monitor TMH providers' perceptions about their delivery of care throughout the remainder of the pandemic and after its resolution. Participant recruitment was limited to users of the Doxy.me telemedicine platform, which may not be representative of all TMH providers or practices. However, participant demographics collected in this study are consistent with those reported in mental health industry statistics (1, 2, 7, 24, 25). Meta-analyses and systematic reviews will be vital to aggregate findings across participant samples and studies. Lastly, these survey data are the product of self-report. Studies in the direct observation of TMH sessions and multicultural care practices will be necessary to understand how providers are adapting to remote care.

Conclusion

Telemental health providers have positive beliefs about telemedicine one year after the pandemic. They felt satisfied and adequately supported in using telemedicine to provide high-quality care to patients. Providers also reported being capable of supporting a remote, patient-centered environment conducive to openly discussing and evaluating online health resources, cultivating therapeutic alliances, and conducting multicultural competent counseling. However, heterogeneity exists in TMH providers' perceptions of healthcare delivery according to *when* they adopted telemedicine in relation to COVID-19 and *how much* of their patient caseload is served remotely. Telemedicine is used now more than ever, and providers who hold positive beliefs

about the technology are using it with most of their caseload. However, novice TMH providers may require additional training and support to successfully establish a working alliance with their patients, especially those who are multicultural.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of South Florida. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors contributed equally to conceptualization, research, and manuscript preparation.

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Conflict of Interest: BW is a shareholder, and all other authors are employees of Doxy.me Inc., a commercial telemedicine company.

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BRIEF RESEARCH REPORT
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Causes of Stress Among Poles and How They Cope With Stress During the COVID-19 Pandemic

Estera Twardowska-Staszek, Krzysztof Biel, Irmina Rostek and Anna Seredyńska*

Institute of Educational Sciences, Jesuit University Ignatianum in Kraków, Kraków, Poland

This study aimed to learn about causes of stress among adult Poles and their ways of dealing with stress during the COVID-19 pandemic. A survey questionnaire was used, as well as two standardized research tools: Endler and Parker's *Coping Inventory for Stressful Situations* (CISS), and Watson and Clark's *Positive and Negative Affect Schedule* (PANAS). The research group comprised 595 people, including 80.5% women. They were 18–75 years old. The most important stress factors were concern for one's health, as well as the current political and economic situation in the country. Most of the participants lean toward avoidance-oriented coping with stress, fewer of them prefer emotion-oriented coping, and the remaining ones focus on task-oriented coping. Task-oriented style is typical of those who are older, married and those who have children. Emotion-oriented coping is more common among women, young people, unmarried people and those without children. Avoidance-oriented style is connected with those who are single, childless, and combining study with work. The most adaptive style of dealing with stress in terms of emotions was task-oriented coping. Psychological support focused on strengthening adaptive strategies of coping with stressful situations is an important task for professionals in the field.

Keywords: COVID-19, coronavirus pandemic, stress, coping strategies, cross-sectional survey

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****Correspondence:***
Estera Twardowska-Staszek
estera.twardowska-staszek@ignatianum.edu.pl

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INTRODUCTION

The whole world has been struggling with the destructive effects of COVID-19 for 2 years. Since reaching Poland, 5540162 people have become infected and 109792 have died of diseases caused by the virus (1).

The COVID-19 pandemic has created a new reality, difficult to compare with other stressful events involving large groups of people: natural disasters or international mass conflicts (2). It is a stressor that, as psychiatrists assume, will increase the number of people in need of mental health professionals (3). Most research results confirm that the pandemic has contributed to an increase in the level of stress experienced by people as well as an increase in the number of patients suffering from depression and anxiety (4–6).

The pandemic contributed to the experience of stress in two ways. A review of studies shows that fear of COVID-19 was reported by 18.1–45.2% of the general population (7). In addition to the stressor associated directly with infection, there are also several stressors related indirectly to the pandemic, e.g., the general political and economic situation of the country, access to healthcare, individual economic situation, isolation and the lack of social contacts, or simply a fear of an unknown future. The meaning of subsequent factors varies in different countries (8), and may also be related to such variables as race (e.g., 9) or age (e.g., 10).

As a consequence of the experience of stress in various areas of functioning people struggle with various problems, mainly those related to anxiety disorders. According to the research results, stress and post-traumatic disorders especially refer to people who work in health services and their family members (e.g., 11). Also, the pandemic exerted a negative influence on people who had already been suffering from mental disorders (12). Their mental health worsened due to increased fear, isolation and cognitive overload. Negative consequences of COVID-related stressors were also found in general populations. Research carried out on a group of 2,457 Poles has revealed that 77% of them are afraid of contracting a disease, 44% have generalized anxiety disorder, and 86% have felt stressed and nervous within the previous 14 days (13).

Autumn and winter of 2020 was a difficult time in Poland. On October 22, 2020, the Constitutional Tribunal ruled that an abortion is (in most cases) inconsistent with the constitution (14). In response, mass social protests against the tightening of abortion regulations in Poland began. As a result, thousands of citizens participated in protests, which took place almost every day until the end of January 2021. In response, the government took further repressive measures, declaring that assemblies during the pandemic were illegal, which resulted in numerous arrests and sometimes the use of police force against the demonstrators (15). Parallel to the fight for women's rights, the fight against the pandemic took place. In December, the number of deaths from COVID-19 exceeded 11,000, and the government introduced a national quarantine. In addition to the closure of schools and universities, gastronomy, cultural facilities, entertainment, sports, and religious institutions, the government introduced a limit of people who can meet at the family table during Christmas and announced the introduction of a curfew (16).

When coping with stress various strategies appear to have differing effects in preventing or supporting psychological symptoms (17). Taking into account the results of studies showing that high resilient copers constitute the smallest group in some populations (18) we assume that the issue of resilience in the context of coping should be considered. The analyses (19) indicate that resilience is based on a "3C" foundation: control, coherence, and connectedness with others. They are the basis for interventions taken in order to minimize the negative effects of stress inducing events.

The objective of the research was to analyze sources of stress among adult Poles and their ways of coping with stress during the COVID-19 pandemic. Moreover, the research aimed at specifying the relationship between coping styles and positive/negative emotions in the context of their adaptiveness. Therefore, three research questions were formulated:

1. What are the main sources of stress in adult Poles during the second wave of the COVID-19 pandemic?
2. What styles of coping with stress are used by adult Poles during the COVID-19 pandemic?
3. Which style/s of coping with stress is/are related to positive and which to negative emotions?

MATERIALS AND METHODS

Participants

A total of 595 people took part in the research. The research participants had to meet the following two criteria: they were to be permanent residents of Poland and aged at least 18. Participation in the research was voluntary and anonymous.

Procedure

The research was carried out in accordance with all Polish and international ethical standards, and with the consent of Ignatianum University's Research Ethics Committee. The study was carried out with the use of the snowball sampling method in social media. This was an example of *ex post-facto* cross-sectional research, carried out with the use of online survey questionnaires sent through e-mails and social media. The survey was carried out between December 2020 and January 2021.

Measures

The research participants were asked to fill in an online questionnaire. Demographic variables were collected with the use of *ad hoc* questions. The analyzed demographic variables included sex, age, marital status, children, education, and employment. Moreover, the participants were asked about their perception of the sources of stress during the pandemic.

The participants' styles of coping with stress were measured using the *Coping Inventory for Stressful Situations* (CISS) by Endler and Parker (20, 21). The questionnaire includes 48 statements related to various behaviors presented by people who experience stressful situations. The respondent is required to provide the answers on a 5-point Likert scale, declaring the frequency of taking up a given activity in difficult situations (from 1–never, to 5–very often). The results of the questionnaire are presented in the form of three styles of coping with stressful situations: task-oriented coping (TOC), emotion-oriented coping (EOC), and avoidance-oriented coping (AOC). The last of these may take the form of either distraction (D) or social diversion (SD).

In order to measure the participants' emotions, the researcher used the *Positive and Negative Affect Schedule* (PANAS) by Watson and Clark (22, 23). PANAS consists of 20 items–adjectives which denote positive and negative emotions. The participant specifies the intensity of such feelings with the use of a 5-point scale (from 1–very slightly or not at all, to 5–extremely). What we obtain are the results in two sub-scales: Positive (PA) and Negative Affect (NA).

Data Analysis

The analysis was carried out using the R programme, version 4.0.3. (24). The comparison of the values of quantitative variables in two groups was made with the use of the Mann-Whitney test. The comparison of the values of quantitative variables in three and more groups was made with the use of the Kruskal–Wallis test. After discovering statistically significant differences, the *post hoc* analysis utilizing Dunn's test was carried out to identify groups with statistically significant differences. The correlations

between quantitative variables were analyzed with the use of semi-partial correlations. The level of significance was established as 0.05 in the analysis.

RESULTS

Participants

A total of 595 people living in Poland took part in the research. Most participants were women (80.50%). The age range was from 18 to 75 years of age (M = 35.95 years). 20.84% of the people surveyed were under 22; 26.22%–from 23 to 34 years of age; 47.06%–aged 35–60; and 5.88% were over 60. Almost half of the participants were married (49.92%), while 41.34% were single. More than fifty percent of the Poles surveyed declared having children (52.10%). 59.33% participants are university graduates, while 27.90% still study. People with secondary education constituted 10.76% of participants; with vocational education–1.85%; with primary education–0.17%. People who worked constituted 53.78% of participants; 19.16% of participants still studied, while 16.47% studied and worked at the same time. Smaller groups of participants included people who do not work (6.72%), as well as retired employees or pensioners (3.87%).

Sources of Stress

Table 1 shows that the research participants declare that the most common stressors during the pandemic are those related to health (difficulty accessing treatment of other diseases and the possibility of contracting COVID-19 by the closest family and friends-as well as those connected with the current situation in the country, i.e. the political and economic situation in Poland). Interestingly, during the time when the risk of contracting the virus and falling severely ill was greater, only less than one fifth of the participants perceived getting infected with COVID-19 as a source of stress.

TABLE 1 | Source of stress during the pandemic according to the people surveyed.

Which of the following situations are the most stressful to you?	*n*	% *
Difficulty accessing treatment of other diseases	338	56.81%
Political situation in Poland	335	56.30%
My family members may get infected with COVID 19	283	47.56%
Economic situation in the country	279	46.89%
Lack of social contacts	275	46.22%
Online learning	209	35.13%
Restrictions	170	28.57%
Lack of respirators and medical staff in hospitals	154	25.88%
No job or risk of losing a job	137	23.03%
My family's financial problems	120	20.17%
Contracting COVID 19	113	18.99%
Other factors	16	2.69%

**The percentage does not add up to 100, because it was not a multiple choice question.*

Styles of Coping With Stress and Positive and Negative Affect

The research results (**Table 2**) show that the highest scores were obtained by the respondents in the TOC subscale, then in the EOC subscale and finally in the AOC subscale. However, taking into account the norms developed for the tool in the period preceding the pandemic–most participants apply avoidance-oriented coping (high level demonstrated by 39,50%), fewer of them–emotion-oriented coping (high level–37,48%), and still fewer of them use task-oriented style of coping with stress (high level–32,77%).

Likewise, while the raw scores of PANAS do not indicate the advantage of negative over positive emotions, referencing them to norms shows 38.15% had a low level of positive emotions, 31.60% people had a high level of positive emotions, and 30.25% people had a medium level of positive emotions. In the sub-scale of negative emotions, 60% people revealed a high level, 29.08% people revealed a medium level, and 10.92%–a low level (25).

Coping Styles and Demographic Variables

Table 3 shows the correlations between the styles of coping with stress and demographic variables. The variables connected with task-oriented coping (TOC) are older age, being married, having children, living in a big city, university education, and employment. Emotion-oriented coping (EOC) is more common among women, younger people, singles, childless people, those with secondary and lower-level education, including those who still go to school, as well as among people who combine study and work. Avoidance-oriented coping (AOC) is related to being single, having no children and combining study with employment. Distraction is typical of younger people, singles and people without children. Social diversion is the most common among people with a university degree, as well as those who study and work at the same time.

Coping Styles and Emotions

Table 4 refers to the relationship between a coping style and positive/negative emotions. There is a positive correlation

TABLE 2 | Participants' questionnaire means scale scores.

Variables	M	Sd
CISS		
TOC	57,16	8,33
EOC	47,74	11,25
AOC	47,01	8,03
D	21,22	5,11
SD	17,26	3,90
PANAS		
PA	26,22	7,22
NA	22,30	7,53

TOC, task-oriented coping; EOC, emotion-oriented coping; AOC, avoidance-oriented coping; D, distraction; SD, social diversion; PA, positive affect; NA, negative affect.

TABLE 3 | Task-oriented, emotion-oriented, and avoidance-oriented coping and demographic variables.

Demographic Variables		CISS									
		TOC		EOC		AOC		D		SD	
		Me quartiles	*p*	Me quartiles	*p*	Me quartiles	*p*	Me quartiles	*p*	Me quartiles	*p*
Sex	Women (*N* = 479)	57 51–62.5	$p = 0.13$	49 41–57	$p < 0.001$*	47 42–52	$p = 0.803$	21 18–24	$p = 0.71$	18 15–20	$p = 0.09$
	Men (*N* = 116)	59 51.75–63		44 34–51		46.5 43–52		22 18–24.25		17 14–19	
Age	Under 22–A (*N* = 124)	54 49–59	$p < 0.001$* D,C > B > A	56 47–62.25	$p < 0.001$* A > B > C,D	48 42.75–55	$p = 0.054$	22.5 18.75–25	$p = 0.023$* A > C	17 14–20	$p = 0.247$
	23–34 years–B (*N* = 156)	56 51–62		50 42–57		48 43–54		22 18–25		18 16–20	
	35–60 years–C (*N* = 280)	60 54–64		45 38–51		46 41–51		21 17–24		17 15–20	
	Over 60 years–D (*N* = 35)	59 56–65		43 35.5–47		46 44–51		22 18–24.5		18 15–19	
Marital Status	Single–A (*N* = 259)	56 50–61	$p < 0{,}001$* B > A	52 44–59	$p < 0.001$* A > B,C	48 42.5–55	$p = 0.016$* A > B,C	22 18–25	$p = 0.025$* A > B,C	17 15–20	$p = 0.288$
	Married–B (*N* = 297)	59 53–65		45 38–52		46 41–51		21 18–24		17 15–20	
	Others–C (*N* = 39)	57 56.5–60		43 36–51.5		46 42–49.5		22 16–23.5		17 14–18.5	
Children	No (*N* = 285)	56 50–60	$p < 0.001$*	52 43–59	$p < 0.001$*	48 43–54	$p = 0.025$*	22 18–25	$p = 0.005$*	17 15–20	$p = 0.934$
	Yes (*N* = 310)	60 53–65		44 38–51		46 41–51		21 17–24		17 14.25–20	
Education	Higher–A (*N* = 353)	60 54–64	$p < 0.001$* A > B,C	46 38–52	$p < 0.001$* C > A,B	47 42–51	$p = 0.394$	21 17–24	$p = 0.001$* B,C > A	18 15–20	$p = 0.002$* A > C,B
	Secondary–B (*N* = 64)	56 48.75–60.25		46 34.75–53.25		46 44–52		23.5 18–26		17 14–19	
	Other–C (*N* = 178)	54 49–59		55 45.25–61		48 42–53		22 18–25		17 14–20	
Employment	Student–A (*N* = 114)	54 49–59	$p < 0.001$* B > C,D,A	55.5 46–61	$p < 0.001$* A,D > C > B	47 39.25–53	$p = 0.016$* D > B,A	21.5 18–25	$p = 0.059$	17 13–19	$p = 0.005$* D > C,A B > A
	Employed–B (*N* = 320)	60 54–64		44 37–51		46 42–51		21 17.75–24		18 15–20	
	Not employed–C (*N* = 63)	68 49.5–61		47 40–54		47 42–51		21 18–25		17 14.5–19.5	
	Employed student–D (*N* = 98)	55 50–60.75		54 47–59.75		49 45–55		22 19.25–25		18 16–20	

**Statistically significant relationship ($p < 0.05$), TOC, task-oriented coping; EOC, emotion-oriented coping; AOC, avoidance-oriented coping; D, distraction; SD, social diversion.*

TABLE 4 | Semi-partial correlations between CISS and PANAS.

PANAS	TOC	EOC	AOC	D	SD
PA	0,292, $p < 0{,}001$*	−0,41, $p < 0{,}001$*	0,032, $p = 0{,}433$	−0,041, $p = 0{,}321$	0,044, $p = 0{,}283$
NA	0,045, $p = 0{,}276$	0,517, $p < 0{,}001$*	−0,026, $p = 0{,}526$	0,023, $p = 0{,}578$	0,005, $p = 0{,}897$

**Statistically significant relationship ($p < 0.05$), TOC, task-oriented coping; EOC, emotion-oriented coping; AOC, avoidance-oriented coping; D, distraction; SD, social diversion; PA, positive affect; NA, negative affect.*

between TOC and positive emotions. EOC correlates positively with negative emotions and negatively with positive emotions. There are no statistically significant relationships between AOC and emotions.

DISCUSSION

The research shows some specific features of the way in which Poles have experienced the pandemic. For most of the research participants, the threat of contracting SARS-CoV-2 is not the greatest source of stress. What they fear the most is the fact that treatment of other diseases is less available during the pandemic and that the health of their closest family members may be affected. The pandemic has clearly shown that the Polish health service is ill-equipped to deal with the direct and indirect consequences of a health crisis. The results of our research confirm that the country's political and economic situation is a significant stressor for Poles. The feeling of being betrayed and abandoned by state institutions correlates with negative emotions (26).

The research results seem to correlate with the data that suggest the adaptive importance of "3C" (control, coherence, and connection) in coping with pandemic stress (27).

Task-oriented coping is related to controlling the surrounding reality and re-formulating the assessment of the situation from threat into challenge. In the context of the pandemic, it may be reflected in taking up tasks reducing the threat of contracting the virus, as well as planning everyday activities, searching for reliable information about the virus, etc. This style of coping has a positive correlation with positive emotions. Complementary results were obtained by Italian researchers who concluded that a sense of self-effectiveness and focusing on a problem strengthen our ability to manage negative emotions (28). This coping style is typical of older people, people who are married, people with children, and employed people, all of which are connected with a more stable lifestyle and responsibility for others.

Coherence, which provides meaning to what is happening, relates to recognizing, naming and accepting emotions that accompany difficult events. Emotion-oriented coping, the essence of which is focusing on one's own feelings, yet combined with taking up actions that aim at releasing emotional tension, seems to be a non-adaptive solution as it negatively correlates with positive emotions and has a positive correlation with negative emotions Similar conclusion were brought by the research indicating a strong correlation between emotional style and depression (17). This coping style is more frequent among younger people, people without children and those with lower levels of education.

Many studies show that connecting with others, remaining in meaningful relationships, perceived social support, has a positive effect on psychological wellbeing (29). At first, analyzing simple correlations between emotions and styles of coping, we found a relationship between social diversion and positive emotions ($r = 0.26$; $p < 0.001$). However, more advanced analyzes did not confirm the existence of such a relationship. Thus, although immersion into the world of social relations may have a salutary effect on psychological wellbeing, several studies (30) show that this effect may be quite opposite. The ambiguity of the obtained results prompts to conduct further research.

The recommendations formulated by the Polish Psychiatric Association (31) indicate the need to pay attention to groups particularly vulnerable to the negative consequences of a pandemic experience: people with pre-pandemic mental disorders history, but also elderly and very young people who do not have enough resources to cope with completely new challenges. Adaptive styles of coping with stress seem to be one of the most important resources in this context. An important task for educators and mental health professionals is to promote and strengthen their use. It may contribute not only to the improvement of the functioning of individuals, but also to the economic recovery of countries (32).

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Ethics Committee of Jesuit University Ignatianum in Kraków. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

ET-S contributed to all the phases of the study, conception and design of the study, results interpretation, and writing and editing of the manuscript. IR contributed to results interpretation, and writing and editing of the manuscript. KB and AS contributed to writing and editing of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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Latent Profile Analysis to Survey Positive Mental Health and Well-Being: A Pilot Investigation Insight Tunisian Facebook Users

Noomen Guelmami[1,2,3], *Amayra Tannoubi*[1,2,3,4], *Nasr Chalghaf*[1,2,4], *Mouna Saidane*[3], *Jude Kong*[5], *Luca Puce*[6], *Azaiez Fairouz*[1,2,4], *Nicola Luigi Bragazzi*[1,6,7]* *and Roobaea Alroobaea*[8]

[1] *Postgraduate School of Public Health, Department of Health Sciences (DISSAL), University of Genoa, Genoa, Italy,* [2] *Group for the Study of Development and Social Environment (GEDES), Faculty of Human and Social Science of Tunis, Tunis, Tunisia,* [3] *Department of Human and Social Sciences, Higher Institute of Sport and Physical Education of Kef, University of Jendouba, Jendouba, Tunisia,* [4] *Department of Human Sciences, Higher Institute of Sport and Physical Education of Sfax, University of Sfax, Sfax, Tunisia,* [5] *Department of Neuroscience, University of Genoa, Genoa, Italy,* [6] *Laboratory for Industrial and Applied Mathematics (LIAM), York University, Toronto, ON, Canada,* [7] *Department of Mathematics and Statistics, York University, Toronto, ON, Canada,* [8] *Department of Computer Science, College of Computers and Information Technology, Taif University, Taif, Saudi Arabia*

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***Correspondence:**
Nicola Luigi Bragazzi
robertobragazzi@gmail.com

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Background: To examine mental health during COVID-19 peaks, lockdown, and times of curfew, many studies have used the LPA/LCA person-centered approach to uncover and explore unobserved groups. However, the majority of research has focused only on negative psychological concepts to explain mental health. In this paper, we take another perspective to explore mental health. In addition, the study focuses on a period of peak decline in the COVID-19 pandemic.

Objective: The present paper aim (a) empirically identifies different profiles among a cohort of Facebook users in Tunisia based on positive factors of mental health using a person-centered approach, (b) outline identified profiles across sociodemographic, internet use, and physical activity, and (c) establish predictors of these profiles.

Methods: Cross-sectional data were collected through an online survey among 950 Facebook users were female (n = 499; 52.53%) and male (n = 451; 47.47) with an average age =31.30 ± 9.42. Subjects filled *Arabic version of Satisfaction with Life Scale, Scale of Happiness (SWLS), Gratitude Questionnaire (GQ-6), International Physical Activity Questionnaire (IPAQ), and the Spirituel Well-Being Scale (SWBS).*

Results: The LPA results revealed three clusters. The first cluster (n = 489, 51,47%) contains individuals who have low scores on the positive psychology scales. The second cluster (n = 357, 37,58%) contained individuals with moderate positive psychology scores. However, a third cluster (n = 104, 10,95%) had high positive psychology scores. The selected variables in the model were put to a comparison test to ensure that the classification solution was adequate. Subsequently, the clusters were compared for the variables of socio-demographics, use of the internet for entertainment and physical activity, the results showed significant differences for gender (low mental well-being for the female gender), socio-economic level (low for the low-income class), and physical activity (low mental well-being for the non-exerciser). However, no significant differences were found for the variables age, location, and use of the Internet for entertainment.

Conclusion: Our results complement person-centered studies (LPA/LCA) related to the COVID-19 pandemic and can serve researchers and mental health practitioners in both diagnostic and intervention phases for the public. In addition, the GQ6 scale is a valid and reliable tool that can be administered to measure gratitude for culturally similar populations.

Keywords: latent profile, survey, positive psychology, mental health, COVID-19, Facebook

INTRODUCTION

After the first case of the infectious disease COVID-19, discovered in Wuhan, China (December 2019) and the spread of a strain with many symptoms and causing high prevalence of hospitalization and/or death worldwide (1), unprecedented health emergency was imposed in several countries and a majority of public sectors were dramatically affected. In response to this health emergency, COVID-19 disease was declared as a pandemic labeled as "Public Health Emergency of International Concern (PHEIC)", the World Health Organization (WHO) and Centers for Disease Control (CDC) began to respond to COVID-19 and its severe impact. Research in this context suggested that COVID-19 have been linked to several of the most significant health, social and economic troubles of the twenty-first century and 250 million people have tested positive for the virus since it began to spread in December 2019, and more than 5 million individuals have perished. Indeed, WHO has been found to have a broad range of physical health challenges and human behavior changes such as sedentary lifestyles, decreased physical activity, insomnia, mental health, disinformation, misinformation spread on the web and social networks, and problematic internet uses (2–4). Furthermore, fear of infection, frustration and boredom, lack of supplies, worry of hospital overcrowding, and financial loss all contribute to the widespread emotional discomfort and increased risk of mental disorders associated with COVID-19 (5, 6), for example, more than a quarter of the Chinese society reported some degree of psychological distress during the first wave of COVID-19 (7). Similarly, other disorders were revealed after the onset of symptoms such as fever, tiredness, and prolonged dry coughs (8), as were social avoidance, anxiety, concern of illness, and global panic (9). Likewise, security guidelines have forced governments to take precautions that ensure physical distancing and self-isolation, such as closing schools, universities, recreational parks, quarantine and firewalls (10, 11). These measures have influenced the quality of life of the majority of people and have resulted in a systematic negative impact on public mental health (12). Several studies have reported unusual and alarming levels of stress, anxiety and depression (13). There has also been an increase in loneliness, self-harm, and suicidal thoughts (14, 15). While high mortality rates have been noted among vulnerable groups (the elderly, obese, diabetics, hypertensive, etc…), the negative effects of the pandemic of the general public's mental health and wellness challenges have been published and well documented in different populations through online collected data (16–18). The majority of studies have agreed that the pandemic has a devastating strategic effect on the deterioration of the health care system which has already been observed in several countries (19–23). However, studies in human psychology and public health in the pandemic context have focused primarily on mental disorders [for example, (13, 24, 25)].

Little research has ranked individuals based on their positive mental health (26). Despite the role of positive psychology factors in the prevention of mental health problems (27), a recent meta-analysis involving internet users reported a trend toward negative mental health parameters such as depression, anxiety, suicidal ideation, fear and stress (28).

Moreover, most of these studies have not given importance to the social and religious context. In fact, religious involvement has been identified as protective factors for mental health (29, 30) and stimulating the positive psychology factors. As an example, spiritual well-being has been highlighted as a key element of social resilience during times of crisis (31, 32). Also, gratitude as a highly valued moral affect in religions (33, 34), was associated with psychological well-being and satisfaction with life (35).

During the COVID-19 pandemic, two mixture modeling techniques have been widely used to segment groups based on several psychological concepts of mental health. The first is Latent Class Analysis (LCA) which deals with qualitative variables, and the second is Latent Profile Analysis (LPA) which deals with continuous variables (36). Latent Profile Analysis (LPA) is a flexible, model-based clustering procedure that supports the probabilistic identification of mental health subgroups. Using this technique, several mental health clusters have been identified for the general population in different countries based on psychopathological symptoms (e.g., stress, anxiety, and depression). But to our knowledge, no study has applied this procedure to class cohorts among positive psychological.

Due to the spread of health-related misinformation and disinformation on social media in problematic ways (37, 38), it is very interesting to target vulnerable groups like Facebook users. Indeed, the massive dissemination of disinformation on the web and social media platforms negatively effects on mental health [see for example: (38)]. In addition, phenomena of Internet addiction have been reported (39). Tunisia can be a favorable geographical space for these problems. The pandemic in this country was associated with high mortality rates (40, 41), behavioral changes (42) and mental health problems (43). Correspondingly, serious internet addiction problems have been reported (41). Furthermore, the country had 6.5 million Facebook users as of January 2020, which is equivalent to 55 percent of the country's total population. As an example,

in pandemic, Sediri et al. (44) found that adult Tunisian women were suffering from severe depression, anxiety, and stress symptoms. Women's use of social media was found to be problematic in ∼40% of cases.

Therefore, the objectives of this study are: (a) empirically identifying, from positive factors of mental health, different profiles among a cohort of Facebook users in Tunisia based on person-centered approach, (b) to outline identified profiles, across the sociodemographic, internet use and physical activity and (c) establish predictors of these profiles.

METHODS

Data Collection and Procedures

Cross-sectional data were collected through a survey designed online using the Google Forms application from October 04 to 28, 2021. We used a snowball sampling method to collect information from Tunisian Facebook users to circulate the questionnaire and involve the maximum number of target people. This method is increasingly applied in studies involving social network users (45, 46). Initially, invitations to fill in an informed consent by specific Google Gmail accounts were distributed on several groups of the social network Facebook. Subsequently, the respondents invited their friends to complete the survey. This procedure makes it possible to create a specific ballot box, in order to be able to control multiple responses. We used this environment based on the Google application's Cloud Computing system which allows for a single response per user. However, the use of this algorithm requires having a Google E-mail address and prohibits access to Internet Protocol (IP) addresses of users for reasons of confidentiality, privacy and security. In the response form, no personal information was obtained (e.g., names, home addresses, email addresses, and phone numbers). While the study follows the Recommended Standards for Conducting and Reporting Online Surveys "CHERRIES" (47).

The inclusion criteria concern each Facebook user aged 18 and over, residing in Tunisia and whose mother tongue is Arabic. However, subjects who do not reside in the country are excluded from the study to maintain the same social and cultural context at the time of the survey.

The study was approved by the local ethics committee of the Institute of Sport and Physical Education of Kef, Jendouba University in Tunisia.

According to Weber et al. (48) the number of Facebook users in Tunisia was 6.5 million. We used Raosoft online sample size calculator (49) and formulas to define subjects needs for this online survey. The method of sampling used in similar previous studies suggested a sample size of 664 as a minimal appropriate participant by assuming a 66% percent response rate, 5% precision or margin of error, and 50% proportion with a 99% confidence interval.

The number of questionnaires was 1,023 regular internet users. We used Mahalanobis distance to eliminate the questionnaires with outlets responses for example random responses and psychological problematic cases ($n = 73$), 950 copies of the measurement instrument were retained. While 8.11% ($n = 77$) of these participants reported having been ill with coronavirus at some point during the pandemic. Participants were female ($n = 499$; 52.53%) and male ($n = 451$; 47.47%) with an average age $=31.30 \pm 9.42$ years. All subjects were of Muslim religion and had permanent access to the internet.

The details of the socio-demographics of the participants and their distributions according to the variables are presented in **Table 2**.

INSTRUMENTS

Sociodemographic Questionnaire

The information solicited on the socio-demographic variables was of age, gender, nationality, country of residence, religion, education level was binary coded (0 < higher; 1 = higher), their residence status (0 < rural; 1 = urban), family income (coded low; medium and high). In addition, access to the internet and its use as a means of entertainment was binary coded (0 = no; 1 = yes).

Arabic Satisfaction With Life Scale [ASWLS]

Among the primary measures of interest in this study was the Satisfaction of Life Scale (SWLS) (50, 51). According to Google Scholar statistics from November 2021, this scale was mentioned in 32,791 papers. This statistic alone demonstrates the magnitude of its impact on the world of study (52). A five-item Likert-type scale has excellent psychometric qualities in terms of both reliability and validity. In terms of reliability, its internal consistency often runs between 0.79 and 0.89, and its rank in item-total correlations typically ranges between 0.51 and 0.80 (53). Indices have been observed to oscillate between 0.83 for 1-month intervals (54), 0.83 for 2-month periods (51), and 0.54 for 4-year periods (53). Regarding the factorial invariance, distinctions in sex or age are seldom seen.

Arabic Scale of Happiness [ASH]

In Arabic context, there are just a few happiness measures. The scale of happiness included 15 short statements as well as five-filler items. Each item was graded on a five-point scale of intensity. The overall score can vary between 15 and 75, with higher numbers indicating greater satisfaction. The results of a primary axis factor analysis, followed by oblique rotation (pattern and structural matrices), provided two factors: general happiness and successful life. Correlations between items and the remainder of the exam varied from 0.42 to 0.77. Internal consistency and temporal stability were shown by Cronbach's alphas and test-retest reliability ranging from 0.82 to 0.94. The Arabic Scale of Happiness (55) had statistically significant correlations with mental health, life satisfaction, optimism, love of life, and self-esteem, demonstrating construct validity (55). Male college and high school students scored higher than their female counterparts did on average. Male and female undergraduates scored higher than their teenage counterparts did on average. The Arabic Scale of Happiness was shown to have strong psychometric qualities. For the present study, we use an average of the total score of the instrument.

Gratitude Questionnaire [GQ-6]

The GQ-6 is a six-item questionnaire designed to assess the dispositional element of gratitude (56). Each item is graded on a seven-point scale ranging from one (strongly disagree) to seven (strongly agree). A simple item is "I have so much to be thankful for". After reversing pertinent items, the scale scores are the total of the items. The scale's higher scores indicate a stronger sense of gratitude. The scale was translated into Arabic using a forward-backward translation process for the purposes of this study. The GQ-6 has strong psychometric qualities in the original article, with a solid one-factor solution and high internal consistency. The internal consistency reliability of the six-item scale, measured by the Cronbach's alpha, was 0.82.

The International Physical Activity Questionnaire (IPAQ)

IPAQ have two available versions: long (five activity domains asked separately) and short (four general items), which may be used through telephone or self-administered techniques. The surveys' goal is to provide standardized instruments that may be used to collect data on health-related physical activity that can be compared across borders. The development of an international physical activity measure began in Geneva in 1998, and extensive reliability and validity testing was carried out across 12 nations (14 locations) in 2000. The final findings indicate that these measures have acceptable measuring qualities for applications in a variety of countries and languages, and that they are appropriate for national population-based prevalence investigations of physical activity participation (57).

In the present study, the Arabic version of the (IPAQ-S) was used. The scale exhibits robust psychometric properties in terms of reliability and validity (58).

The Arabic Version of the Spiritual Well-Being Scale [SWBS]

The Spiritual Well-Being Scale (SWBS) was developed over 30 years ago (59, 60) and has since become a widely used and well-researched tool (61). Despite the fact that the SWBS was initially established in a Christian context and influenced by the Judeo-Christian idea of well-being, Ellison (59) claimed that it is a nonsectarian tool that may be used by other religions that have a personal experience of God. As a result, the SWBS was produced to be extensively used to assess spiritual well-being in religious and unreligious people, as well as people of other religions and cultures.

The SWBS is a self-report paper–pencil instrument with 20 items. It takes 10–15 min to finish. On a six-point Likert scale, ranging from strongly agree to strongly disagree, each item is answered. The RWB and EWB subscales are the two subscales of the SWBS. Ten items are intended to assess RWB and include the term "God," whereas ten items assess EWB and include questions on life fulfillment and direction. To reduce any potential response bias, around half of the items are written in the other manner. Each SWBS item is scored on a scale of one to six, with a higher number indicating greater well-being. Negatively worded items are recorded in the reverse way.

The SWBS and its subscales have great internal consistency, according to the reliability results. Cronbach's alpha scores for the SWBS climbed from 0.66 to 0.85. Cronbach's alpha values for the Arabic SWBS (62) and its subscales (RWB and EWB) were similar to those of other studies with varied samples using the original English version of the SWBS (59, 63, 64), who demonstrated that the SWBS has good internal consistency and reliability consistency. Overall, the SWBS and its subscales are valid and reliable measures that may be used with the population in the Arabic Islamic culture.

Statistical Analysis

Statistical analyses and confirmatory factor analyses were performed using SPSS Version 26.0.0.0 (IBM, USA) and SPSS Amos software Version 23.0.0.0 (IBM, USA) respectively. While the Mclust and Tidy LPA R Studio packages have been adopted for LPA.

The preliminary data analysis was performed by Skewness and Kurtosis normality tests. First, scores for the adapted scale GQ6 were undergone exploratory factor analysis, which performed by the Unweighted Least Squares method with Promax rotation and Kaiser-Mayer-Oklins (KMO) normalization. We retained solutions for KMO $>$ 0.60, Eigenvalue $>$ 1 and a significant Bartlett test (Chi2). The GS6 structure was inspected by confirmatory factor analysis (CFA). Several adjustment indexes of the CFA were retained to examine the model: (1), (2) Goodness of Fit Index GFI. (3) Adjusted Goodness of Fit Index AGFI; (4) Comparative Fit Index (CFI); (5) the Tucker-Lewis index (TLI); (6) Root mean square residual (RMR) and (7) the Root Mean Square Error of Approximation (RMSEA). The $\chi 2$ must not be significant; however, this criterion is very criticized on large samples. While $\chi 2$/DF (DF = degrees of freedom) is widely used and must be less to 2 or superior to 5. According to the recommendations of Hu and Bentler (65), the GFI and AGFI must have values $>$0.90 to accept the model. TLI and CFI values $>$0.95 represent a good fit for the model. The RMSEA should be $<$0.06 for good model fit and $<$0.08 for acceptable model fit (65, 66).

The reliability of all positive psychology scales was achieved by calculating the internal consistency Cronbach's α coefficient. The recommended threshold for the indices is 0.70 to accept it and 0.80 for good reliability.

LPA were used to classify individuals (clusters) with similar characteristics in the various psychological tests performed. This approach is a well-known mixture-model for identifying homogenous latent classes or subgroups within a large heterogeneous group.

In this procedure, four Tidy LPA models (with 2, 3 and 4 classes) were investigated successively: model 1 (Varying means, equal variances, and covariances fixed to 0), model 2 (varying means, equal variances, and equal covariances), model 3 (Varying means, varying variances, and covariances fixed to 0) and model 6 (Varying means, varying variances, and varying covariances). Before analysis, a robust variant of the Mahalanobis distance based on the minimum covariance determinant was considered to detect and delete multivariate outliers.

TABLE 1 | Latent profile fit statistics for attribute preference model with four models and five profiles.

Model	Classes	AIC	BIC	Entropy	prob_min	prob_max	BLRT_p
1	2	10,188.05	10,280.32	0.94	0.98	0.99	0.01
1	3	8,638.08	8,764.35	0.94	0.96	0.98	0.01
1	4	8,051.22	8,211.48	0.90	0.91	0.99	0.01
2	2	9,960.84	10,082.26	0.92	0.97	0.98	0.01
2	3	8,570.54	8,755.09	0.94	0.96	0.98	0.01
2	4	7,884.34	8,132.02	0.92	0.92	0.98	0.01
3	2	7,590.89	7,756.01	0.76	0.90	0.95	0.01
3	**3**	**7,414.30**	**7,613.42**	**0.83**	**0.90**	**0.94**	**0.01**
3	4	7,376.37	7,609.48	0.75	0.75	0.95	0.01
6	2	7,371.83	7,638.94	0.70	0.90	0.92	0.01
6	3	7,225.43	7,628.51	0.80	0.90	0.92	0.01
6	4	7,099.44	7,638.50	0.72	0.78	0.95	0.01

Bold values: retained model.

The fit of the latent profile model is assessed using a variety of statistical measures. (1) Bayesian information criterion [BIC; (67)]. According to several studies (68, 69), this is the most reliable indication of model fit. The BIC encourages models to be as simple as possible, and it can be used to compare competing LPA solutions. BICs with a lower value suggest a better fit. (2) Akaike's information criterion was being studied (AIC). Similarly, a significant value of the bootstrap likelihood ratio test (BLRT) was also considered in selecting the number of classes. (3) The BLRT uses a Bootstrap resampling method to approximate the *p*-value of the generalized likelihood ratio test. (4) Entropy values that are equal to or >0.80 are associated with 90% accurate assignment accuracy, while entropy values of 0.64 and below are associated with high classification error rates.

The comparison between the clusters on all the variables of the LPA model was carried out by the Multivariate analysis of covariance (MANCOVA).

The comparison between clusters of each continuous variable was performed by one-way variance analyses with Bonferroni post-hoc test. In addition, Effect size (Eta Squared) was examined for each comparison. While categorical variables comparisons were made by Chi2 tests with Cramer's *V* effect size.

Completely, gender, family income, academic level, dwelling, and physical activity practice were used in a multinomial logistic regression analysis (with age as a Covariate) to see whether factors had a significant impact on positive mental health outcomes.

RESULTS

At first, the data was visually inspected to make sure that there were no anomalies in the cases, then the skewness and kurtosis coefficients. Scale scores did not present any problems of normality (see **Table 1**).

Before entering the scores of the scales in the LPA model, we carried out a psychometric examination for the GQ-6 since the scale has not been validated on an Arab population. In addition, a check of the internal consistency of the factors of the other scales was carried out to ensure that our data are adequate for the analysis.

We psychometrically tested the adapted version of GQ-6 through exploratory factor analysis, examination of its reliability through Cronbach's alpha internal consistency measure and confirmatory factor analysis.

The Kaiser-Meyer-Olkin index for the sampling quality measure was 0.90 with Bartlett Chi-square = (2,799.70, ddl = 15; $p < 0.01$) sphericity test value. The univariate one-factor model explained 64.31% of the total variance (Eigen value = 3.86).

The results of the confirmatory factor analysis provided a Chi2 value = 46.86 (ddl = 12; $p < 0.01$) with indices (AGFI = 0.96; GFI = 0.98), (CFI = 0.99; TLI = 0.98 and for the measurement error RMR = 0.03; RMSE = 0.067 90 % CI [0.049–0.086].

Subsequently the reliability of the other scales was examined by the same internal consistency coefficients. The results confirmed the reliability of the measurement scales. Indeed, for GQ-6, the coefficient alpha was 0.89 (95%CI [0.88–0.90]).

For spiritual well-being scale alpha = 0.86 (95%CI [0.85–0.088]) and 0.87 (95%CI [0.86–0.088]) for SWB and EWB, respectively.

Similarly, alpha values were = 0.88 (95%CI [0.87–0.90]), alpha = 0.85 (95%CI [0.84–0.86]), alpha = 0.88 (95%CI [0.87–0.90]) For SWLS, AHS and FS.

All four models were examined for 2- to 4-class solutions. The lowest Aic and BIC values were highlighted for model 3 (Aic = 7,414.30; Bic = 7,613.42) and model 6(Aic = 7,225.43; Bic = 7,628.5). Examination of these two indices gives us results that are favorable to the three-class model 6, since the two entropies for 4 clusters are 0.75 (model 3) and 0.72 (model 6), respectively. Also, the posterior probabilities of cluster membership for affected individuals are in the range [0.90–0.94] and exceeded a minimum threshold of 0.70.

The model fit indices from the latent profile analysis are presented in **Table 1**. Among the four models tested, the model, which presents the most values of Aic and Bic and an adequate entropy, is model 3.

To ensure the robustness of the solution, an analysis of variance tests with the scores of the five scales was performed. On all the scales, very significant differences were demonstrated ($p < 0.001$). In addition, the Bonferroni Post-Hoc test showed that cluster 3 has the highest scores on all positive psychology scales, cluster 2 has the moderate scores and cluster 1 has the lowest scores (see **Figure 1**).

As shown in **Table 2**, the first cluster is formed by 59% women, 40.90% men with a mean age of 31.07 ± 9.46. This group is divided into 37.63% with low family income, 40.08% with middle income and 22.29% with high family income. The academic background of this group of people was mostly higher education (62.78%) and almost 37% reported that reported that they use Internet as entertainment medium. According to the practice of physical activity, the distribution of individuals was low (37.83%), average (39.06%) and vigorous (23.11%).

While the second cluster is composed of 48.74% women and 51.26% men with a mean age of 31.10 ± 9.08. This cluster is subdivided for the family income variable: into low (26.33%), medium (48.18%) and high (41.35%). Nearly 61% of this group

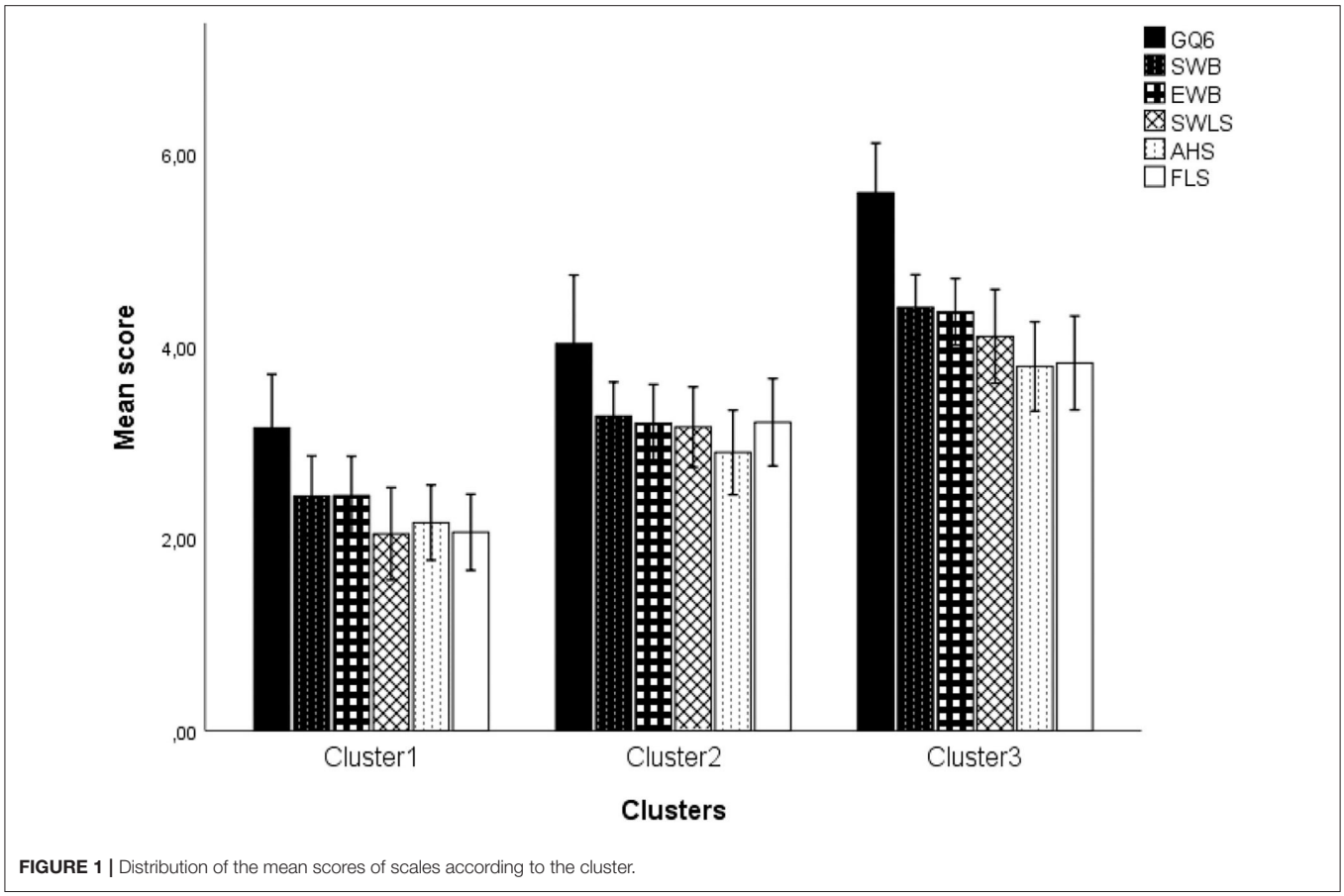

FIGURE 1 | Distribution of the mean scores of scales according to the cluster.

had higher education. In addition, 31.93% of the individuals reported that they use Internet as entertainment medium. The examination of physical activity in this group showed the following results: 35.01% are physically inactive, 40.90% are moderately active and 24.09% practice vigorous physical activity (see **Table 2**).

The third cluster contains 34.62% of women and 65.38% of men with a mean age of 31.10 ± 9.08. The repair by family income for cluster 3 was 27.88% for low levels, 30.77% for medium level and 41.35% for high levels. 23.08% of individuals in this cluster reported that they use Internet as entertainment medium. The majority of this group performs rigorous physical activity (44.23%), compared to 39.42% who perform moderate physical activity and 16.35% who are physically inactive (**Table 2**).

No significant difference between the three clusters was demonstrated for the place of residence (urban vs. rural) and the Internet entertainment medium.

Multinomial Logistic Regression

Modeling the likelihood of predicting class memberships was done using multinomial logistic regression models. The calculated standard error (SE), Wald test values, and adjusted odds ratio (AOR) with their 95 percent confidence intervals are summarized in **Table 3**.

Results of multinomial logistic regression analysis indicated that poor mental health class were related to female gender (AOR = 3.05; 95% CI: 1.88–4.94), poor economic level (AOR = 2.11; 95% CI: 1.22–3.67), medium Family Income (AOR = 2.16; 95% CI: 1.26–3.70), and weak physical activity (AOR = 3.38; 95% CI: 1.81–6.31). However, good mental health was associated to gender (AOR = 1.97; 95% CI: 1.20–3.22), medium Family Income (AOR = 2.29; 95% CI: 1.33–3.94) and Weak physical activity (AOR = 3.18, 95% CI: 1.68–6.01) (see **Table 3**).

DISCUSSION

The present paper aim (a) empirically identifies different profiles among a cohort of Facebook users in Tunisia based on positive factors of mental health using a person-centered approach, (b) outline identified profiles across sociodemographic, internet use, and physical activity, and (c) establish predictors of these profiles.

Initially, an adaptation of the GQ-6 scale was required to measure gratitude. The initial version of the instrument underwent translation into Arabic using the committee method and was subjected to both exploratory and confirmatory factor analysis to test its structure. The results of both analyses confirmed the uni-factorial model initially established. Adaptations of the gratitude questionnaire (GQ-6) in Brazil support our evidence of the validity and reliability of the scale for a single-factor structure (70). The study confirmed a unidimensional solution for two different samples (CFI = 0.99 and CFI = 0.97) with Cronbach's alpha of 0.87. However, the

TABLE 2 | Characteristics of the three clusters.

Variables			Clusters			Chi2/*F* Value	Cramer's *V*
			Cluster1	Cluster2	Cluster3		
Gender	Female	*n*	289	174	36	23,91**	0,16
		%	59,10%	48,74%	34,62%		
	Male	*n*	200	183	68		
		%	40,90%	51,26%	65,38%		
Socio economic level	Poor	*n*	184	94	29	27,81**	0,12
		%	37,63%	26,33%	27,88%		
	Medium	*n*	196	172	32		
		%	40,08%	48,18%	30,77%		
	High	*n*	109	91	43		
		%	22,29%	25,49%	41,35%		
Academic level	Graduate	*n*	307	218	71	1,79	0,043
		%	62,78%	61,06%	68,27%		
	Ungraduate	*n*	182	139	33		
		%	37,22%	38,94%	31,73%		
Dwellings	Urbain	*n*	306	243	70	2,98	0,06
		%	62,58%	68,07%	67,31%		
	Rural	*n*	183	114	34		
		%	37,42%	31,93%	32,69%		
Internet Entertainment medium	Yes	*n*	150	114	24	3,05	0,06
		%	30,67%	31,93%	23,08%		
	No	*n*	339	243	80		
		%	69,33%	68,07%	76,92%		
IPAQ	Weak	*n*	185	125	17	27,22**	0,12
		%	37,83%	35,01%	16,35%		
	Moderate	*n*	191	146	41		
		%	39,06%	40,90%	39,42%		
	Vigorous	*n*	113	86	46		
		%	23,11%	24,09%	44,23%		
Age			31,07 ± 9,46	31,10 ± 9,08	33,14 ± 10,20	2,231	0,005
GQ6			3,15 ± 0,56	4,03 ± 0,71	5,60 ± 0,52	732,872***	0,61
SWB			2,44 ± 0,42	3,28 ± 0,35	4,41 ± 0,34	1,285,721***	0,73
EWB			2,45 ± 0,41	3,20 ± 0,41	4,36 ± 0,35	1,092,456***	0,70
SWLS			2,05 ± 0,48	3,16 ± 0,42	4,11 ± 0,49	1,156,743***	0,71
AHS			2,17 ± 0,39	2,90 ± 0,44	3,79 ± 0,46	770,985***	0,62
FLS			2,07 ± 0,40	3,21 ± 0,46	3,83 ± 0,49	1,139,933***	0,71

*Overall MANCOVA: Wilks' Lambda =0.38; F (6, 943) = 95.86*** (**Eta** =0.62). **: p < 0.01; ***: p < 0.001. The first profile (51.47%) presents vulnerable cluster in terms of positive mental health. The second profile (37.58%) presents clusters with moderate positive mental health. The third profile (10.95%) presents people in good positive mental health.*

study of Dixit and Sinha (71) kept the same factor structure, but with only five scale items with an alpha reliability of 0.74.

Before proceeding to the identification of the profiles, reliability tests by calculating the classical Cronbach's alpha coefficient with confidence intervals on all the scales was carried out to ensure the reliability of the measures. The results were satisfactory and made it possible to integrate all the scales into an LPA model since all the scales presented an adequate internal consistency.

The LPA results revealed three clusters. The first cluster contains individuals who have low scores on the positive psychology scales. The second cluster contained individuals with moderate positive psychology scores. However, a third cluster had highly positive psychology scores. The selected variables in the model were put to a comparison test to ensure that the classification solution was adequate. Subsequently, the clusters were compared to the variables of socio-demographics, use of the internet for entertainment and physical activity, the results showed significant differences for gender (low mental well-being for the female gender), socio-economic level (low for the low-income class), and physical activity (low mental well-being for the non-exerciser). However, no significant differences were found in the variables age, location, and use of the Internet for entertainment.

TABLE 3 | Multinomial logistic regression for the positive mental health profiles.

Clusters[$]	Predictors	SE	Wald test	AOR	95% Confidence Interval for AOR	
					Lower Bound	Upper Bound
Cluster1	Age[a]	0.01	2.66	0.98	0.96	1.00
	[Gender[b] =Female]	0.25	20.59	3.05***	1.88	4.94
	[Family Income[c] =Poor]	0.28	7.09	2.11**	1.22	3.67
	[Family Income =Medium]	0.27	7.92	2.16**	1.26	3.70
	[Academic level[d] =Graduate]	0.26	3.69	0.61	0.37	1.01
	[Dwelling[e] =Urban]	0.24	0.42	0.86	0.53	1.37
	[Internet[f] =No]	0.26	0.90	0.78	0.47	1.31
	[IPAQ[g] =Weak]	0.32	14.64	3.38***	1.81	6.31
	[IPAQ=Moderate]	0.26	2.82	1.55	0.93	2.57
Cluster2	Age[a]	0.01	2.86	0.98	0.96	1.00
	[Gender[b] =Female]	0.25	7.28	1.97**	1.20	3.22
	[Family income[c] =Poor]	0.29	0.89	1.32	0.74	2.33
	[Family income=Medium]	0.28	8.97	2.29**	1.33	3.94
	[Academic level[d] =Graduate]	0.26	2.68	0.65	0.39	1.09
	[Dwelling[e] =Urban]	0.25	0.23	1.13	0.69	1.83
	[Internet[f] =No]	0.27	1.46	0.72	0.43	1.22
	[IPAQ[g] =Weak]	0.33	12.63	3.18***	1.68	6.01
	[IPAQ=Moderate]	0.27	2.54	1.53	0.91	2.57

*[$]Class 3, reference; SE, standard error; AOR, Adjusted Odds Ratio; [a]age, Covariate; [b]male, reference; [c]High Family Income, reference; [d]ungraduated, reference; [e]Rural, reference; Not uses internet for Entertainment, reference; Vigorous, reference. **p < 0.01; ***p < 0.001.*

According to the findings of a multinomial logistic regression study, poor mental health was linked to female gender, low economic status, medium economic status, and low physical activity. On the other hand, good mental health was related to gender, a middle socioeconomic status, and a lack of physical exercise.

To our modest knowledge, no studies have attempted to identify latent groups (LPA or latent class analysis on categorical variables LCA) from positive psychology parameters in the context of COVID-19. However, several studies from a negative or mixed (negative/positive) perspective has been highlighted profile identification for psychological distress, well-being and general mental health from online surveys. As an example, Pierce et al. (72) used LPA techniques to identify psychological distress clusters based on symptoms using the Brief-Symptom Inventory-53. Three latent classes defined by the level of symptom severity were identified (mild, moderate, and severe). Similarly, in another study incorporating negative mental health constructs, Fernández et al. (73), tested an LPA model at ∼4,400 subjects in Argentina that used the constructs of distress and anxiety. Following the analysis, the classification resulted in three profiles that justified the model. However, the results were related to the quarantine phase. In another study, Yalçin et al. (74) identified three latent profiles among University students in Turkey from fear, depression, anxiety, stress, mindfulness, and resilience related to COVID-19. The results also revealed that 38% of the participants were classified in the low psychological symptoms profile vs., 16% who were classified in the high psychological symptoms group. Similarly, female gender was related to high symptoms.

In another example, Fernandez-Rio et al. (75) identified three groups of mental well-being: high (with low depressive symptoms, higher effect and resilience), moderate, and low for an age range above 16 years. In line with the present study, similar results were put for physical activity and gender variable. In fact, the group that presented a highly mental well-being practiced a vigorous and moderate physical activity before the quarantine (81.1%), in addition it contains much fewer women. Similarly for the gender variable, previous research (76–78), indicates that the female gender has a significantly higher risk of psychosomatic health problems and low life satisfaction compared to boys. Fischer (79) explains girls' low mental well-being as a result of being expected to be more emotionally sensitive and expressive.

Regarding the practice of physical activity, the current results agree with a paper by Zhang and Chen (80) highlighted a positive correlation between physical activity, Happiness, and life satisfaction, which are two components of Chinese students' subjective well-being.

Consistent with our study for the family income variable, (81), in a survey of health and well-being for students in Wales, UK, showed that latent classes with higher mental well-being were more affluent. Also, other studies have established strong links between economic standard of living and mental well-being, however other results have suggested the presence of mediating variables, for example the feeling of insecurity among workers (82).

However, our results were not able to show differences between classes according to age, on the other hand, the study of Bernabe-Valero et al. (83) found an inverse association between negative effect and age, indicating that the higher

the age, the lower the negative affects scores. Other studies such as Bidzan-Bluma et al. (84) found that older individuals had better well-being scores than younger individuals. Within this framework, Ebert et al. (85), in a study with participants from the crowdsourcing platform, MTurk, found that mean age differences were observed. However, the trajectory of change did not differ by age. This suggests that responses to COVID-19 maybe age invariant and that effects on well-being are not immediate but may emerge over a longer period of time or in relation to social participation (86).

Daly et al. (87) reported different results for socio-demographic groups examined on mental health problems in a representative British sample. The increase was greatest among those aged 18–34, followed by women and those with higher incomes and education. However, the results that were reported at the beginning of the pandemic were variable over time.

Regarding the association between Internet use and mental health, previous studies have discovered mixed results and depend on several factors. For example, Lam et al. (88) found that frequent Internet use might have beneficial effects on depression and life satisfaction in older adults.

From a different angle, the found clusters point to strong links between thankfulness and spiritual well-being and the other positive psychology variables. Several research (89–92) have shown correlations between religion, well-being, stress management, and happiness. Many additional studies have also shown a link between spirituality and dimensions of subjective well-being including life satisfaction, optimism, self-esteem, and the sense of having lived a meaningful life (93–97). Spirituality may also help patients build psychological toughness and resilience, and patients who are conscious of their own inner strength can create positive attitudes (98, 99). Spirituality and religious coping behaviors (100, 101), such as prayer, supplication, Quranic recitation, trusting and remembering God, forgiveness, patience, starting the day with positive ideas, thanking God for His blessings, are likely to become a coping mechanism after a traumatic experience (32) and may be a key determinant of post-traumatic growth (102). During the pandemic, religious groups rallied to fight the epidemic and its ramifications, demonstrating that religion can have a substantial impact on communal perceptions in times of crisis (103). Spirituality, in this view, conveys hope for the future and may help people cope with problems (104). The COVID-19 pandemic, according to González Sanguino et al. (105), has raised persons' spiritual requirements has been reported to demonstrate the necessity of spirituality more clearly.

LIMITATION OF THE STUDY

Similar to any research, this study had some limitations that we must point out.

First, the exploratory and confirmatory factor analysis of the GQ6 scale were conducted on a single sample and the discriminant and convergent validity were not examined. Future research should examine these psychometric tests across other samples.

Second, resilience as a specific mental health construct in the context of the pandemic has not been examined due to the multitude of scales used. It is crucial that it must be incorporated into other studies to complement our work. Specially, during this study, we did not examine pathological people in terms of mental health. Future research should consider this population.

Third, the study was cross-sectional, further longitudinal studies need to be conducted to examine the transition of latent profiles during different waves of the COVID-19 pandemic.

Finally, future research needs to examine the role of social media and changes in the quality of life and peer relationships that may help explain trends in mental well-being.

CONCLUSION AND RECOMMENDATIONS

The findings of the study led to the identification of three latent profiles: low, moderate, and high positive mental health. It has been shown that a large percentage of Facebook users are vulnerable in terms of mental health. The outcomes also revealed substantial gender, socio-economic, and physical activity practice differences. Moreover, the multinomial logistic regression analysis connected poor mental health to female gender, low socioeconomic position, middle socioeconomic status, and low physical activity. Mental health was linked to gender, middling socioeconomic class, and lack of physical activity.

This study, complement person-centered studies (LPA/LCA) related to the COVID-19 pandemic and can serve mental health researchers and practitioners in the diagnostic and intervention phase.

In addition, psychometric test results suggested that the Arabic version of the GQ-6 scale is a valid and reliable tool and can be administered to measure gratitude toward culturally similar populations.

A need to identify and analyze the constructs of positive psychology can inform the improvement of the practice of psychological intervention, prevention and improve social dialogue. Indeed, focusing on what is going well in life and the positive aspects can contribute to the optimal functioning and development of individuals.

Practical measures to manage our mental health during these difficult times include consuming official media and accessing reliable sources of information that can limit the spread of misinformation related to COVID-19.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

This work has received approval from the Ethics Committee of the "Research Unit, Sportive Performance, and Physical Rehabilitation, High Institute of Sports and Physical Education,

Kef, University of Jendouba, Jendouba, Tunisia" and received ethical clearance from the UNESCO Chair "Health Anthropology Biosphere and Healing Systems," University of Genoa, Genoa (Italy), the Higher Institute of Sport and Physical Education of Kef, Kef (Tunisia), and the Higher Institute of Sport and Physical Education of Sfax, Sfax (Tunisia). The proposal has been also approved by the Jendouba University Ethics Committee and was undertaken following the legal standards of the Helsinki declaration in 1964 and its corresponding amendments. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

NG, AT, NC, AF, NB, and RA have conceived and designed the experiment. NG, AT, NC, MS, JK, LP, AF, NB, and RA have collected and analyzed data. All authors drafted and critically revised the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.824134/full#supplementary-material

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BRIEF RESEARCH REPORT
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Mental State of Inpatients With COVID-19: A Computational Psychiatry Approach

Mikhail Yu. Sorokin[1*†], *Ekaterina I. Palchikova*[2], *Andrey A. Kibitov*[3†], *Evgeny D. Kasyanov*[4], *Maria A. Khobeysh*[1] *and Elena Yu. Zubova*[3]

[1] *The Integrative Pharmaco-Psychotherapy of Patients With Mental Disorders Department, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia,* [2] *The Geriatric Psychiatry Department, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia,* [3] *The Educational Department, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia,* [4] *The Translational Psychiatry Department, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia*

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Edited by:
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***Correspondence:**
Mikhail Yu. Sorokin
m.sorokin@list.ru

[†] These authors have contributed equally to this work and share senior authorship

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Background: The overload of healthcare systems around the world and the danger of infection have limited the ability of researchers to obtain sufficient and reliable data on psychopathology in hospitalized patients with coronavirus disease 2019 (COVID-19). The relationship between severe acute respiratory syndrome with the coronavirus 2 (SARS-CoV-2) infection and specific mental disturbances remains poorly understood.

Aim: To reveal the possibility of identifying the typology and frequency of psychiatric syndromes associated with acute COVID-19 using cluster analysis of discrete psychopathological phenomena.

Materials and Methods: Descriptive data on the mental state of 55 inpatients with COVID-19 were obtained by young-career physicians. Classification of observed clinical phenomena was performed with k-means cluster analysis of variables coded from the main psychopathological symptoms. Dispersion analysis with p level 0.05 was used to reveal the clusters differences in demography, parameters of inflammation, and respiration function collected on the basis of the original medical records.

Results: Three resulting clusters of patients were identified: (1) persons with anxiety; disorders of fluency and tempo of thinking, mood, attention, and motor-volitional sphere; reduced insight; and pessimistic plans for the future ($n = 11$); (2) persons without psychopathology ($n = 37$); and (3) persons with disorientation; disorders of memory, attention, fluency, and tempo of thinking; and reduced insight ($n = 7$). The development of a certain type of impaired mental state was specifically associated with the following: age, lung lesions according to computed tomography, saturation, respiratory rate, C-reactive protein level, and platelet count.

Conclusion: Anxiety and/or mood disturbances with psychomotor retardation as well as symptoms of impaired consciousness, memory, and insight may be considered as neuropsychiatric manifestations of COVID-19 and should be used for clinical risk assessment.

Keywords: SARS-CoV-2 infection, psychiatric disorder, mental status test, cluster analysis, COVID-19

INTRODUCTION

The neurotropic nature of severe acute respiratory syndrome with the coronavirus 2 (SARS-CoV-2) predetermines psychiatric disorders in some patients with coronavirus disease 2019 (COVID-19) (1–3). However, most publications on the psychological and mental impact of COVID-19 present the results of online and cross-sectional studies of the general population (4–6), some researches emphasize the healthcare service burden of clinics (7), and other studies present the post-recovery data of patients who have suffered the acute SARS-CoV-2 infection earlier (8–12). Even the clinical findings from previous coronavirus crises are mostly symptom- and dimension-oriented (13, 14).

The complex clinical picture and frequency of psychiatric syndromes in patients with current SARS-CoV-2 infection remain poorly understood (15, 16). A few studies present case reports of rare psychiatric conditions (17, 18). Some data were published about the existence of neurological disturbances in hospitalized patients with COVID-19 (19–21). Few studies are systematic assessments of the mental status of inpatients with COVID-19 (22, 23). These results are often obtained by non-psychiatric health professionals. At the same time, neuropsychiatric disorders are a COVID-19 death risk factor (23, 24), so they need to be diagnosed in a timely manner and appropriately treated. In this case, the lack of data on typical mental status variations in COVID-19 patients must be addressed because of the importance of this phenomenological information as a potential target for clinical screening and risk assessment by general practitioners.

At the same time, the extreme overload of healthcare systems around the world and the danger of infection have limited the ability of psychiatric researchers to obtain sufficient and reliable data on psychopathology in hospitalized patients with COVID-19. The relationship between severe infection and specific psychiatric syndromes remains to be explored. Back in the early days of psychiatry as a medical specialty, solving similar problems associated with syphilis and progressive paralysis took more than 100 years (25). Computational psychiatry is considered a promising methodology for assessing complex clinical events with a large number of factors and predictors that can lead to ambiguous clinical conditions in patients (26, 27). An important aspect of this approach is verification of the observed mental disturbances using certain pathogenetic indicators, such as inflammation and abnormalities of physiological functions (28).

The hypothesis of the study is as follows: nervous system damage caused by SARS-CoV-2 can have a variety of psychopathological manifestations in patients and must be associated with specific clinical parameters.

The aim of the study is as follows: to reveal the possibility of identifying the typology and frequency of psychiatric syndromes associated with acute COVID-19 using cluster analysis of discrete psychopathological phenomena.

METHOD

The assessment of the mental state of patients with COVID-19 requires specialized education and sufficient clinical practice of a physician. These requirements are unattainable in the real world of the COVID-19 crisis. During their mandatory general medicine practice in the northwest region of Russia, trainees of the National Medical Research Center for Psychiatry and Neurology obtained descriptive data on the mental state of 55 inpatients with COVID-19 (**Figure 1**). Between December 2020 and March 2021, resident psychiatrists, neurologists, and psychotherapists conducted semi-structured interviews with acute COVID-19 inpatients in infectious disease departments. Certain descriptors of psychopathological syndromes, laboratory results, and sociodemographic data of patients, as well as sources for their acquisition, are presented in **Supplementary Table 1**.

Young career physicians who had already completed their basic and advanced training courses in psychopathology provide enough quality in the process of data acquisition. To standardize the mental state assessment and to maximize inter-rater reliability, discrete psychopathological phenomena were pre-identified for raters. They used a scale from 0 to 1 point, where 0 = absence and 1 = presence of violations. The possible range of severity between 0 and 1 point should provide "artifact correction" during data acquisition, and k-means cluster analysis of quantitative variables coded from the main psychopathological symptoms allowed to perform classification of observed clinical phenomena. Quality control during data acquisition, artifact correction, and robust statistical algorithms are considered essential for computational technologies in psychiatry (29). The Student's *t*-test and the Mann–Whitney *U*-test with p-level of 0.05 were used to reveal cluster differences in parameters of inflammation and respiration function which were suggested as a physiological background of psychopathology in COVID-19 patients. Chi-square test was used for the assessment of cluster differences in socio-demographic parameters and presence of comorbidities. Clinical parameters of the patients were collected on the basis of the original medical records. Descriptions of subgroups were presented in means M[SD] or medians Me(IQR) depending on the results of distribution normality tests (Kolmogorov–Smirnov K-test). IBM SPSS Statistics (RRID:SCR_019096) was used.

The study design was controlled by the independent ethical committee. It was in conformity with the Helsinki Declaration and the standard of good clinical practice (GCP). It included collection of anamnestic socio-demographic data and clinical parameters based on the original medical records after the patients signed a voluntary informed consent, and their current mental state was tested.

The inclusion criteria were the following: (1) ability to read and understand and readiness to sign a voluntary informed consent to take part in the study; (2) a hospitalization due to COVID-19 diagnosis; and (3) ability to fulfill the study procedures.

The non-inclusion criteria were the following: (1) extremely high severity of the current condition with insufficient respiratory function and (2) age <18 years. Exclusion criterion

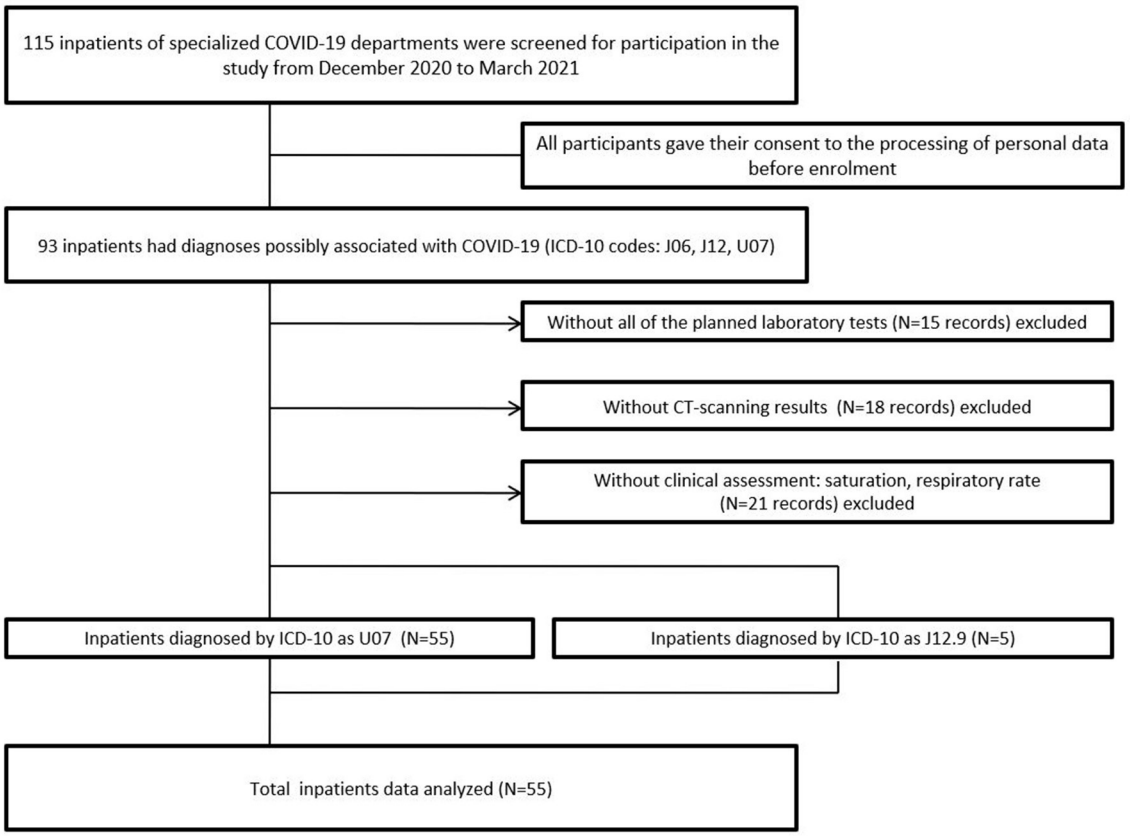

FIGURE 1 | Flowchart of participant recruitment.

was the following: refusal to comply with the study procedures at any stage of the study.

RESULTS

The sample of patients consisted of 21 men and 34 women, with a mean age of 51.5 [20.9] years. Higher and not completed higher education was characteristic of 30 patients (54.5%), secondary education of 11 patients (20.0%), and primary education of 14 patients (25.5%). The majority of the sample of patients were married people−33 (60%), and the smaller share was single persons−21 patients (38.2%). Also, the majority of the patients studied or worked full time−31 (56.4%), and the smaller share was unemployed−23 (41.8%). Data about the marital status for one patient (1.8%) and about the occupation for another one (1.8%) were missing (**Supplementary Table 2**). The most prevalent comorbidities were cardiovascular disorders −11 patients (20.0%), then endocrine disorders−6 (10.6%), gastrointestinal−5 (9.1%), and respiratory−2 (3.6%); renal and neurological disorders were the rarest—in 1 patient (1.8%) for each comorbidity. The mean percentage of lung lesions according to computed tomography data was 20.1% [19.1], and saturation lower than 95% was characteristic of 16 patients.

Three resulting clusters of patients were identified (without differences in gender and somatic and mental comorbidities) (**Figure 2A**). The first cluster [$n = 11$ (20%)] was of patients with anxiety; disorders of fluency and tempo of thinking, mood, attention, and motor-volitional sphere; reduced insight; and pessimistic plans for the future. The second cluster [$n = 37$ (67%)] was of patients without psychopathology. The third cluster [$n = 7$ (13%)] was of patients with disorientation; disorders of memory, attention, fluency, and tempo of thinking; and reduced insight (**Figure 2B**).

Representatives of cluster 1, in comparison with cluster 2 (without mental disturbances), had more lung lesions according to computed tomography: 20% (34) vs. 15% (18), $p = 0.018$. There were no significant differences in saturation, respiratory rate, and other laboratory parameters, as well as in age between patients from cluster 1 and cluster 2.

Other patients with mental abnormalities (cluster 3) were older: 76.9 [14.7] vs. healthy patients (cluster 2) 50.9 [17.8], $p = 0.001$, as well as vs. patients with anxiety and mood disturbances (cluster 1) 60.9 [24.3], $p = 0.027$. Cluster 3 patients, in comparison with cluster 2 (patients without mental abnormalities), were clinically different by a more severe course of the disease based on the results of laboratory

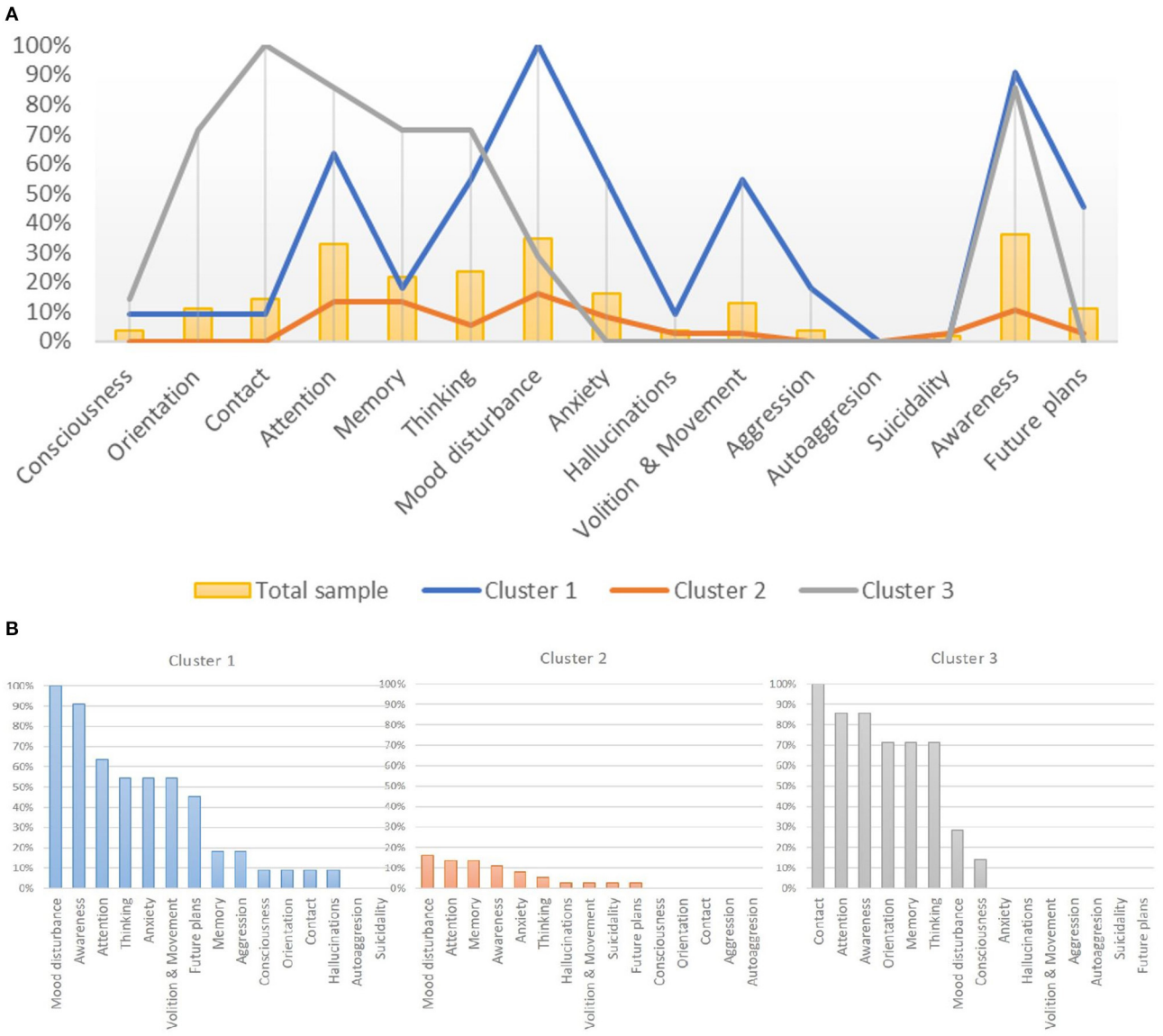

FIGURE 2 | (A) The frequency of psychopathological syndromes in patients with COVID-19 infection within three defined clusters. **(B)** Psychopathological profiles of inpatients with COVID-19 infection in each determined cluster.

and instrumental methods: a higher percentage of lung damage [31% (35) vs. 15% (18), $p < 0.001$]; higher level of C-reactive protein [126 mg/L (236) vs. 10 mg/L (21), $p < 0.001$]; lower saturation [89% (13) vs. 97% (4), $p < 0.001$]; and higher respiratory rate [21 (6) vs. 18 (4), $p < 0.001$].

Patients from cluster 3 vs. cluster 1 clinically differed: a higher percentage of lung lesions on computed tomography [31% (35) vs. 25% (34), $p = 0.029$], higher C-reactive protein level [126 mg/L (236) vs. 16 mg/L (88), $p < 0.001$], lower saturation [89% (13) vs. 95.5% (4), $p = 0.005$], higher respiratory rate [21/min (6) vs. 19/min (7), $p = 0.035$], and lower platelet count [139 * 10^9/L (129) vs. 322 * 10^9/L (129), $p = 0.006$].

DISCUSSION

To our knowledge, this is the first study performed using the computational psychiatry approach to assess the presence and typology of psychopathological syndromes in patients with acute COVID-19. The hypothesis of the study was confirmed: differences in the presence of psychopathology and the development of a certain type of impaired mental state were associated with specific clinical and laboratory parameters of patients. The combined representation of anxiety and/or mood disturbances with psychomotor retardation was characteristic of 20% of inpatients with acute COVID-19. Symptoms of impaired consciousness and memory, combined with impaired insight, were present in 13% of the sample.

The study had several limitations. Firstly, patients in extremely severe current condition with insufficient respiratory function were not included in the study, although they could have more pronounced mental disturbances. The second limitation was the small size of the sample due to the limited access to COVID-19 patients. Thirdly, standardized psychiatric diagnostic methods and tests or specific surveys (30) were not used because of the lack of time and acute infection process in the study participants. The structure of mental state examination traditionally used in Russian medical praxis founded mainly in German psychiatry was implied (31). The list of psychopathology dimensions used for assessment in the study is matched to British Medical Association guidance (2004). The slight modification of this list was made in accordance with the basic course in psychopathology (32). The fourth limitation was the issue of reliability of assessment performed by a general physician without psychiatric license. To minimize this possible weakness, in the study residents in psychiatry, neurology, and psychotherapy performed the assessment of the mental state within their competencies due to not only basic but advanced courses in psychopathology. This made data acquisition robust enough for further computational processing.

The results of the study should be used for better risk assessment of people with coronavirus infection and prediction of neuropsychiatric consequences as a marker of a more unfavorable course of the disease.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Independent Ethics Committee of V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

EZ and MS: conceptualization of the study, goals and aims, and resources. MS, EP, and AK: investigation. MS and AK: methodology, statistics, and writing (original draft). MS and MK: writing (review and editing). MS, EP, and EK: project administration. All authors read and approved the final version of the manuscript.

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SUPPLEMENTARY MATERIAL

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ORIGINAL RESEARCH
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Psychological Symptom Progression in School-Aged Children After COVID-19 Home Confinement: A Longitudinal Study

*Xinyan Xie, Qi Liu, Kaiheng Zhu, Qi Jiang, Yanan Feng, Pei Xiao, Xiaoqian Wu and Ranran Song**

Department of Maternal and Child Health and Ministry of Education (MOE) Key Lab of Environment and Health, School of Public Health, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China

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Daria Smirnova, Samara State Medical University, Russia

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Gaia Sampogna, University of Campania "L. Vanvitelli", Italy
Chongjian Wang, Zhengzhou University, China
Hamdi Chtourou, University of Sfax, Tunisia

***Correspondence:**
Ranran Song
songranran@hust.edu.cn

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Background: The long-term mental health effects of coronavirus disease 2019 (COVID-19) in children are rarely reported. We aimed to investigate the progression of depressive and anxiety symptoms among a cohort of children in the initial epicenter of COVID-19 in China.

Methods: Two waves of surveys were conducted in the same two primary schools in Wuhan and Huangshi, Hubei province: Wave 1 from 28 February to 5 March, 2020 (children had been confined to home for 30–40 days) and Wave 2 from 27 November to 9 December, 2020 (schools had reopened for nearly 3 months). Depressive and anxiety symptoms were estimated using the Children's Depression Inventory – Short Form (CDI-S) and the Screen for Child Anxiety Related Emotional Disorders (SCARED), respectively. ΔCDI-S and ΔSCARED scores between Wave 2 and Wave 1 were calculated and further categorized into tertiles. Multivariable linear regression and multinomial logistic regression models were then applied.

Results: A total of 1,224 children completed both surveys. The prevalence of mental health outcomes at Wave 2 increased significantly compared to Wave 1, specifically depressive symptoms (age-standardized prevalence rates: 37.5 vs. 21.8%) and anxiety symptoms (age-standardized prevalence rates: 24.0 vs. 19.6%). Higher ΔSCARED scores were observed in females and children in Wuhan, and children with experience of neglect had higher ΔCDI-S (β = 1.12; 95% CI = 0.67–1.58) and ΔSCARED (β = 6.46; 95% CI = 4.73–8.19) scores compared with those without experience of neglect. When the Δ scores were further categorized into tertiles, similar results were found.

Conclusions: The prevalence of depressive and anxiety symptoms after schools resumed was increased compared with that during the home quarantine period, even though the COVID-19 pandemic was under control. Females and children in Wuhan, and also children with experience of neglect were at increased risk of mental health disorders.

Keywords: depressive symptom, anxiety symptom, school-aged children, coronavirus disease 2019, longitudinal study

INTRODUCTION

Mental health has been increasingly seen as a major public health problem. It is estimated that between 10 and 20% of children and adolescents suffer from some type of mental health disorder (1). As most mental health disorders begin in childhood, a sensitive period of child development, early identification and treatment of mental health needs during this time is essential (2).

The coronavirus disease 2019 (COVID-19) outbreak was declared a pandemic by the World Health Organization (WHO), and COVID-19 emergency measures (i.e., city-wide lockdown) began in Wuhan, Hubei province on 23 January, 2020. This was eventually followed by other cities in Hubei province (3, 4). According to the Ministry of Education, the COVID-19 pandemic has caused long-term home restrictions for 180 million primary and secondary school students (5). In Hubei province, primary schools have been closed and shifted to home-based distance-learning models for the whole Spring semester. Hence, children did not have face-to-face learning until September 2020. Recent literature suggested that COVID-19 itself, along with school closures and home quarantine caused by COVID-19, has adversely affected children's mental health (6–9). COVID-19 has become a major global threat, impacting the mental well-being of children (10, 11). A series of studies from Effects of home Confinement on multiple Lifestyle Behaviours during the COVID-19 outbreak (ECLB-COVID19), an international online survey on mental health and multi-dimensional lifestyle behaviors during home confinement, have also highlighted the significant impact that home confinement has had on health, mental well-being, mood, life satisfaction, and multidimensional lifestyle behaviors (12–17). COVID-19 home confinement has negatively impacted mental health, with a greater proportion of people experiencing psychosocial and emotional disorders (14).

A range of mental health problems have accompanied the pandemic, such as depressive/anxiety disorders and post-traumatic stress disorder (PTSD) (18). For instance, isolated children had average PTSD scores that were four times higher than those of children who were not isolated (19). The mental health problems of children could continue into adulthood and adversely affect their physical and mental health (11). Depressive and anxiety symptoms are considered to be the early stages of major depressive disorder and anxiety disorder (20, 21), both of which could lead to poor academic performance, impaired cognitive function, social problems, and impaired psychosocial functions (20–22). The COVID-19 pandemic and the related measures against it, including self-isolation, quarantine, and social distancing, could have a detrimental impact on mental health. Individuals had to face significant changes in everyday life, possibly causing acute fight-or-flight responses (23). Uncertainty, fear, and discrimination toward infected people and their family members might generate psychological consequences that would need to be addressed by professionals and psychiatrists (24). The psychiatric problems that accompanied COVID-19 might therefore be a marathon rather than a sprint (25).

Until now, the majority of existing studies have focused on cross-sectional data, which cannot examine the long-term impact of COVID-19 over time (26–28). Our previous cross-sectional study conducted between 28 February and 5 March 2020 found that the prevalence of depressive (17.2%) and anxiety (18.9%) symptoms of children in Hubei province was higher than from other surveys in China (6). One longitudinal cohort study of children and adolescents in an area of China with a low risk of COVID-19 showed that the prevalence of psychological symptoms was higher after school reopening (on May 2020) than before the COVID-19 outbreak (29). Therefore, there is an urgent need for long-term follow-up studies on the psychological symptoms of school-aged children, especially those in the high risk area of the COVID-19 outbreak (30). We aimed to examine depressive and anxiety symptoms among a cohort of children after school reopening in Wuhan and Huangshi, Hubei province, China based on our previous study about the mental health status of children during the COVID-19 outbreak (6). We hypothesized that the impact of COVID-19 on the mental health of children may be long term and that the mental health status of children may worsen over time.

MATERIALS AND METHODS

Study Design

At Wave 1, we conducted the survey among children in Grades 2–6 at two primary schools in Hubei province from 28 February to 5 March 2020 through an online crowd-sourcing platform. At that time, children had been confined in their home for 30–40 days. Children took the online survey after their guardian agreed to the statement "I permit my child to participate in the survey" in the survey link. Detailed information were shown in our previous article (6).

At Wave 2, we conducted the second survey at the same schools between 27 November and 9 December 2020 on site. At that time, cities had been unsealed for nearly 7 months and schools had reopened for nearly 3 months. We obtained oral informed consent from parents by inquiring through head teachers. The investigators organized children to independently accomplish the questionnaires in class and encouraged them to complete the questionnaire as much as possible.

This study was approved by the Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology. Informed consent of the children and their guardians was obtained after the nature of the procedures had been fully explained. There was no disclosed information that might identify a particular person. All procedures performed in studies involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments.

Study Population

Wave 1

A total of 2,330 children in Grades 2–6 from two primary schools in Hubei province were invited to participate the survey and 1,784 participants completed the survey (675 children residing in Wuhan and 1,109 in Huangshi). The response rate was 76.6%. All questionnaires passed the quality audit, and the effective rate was 100.0%.

Wave 2

Children were promoted to the next grade in September each year, and all the children in the two primary schools were promoted at Wave 2. Therefore, the second survey started with children in Grade 3. As children in Grade 6 at Wave 1 were promoted from the primary school to the junior middle school, they were not included in the follow-up at Wave 2. A total of 2,245 children in Grades 3–6 from the same schools, including 698 from Wuhan and 1,547 from Huangshi, were invited to participate in the survey at Wave 2. Among these children, 2,211 completed the survey, with a response rate of 98.5%. After a quality audit, 2,209 questionnaires were further analyzed, with an effective rate of 99.9%.

Using student names and IDs, we matched the questionnaires from both waves. There was a total of 1,224 children who completed both surveys, with 689 (56.3%) male and 805 (65.8%) participats who resided in Huangshi. The data from those 1,224 children were used in all analyses.

Measures

In both surveys, the gender, grade, location of school, and depressive and anxiety symptoms of participants were collected. In China, children aged 6 enter primary school and are about 11 years old when they are in grade 6. Thus, the grade could be a good approximation of age. Detailed information was shown in our previous article (6). Depressive and anxiety symptoms were measured using the Children's Depression Inventory—Short Form (CDI-S) and the Screen for Child Anxiety Related Emotional Disorders (SCARED), respectively. Additionally, at Wave 1, COVID-19-related questions were collected. At Wave 2, the daily sleep time in the past week and experience of neglect in the previous year were measured and collected via five items in the Conflict Tactics Scales, Parent-child Version (CTSPC).

Depressive symptoms

Depressive symptoms were estimated using the CDI-S at Waves 1 and 2 (31). The CDI-S consists of 10 items, each with a score of 0–2. Each item requires respondents to rate the severity of each symptom of depression. The CDI-S has shown good internal consistency (Cronbach's $\alpha = 0.75$) in the study with Chinese children (32). The total score ranges from 0 to 20. A higher score indicates more severe depressive symptoms, while a CDI-S value of ≥ 4 is defined as depressive symptoms (33). The difference (Δ) in CDI-S score between Wave 2 and Wave 1 was calculated via subtraction, with a positive/negative change representing an increase/decrease of CDI-S score at Wave 2, respectively. Based on the tertiles of the ΔCDI-S score, it is further categorized into low (< 1), moderate (≥ 1, < 3), and high (≥ 3) change.

Anxiety Symptoms

Screen for Child Anxiety Related Emotional Disorders is a 41-item self-report instrument that was used to measure anxiety symptoms at Waves 1 and 2 (34). The questionnaire proved to have adequate reliability (retest reliability: 0.567–0.608; internal consistency: 0.890) and fair validity (correlation coefficients from 0.300 to 0.444) (35). Children rate each symptom on a three-point Likert scale: 0 (almost never), 1 (sometimes), and 2 (often). Total scores ranged from 0 to 82, and the accepted cut-off score for anxiety disorder is 23 (35). Children with higher scores have more severe symptoms of anxiety. The ΔSCARED score between Wave 2 and Wave 1 was calculated and was used to indicate an increase/decrease of SCARED score in Wave 2. Based on the tertiles of the ΔSCARED score, it is further categorized into low (< 0), moderate (≥ 0, < 11), and high (≥ 11) change.

Neglect

Five items covering neglect behaviors in the CTSPC were used to measure the experience of neglect (36). Children were asked to report their experience of neglect in the preceding year at Wave 2. Thus, children's experience of neglect at the time of the first survey was also covered. The affirmative responses to any item were used to represent self-reported exposure to neglect.

With regard to COVID-19, children were asked to answer two questions at Wave 1: 1) "Which are more likely the host of SARS-CoV-2?," with choices that include "wild animals," "domesticated animals," and "do not know," and 2) "Which of the following protective measures have you taken during the COVID-19 outbreak?," with choices that include "Reminding my family members to wear masks," "Convince my family members not to go out or gathering," "Ventilating the house frequently," and "Washing hands frequently." Children who chose wild animals and those who had taken all protective measures were deemed to know the host of SARS-CoV-2 and how to take protective measures during the COVID-19 pandemic.

Statistical Analysis

All analyses were performed in Statistical Package for the Social Sciences (SPSS) 22.0 and Microsoft Excel (2016). Both R (v3.2.5) and Microsoft Excel (2016) were used to generate the figures. Frequencies and percentages were summarized for categorical variables. Means and standard deviations were used to describe continuous variables. Age-standardized prevalence rates of depressive and anxiety symptoms were calculated based on the Chinese population from the 2020 China census data (37). We used McNemar's test to evaluate the trend in the prevalence of psychological symptoms between the two waves. We also performed multivariable linear regression models to examine the ΔCDI-S and ΔSCARED scores. Multinomial logistic regression models were applied to examine the tertiles of the ΔCDI-S and ΔSCARED scores. Multiple imputation with 20 times interpolation was carried out for independent variables that had a few nonresponses [daily sleep time (missing data, 20.5%) and neglect behaviors (missing data, 0.8%)]. Sensitivity analysis using the complete data was also performed to evaluate the validity of multiple imputation. The odds ratio (OR), β value, and 95% confidence interval (95% CI) were reported and p-values were two-tailed, with a significance level at 0.05.

RESULTS

Among 1,224 children who completed both surveys, 689 (56.3%) children were males and 805 (65.8%) resided in Huangshi. The average ages of children were 9.32 ± 1.10 years at Wave 1 and 10.07 ± 1.10 years at Wave 2, with 1.1% of children lacking

TABLE 1 | Demographic characteristics of children who completed both surveys.

Characteristic	*n*	Percentage (%)
Overall	1,224	100.0
Gender		
Male	689	56.3
Female	535	43.7
School location		
Wuhan	419	34.2
Huangshi	805	65.8
Grade		
Grade 3	337	27.5
Grade 4	292	23.9
Grade 5	340	27.8
Grade 6	255	20.8
Taking all protective measures during COVID-19[a]		
No	663	54.2
Yes	561	45.8
Knowing the host of SARS-CoV-2[a]		
No	356	29.1
Yes	868	70.9
Daily sleep time[b]		
< 8 h	309	25.2
≥8 h	664	54.2
Missing data	251	20.5
Parent-Child Tactics Scale Neglect-neglect behaviors[b]		
Neglect	854	69.8
Non-neglect	360	29.4
Missing data	10	0.8

[a] *The items were investigated at Wave 1.*
[b] *The items were investigated at Wave 2.*

TABLE 2 | Distribution of scale scores of children who completed both surveys.

		CDI-S	SCARED
Wave 1			
	Symptoms, No. (%)	250 (20.4)	232 (19.0)
	No symptoms, No. (%)	974 (79.6)	992 (81.0)
	Mean and standard deviation	2.22 (2.49)	13.86 (10.37)
Wave 2			
	Symptoms, No. (%)	487 (39.8)	406 (33.2)
	No symptoms, No. (%)	723 (59.1)	811 (66.3)
	Mean and standard deviation	3.57 (3.29)	18.98 (12.44)
	Missing data, No. (%)	14 (1.1)	7 (0.6)
Δ score			
	Mean and standard deviation	1.35 (3.68)	5.09 (14.31)
	1st tertile, No. (%)	539 (44.0)	414 (33.8)
	Δ score range	< 1	< 0
	2nd tertile, No. (%)	308 (25.2)	419 (34.2)
	Δ score range	≥ 1, < 3	≥ 0, < 11
	3rd tertile, No. (%)	363 (29.7)	384 (31.4)
	Δ score range	≥ 3	≥ 11
	Missing data, No. (%)	14 (1.1)	7 (0.6)

Δ score was change of scale scores from Wave 1 to Wave 2.
CDI-S, Children's Depression Inventory-Short Form; SCARED, The Screen for Child Anxiety Related Emotional Disorders.

age information. The percentages of participants in Grades 3–6 were 27.5% (337), 23.9% (292), 27.8% (340), and 20.8% (255), respectively. There were 45.8% of children who took all required protective measures during COVID-19 and 70.9% who knew the host of SARS-CoV-2 at Wave 1. Additionally, 54.2% of children had more than 8 h of daily sleep time and 69.8% showed that they had experience of neglect in the preceding year at Wave 2 (**Table 1**).

Age-standardized prevalence rates of depressive symptoms at Wave 1 and Wave 2 were 21.8 and 37.5%, respectively, and were 19.6 and 24.0%, respectively, for anxiety symptoms. A total of 20.4% (250) of participants had depressive symptoms at Wave 1 and 39.8% (487) at Wave 2. The average score of the CDI-S rose from 2.22 (2.49) for Wave 1 to 3.57 (3.29) for Wave 2. For the anxiety symptoms, 19% (232) of children were detected at Wave 1 and 33.2% (406) were detected at Wave 2. The average score of SCARED were 13.86 (10.37) and 18.98 (12.44), respectively (**Table 2**). The distributions of ΔCDI-S and ΔSCARED were shown in **Supplementary Figure S1**. The mean score of CDI-S and SCARED for the two waves was reported in **Supplementary Figure S2A**. For both scales, we found that the score was increased at Wave 2 compared with those at Wave 1 for each grade. The mean and standard deviations of ΔCDI-S and ΔSCARED were 1.35 (3.68) and 5.09 (14.31), respectively (**Table 2**). As shown in **Supplementary Figure S2B**, children in Wuhan had a higher change of SCARED score than those in Huangshi.

As shown in **Table 3**, the prevalence of mental health outcomes among children at Wave 2 significantly increased from those levels at Wave 1, specifically in depressive symptoms [39.8% (Wave 2) vs. 20.4% (Wave 1), $p < 0.001$] and anxiety symptoms [33.2% (Wave 2) vs. 19.0% (Wave 1), $p < 0.001$]. Further subset analyses for gender, grade, and school location showed similar results (all $p < 0.001$). **Tables 4**, **5** showed the OR and β for associations of Δ score and demographic characteristics in the regression models. Children with experience of neglect had higher ΔCDI-S scores (β = 1.12; 95% CI = 0.67–1.58) and ΔSCARED score (β = 6.46; 95% CI = 4.73–8.19) compared with those without neglect. Children with experience of neglect had higher odds in the 3rd tertile of the ΔCDI-S score (OR = 2.51; 95%CI = 1.82–3.47). Similar results were found for ΔSCARED score (2nd tertile vs. 1st tertile, OR = 1.37; 95% CI = 1.02–1.84; 3rd tertile vs. 1st tertile, OR = 3.46; 95% CI = 2.45–4.89). Females had significantly higher Δ score of SCARED than males (β = 1.83; 95% CI = 0.26–3.40) and children in Wuhan had significantly higher ΔSCARED score than those in Huangshi (β = 3.42; 95% CI = 1.77–5.07). Children in Wuhan had higher odds in the third tertile of ΔCDI-S score (OR = 1.38; 95% CI = 1.03–1.83) and the third tertile of ΔSCARED score (OR = 1.65; 95% CI = 1.22–2.25). We also found that students in Grade 4 and 5 had lower ΔCDI-S score compared with those students

TABLE 3 | Change of psychological symptoms outcomes among children at two surveys.

Characteristics	Depressive symptoms			Anxiety symptoms		
	Wave 1 Yes, n (%)	Wave 2 Yes, n (%)	*P*-value	Wave 1 Yes, n (%)	Wave 2 Yes, n (%)	*P*-value
Overall	250 (20.4)	487 (39.8)	<0.001	232 (19.0)	406 (33.2)	<0.001
Gender						
Male	145 (21.0)	276 (40.6)	<0.001	126 (18.3)	199 (29.1)	<0.001
Female	105 (19.6)	211 (39.8)	<0.001	106 (19.8)	207 (38.8)	<0.001
School location						
Wuhan	106 (25.3)	193 (46.2)	<0.001	79 (18.9)	176 (42.0)	<0.001
Huangshi	144 (17.9)	294 (37.1)	<0.001	153 (19.0)	230 (28.8)	<0.001
Grade						
Grade 3	48 (14.2)	124 (37.5)	<0.001	54 (16.0)	106 (31.8)	<0.001
Grade 4	63 (21.6)	107 (37.2)	<0.001	56 (19.2)	112 (38.6)	<0.001
Grade 5	80 (23.5)	145 (42.9)	<0.001	78 (22.9)	107 (31.5)	0.006
Grade 6	59 (23.1)	111 (43.9)	<0.001	44 (17.3)	81 (31.9)	<0.001

P-value was derived from McNemar's test.
Depressive symptoms were measured by the Children's Depression Inventory-Short Form.
Anxiety symptoms were measured by the Screen for Child Anxiety Related Emotional Disorders.

in Grade 3 ($\beta = -0.93$; 95% CI $= -1.50$ to -0.36; $\beta = -0.68$; 95% CI $= -1.23$ to -0.14). The sensitivity analyses that used complete data before multiple imputation showed similar results (**Supplementary Tables S1, S2**).

DISCUSSION

This study suggested that about 3 months after school reopening, the prevalence of depressive and anxiety symptoms among children in Hubei province remained elevated compared with that during the COVID-19 pandemic lockdown. When considering the ΔCDI-S and ΔSCARED scores, the risk factors for a high change from Wave 1 to Wave 2 were: the school in Wuhan, being female, and having experience of neglect.

The psychological and mental effects of major public health events could be long term (38–40). Lessons from the outbreak of severe acute respiratory syndrome (SARS) in 2003 indicated that the mental health of survivors did not improve over time and gradually deteriorated (41). The post-traumatic disturbance of residents in areas with high SARS prevalence, regardless of age, was more intense than in areas with low prevalence (42). A national mental health study among adolescents in China, administered separately in February and April 2020, showed that the prevalence of depression and anxiety significantly increased over time (43). In addition, surveys covering 5,285 adults in the USA found that the prevalence of adverse mental health symptoms during the later phase of the COVID-19 pandemic (September 2020) was higher than in June 2020 (44). Daly et al. found that a pronounced and prolonged deterioration of mental health occurred between April and June 2020 among participants of the nationally representative United Kingdom Household Longitudinal Study (45). Studies in Italy showed an increase in stress and depression among citizens along with a different time course of mental health problems between men and women (46, 47). Our results among children in Hubei province, China, were consistent with these findings. Although different socio-cultural contexts (i.e., tight and loose cultures) led to a varied response to a global pandemic (48), COVID-19 seemed to have a similar impact on the long-term consequences of mental health.

The significant increase in the prevalence of depressive and anxiety symptoms may be related to the fact that an online mental health service in the early phase of COVID-19 in China was not designed for children (49). Children who developed psychological symptoms at Wave 1 may persist with these symptoms until Wave 2 due to lack of effective intervention. For children with depressive symptoms, there will be considerable difficulties in resuming normal life after school reopening (50). The other important thing to note in this study was that we used screening criteria, rather than clinical thresholds, of the CDI-S (≥ 7) (51) and SCARED (≥ 25) (52). This was because we tried to screen out more children at high or potential risk from the aspect of early prevention, especially for the children in Wuhan who experienced the pandemic earlier and more severely. Although the sample size was limited and is not fully representative of the population in Hubei province, the evidence of increased depressive and anxiety symptoms suggested that there is a great need to provide timely psychological support to enhance resilience and reduce fear and anxiety (53). On a related note, timely mental health education and treatment should be available for these children (54).

Consistent with previous findings, females had higher SCARED scores in our study (43, 55). The gender difference in anxiety symptoms may be partly attributable to relationships between adrenarcheal hormones and functional connectivity of the amygdala according to an imaging study in children (56). Hormone levels in females were inversely associated with the connection from the right amygdala to the insula, but were positively associated with the connection from the left amygdala to anterior cingulate cortex in males. Furthermore, we found that children in Wuhan at Wave 2 had a higher ΔSCARED score than

TABLE 4 | Association between demographic characteristics and the difference in Children's Depression Inventory-short form (ΔCDI-S) score.

Characteristic	2nd tertile (≥ 1, < 3) OR (95%CI)	3rd tertile (≥ 3) OR (95%CI)	Linear model β (95%CI)
Gender			
Female vs. Male	0.81 (0.61,1.07)	0.94 (0.72,1.24)	0.20 (−0.21,0.61)
School location			
Wuhan vs. Huangshi	1.35 (1.00,1.82)	1.38 (1.03,1.83)	0.33 (−0.10,0.76)
Grade			
Grade 4 vs. 3	0.80 (0.54,1.19)	0.72 (0.49,1.05)	−0.93 (−1.50, −0.36)
Grade 5 vs. 3	1.02 (0.71,1.45)	0.77 (0.54,1.12)	−0.68 (−1.23,- −0.14)
Grade 6 vs. 3	0.94 (0.62,1.43)	1.07 (0.72,1.58)	−0.20 (−0.80,0.39)
Protective measures during COVID-19 (Wave 1)			
Yes vs. No	0.95 (0.71,1.26)	0.91 (0.69,1.19)	0.12 (−0.29,0.53)
Knowing the host of SARS-CoV-2 (Wave 1)			
Yes vs. No	0.90 (0.66,1.22)	1.15 (0.85,1.56)	0.32 (−0.13,0.77)
Daily sleep time (Wave 2)			
< 8 vs. ≥ 8 h	1.12 (0.83,1.53)	1.19 (0.85,1.67)	0.29 (−0.20,0.78)
Neglect (Wave 2)			
Yes vs. No	1.34 (0.99,1.83)	2.51 (1.82,3.47)	1.12 (0.67,1.58)

Ref, Reference; OR, odds ratios; CI, confidence intervals; CDI-S, Children's Depression Inventory-Short Form.
ΔCDI-S score was the change of scale scores from Wave 1 to Wave 2.
OR (95% CI) were derived from the multinomial logistic regression model and the first tertile was the reference group (score < 1).
β (95% CI) were derived from generalized linear regression.

TABLE 5 | Association between demographic characteristics and difference in Screen for Child Anxiety Related Emotional Disorders (ΔSCARED) score.

Characteristics	2nd tertile (≥0, < 11) OR (95%CI)	3rd tertile (≥ 11) OR (95%CI)	Linear model β (95%CI)
Gender			
Female vs. Male	1.03 (0.78,1.36)	1.30 (0.98,1.74)	1.83 (0.26,3.40)
School location			
Wuhan vs. Huangshi	1.47 (1.09,1.98)	1.65 (1.22,2.25)	3.42 (1.77,5.07)
Grade			
Grade 4 vs. 3	1.04 (0.70,1.54)	1.03 (0.69,1.54)	0.63 (−1.55,2.80)
Grade 5 vs. 3	1.02 (0.73,1.44)	0.71 (0.48,1.04)	−1.58 (−3.67,0.50)
Grade 6 vs. 3	1.01 (0.68,1.51)	0.91 (0.60,1.39)	−0.24 (−2.52,2.03)
Protective measures during COVID-19 (Wave 1)			
Yes vs. No	0.94 (0.71,1.23)	0.88 (0.66,1.17)	−0.51 (−2.08,1.06)
Knowing the host of SARS-CoV-2 (Wave 1)			
Yes vs. No	0.88 (0.65,1.19)	0.98 (0.71,1.35)	0.55 (−1.17,2.27)
Daily sleep time (Wave 2)			
< 8 vs. ≥ 8 h	1.25 (0.92,1.70)	1.27 (0.92,1.77)	0.62 (−1.14,2.37)
Neglect (Wave 2)			
Yes vs. No	1.37 (1.02,1.84)	3.46 (2.45,4.89)	6.46 (4.73,8.19)

Ref, Reference; OR, odds ratios; CI, confidence intervals; SCARED, Screen for Child Anxiety Related Emotional Disorders.
ΔSCARED score was the change of scale scores from Wave 1 to Wave 2.
OR (95% CI) were derived from the multinomial logistic regression model and the first tertile was the reference group (score < 0).
β (95% CI) were derived from the generalized linear regression.

those in Huangshi, which may be attributed to the fact that the epidemic in Wuhan was more severe than in Huangshi, and that children in Wuhan have been isolated at home for longer periods (57). Moreover, we found higher ΔCDI-S and ΔSCARED scores at Wave 2 in children with experience of neglect in the preceding year vs. those without neglect. The experience of neglect over the past year also included the children's experience at the time of the first survey. This may be partly attributed to the fact that children might have a decreased frequency of positive parent–child interaction after the school reopened, which increased the probability of neglect (58). Changes to daily family life due to financial hardship and social restrictions on parents may increase parental stress and lead to an increase in adverse childhood experiences (ACEs), including neglect (59). In this study, 69.8% of children reported experience of neglect in the preceding year at Wave 2, which was higher than a previous study among Chinese elementary students in Shanghai, China (52.26%) (60). ACEs, such as abuse and neglect, are associated with increased risk for depression, anxiety, and PTSD (61), along with elevated mortality rates (62). Although Chinese parents have a more democratic parenting style influenced by Western thoughts, the power disparity between parents and children in traditional Chinese culture may facilitate ACEs. Support for dealing with family difficulties and available child welfare services are needed.

Although we explored psychological problems among the cohort of children in Hubei province, China, there were several limitations. First, the results may be generalized only to children in school. We adopted a cluster sampling method and selected two primary schools for the surveys. The sample was therefore not necessarily representative of the whole population of children in China. Second, no information on household income or other types of ACEs was surveyed. The impact of the COVID-19 pandemic may be related to parental unemployment/loss of household income and high-stress home environments, thus increasing the likelihood of ACEs or emotional problems (63). We also did not collect information related to family functioning or family context. Third, children in higher grades were more likely to suffer from mental health problems (64). The students in

Grade 6 at Wave 1 were lost during follow-up due to promotion from primary school to junior middle school, which may lead to an underestimation of the prevalence of depressive and anxiety problems at Wave 2. Fourth, we did not collect information on learning styles. The learning styles were inconsistent between the two surveys (home learning vs. studying on campus), which may have an impact on the mental health of students. Furthermore, we used electronic questionnaires when students were confined to home and paper-based questionnaires when students were at school. Although we adopted some methods to ensure that students completed the questionnaires independently, we still need to unify the form of survey tools in future studies. Finally, we reported the symptoms rather than the clinical diagnoses because of the short follow-up period.

In conclusion, our study identified increased prevalence of depressive and anxiety symptoms among a cohort of children in Hubei province, China, despite the fact that the COVID-19 pandemic had been brought under control and schools had reopened. The mental health problems of children are warnings. There is a lack of knowledge on the long-term psychological impact of COVID-19 on children, and our results fill an important gap in the research. In addition, China is one of the early affected countries whose schools are now functioning normally. Our study, focusing on the progression of psychological symptoms in children who have experienced long-term home quarantine and have now resume school, may guide the mental health support plan in other countries (65). We anticipate that our results may be helpful to decision makers and that post-COVID-19 public health for mental health protection be given priority. Schools, which are the primary provider of mental health services for many children (66), should take timely action to mitigate the disruption of COVID-19 on children when they return to school, especially those who have experienced neglect within their families (2). For psychiatrists and healthcare professionals, they may participate in educational and media activities for children, parents, or educators about the mental health distress caused by physical distancing and quarantine. They should also alert policy makers of the long-term consequences of COVID-19 and the increased demand for mental health services (67). Continuing to follow-up these children and giving attention to their emotional problems is also necessary.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the data are not publicly available due to privacy/ethical restrictions: Requests to access the datasets should be directed to RS, songranran@hust.edu.cn.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology. Written/oral informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

XX and RS conceived the study. XX, QL, KZ, YF, and RS critically appraised the data. XX, KZ, QJ, XW, and PX prepared the initial manuscript. RS reviewed and edited the manuscript. All authors collected data for the study and critically reviewed and approved the final manuscript.

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SUPPLEMENTARY MATERIAL

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Religion and the Mediating Role of Alexithymia in the Mental Distress of Healthcare Workers During the Coronavirus Disease 2019 Pandemic in a Psychiatric Hospital in China

Fushuai Zhao[1†], *Hsuan Lung*[2†], *Po-Fei Chen*[3], *Mei-Chung Chang*[4] *and For-Wey Lung*[5,6,7,8*]

[1] *Anning Psychiatric Rehabilitation Hospital, Changchun Sixth Hospital, Changchun City, China,* [2] *Department of Dentistry, Kaohsiung Chang Gung Memorial Hospital and Chang Gung University College of Medicine, Kaohsiung, Taiwan,* [3] *Department of Psychology, Calo Psychiatric Center, Pingtung, Taiwan,* [4] *Department of Nursing, Calo Psychiatric Center, Pingtung, Taiwan,* [5] *Department of Medicine, Calo Psychiatric Center, Pingtung, Taiwan,* [6] *Graduate Institute of Medical Sciences, National Defense Medical University, Taipei, Taiwan,* [7] *International Graduate Program of Education and Human Development, National Sun Yat-sen University, Kaohsiung, Taiwan,* [8] *Institute of Education, National Sun Yat-sen University, Kaohsiung, Taiwan*

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***Correspondence:**
For-Wey Lung
forwey@seed.net.tw

[†] *These authors share first authorship*

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The outbreak of the coronavirus disease 2019 (COVID-19) has created unprecedented challenges to the healthcare system, religion, and alexithymic trait that impacts the psychological resilience of healthcare workers during the COVID-19 pandemic. This study aimed to investigate the role religion and alexithymia play in mental distress and the level of happiness of psychiatric hospital healthcare workers in China amidst the COVID-19 pandemic. Furthermore, whether symptom dimensions (anxiety, depression, hostility, inferiority, and insomnia) are associated with the level of happiness, and a 6-month follow-up was also investigated. A total of one-hundred and ninety healthcare workers were recruited from a psychiatric hospital in Jilin, China, and 122 were followed up after 6 months. All participants filled out the 20-item Toronto Alexithymia Scale, five-item Brief-Symptom Rating Scale, and the Chinese Oxford Happiness Questionnaire. The mental distress of healthcare workers decreased from 2.6 to 1.5% in 6-months. Religious belief was not associated with the mental distress or happiness of healthcare workers. Instead, for those whose anxiety decreased over 6 months, their social adaptation status increased. For those whose inferiority level decreased over time, their perceived level of psychological well-being and overall happiness increased. In over half a century of living in different societies, religion stabilizes the mental health of those in Taiwan amidst the stress of the COVID-19 pandemic, but not in China. However, both regions found healthcare workers with alexithymic traits experienced a higher level of mental distress, implying that the collectivist culture of Confucian philosophy continues to influence the emotional expression and alexithymic traits of healthcare workers in China and Taiwan. To ensure a healthy and robust clinical workforce in the treatment and control of the pandemic, the cultural impact on the psychological resilience of medical workers needs to be addressed.

Keywords: coronavirus disease 2019, healthcare worker, mental distress, alexithymia, religion

INTRODUCTION

The outbreak of COVID-19 has created unprecedented challenges to the health care system globally. Increased stress experienced by healthcare workers has caused high levels of anxiety, depression, sleep disorders, burnout syndrome, and post-traumatic stress disorders (1), with a prevalence of up to 25.8–67.55% of anxiety, 24.3–55.89% of depression, and 45–62.99% of stress in systematic reviews (2, 3). Although compared to frontline healthcare workers who have direct care and contact with patients with COVID-19, healthcare workers working in psychiatric departments showed lower levels of mental distress (4). However, with the 4% high fatality rate of COVID-19 in China (5), there is an increased risk of mortality in patients with schizophrenia spectrum disorder (6). Medical staff in psychiatric hospitals also need extensive knowledge and relevant training in COVID-19 care (7).

Resilience is the ability of an individual to withstand setbacks, adapt positively, and recover from difficulties (8). Since healthcare professionals play an important role in the treatment and control of the pandemic, their mental and physical health conditions, and psychological resilience when faced with the pandemic becomes vitally important. Religion can help people develop coping strategies during stressful life situations (9), for it can provide social support, a healthy lifestyle, and meaning in life (10), and also plays a protective factor for mental health amidst the pandemic lockdown (11). Similarly, a previous study in Taiwan found religion to impact the mental health and level of happiness of healthcare workers, playing a vital role in the psychological resilience amidst the COVID-19 pandemic (4). Different emotional reactions and symptoms may appear at different periods of the pandemic. A previous study found anger post-disaster can predict psychological distress at follow-up, and hostility is high immediately post-disaster, but dissipate in a year (12). The five-item Brief Symptom Rating Scale (BSRS-5) measures the five symptoms of anxiety, depression, hostility, inferiority, and insomnia, and has been used to assess the mental distress of healthcare professionals in psychiatric and general hospitals (4). Therefore, the individual items within the BSRS-5 can also reflect different reactions under stress and stress reactions at different stages of the pandemic.

Besides different symptoms reactions, the alexithymic trait has also been shown to play a mediating role between COVID-19 exposure, posttraumatic stress disorder, and depressive symptoms (13). People who have alexithymic traits include those who have difficulty in identifying their feelings, differentiating feelings, verbalizing feelings, and communicating feelings (14). Alexithymia modulates the cortisol level in response to stressful events (15) and can predict the development of psychopathology during the pandemic (16). General and psychiatric hospital healthcare workers showed similar alexithymia levels, however, those healthcare workers that had alexithymic traits were more likely to experience mental distress and lower level of happiness (4). Therefore, the alexithymic trait is also an important predictor of psychological resilience during the COVID-19 pandemic among healthcare workers.

Since China and Taiwan share common cultural roots, traditions, and ancestries, but have lived in different societies for over half a century. A study in Taiwan showed religion and alexithymic trait both impacts the psychological resilience of healthcare workers during the COVID-19 pandemic (4). Therefore, the aim of this study was to investigate the role religion and alexithymia play in mental distress and the level of happiness of psychiatric hospital healthcare workers in China amidst the COVID-19 pandemic. Furthermore, whether symptom dimensions (anxiety, depression, hostility, inferiority, and insomnia) are associated with the level of happiness, and at 6-month follow-up was also investigated.

MATERIALS AND METHODS

Participants

Healthcare workers, including administrative personnel, nurses, physicians, pharmacists, social workers, psychologists, radiologists, etc. from a psychiatric hospital in Jilin, China were conveniently recruited. The baseline questionnaires were collected from May 8th to June 1st, 2020 and followed up 6 months later (January 15th to February 1st of 2021). A total of one-hundred and ninety healthcare workers were recruited at the first stage and 122 (64.21%) at follow-up. Those who were unable to participate at the follow-up stage were due to the shifts of healthcare workers. The hospital has a total of 224 employees; thus our study had a response rate of 84.8%. The procedures performed in this study were approved by the Institutional Review Board of a teaching hospital in Taiwan, and informed consent was obtained from all participants after a detailed explanation of the study.

Measurement

All information collected was from participants' self-report. The participants filled out the 20-item Toronto Alexithymia Scale (TAS-20), five-item Brief-Symptom Rating Scale (BSRS-5), and the Chinese Oxford Happiness Questionnaire at baseline (time = 1) and 6-month follow-up (time = 2). All the surveys collected were in Chinese and were of participants' self-report.

Religion

The major religion in China includes Buddhism, Taoism, Protestantism, Islam, Catholicism, and folk religions (17). Therefore, the demographic information sheet included the religious faith choices of "Buddhism/Taoism," "Christian (Protestant)/Catholic," "Shamanism" (local folk religion), and "others."

Alexithymia

The Chinese version of the TAS-20 was translated from the original TAS-20 scale, developed to measure alexithymia in three dimensions: difficulty identifying feelings (DIF), difficulty describing feelings, and externally oriented thinking (18). Participants who scored ≧60 on the TAS-20 were considered to have alexithymia (19). Furthermore, those who score ≧21 in the DIF dimension have also been found to be at higher risk for psychiatric disorders (20). Therefore, the cutoff point of 60/61

for total TAS-20 and 21/22 for the DIF scale were both used in this study.

Mental Health Condition

The Chinese version of the BSRS-5 has been shown to be valid to screen for mental health conditions of psychiatric inpatients, general medical patients, and community residents in Taiwan (21). The BSRS-5 measures the mental health distress of participants in five symptom domains of anxiety, depression, hostility, interpersonal sensitivity/inferiority, and insomnia. The cutoff of 9/10 was valid to screen for healthcare workers who had higher psychological distress under the COVID-19 pandemic in Taiwan (4). Therefore, a cutoff of 9/10 was used in this study.

Happiness

The culturally modified seven-item Chinese Oxford Happiness Questionnaire was used to measure the self-perceived level of happiness of the healthcare workers. The culturally modified Chinese version of the happiness scale can be separated into two dimensions of social adaptation status (SAS; 4 items) and psychological well-being (PWB; three items) (22).

Statistical Analysis

Descriptive analysis was used to analyze the demographic information and TAS-20, BSRS-5, and Chinese Oxford Happiness Questionnaire scores of the healthcare workers at the beginning of the pandemic and at the 6-months follow-up. Additionally, generalized equation estimation (GEE) analysis was used to analyze the factors which influenced the psychological resilience of the healthcare workers during the pandemic. GEE exchangeable covariance structure was chosen, it is the most suitable method of analysis for the measurement of repeated data. Parsimonious GEE models were presented, which means that only statistically significant ($p \leq 0.05$) variables were presented. All analysis was processed using the Statistical Package for the Social Sciences (SPSS) 26.0 for Windows software (SPSS Inc., Chicago, USA).

RESULTS

The sociodemographic data, alexithymic traits, religion, psychological distress, perceived level of happiness of healthcare workers amidst the pandemic, and 6-month follow-up are shown in **Table 1**. Results showed a statistically significant difference in the total happiness scale between baseline and 6 months ($F = 4.84$, $p = 0.29$).

GEE was used to investigate which factors were associated with mental health distress level and perceived happiness, psychological well-being, and social adaptation status of these healthcare workers during the pandemic, and at 6 months follow-up. As **Table 2** shows, religion was not associated with the mental health and perceived happiness of healthcare workers.

The second GEE model investigated which factor was associated with the perceived happiness of the healthcare workers. Factors of interest included sex, age, religion, and mental distress level (BSRS total store). Since BSRS was the only factor associated with the perceived level of happiness of the healthcare workers, symptom domains of the BSRS (anxiety, depression, hostility, interpersonal sensitivity/inferiority, and insomnia) and its association with perceived happiness (including psychological well-being and social adaptation status) was further investigated in the second model. Additionally, symptoms domains that were shown to be associated with the perceived level of happiness, their interaction with time were also analyzed. The parsimonious results in **Table 3** show the perceived level of happiness increased after 6 months ($\beta = 0.68$, $p = 0.034$). Of the five dimensions of the BSRS-5, those who had higher hostility levels perceived lower levels of happiness ($\beta = -0.64$, $p = 0.002$), and the interaction of inferiority and time showed higher inferiority levels over time also decreased the level of perceived happiness ($\beta = -1.28$, $p = 0.001$).

Regarding the psychological well-being dimension of the happiness scale, GEE results showed healthcare workers perceived better psychological well-being after 6 months ($\beta = 0.37$, $p = 0.049$). However, those who had higher inferiority level over time perceived lower levels of psychological well-being ($\beta = -0.50$, $p = 0.009$). On the other hand, no statistically significant differences between the baseline and follow-up level of social adaptation status were reported in healthcare workers. However, those who perceived a higher level of anxiety over time, and those who perceived a higher level of inferiority perceived a

TABLE 1 | Socio-demographic and clinical characteristics of healthcare workers at baseline and 6-months follow-up ($N = 323$).

	Amidst the pandemic $n = 191$	**6-months follow-up $n = 132$**	
Variable	***n* (%)**	***n* (%)**	χ^2
Sex			0.11
Male	39 (20.4)	29 (22.0)	
Female	152 (79.6)	103 (78.0)	
Department			<0.01
Medical	162 (84.8)	112 (84.8)	
Administrative	29 (15.2)	20 (15.2)	
Married	88 (46.1)	67 (50.8)	0.69
Religious faith			
Buddhism/Taoism	10 (5.5)	6 (4.9)	
Christian/Catholic	4 (2.2)	3 (2.4)	
Shamanism	2 (1.1)	1 (0.8)	
Others	47 (26.0)	33 (26.8)	
No religion	118 (65.2)	80 (65.0)	
TAS-20 ≥61	5 (2.6)	5 (3.8)	0.36
TAS-DIF ≥22	13 (6.8)	3 (2.3)	3.41
BSRS-5 ≥10	5 (2.6)	2 (1.5)	0.44
Variable (range)	**Mean (SD)**	**Mean (SD)**	***F***
Age (21–74)	32.13 (10.0)	32.39 (9.0)	0.95
TAS-20 total score (20–80)	44.72 (8.8)	43.49 (8.9)	0.10
BSRS-5 total score (0–20)	2.60 (2.9)	2.56 (2.9)	0.03
Happiness Scale (11–28)	21.49 (2.8)	21.53 (3.4)	4.84*
Social adaptation status (5–16)	13.16 (1.7)	13.11 (2.0)	1.81
Psychological well-being (3–12)	8.34 (1.8)	8.42 (2.0)	2.34

*TAS-20, 20-item Toronto Alexithymia Scale; TAS-DIF, Difficulty identifying feelings dimension of TAS-20; BSRS-5, five-item Brief-Symptom Rating Scale; *p < 0.05.*

TABLE 2 | Generalized equation estimation model of the association of religion on the mental health and level of happiness of healthcare workers over time.

Dependent variable	Independent variable	ß	S.E.	95% C.I.	*p*
BSRS	Religion	−0.06	0.45	−1.0 to 0.83	0.877
Perceived happiness	Religion	−0.30	0.54	−1.36 to 0.77	0.587
Psychological well-being	Religion	−0.09	0.37	−0.81 to 0.64	0.818
Social adaptation status	Religion	−0.22	0.25	−0.70 to 0.27	0.379

BSRS-5, Five-item Brief-Symptom Rating Scale.

TABLE 3 | Parsimonious generalized equation estimation model of the factors associated with the level of happiness of healthcare workers over time.

Dependent variable	Independent variable	ß	S.E.	95% C.I.	*p*
Perceived happiness	Time	0.68	0.32	0.05 to 1.31	0.034
	BSRS- Hostility	−0.64	0.21	−1.05 to −0.24	0.002
	BSRS-Inferiority	0.93	0.69	−0.43 to 2.29	0.180
	BSRS-Inferiority * Time	−1.28	0.39	−2.04 to −0.51	0.001
Psychological well-being	Time	0.37	0.19	<0.01 to 0.75	0.049
	BSRS-Inferiority	0.18	0.32	−0.46 to 0.81	0.586
	BSRS-Inferiority * Time	−0.50	0.19	−0.87 to −0.12	0.009
Social adaptation status	Time	0.21	0.21	−0.19 to 0.62	0.307
	BSRS-Anxiety	0.46	0.40	−0.33 to 1.25	0.255
	BSRS-Anxiety * Time	−0.66	0.27	−1.19 to −0.14	0.013
	BSRS-Inferiority	−0.40	0.15	−0.70 to −0.11	0.007

*BSRS-5, Five-item Brief-Symptom Rating Scale; * interaction.*

TABLE 4 | Parsimonious generalized equation estimation model of the factors associated with the mental health distress level of healthcare workers.

Dependent variable	Independent variable	ß	S.E.	95% C.I.	*p*
BSRS	Time	−0.10	0.23	−0.55 to 0.36	0.679
	TAS-20 61	−2.49	0.84	−4.13 to −0.85	0.003
BSRS	Time	0.11	0.23	−0.34 to 0.56	0.625
	DIF 22	−4.37	1.27	−6.87 to −1.88	0.001

TAS-20, 20-item Toronto Alexithymia Scale; DIF, Difficulty identifying feelings dimension of TAS-20.

lower level of happiness at follow-up ($\beta = -0.66$, $p = 0.013$; $\beta = -0.40$, $p = 0.007$).

Finally, the third GEE model investigated the factors associated with mental distress level of healthcare workers. Factors of interest included sex, age, religion, and alexithymic trait (TAS-20 ≥61), and their interaction with time. The GEE model showed alexithymic trait was the only factor associated with the mental health distress level of the healthcare workers (**Table 4**). Those showing alexithymic traits (TAS ≥61) are at risk for higher levels of mental distress ($\beta = -2.49$, $p = 0.003$). Additionally, those who scored ≧22 in the DIF dimension of TAS-20 also experienced greater mental distress ($\beta = -4.37$, $p = 0.001$).

DISCUSSION

Our study showed, of the 191 healthcare workers in a psychiatric hospital in China, 2.6% reported having mental distress amidst the COVID-19 pandemic, and 1.5% at 6-months follow-up. Religion was not associated with mental distress or happiness in this group of healthcare workers. Instead, among the five symptom domains of anxiety, depression, hostility, inferiority, and insomnia, psychiatric healthcare workers who experienced higher hostility amidst the pandemic, perceived a lower level of happiness. The 6-month follow-up showed that inferiority decreased over time, which increased the perceived level of happiness and psychological well-being. In the same line, those who reported lower inferiority levels, perceived better social adaptation status. Besides inferiority, healthcare workers whose anxiety level decreased over the 6-month period, their social adaptation status also increased. Finally, those with alexithymic traits and/or who scored higher than 21 in the DIF dimension, experienced a higher level of mental distress compared to healthcare workers who did not have the alexithymic trait.

The level of mental distress amongst psychiatric healthcare workers was 2.6% amidst the pandemic, and lower (1.5%) at

6-months follow-up. This prevalence of mental distress is similar to the 2.96% reported in healthcare workers in psychiatric hospitals in Taiwan (4). However, this is much lower than the prevalence of 25.8–67.55% reported by healthcare professionals in systematic reviews (2), and 19.6 and 34.7% of anxiety and depression in the general public during the pandemic in China (23). The sampling period of the above systematic review and general population studies were earlier on in the pandemic, with the addition of information and experience of combating the pandemic from different countries, the level of distress of healthcare workers may have changed. Additionally, the distress level of healthcare workers also changes according to their regional incidence rates (24).

Amongst the symptoms of anxiety, depression, hostility, inferiority, and insomnia. Healthcare workers who reported a higher level of hostility perceived a lower level of happiness. The relationship between the level of hostile attribution and happiness is correlational (25), unhappy people may be prone to interpret ambiguous situations in an unfavorable way, which leads to negative emotions (anger) (26), and a lack of optimistic attributions may also lead to the low perceived level of psychological well-being (27).

This study also found those whose level of inferiority decreased over the period of 6 months, perceived better happiness and psychological well-being. In addition, those who reported lower inferiority levels, perceived better social adaptation status. This is in line with a previous study that found individuals with increased inferiority levels are more likely to self-concealment, which decreased their level of perceived happiness (28). Additionally, university students who spend more time participating in enjoyable activities of positive psychology reported lower levels of inferiority (29), which is associated with a higher level of subjective well-being (30).

The last symptom dimension associated with the happiness level of healthcare workers was anxiety. With healthcare workers whose anxiety level decreased over 6 months, associated with increased social adaptation status. Healthcare providers can generate remarkable stress and emotional turmoil during the outbreak of a pandemic like COVID-19 (31). Concerns about being infected and the possibility of putting the health of their family and friends at risk may cause healthcare workers to feel isolated and distressed (32). In addition, frontline medical personnel reports feeling less socially adapted compared with second-line medical personnel (33). Fortunately, a follow-up study in Taiwan also showed that the social adaptation status of healthcare workers increased over time (4).

No association was found between religion and mental distress or happiness in this group of healthcare workers. This result differed from a previous study that found religion as a psychological resilience factor among healthcare workers in Taiwan amidst the COVID-19 pandemic (4). These differences show that although China and Taiwan are of the same ethnic group, with common cultural roots, traditions, and ancestries. However, through the one-hundred-year process of social modernization in China (34), it was until the late 1970s that China adopted its policy of reform to open up political discourse and academic community on the topic of religion (35), as shown by less than ten percent of healthcare workers which reported to have religious faith in our study. In over half a century of living in different societies, religion stabilizes the mental health of those in Taiwan amidst the stress of the COVID-19 pandemic (4), but not in China. However, a previous study in China found a disparity in age and urbanization in the effect of religion on health, with religion significantly improving the health of urban residents and those over the age of 60 (36). However, another study also showed no association between religious belief and the health of elderly people (37). Showing inconsistent results in the impact of religion on health in China.

Although religious beliefs showed different impacts on the happiness of healthcare workers in China and Taiwan, however, both regions found healthcare workers with the alexithymic trait (TAS-20 $\geq$61) experienced a higher level of mental distress. This study further found those who scored over 22 in the DIF dimension of TAS-20 also experienced greater mental distress. This shows a collectivist culture of Confucian philosophy, encouraging the restraint of emotion, avoidance of interpersonal conflicts, and suppression of individual rights to maintain harmony with others continues to influence the emotional expression and alexithymic trait of healthcare workers in China and Taiwan. This cultural influence is also shown in the slower emotional development of children in a birth cohort study in Taiwan (38). Barella and Graffigna proposed that since healthcare professionals often have to deal with unexpected emotions from both patients and themselves, an emotional expression of healthcare providers may be considered unprofessional and inconvenient, implicitly encouraging clinicians' alexithymic traits to detach themselves from emotions (39). However, this alexithymic trait can influence the well-being of the healthcare providers, and the quality of medical care (40).

A limitation of this study was that data for this study were collected from one psychiatric hospital in China, therefore the generalizability of this study to other populations may be restricted. Especially since the psychological distress of healthcare workers in the epicenter of the pandemic were higher than those further from the epicenter (41), and the distress level of healthcare workers also changes according to the incidence rates in their region (24).

The strength of this study is that the mental distress and alexithymia levels of healthcare workers were followed-up over 6 months amidst the COVID-19 pandemic. Our follow-up study showed religious belief did not have an association with the mental distress of healthcare workers in China. Instead, the mental distress of healthcare workers decreased over time, and for those healthcare workers whose anxiety decreased over 6 months, their social adaptation status increased. Additionally, for those whose inferiority level decreased over time, their perceived level of psychological well-being and overall happiness increased. Healthcare workers with alexithymic traits were associated with a higher level of mental distress. Implementing strategies to assist healthcare workers with alexithymic traits in identifying their emotions and regulating their emotions can prevent or mitigate their mental distress. During a healthcare crisis, such as the COVID-19 pandemic, sharing emotions, concerns, and worries can make all those involved

in the crisis feel more responsible and aware of how much their behavior can contribute to effectively coping with the stressful consequences of the situation (42). The Confucian and collectivist cultural impact on emotional expression needs to be considered. To ensure a healthy and robust clinical workforce in the treatment and control of the pandemic, policymakers should address the mental health needs of medical workers by funding preventive and promoting psychological resources (43), including spiritual resources and values for coping with the pandemic (44).

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Kaohsiung Armed Forces General Hospital. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HL and F-WL conceptualized the study. FZ and M-CC overlooked the sampling and experimental procedures. P-FC and F-WL undertook the statistical analysis and interpreted the analysis. P-FC wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

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Development and Validation of a Questionnaire to Assess Social Participation of High Risk-Adults in Germany During the COVID-19 Pandemic

Dominik Schröder[1], Gloria Heesen[1], Stephanie Heinemann[1], Eva Hummers[1], Alexandra Jablonka[2,3], Sandra Steffens[2], Marie Mikuteit[2], Jacqueline Niewolik[2], Tobias R. Overbeck[4], Jonathan Kallusky[4] and Frank Müller[1]*

[1] Department of General Practice, University Medical Center, Göttingen, Germany, [2] Department of Rheumatology and Immunology, Hannover Medical School, Hanover, Germany, [3] German Center for Infection Research (DZIF), Partner Site Hannover-Braunschweig, Hanover, Germany, [4] Department of Hematology and Medical Oncology, University Medical Center Göttingen, Göttingen, Germany

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***Correspondence:**
Dominik Schröder
dominik.schroeder@med.uni-goettingen.de

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Background: Restrictions to contain the COVID-19 pandemic affect the social participation of people worldwide. Especially those at high risk for a severe disease tend to abstain from social gatherings. While there are a few questionnaires to measure social participation in elderly or chronic patients, a valid survey instrument that includes pandemic-related social participation is needed.

Methods: We developed a social participation questionnaire that aims to assess pandemic-related restrictions in social participation. Items were developed using a theory and literature-based approach and then compiled in a discursive process involving experts and lay people. This was followed by the validation of the questionnaire through a cross-sectional survey on 431 individuals. Items with low item-total correlations and low factor loadings using exploratory factor analysis [EFA] were excluded. Using EFA on the remaining items, the factor structure was retrieved and tested with a confirmatory factor analysis [CFA]. Internal consistency was assessed with Chronbachs α.

Results: Initially, 27 items were developed which were used for validation. 13 items were excluded due to low item-total correlations and factors loadings. EFA of the remaining 14 items revealed three factors which were identified as domains "active social participation," "wellbeing," and "restrictions". CFA showed an acceptable model fit using the three-dimensional structure. Chronbachs α of 0.81 and McDonalds Ω of 0.87 indicate good internal consistency. Correlation analysis showed an association between the developed questionnaire and previously-established participation and mental health scales.

Conclusion: This study suggests that our 14 item questionnaire is of high reliability and validity and can be used to measure social participation during a pandemic.

Keywords: social participation, pandemic questionnaire, COVID-19, SARS-CoV-2, quality of life, questionnaire validation, questionnaire development and validation

INTRODUCTION

The still ongoing coronavirus disease [COVID-19] pandemic affects various aspects of life worldwide (1–6). Especially with dynamic changes of social restrictions, vaccine progress and occurrence of infection, the effect on how people pursue everyday life and participate in social activity of any kind can also change dramatically.

Until recently, social participation was discussed primarily in connection with people with physical, mental or sensory impairments of physiological functions, especially in the elderly (7, 8). The concept of social participation used in medical research has been adopted from the fields of geriatrics, disability research and rehabilitation (9–11). In these concepts, it is assumed that individual illnesses, symptoms or aging processes change or even limit an individual's ability to engage in social participation. Vice versa, social participation is generally associated with positive health outcomes. Improving social participation is one of the key strategies to combat the challenges of an aging population (12, 13). Known interventions to enhance social participation, in addition to medical and rehabilitation interventions, are to provide accessibility in various services like public transportation (14). As social participation can be summarized as "a person's involvement in activities that provide interaction with others in society or the community" and is thus a broad concept which also applies to pandemic situations and the impact of the restrictions on daily life during the course of a pandemic. Existing survey instruments often reflect the domains of the International Classification of Functioning, Disability and Health [ICF] or surrogates and are used to assess how specific individual medical conditions impact social participation but not a pandemic threat (15–17). Thus, these instruments do not address social fields affected by the pandemic (e.g. safety of the own person in the public space). Additionally, existing survey instruments are mainly used for rehabilitation research. Therefore, the need for new, validated, pandemic-appropriate instruments has become apparent. This is supported by the fact that especially so far non-validated, unstandardized or not fit-for-purpose instruments are being used in pandemic research (18–22).

Here, we describe the development and validation of a new questionnaire which was used to assess social participation during a pandemic in persons with a high-risk for a severe COVID-19 infection.

MATERIALS AND METHODS

The methods used in the development and validation of the questionnaire are based on current best practices (23, 24).

Development of Items for the Pandemic Social Participation Questionnaire (PSP-Q)

The item development was performed in a discursive process following both deductive (literature review, assessment of existing scales) and inductive (group discussions on items with both experts and potential participants) approaches. Final refinement was undergone after pre-testing.

First, a theory- and literature-review using PubMed screening for articles on "social participation" and "quality of life questionnaire" in English and German language was undertaken. Additionally, we conducted a Google search for gray literature including national and international conventions and classification about social participation and rehabilitation. The purpose was to specify and identify domains and possible dimensions as well as assessment of existing scales.

The literature was fed back into a discursive process with authors and other experienced scientists from the Department of General Practice at University Medical Center Göttingen. We identified that existing questionnaires were based mainly on the International Classification of Functioning, Disability and Health [ICF] framework. The ICF, on the other hand, was considered hardly able to measure pandemic-specific impacts on social participation, as it assumes impairments to social participation only due to disease, as opposed to an external cause or hazard. Thus, emphasis was placed on identifying dimensions, that extend the existing framework of ICF. Following agreement in the group, we used the Annual Participation Report published by the German Federal Ministry of Labor and Social Affairs as the dimensional framework for social participation (25). This in turn is based in large parts on the United Nations Convention on the Rights of Persons with Disabilities (26). The framework includes the dimensions "Family and social network," "Education and training," "Employment and material life situation," "Daily living," "Health participation," "Leisure, culture and sports," "Security and protection of the own person," and "Political and civil participation" and thus domains that were not recognized by ICF. Items were then derived interpreting existing survey instruments on social participation (27, 28), quality of life (29, 30), and the ICF (31) with the aim to provide at least two items per dimension. This resulted in a pool of items that were subsequently reduced by excluding duplicate items. It was consented not to pose questions but to provide statements on which probands can rate on a five-point Likert scale, whether they agree or disagree. Since certain items cannot be answered meaningfully in some circumstances (e.g. items concerning work life by retired persons), an additional category "not applicable to me" was added (32). The development of the items was based on the principle of comprehensibility; specifically, items should be formulated positively and negation should be avoided. Clear, simple sentence construction without abbreviations or technical terms was used. Particular attention was paid to statements about intensity, which ideally should be avoided. In total, 30 questions were derived from this first process. Questions were assigned in random order and compiled into a preliminary questionnaire.

Next, the first version of the questionnaire was discussed item by item in five sessions with each two people at high risk for a severe COVID course. This group was recruited pragmatically since the media reported the begin of the study before the first participant was included in the study. As a result, numerous people under immunosuppression came forward and expressed interest in participating in the study. Some of these individuals were approached and asked if they would be available for an open discourse about study questionnaires and their

experiences during the COVID-19 pandemic. Group discussions were conducted as online video conferences in early spring 2021 when legal restrictions were in place on civil life. The group was given the task of speaking out loud about everything that comes to mind on each question and linking it to the participants' own current experiences, life situations, and expectations. As a result of this process, certain items were classified as too abstract (e.g., "I feel uncomfortable being close to others") and transformed into more lifelike episodes based on participants' vivid experiences ("I hug friends and relatives to greet them when they are important and close to me") (24). Additionally, the wording of the items was changed to be more precise and clear. In total, we developed 27 items during this phase. These items did not overlapped in every case with either ICF or the dimensional framework derived from the Convention on the Rights of Persons with Disabilities (26). However these items are needed to reflect the impact of the pandemic and we consented to use an *a posteriori* approach to identify domains.

For a pilot test of the PSP-Q, we asked 10 colleagues and their family members who are affiliated with the Department of General Practice but not involved in the questionnaire development to read and fill out the questionnaire. These persons were asked to provide feedback about the now article based questionnaire, regarding comprehensibility, and answerability, especially with regards to readability and layout. Additionally, we wanted to investigate how long it takes to complete the questionnaire. After this pilot test, the PSP-Q was finalized.

Study Design and Participants

This questionnaire development and validation project is part of the CoCo Immune Study (33). In the CoCo Immune Study, participants with a high risk of a severe COVID-19 illness due to immunosuppressive therapy (e.g., due to autoimmune diseases or cancer treatment) or due to older age (participants aged 80+) were recruited for a 12-months observational study following COVID-19 vaccination. No intervention, treatment or counseling took place. Only participants aged 18 years or older were recruited.

We followed different recruitment strategies. To begin, potential participants were informed by local media reports, posters and flyers in private practices, vaccination centers, clinics and hospitals in the Southern Lower Saxony Region. Participants who contacted the study team and fulfilled the inclusion criteria were subsequently enrolled. Additionally, patients were enrolled who fit to the inclusion criteria and attended the outpatient clinics of the Department of Rheumatology and Immunology of the Hannover Medical School or the Department of Hematology and Medical Oncology of the University Medical Center Göttingen. Thus, recruitment was based on a pragmatic sample (real life sample).

Data Collection and Management

At enrollment, participants completed a self-reported questionnaire on sociodemographic (age, gender, education level) and medical characteristics (diseases, pharmacotherapy), COVID-19 specific characteristics (previous SARS-CoV-2 infection, vaccine used for immunization) and the included scales. Data were entered into the EvaSys digital survey system (EvaSys GmbH, Lüneburg, Germany) and exported from there directly into SPSS data format. Only data from participants which completed all 27 items of the newly-developed questionnaire are used for statistical analyses.

Measures

PSP-Q

The PSP-Q evaluates social participation with 27 items. A five-point likert-scale was used in all items ranging from 1 = strongly agree to 5 = strongly disagree. Additionally, participants had the possibility to state that question is not applicable to them which was then rated with the highest social participation as either strongly agree or strongly disagree depending on the poling of the item. To calculate the total score, negative items were reversed and summed up with all included items. Higher scores indicate a higher social participation with scores ranging between 27 and 135.

Patient Health Questionnaire-4 (PHQ-4)

The PHQ-4 is a brief, validated, high reliable (Cronbachs α 0.85) measure of anxiety and depression symptoms (34, 35). This scale consists of two subscales PHQ-2 for depressive symptoms and GAD-2 for anxiety, consisting of two four-point Likert-type items (0–3) for each subscale, and also produces an overall psychological distress sum score ranging from 0–12 while higher scores indicates impaired mental wellbeing. A sum score of $\geq$3 on either subscale or $\geq$6 on the whole scale is considered the cutoff point for identifying possible symptoms of clinical relevant anxiety or depression. Compared to the Brief Symptom Inventory, the PHQ-4 has a specificity of 94.5% and sensitivity of 51.6% (36).

Index for the Assessment of Health Impairments (IMET)

The IMET is a questionnaire to measure social participation based on the International Classification of Functioning, Disability and Health [ICF] (27, 28). It was initially developed to assess participation and involvement for persons suffering from a chronic disease. The main field of application is in the area of rehabilitation science research. The IMET is uni-dimensional and consists of 9 items with a 11 (0–10) level Likert-scale where higher scores indicate lower social participation consistently across all items. The sum of all 9 items can be used to determine the overall social participation with a high internal reliability (Cronbachs α 0.90). Higher scores indicate a lower level of social participation. The IMET was used during the COVID-19 pandemic by Mergel & Schützwohl to assess social participation before and after the lockdown in participants with a mental disorder and participants from the general population (22, 37).

In addition to the PHQ-4 and IMET, the health-related quality of life and subjective health status of the last 2 weeks was assessed each with a single item on a seven-point Likert-scale. Higher scores indicate a poorer health status or a lower quality of life.

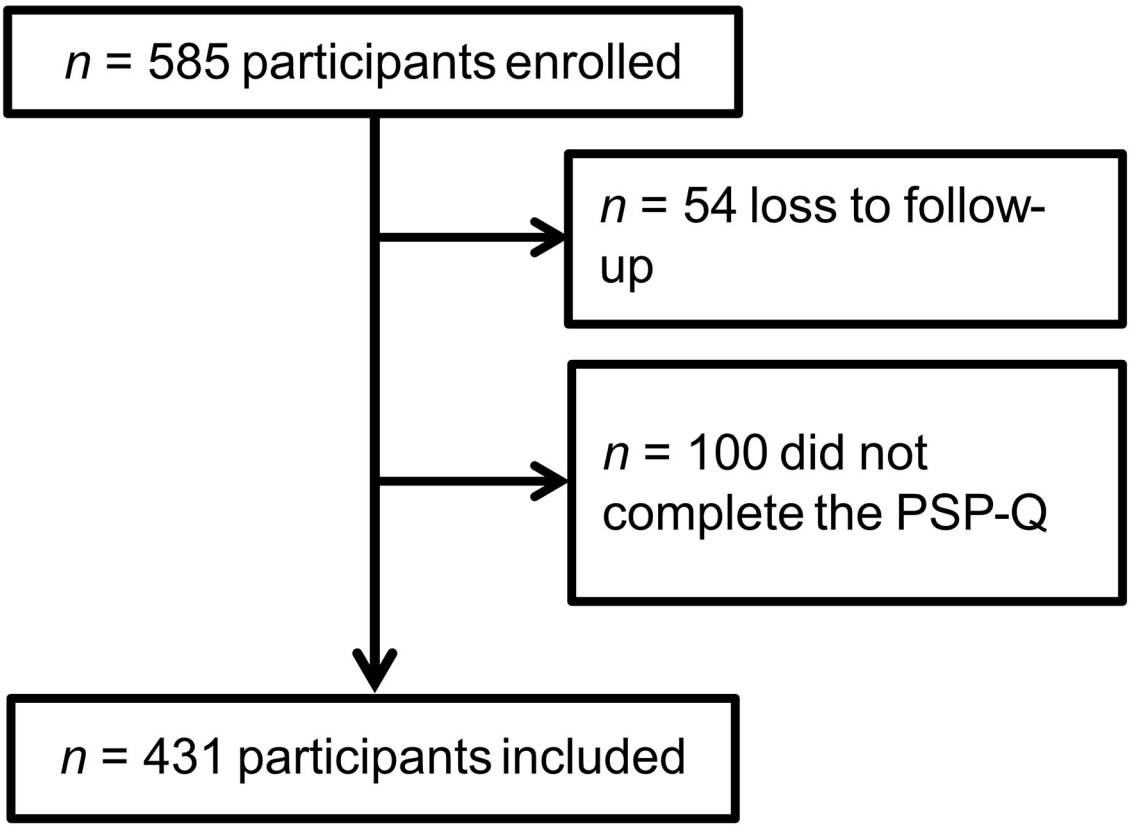

FIGURE 1 | Flowchart of participants included in the analysis.

Data Analysis

Data analysis was conducted using two independent random samples stratified by gender. One sample was used for item analysis and exploratory-factor-analysis [EFA] ($n = 215$) to select items and extract factors. The other sample ($n = 216$) was used in confirmatory factor analysis [CFA] to verify the extracted factor structure from the EFA and assess the internal consistency on independent data.

Item Analysis and EFA

The individual items of the PSP-Q were examined using the mean, standard deviation, and the item-total correlation. Items with an item-total correlation of <0.30 were excluded from the final questionnaire.

The set of items were checked for eligibility to conduct an exploratory factor analysis using the KMO [Kaiser-Meyer-Olkin-Criteria] index score and Bartlett's test of sphericity (38, 39). A KMO index score of 0.8 or greater and a statistically significant Bartlett's test of sphericity indicate the eligibility of the items to conduct a principal component analysis [PCA]. The number of extracting factors was examined using parallel analysis (40). A PCA with varimax rotation was used to extract the factors and factor loading. Items were excluded with a factor loading below 0.4 or when a cross-loading between the primary and alternative factor loading with a distance ≤ 0.1 occurred. If an item was excluded the PCA was conducted again without the excluded items.

Construct Validity

To verify the extracted factor structure from the EFA, a confirmatory factor analysis [CFA] was conducted. Several indices were reported to assess the model fit. Reported indices were: Comparative Fit Index [CFI], Tucker Lewis Index [TLI], Root Mean Square Error of Approximation [RMSEA] and Standardized Root Mean Square Residual [SRMSR]. A close Model fit was determined by cut-off thresholds of 0.95 for CFI and TLI, 0.05 for RMSEAR and 0.06 for SRMR (41, 42).

Pearson correlations between the newly-developed questionnaire and already established questionnaires measuring similar constructs were calculated.Value thresholds of 0.1, 0.3, 0.5 stand for a small, medium, and large correlation, respectively (43).

Internal Consistency

Cronbachs α and McDonalds Ω was used to assess the internal consistency of the questionnaire and between individual factors extracted from the EFA. As for Chronbachs and McDonalds Ω

TABLE 1 | Participants characteristics ($N = 431$).

Gender	
Female	241 (57.7)
Male	177 (42.3)
Age, years	
Mean (SD)	58,85 (16,52)
Median (IQR)	58 (23)
<40	60 (14.0)
40–65	210 (49.0)
>65	159 (37.1)
School education[a]	
Low	80 (19.2)
Middle	124 (29.8)
High	200 (48.1)
Other	12 (2.9)
Household*	
Parenting	74 (17.2)
Single parent	8 (1.9)
Living alone	105 (24.4)
Care of relatives	45 (10.4)
Morbidities*	
Hypertension	173 (40.1)
Heart failure	14 (3.2)
Diabetes type 2	31 (7.2)
Chronic obstructive pulmonary disease	14 (3.2)
Risk group*	
80+	57 (13.6)
Immunosuppressed	294 (70.3)
Active oncological treatment	94 (22.5)

*If not other stated data is n (%), *multiple selection possible, [a]school education is based on secondary school level; SD, standard deviation; IQR, Interquartile range.*

values $\alpha \geq 0.7$ can be interpreted as acceptable, ≥ 0.8 as good and ≥ 0.9 as excellent (44, 45).

Further scores of the PSP-Q are tested with the Kolmogorov-Smirnov and Shapiro-Wilk test for a normal distribution. A non-significant result indicated a normal distribution of the data. The excess kurtosis and skewness will be additionally reported where values between −2 and +2 indicated a normal distribution of the data (46).

The statistical analysis was performed using the statistic software SPSS Version 27 (IBM, Armonk, NY) and R (Version 4.1.1). R was used to conduct and visualize the EFA, CFA and calculate Chronbachs alpha using the packages lavaan, lavaanPlots, paran and psych (47–50). If not stated otherwise, results were considered statistically significant if the p value was ≤ 0.05.

Ethics

The study received approval by the Ethics Committee of the University Medical Center Göttingen (No. 29/3/21). All participants gave their written consent. The CoCo Immune Study is registered in the German Clinical Trials Register, an approved Primary Register in the WHO network (DRKS00023972).

RESULTS

In total, 585 participants were enrolled in the study of which 54 were lost to follow-up (9.2%). Of these persons, 431 participants completed PSP-Q with all 27 items and this data was used for further statistical analysis (**Figure 1**). This data results in an item to participants' ratio of 1:15.9. The first participant completed the survey on March 30, 2021 and the last participant on September 2, 2021. The included participants were mostly female (57.7%). The ages ranged from 18 to 97 years with a mean age of 58.9 years. Nearly half of the participants (48.1%) had a college preparatory school education level (**Table 1**).

Item-total correlations varied between 0.06 and 0.49, where eight items had an item-total correlation bellow 0.3 and were therefore excluded from further analysis. The remaining 19 items were eligible for an EFA with a Kaiser–Meyer–Olkin statistic of 0.82. The Bartlett's test of sphericity was also significant ($x2(171) = 936$, $p < 0.01$). Using parallel analysis adjusted eigenvalues ≤ 1 indicate three factors to extract in EFA. Using EFA four items had factor loadings <0.4 and one item had cross-loading with a distance ≤ 0.1. These five items were therefore excluded from further analysis. The EFA was recalculated without the excluded items and identified three latent constructs which explained 51.0% of the total variance (see **Figure 2**). The highest factor loadings on each item ranged from 0.48 to 0.74 (**Table 2**). The three extracted factors were interpreted by the researchers as domains of "wellbeing" (F1), "active social participation" (F2), and "restrictions" (F3).

The model fit indices of the three-factor model revealed by the EFA were: CFI = 0.94; TFI = 0.93; RMSEA = 0.054 (90% CI [0.036 – 0.070]) and SRMR 0.07 (**Figure 3**). Only RMSEA indicate a close model fit.

Significant negative correlations were found between the PSP-Q and all other included scales. A medium correlation could be found in the IMET, PHQ-4 and its sub-scales. Subjective health status indicates a small correlation and quality of life indicates a medium correlation with the PSP-Q. The second subscale interpreted as "active social participation" showed no significant correlation regarding the other included constructs (**Table 3**).

To measure the internal consistency of the PSP-Q, Chronbachs α and McDonalds Ω was calculated. The PSP-Q as a whole had an α 0.81 where the α of the individual factors ranged from 0.70 to 0.78. McDonalds Ω was 0.84 for the whole scale and between 0.76 and 0.72 on the individual factors (**Table 4**).

Sum scores of the PSP-Q ranged in the analyzed sample of 431 participants between 18 and 70 with a mean of 45.43 with a standard deviation of 10.64. Both, the Shapiro-Wilk test (p 0.58) and Kolmogorov-Smirnov test (p 0.13), yields a non-significant result which indicates a normal distribution of the questionnaire scores. Excessive kurtosis (−0.34) and skewness (−0.14) of the PSP-Q score distribution supports the Shapiro-Wilk and Kolmogorov-Smirnov test statistic with not crossing the cutoffs −2 or +2.

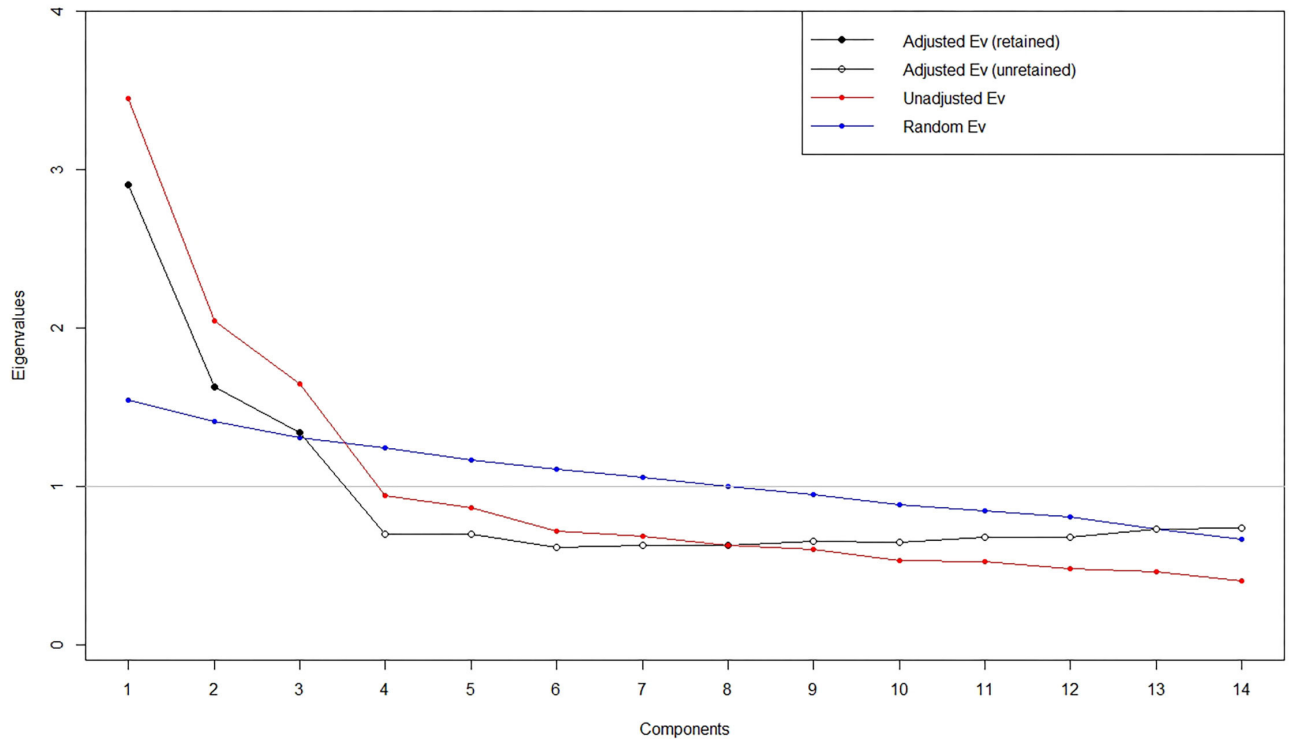

FIGURE 2 | Parallel analysis scree plot.

TABLE 2 | Factor loadings of the final items included in the PSP-Q.

	Factor 1	Factor 2	Factor 3
% of Varaince explained	**24.7**	**14.6**	**11.8**
Wellbeing 1	**0.52**		
Wellbeing 2	**0.48**		
Wellbeing 3	**0.55**		
Wellbeing 4	**0.57**		
Wellbeing 5	**0.52**		
Wellbeing 6	**0.61**		
Active social participation 1		**0.60**	
Active social participation 2		**0.74**	
Active social participation 3		**0.68**	
Active social participation 4		**0.56**	
Restrictions 1	0.36		**0.55**
Restrictions 2			**0.68**
Restrictions 3			**0.64**
Restrictions 4			**0.43**

Factor loadings < 0.3 are omitted. Bold values indicate the assigned factor for each item.

DISCUSSION

Summary of Main Findings

The COVID-19 pandemic presents us with new challenges. Previous (social) participation questionnaires were developed for use in rehabilitation studies and these instruments focus on health impairments, social and work integration. With the COVID-19 pandemic, additional dimensions need to be addressed such as close social contact with family and friends and social restrictions. To add these pandemic-relevant aspects to existing dimensions of social participation, we developed the PSP-Q consisting of 14 items. Our results show that the PSP-Q is of high reliability and validity and can be used to measure social participation during a pandemic.

Social participation is a key construct reflecting a person's interactions with others and is associated with other constructs reflecting various health outcomes. Any medical treatment should aim to maintain or restore social participation. The recent COVID-19 pandemic and the social implications of the public health restrictions to decrease the spread of the SARS-CoV-2 virus have still not been fully explored. In particular, persons with at high risk for a severe COVID-19 disease course are challenged with complicated risk assessments about how much they should abstain from meeting others and engaging in social activities. Many uncertainties arise also regarding vaccines and vaccinations. Social participation can be a good concept to assess the impact of these challenges and uncertainties on behavior. The PSP-Q also expands the perspective about the impact of COVID-19 restrictions, measuring dimensions beyond the sphere of mental symptoms.

Already published studies measuring social participation in the COVID-19 pandemic have used newly-developed

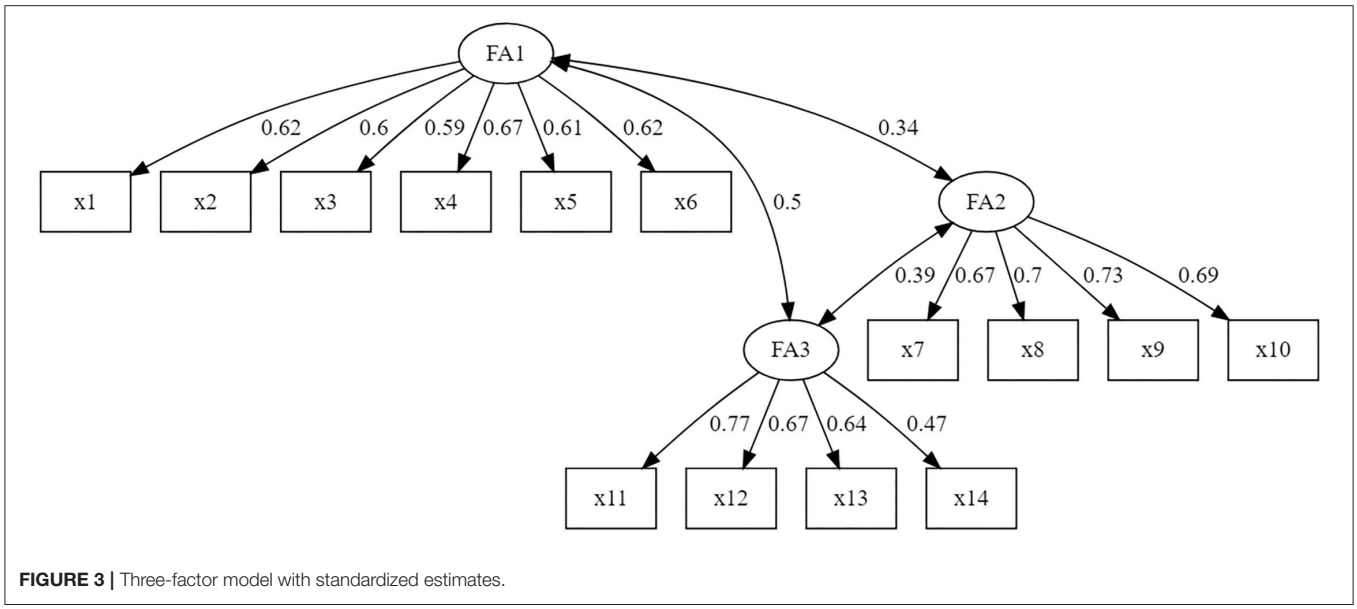

FIGURE 3 | Three-factor model with standardized estimates.

TABLE 3 | Correlation between the PSP-Q and its subscales.

	PSP-Q	PSP-F1	PSP-F2	PSP-F3
IMET	**−0.34**	**−0.47**	−0.01	**−0.27**
PHQ-4	**−0.43**	**−0.58**	−0.05	**−0.30**
PHQ-2	**−0.41**	**−0.59**	−0.05	**−0.36**
GAD-2	**−0.36**	**−0.47**	−0.05	**−0.29**
Subjective health status	**−0.21**	**−0.27**	−0.03	**−0.24**
Quality of life	**−0.30**	**−0.42**	0.01	**−0.26**

Bold indicates a significant association ($p < 0.05$); IMET, Index for the Assessment of Health Impairments; PHQ-4, Patient Health Questionnaire-4; PHQ-2, Patient Health Questionnaire-2; GAD-2, Generalized Anxiety Disorder Scale-2.

TABLE 4 | Chronbachs α of the PSP-Q and it subscales.

	Chronbachs α (95% CI)	McDonalds Ω
PSP-Q (14 items)	0.81 (0.78–0.85)	0.87
Factor 1 (6 items)	0.79 (0.74–0.83)	0.79
Factor 2 (4 items)	0.79 (0.74–0.83)	0.79
Factor 3 (4 items)	0.73 (0.67–0.79)	0.75

questionnaires or modified already existing scales that are not validated (19). Mergel and Schützwohl (22) used the IMET a participation scale developed to measure rehabilitation success to assess the effect of the pandemic lockdown in Germany on social participation (22). The PSP-Q could provide further insights regarding these research topics. Between the IMET and PSP-Q only a medium correlation was found. Further the subsscale "active social participation" shows no correlation with the IMET and other health-related measures. Our results show that the PSP-Q measures different aspects of social participation than the IMET and may reflect the social participation a pandemic more appropriate during. A comparison of these two measures in a longitudinal study evaluating different social restrictions during the pandemic is needed to reveal further differences between the two scales. Ammar et al. (19) found a negative impact of home confinement on social participation using a modified version of the Short Social Participation Questionnaire that was not validated (19). While the PSP-Q reflects the subjective agreement with a given statement the modified version of the Short Social Participation Questionnaire measures the actual social participation in a time frame.

The PSP-Q consists of 14 items which is on par with already existing multidimensional scales measuring participation (51–53). Further research should implement the PSP-Q in longitudinal studies to measure the influence of various population restriction measures and the effect of vaccination campaigns upon individual levels of social participation. One such policy example is the lifting of social restrictions in some countries (e.g., Denmark) with the COVID-19 pandemic still ongoing. Also, cultural differences need to be considered. In addition, the questionnaire was not exclusively designed for the current COVID-19 pandemic, but could also be used to measure social participation in other communicable diseases with pandemic or endemic dimensions. Possible implementation of the PSP-Q beyond the COVID-19 pandemic could include regional influenza epidemics. The PSP-Q is available in the **Supplementary Material** in German. An English translation of the questionnaire is included for reference, but this version was not used during the validation.

Limitations

The development and validation of the questionnaire comes with limitations. Due to the pandemic situation and high-risk adults as the target group, the study was done with a minimium of personal contact and was therefore carried out in a more pragmatic way. For example, in-person focus group discussions with target or expert groups were not possible during the development of the questionnaire.

Over 25% of the participants of the initial 535 participants were excluded due to loss-to-follow-up or missing items in the PSP-Q. A loss-to-follow bias cannot be prevented. Also, missing answers could not be completely at random and therefore biased. The items of the questionnaires are to date only available in the German language. Persons with a high risk for severe COVID-19 infection in our sample were mostly taking immunosuppressive medication (70.3%). Only 13.6% of the sample were 80 years or older. Only high-risk adults were included which is why the use of the PSP-Q on a different target group needs re-validation.

The total explained variance by the three latent factors was 51.0%. Items with a factor loading below 0.4 on the highest loading factor were excluded. In the literature, this value differs between 0.3 and 0.5 with no clear consensus. As reliability criteria, only internal consistency was used in this analysis. The retest reliability was not feasible because social participation would differ between different time points during a pandemic e.g., with changing restrictions regarding social gatherings and cultural events. Only RMSEA met the criteria for a close model, where the other model fit indicies were close to the the cut off values and can be intereted as acceptable model fit. The choice of cut-off values of model fit indices varies in the literature with no clear consensus.

CONCLUSION

The PSP-Q is a valid and reliable questionnaire with 14 items which assess social participation of high-risk groups during a pandemic. The sub-domains of the PSP-Q measure the dimensions "wellbeing," "active social participation," and "restrictions." The strong correlation between the PHQ-4 and the sub-domain "wellbeing" of the PSP-Q showed an association between social participation and mental health. Nevertheless, the dimension "active social participation" showed no correlation with other questionnaires, indicating a missing dimension in the existing instruments. The PSP-Q can be used to measure the effect of various interventions and changes during the pandemic with regards to the effects upon social participation (e.g., social restrictions and vaccination progress) in high-risk groups.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the University Medical Center Göttingen. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

FM and AJ: research design. FM, GH, JN, TO, and JK: data collection. DS and FM: data analysis, interpreting results, and writing first draft. SS and SH: english-language editing. All authors writing and contributing to writing of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.831087/full#supplementary-material

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Factors Associated With Depressive Symptoms in Individuals Who Have Experienced COVID-19 Self-Quarantine

Hye-Young Jang[1], *Young Ko*[2*] *and Song-Yi Han*[3]

[1] School of Nursing, Hanyang University, Seoul, South Korea, [2] College of Nursing, Gachon University, Incheon, South Korea, [3] Department of Nursing Science, Sunmoon University, Asan-si, South Korea

The purpose of this study was to identify the factors associated with depressive symptoms in individuals who have experienced self-quarantine because of coronavirus disease exposure or infection using Lazarus and Folkman's stress, coping, and adaptation theory, and George's Social Antecedent Model of Depression. This was a cross-sectional study that used data from the 2020 Korean Community Health Survey. A complex sample design was used to analyze the data. Descriptive statistics, the Rao-Scott X^2 test, and logistic regression analysis were conducted to identify factors associated with depressive symptoms. Approximately 5.3% of the subjects had depressive symptoms. The factors associated with depressive symptoms were age, level of education, household income, changes in daily life due to coronavirus disease, whether someone provided assistance during the self-quarantine, perceived health status, and hospital consultation due to depressive symptoms. The findings of this study will be utilized as basic data for the development of programs to alleviate and prevent depressive symptoms in self-quarantine individuals.

Keywords: coronavirus, COVID-19, COVID-19 measures, depressive symptom, self-quarantine

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***Correspondence:**
Young Ko
moodory@gmail.com

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INTRODUCTION

In March 2020, the World Health Organization declared coronavirus disease (COVID-19) a pandemic, in order to promote international cooperation and response. Many countries have established COVID-19 measures, such as social distancing and quarantining to prevent the spread of the disease (1).

In particular, proper management and control of individuals who are in contact with COVID-19 infected patients are of utmost importance to prevent the spread of COVID-19. In Korea and many other countries, infected patients and those who have been in close contact with infected patients are isolated for 2 weeks as a primary response (2–4). Individuals under self-quarantine are physically isolated and prohibited to make any direct contact with others and to share daily items with others for at least 14 days. Public health officers monitor them by the self-quarantine safety protection app (5).

Such physical isolation is effective in preventing the spread of COVID-19; however, self-quarantine measures not only limit the interactions of the quarantined individual, but also have negative economic, emotional, and social effects on him or her (6–8). Lee et al. (9) showed that

individuals practicing self-quarantine are highly likely to experience fear and uncertainty about infection and psychological withdrawal. In addition, interruptions in their social relationships lead to a sense of loss, depression, anxiety, stress, and fear of stigmatization, and isolation of their family members further causes psychological pain such as guilt and depression (6–8). Therefore, it is important to minimize the negative consequences of self-quarantine on mental health.

Previous studies on self-quarantine and depression due to infectious diseases found that 31.2% of those in self-quarantine due to severe acute respiratory syndrome showed depressive symptoms, and 3.0% of individuals who were in contact with patients with Middle East respiratory syndrome showed depressive symptoms after self-quarantine. In addition, the incidence of depression has been found to be 2.5 times higher in those who have experienced self-quarantine than in those who have not (3, 10, 11). A study on adults in the United States indicated that the prevalence of depression was three-folds higher during the COVID-19 pandemic than before the pandemic (12). In Korea, in 2020, 22.8% of adults aged 19 years or older were at risk for depression, which was six times higher than the 3.8% reported for 2018, before the COVID-19 pandemic (13). These findings suggest that depression experienced by those in self-quarantine results from the stress of adapting to sudden environmental changes. As the prevalence of depression is high in those practicing self-quarantine, it is necessary to systematically analyze the relationship between risk factors and depression in this group. Therefore, in this study, we applied Lazarus and Folkman's (14) stress, coping, and adaptation theory and George's (15) Social Antecedent Model of Depression (SAMD) to identify the factors of depression in individuals who have experienced self-quarantine because of coronavirus disease exposure or infection. The SAMD includes biological, psychological, and social factors rather than the fragmentary aspects of the cause of depression (15) and is ideal for the systemic evaluation of various factors related to depression in those who were in self-quarantine due to COVID-19.

Therefore, we identified the risk and buffering factors for depression in those who were in self-quarantine due to COVID-19 and provided basic data to improve our understanding of depression in this group and to seek adequate measures for treatment and prevention.

Conceptual Framework

To identify the factors of depression in subjects who had experienced self-quarantine during COVID-19, Lazarus and Folkman's (14) stress, coping, and adaptation theory, and George's (15) SAMD were used to establish the conceptual framework of the study (**Figure 1**). Lazarus and Folkman's (14) theory has been used as a theoretical framework in many previous studies on stress, coping, and adaptation by systematically and logically explaining the overall process of evaluation, coping, and adaptation and causal antecedents of stressful events. In addition, George's (15) theory explains the relationship between depression and various factors at different stages to systematically and comprehensively measure the factors affecting depression. The SAMD has six stages: (1) demographic factors; (2) early life events and achievements; (3) later life events and achievements; (4) social integration; (5) vulnerability and protective factors; and (6) provoking and coping efforts.

The conceptual framework used in this study was constructed by modifying the factors of each stage of the SAMD to consider the situational characteristics of self-isolated individuals during the COVID-19 pandemic. Contextual factors included general characteristics of the subjects (age, gender, education, occupation, economic status) and recent events (changes in daily life due to COVID-19). Factors related to individual cognition and coping included social integration (whether someone provided assistance during the self-quarantine), vulnerability factors (perceived health status), protective factors (marital status, living arrangement), and coping factors (hospital consultation due to depressive symptom). The negative outcome variable was depression.

MATERIALS AND METHODS

Research Design

This was a cross-sectional study that used data from the 2020 Korean Community Health Survey (KCHS) to identify factors associated with depressive symptoms among individuals who had experienced self-quarantine during the COVID-19 pandemic using Lazarus and Folkman's (14) stress, coping, and adaptation theory and George's (15) SAMD.

Participants and Data

This study analyzed data from the KCHS. Since 2017, the Research Ethics Review Committee (RERC) of the Centers for Disease Control and Prevention decided that the KCHS corresponds to a study conducted by the state for public welfare. Therefore, on the basis of the opinion that it is possible to conduct an investigation without the approval of the RERC, data were collected without review by the RERC. Written informed consent was obtained from all subjects before participation. The data were collected in accordance with the disclosure and management regulations of the Korea Disease Control and Prevention Agency. We conducted this study with the approval of the institutional review board of the Gachon University to which the researchers belong (No. 1044396-202109-HR-198-01).

The KCHS has been conducted annually since 2008 by the Korea Disease Control and Prevention Agency to provide population-based statistics for developing and evaluating national healthcare plans. The KCHS is a nationwide, community-based health survey and the target population is adults aged 19 years or older living in local communities across the country. The selection of survey households was carried out in a two-stage design. In the first stage, sample areas were extracted by the probability-proportional-to-size sampling, in the second stage, the households were extracted by the systematic sampling (16). A total of 765 trained interviewers (3 interviewers per 255 public health centers) who have received training related to the survey visited the sampled households and conducted one-on-one computer assisted personal interviews (CAPI). The data were collected from August 16 to October 31, 2020, and a total of 229,269 subjects participated in the 2020 KCHS, This

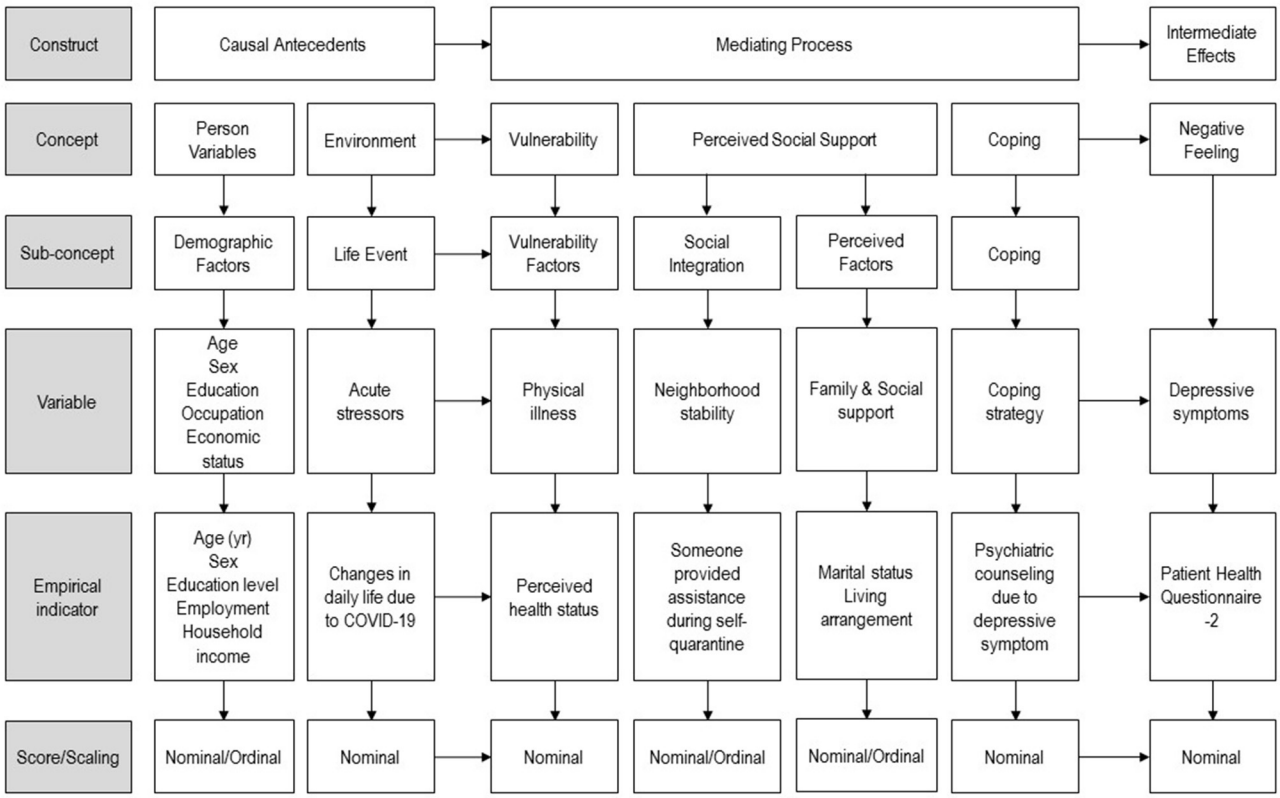

FIGURE 1 | Substruction model of the theory of this study.

study was conducted on 1,071 subjects who had experienced self-quarantine during COVID-19 among 229,269 subjects.

Study Variables

The following study variables were included, based on George's (15) SAMD:

Demographic Characteristics

The demographic characteristics of the study subjects included age, gender, education level, employment, and household income. Age was classified as <40 years, 40–64 years, and >65 years, and education level was classified as elementary school, middle school, high school, and college. Employment was classified as currently employed or unemployed, and household income was classified as <1 million won, 1–2.99 million won, 3–4.99 million won, and >5 million won.

Life Event

Life event referred to changes in daily life due to COVID-19. The state of daily life before the COVID-19 pandemic was considered 100 points, complete stoppage of daily life was assigned a score of 0, and no change was given a score of 100 points. Lower scores indicated greater changes in daily life.

Vulnerability

Vulnerability was determined by perceived health status, which was measured with the question "How do you usually feel about your health?" The question was scored on a scale ranging from 1 ("very good") to 5 ("very bad") points. A higher score indicated worse perceived health status. Perceived health status has good validity as a strong predictor of morbidity, mortality, and use of health care services among various subjects (17, 18) and reported good test–retest reliability (19).

Social Integration and Protective Factors

Social integration and protective factors were used to measure the level of family and social support. They included marital status, living arrangement, and whether another person provided assistance during the self-quarantine. Marital status was classified as married or not married (single, divorced, or widowed). Living arrangement was classified as living alone or living with others. The question on whether another person provided assistance during the self-quarantine was answered as "yes" or "no."

Coping

Coping was measured as consultations with psychiatrists for depressive symptoms, which was classified as "yes" or "no."

Depressive Symptoms

Depressive symptoms was measured using the Patient Health Questionnaire-2 (PHQ-2) (20). The PHQ-2 is a self-reporting test to screen for depression, which consists of questions 1 and 2 of the Patient Health Questionnaire-9. Among the diagnostic criteria for major depressive disorder listed in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders, it consists of two areas: depressed mood and decreased interest, which are core symptoms included in the PHQ-2. Responses are scored on a 4-point Likert scale, ranging from 0 ("not at all") to 3 ("almost every day"), with the total score ranging from 0 to 6. In this study, a total score of 3 or higher indicated that the subject had depressive symptoms.

Data Analysis

This study used raw data from the 2020 KCHS, which was a stratified sampling design rather than a simple random sampling design, so it is recommended to apply the complex sampling design for analysis (16). Therefore, we analyzed the data using a complex sample design by applying weights, stratification, and cluster. Descriptive statistical analysis was conducted on the measured variables, and the difference in depressive symptoms according to the measured variables was analyzed using the Rao-Scott X^2 test. Logistic regression analysis was conducted to identify the factors associated with depressive symptoms. The SPSS/WIN 22.0 program (SPSS, Chicago, Illinois, USA) was used, and the statistical significance level was set to $p < 0.05$.

RESULTS

General Characteristics of the Subjects

Of all the subjects, 53.4% were men and 46.6% were women. The average age was 40.01 years. In addition, 63.8% had a college or higher level of education, 42.7% of the household income was 5 million won or more, and 62.7% were employed. The average score for changes in daily life due to COVID-19 was 48.92 out of 100, and the average score for perceived health status was 2.26 out of 5. It was also found that 51.1% were married, and 13.7% lived alone. Eighty-seven of the subjects had someone who could help them during self-quarantine, and 2.1% of the subjects underwent psychiatric counseling for depressive symptoms (**Table 1**).

There were significant differences in depressive symptoms in terms of age ($\chi 2 = 79.59$, $p < 0.001$), household income ($\chi 2 = 11.16$, $p < 0.001$), changes in daily life due to COVID-19 ($\chi 2 = 4.93$, $p < 0.001$), perceived health status ($\chi 2 = -4.14$, $p < 0.001$), marital status ($\chi 2 = 14.52$, $p < 0.001$), living arrangement ($\chi 2 = 33.43$, $p < 0.001$), whether someone provided assistance during the self-quarantine ($\chi 2 = 8.76$, $p < 0.001$), and psychiatric counseling for depressive symptoms ($\chi 2 = 139.39$, $p < 0.001$) (**Table 1**).

Factors Related to Depressive Symptoms

Factors related to depressive symptoms were verified using logistic regression analysis. Being aged 40–64 years [odds ratio (OR) 0.35, 95% confidence interval (CI) = 0.24–0.51], being aged >65 years (OR 0.02, 95% CI = 0.01–0.05), having less than a middle school education (OR 1.98, 95% CI = 1.14–3.44), having a household income <1 million won (OR 5.71, 95% CI = 1.77–18.40), having a household income between 1 and 2.99 million won (OR 2.35, 95% CI = 1.29–4.29), having a household income between 3 and 4.99 million won (OR 2.13, 95% CI = 1.23–3.71), having had changes in daily life due to COVID-19 (OR 0.98, 95% CI = 0.96–0.98), with poor perceived health status (OR 1.49, 95% CI = 1.14–1.93), having not been provided with assistance during the self-quarantine (OR 1.79, 95% CI = 1.13–2.84), and having undergone psychiatric counseling for depressive symptoms (OR 5.00, 95% CI = 2.92–8.57) had statistically significant associated with depressive symptoms (**Table 2**).

DISCUSSION

We identified the factors associated with depressive symptoms in individuals who had experienced self-quarantine due to COVID-19 using Lazarus and Folkman's (14) stress, coping, and adaptation theory and George's (15) SAMD.

The prevalence of depressive symptoms identified in this study was higher than that observed in the 2019 KCHS conducted before the COVID-19 pandemic. In a study on adults in the United States, the prevalence of depressive symptoms increased by more than three-fold from 8.5% before the pandemic to 27.8% after the pandemic (12). In another study of 4,335 adults conducted in Germany (6), 31.1% of adults had depression during the pandemic. In addition, 307 (26.5%) out of 1,160 adults had depression during the pandemic in China (11). These results suggest that the COVID-19 pandemic negatively affects mental health. However, the prevalence of depressive symptoms in our study was low compared with other countries, and this may be attributed to the effects of national psychological prevention measures. In Korea, the Ministry of Health and Welfare has formed an integrated psychological support group to provide psychological support such as telephone and face-to-face counseling for the general public, infected individuals and their families, those in self-quarantine, and families of those who died due to COVID-19 infection (21). There is evidence that these measures have lowered the prevalence of depressive symptoms during the pandemic. In addition, according to a report from the Organization for Economic Co-operation and Development, the prevalence of mental health is affected by the strictness of a country's quarantine policies and the number of deaths due to COVID-19 (22). At the time of this study's data collection, the fatality rate due to COVID-19 was 2.03%-3.67% in the United States and Europe, 5.65% in China higher than 1.54% in Korea, which may have affected the prevalence of depression due to COVID-19 (23).

The contextual factors that related to depressive symptoms were age, level of education, and economic status. Consistent with previous findings, younger age and lower education levels were associated with greater depression (6, 11, 24–26). In addition, lower income was associated with higher levels of depression.

This finding corresponds with those of previous studies that indicated that financial problems cause serious socioeconomic distress and increase depression (2, 11, 12, 21, 26). Brooks et al.

TABLE 1 | General characteristics of subjects ($N = 1,071$).

Variable	Category	Total *n* (%) M ± SE	Depressive symptoms		Rao-Scott χ^2(p) /t(p)
			No *n* (%) or M ± SE	Yes *n* (%) or M ± SE	
Demographic factors					
Age (years)		40.01 ± 0.31	40.31 ± 0.33	34.43 ± 0.73	
	<40	501 (46.8)	465 (92.4)	36 (7.6)	79.59 (<0.001)
	40–64	414 (38.7)	397 (96.9)	17 (3.1)	
	≥ 65	156 (14.5)	152 (99.4)	4 (0.6)	
Gender	Men	572 (53.4)	538 (94.3)	34 (5.7)	0.81 (0.370)
	Women	499 (46.6)	476 (95.0)	23 (5.0)	
Level of education	≤Middle school	140 (13.1)	132 (94.4)	8 (5.6)	1.29 (0.268)
	High school	247 (23.1)	235 (95.9)	12 (4.1)	
	≥ College	684 (63.8)	647 (94.3)	37 (5.7)	
Household income (unit: KRW 10,000 won/ month)	<100	86 (8.0)	78 (86.3)	8 (13.7)	11.16 (<0.001)
	100–299	248 (23.2)	231 (91.9)	17 (8.1)	
	300–499	280 (26.1)	263 (93.3)	17 (6.7)	
	≥500	445 (42.7)	430 (97.1)	15 (2.9)	
Employment	Yes	671 (62.7)	640 (95.1)	31 (4.9)	1.14 (0.287)
	No	400 (37.3)	374 (94.0)	26 (6.0)	
Life event					
Changes in daily life due to COVID-19		48.92 ± 0.52	49.53 ± 0.53	38.12 ± 2.24	4.93 (<0.001)
Vulnerability factors					
Perceived health status		2.26 ± 0.02	2.25 ± 0.02	2.60 ± 0.08	−4.14 (<0.001)
Social integration and protective factors					
Marital status	Yes	578 (54.0)	557 (96.1)	21 (3.9)	14.52 (<0.001)
	No	493 (46.0)	457 (93.2)	36 (6.8)	
Living arrangement	Living with others	924 (86.3)	878 (95.2)	46 (4.8)	33.43 (<0.001)
	Living alone	147 (13.7)	136 (90.2)	11 (9.8)	
Whether someone provided assistance during the self-quarantine	Yes	932 (87.0)	889 (95.1)	43 (4.9)	8.76 (0.004)
	No	139 (13.0)	125 (91.5)	14 (8.5)	
Coping					
Psychiatric counseling due to depressive symptom	Yes	23 (2.1)	16 (68.3)	7 (31.7)	139.39 (<0.001)
	No	1,048 (97.9)	998 (95.1)	50 (4.9)	

(2) reported that individuals with low incomes are more likely to be affected by temporary income loss during self-quarantine than those with high incomes. Therefore, if possible, financial compensation should be provided to individuals with low income who self-quarantine, and policies should be developed to provide such compensation.

Our findings showed that changes in daily life due to COVID-19 had related to depressive symptoms, with greater changes in daily life being associated with higher depressive symptoms. Similar findings were observed in previous studies (6, 25, 27) in which changes in daily life, such as social distancing, working from home, delayed first day of school, and difficulties in using hospitals due to COVID-19, may lead to various psychological problems such as personal stress, anxiety, depression, fear, anger, and loneliness. Also, in a qualitative study examining the experiences of the older adults about the changes in their daily life due to COVID-19, similar findings were observed which complained of boredom, isolation, depression and anxiety while experiencing limited use of welfare centers for the elderly and job interruption (28). In particular, changes in daily life can lead to conflicts in various relationships. Increased time spent at home due to the COVID-19 pandemic has led to more family conflicts (21), and at school and work, conflicts in interpersonal relationships over prevention measures such as wearing masks have increased (29). Such mistrust and conflicts in relationships can lead to secondary traumatic experiences and severe depression (30–33). Therefore, to minimize the changes in daily life due to COVID-19 and to aid individuals in adapting and

TABLE 2 | Logistic regression ($N = 1,071$).

Variable	Category	OR (95% CI)	*p*
Demographic factor			
Age (years)	<40	1 (referent)	
	40–64	0.35 (0.24–0.51)	<0.001
	≥65	0.02 (0.01–0.05)	<0.001
Gender	Men	0.88 (0.63–1.22)	0.431
	Women	1 (referent)	
Level of education	≤Middle school	1.98 (1.14–3.44)	0.016
	High school	0.79 (0.37–1.68)	0.534
	≥College	1 (referent)	
Household income	<100	5.71 (1.77–18.40)	0.004
(unit: KRW 10,000 won/month)	100–299	2.35 (1.29–4.29)	0.006
	300–499	2.13 (1.23–3.71)	0.008
	≥500	1 (referent)	
Employment	Yes	1 (referent)	0.167
	No	1.42(0.86–2.32)	
Life event			
Changes in daily life due to COVID-19		0.98 (0.96–0.98)	<0.001
Vulnerability factors			
Perceived health status		1.49 (1.14–1.93)	0.003
Social integration and protective factors			
Marital status	Yes	1 (referent)	0.175
	No	0.78 (0.54–1.12)	
Living arrangement	Living with others	1 (referent)	0.084
	Living alone	1.58 (0.94–2.67)	
Whether someone provided assistance during the self-quarantine	Yes	1 (referent)	0.014
	No	1.79 (1.13–2.84)	
Coping			
Psychiatric counseling due to depressive symptom	Yes	5.00 (2.92–8.57)	<0.001
	No	1 (referent)	

CI, confidence interval; OR, odds ratio.

coping with new daily lifestyles, active countermeasures must be sought. Moreover, efforts are required to reduce the conflicts that may occur in various relationships.

We observed that the presence of someone who could help during self-quarantine was a protective factor against depressive symptoms. In this study, social support did not refer to the level of actual help, but perceived support that subjects could rely on someone for help when needed. This suggests that the perception of a social network rather than the actual exchange of social relationships may help alleviate depression (34). Previous studies showed that social support has positive effects, such as reducing depression through the actual exchange of resources (9, 35, 36), and based on these findings, measures focusing on offline-centered direct interactions through expansion of social networks have been mainly suggested. However, quarantine measures on social distancing limit the active implementation of such strategies. Therefore, our findings on the effects of perceived support may be significant for the reduction of depressive symptoms during the COVID-19 pandemic, in which prevention is heavily focused on social distancing. Perceived social support and mutual trust are strong protective factors for mental health and act as universal psychological safety nets (37). Thus, during the COVID-19 pandemic, which limits direct interactions between individuals, it is important to maintain a positive psychological bond with friends and neighbors using various resources, such as active communication by phone, e-mail, and social network services. In a qualitative study of college students' experiences of daily life changes due to COVID-19, psychological bonding was expressed as "the aesthetics of triviality," he said that when he was surrounded by feelings of isolation, the other person sensitively grasped it, paid attention to it, and was grateful for a simple call asking for his/her best regards (38). Such psychological bonding promotes emotional stability and self-esteem for psychosocial adaptation and enhances problem-solving ability, thereby having positive effects on mental health (39).

In our study, poor perceived health status was a vulnerability factor, leading to greater depressive symptoms. This finding is consistent with those of previous studies (9, 40). Perceived health status is more closely related to depressive symptoms

than chronic disease and functional status, which are objective indicators of physical health. Therefore, to help promote positive perceived health status, measures such as online health promotion, physical exercise, and health education programs are necessary during the COVID-19 pandemic.

Our data showed that depressive symptoms were higher in those who received psychiatric counseling for depression. In agreement with our findings, a previous study showed that experiences of counseling or treatment for depression are a behavioral coping style to overcome depressive symptoms and that more experiences of counseling or treatment lead to more depression (41). This means that the experience of treatment for depression is a positive coping behavior to overcome depression, and at the same time, it is a risk factor for exposure to depression or a risk of recurrence (40). Therefore, further in-depth studies should be conducted on the relationship between the experiences of depression treatment and depressive symptoms.

Implications for Public Health

We systematically and comprehensively identified the factors associated with depressive symptoms based on Lazarus and Folkman's (14) stress, coping, and adaptation theory and George's (15) SAMD. Among contextual factors, age, level of education, and economic status were factors related to depressive symptoms, suggesting that policies on COVID-19 measures should consider the characteristics of subjects. In addition, this study is significant as it identified the vulnerability and protective factors of depressive symptoms and provided basic data for the development of programs to alleviate and prevent depressive symptoms in self-quarantine individuals.

As the COVID-19 pandemic continues, long-term measures such as vaccination are being encouraged and efforts such as "With Corona" are being carried out to return to pre-COVID-19 pandemic daily life. However, self-quarantine remains an important preventive measure against the spread of the disease. Therefore, mental health should be a primary concern during self-quarantine. Systems to screen for those with vulnerable mental health before self-quarantine should be established and implemented, and mental health assessments should be regularly conducted even during self-quarantine. Thus, if a high-risk group or a person with symptoms related to mental health is found, active psychological support, such as referral to specialized mental health services, should be provided. In addition, systems to follow up and manage mental health after self-quarantine should be prepared as well, and various psychological support services should be developed to prevent the onset of mental health problems such as depression at an early stage and mental health should not deteriorate through continuous monitoring.

Limitations

Our study has some limitations. First, we used cross-sectional data, there is a limitation in that it is difficult to accurately identify a causal relationship. Second, the PHQ-2 used in this study has limitations as it is a screening tool, not a diagnostic tool. Third, in this study, only data on depression symptoms that occurred over the past 2-weeks were collected and used. Although the period between the end of self-quarantine and the time of the survey was not clearly known, the symptoms of depression after self-quarantine were investigated. Nevertheless, we could not exclude subjects who might have previously depressive symptoms. Fourth, we assessed daily life changes with a single item. However, the validity and reliability of the single item have not been reported in previous studies. In the future, it is suggested to verify the reliability and validity of the scale. Finally, we did not measure various coping strategies (e.g., use of medication, psychotherapy, and locus of control) that were proposed in SAMD (15). In the future, it is suggested to conduct research including various coping strategy variables.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by an Institutional Review Board of the Gachon University (No. 1044396-202109-HR-198-01). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

H-YJ and YK conceived and designed the study and analyzed the data. H-YJ and S-YH wrote the first draft. All authors contributed to revisions of the manuscript and critical discussion and have read and agreed to the published version of the manuscript.

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The Public's Preferences for Psychological Interventions During the COVID-19 Pandemic: A Discrete Choice Experiment

Hui-qin Li[1†], *Shu-xiang Liu*[1†], *Hui Xue*[2], *Hua Yuan*[1] *and Xiu-ying Zhang*[1*]

[1] *Department of Fundamental Nursing, School of Nursing, Jilin University, Changchun, China,* [2] *Department of Histology and Embryology, College of Basic Medical Sciences, Jilin University, Changchun, China*

Aims: To explore the public's preference for psychological interventions through a discrete choice experiment and to provide references for formulating psychological intervention policies and establishing psychological intervention procedures in response to public health emergencies.

Methods: This study is a discrete choice experiment. Attributes and levels were identified through literature reviews, in-depth interviews, focus group discussions, and expert consultations. Experimental design principles were applied to generate choice sets containing different attribute levels and develop a survey instrument. Convenience sampling was conducted nationwide, and 1,045 participants were investigated. A mixed logit model was used to evaluate the public's preferences.

Results: All attributes in our study were found to have a significant influence on the public's preferences for psychological interventions during the COVID-19 pandemic. The public's preferences for providers and duration were influenced by the public's levels of education and classifications. Furthermore, the most ideal scenario was found to be a one-on-one psychological intervention provided by family and friends through social network platforms, for which the frequency is twice per week, and the duration of each intervention is 0.5–1 h.

Conclusions: The public's preferences for psychological interventions during the COVID-19 pandemic are affected by the method, form, frequency, provider, and duration of interventions. Our findings provide references for the formulation of psychological intervention policies and the establishment of psychological intervention procedures in response to public health emergencies.

Keywords: public health, psychological health, health care, health policy, preferences

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***Correspondence:**
Xiu-ying Zhang
z_xy@jlu.edu.cn

[†]*These authors share first authorship*

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INTRODUCTION

COVID-19 has greatly endangered the health and life safety of the public and attracted attention from all countries and regions. According to a report from the World Health Organization (WHO) on 1 February 2022, the number of people infected with COVID-19 has exceeded 376 million, and the number of deaths totals 5.6 million (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/). At present, home quarantine is the main means through

which to prevent COVID-19 infection and the spread of the pandemic. However, the loss of face-to-face communication and other regular social interventions caused by quarantine have made the public experience stressful situations (1), and such short-term stressful situations may develop into adaptation disorders and posttraumatic stress disorder (PTSD) (2). In addition, during the COVID-19 pandemic, the threat of disease and the economic burden caused by the suspension of work have had a negative impact on the public's mental and psychological states, which have manifested as anxiety, depression, and stress (3–5). Many studies have assessed the psychological impact of COVID-19 and found high levels of psychological distress (6–12). Furthermore, the overflow of information about the COVID-19 pandemic has also triggered public panic, which may lead to extreme behaviors such as suicide (13). Therefore, it is necessary to provide effective psychological interventions for the public to prevent and/or alleviate mental and psychological problems.

Faced with the COVID-19 pandemic, various regions in China have implemented corresponding psychological interventions. However, some medical staff are unwilling to accept the current psychological interventions provided by some teams or individuals (14). Furthermore, some researchers have claimed that the mental health needs of COVID-19 patients, suspected patients with COVID-19, quarantined family members, and medical personnel have been poorly handled (5), which may be due to a lack of understanding about the public's mental health needs and preferences for psychological interventions. Understanding the public's preferences for psychological interventions is conducive to the formulation of more acceptable and targeted psychological intervention strategies to improve the effectiveness of such interventions.

A discrete choice experiment (DCE) is the most common and main preference measurement method (15); it can not only calculate the regression coefficient and willingness to pay (WTP) to reflect people's preferences but also simulate the influence of changes in influencing factors on these preferences (16, 17). In the field of health psychology, DCEs are often used to design patient-centered psychological care measures. Goodall et al. conducted a DCE to determine the preferred characteristics of psychosocial support services for adolescents and young people with cancer or blood diseases and their caregivers (18). Herman et al. used DCE to explore patients' preferences for mental health services provided to low-income Hispanics engaged in primary care (19). Lokkerbol et al. used a DCE to assess the preferences of patients with depression and anxiety for psychotherapy (20, 21). However, no research has explored the public's preference for psychological interventions during COVID-19 pandemic public health emergencies to provide a reference for the formulation of such intervention programs. Therefore, the purpose of this study is to explore the public's preference for psychological interventions during the COVID-19 pandemic through a DCE to provide a reference for the formulation of psychological intervention policies and the establishment of psychological intervention procedures in response to public health emergencies and to provide references for randomized controlled experiments to explore the differences in the effects of psychological interventions during public health emergencies.

METHODS

Design

This study used a DCE approach to understand the public's preferences for psychological interventions in COVID-19 pandemic public health emergencies. The main processes of this DCE include determining attributes and levels, experimental design, data collection, and data analysis, the details of which are shown in **Figure 1**.

Determining Attributes and Levels

Step I: Literature Review

We determined attributes and levels based on published recommendations (22, 23). First, the literature was searched through electronic databases, such as CNKI, Wanfang Database, PubMed, Web of Science, and Embase, and full-text articles, available before 31 July 2020, were reviewed. The search strategy was "COVID-19" OR "public health emergencies" AND "mentality" OR "psychology" OR "psychic." Then, we extracted the psychological status and its influencing factors of the public under COVID-19 and public health emergencies, the public's needs and expectations for psychological interventions, and the factors affecting the public's acceptance of psychological interventions. We identified 6 potential attributes based on the literature review, which we discuss later in our qualitative study.

Step II: In-Depth Interviews

Based on the literature review, an interview outline was developed, and one-to-one in-depth interviews were conducted by telephone due to the impact of COVID-19. The interview outlines were as follows: (1) the current psychological state of the interviewees, (2) the currently available psychological intervention strategies, (3) the accessibility of psychological intervention services, (4) the availability of emotional or economic resources, (5) the need for psychological intervention during the COVID-19 pandemic, and (6) interviewees' attitudes and suggestions concerning psychological intervention during COVID-19 and public health emergencies. Using purposive sampling, interviewees were chosen according to their location, age, and education level. Interviews were carried out until their content reached saturation. All interview data of the 12 interviewees were recorded and transcribed verbatim and analyzed with NVivo 12.0. Eventually, the list of potential attributes was expanded to nine, namely, place, mode, frequency, form, provider, continuity, content, total length of time of instruction, and duration of each instruction.

Step III: Focus Group Discussions and Expert Consultations

Focus group discussions were conducted by video conference after the in-depth interviews. Fifteen participants were included based on different regions, educational backgrounds, ages, and exposure to COVID-19, and they were randomly divided into 3 groups, with 5 participants in each group. During each discussion, participants were provided with 9 attributes obtained from the literature review and in-depth interviews and asked to add new attributes and discuss the definition of these attributes

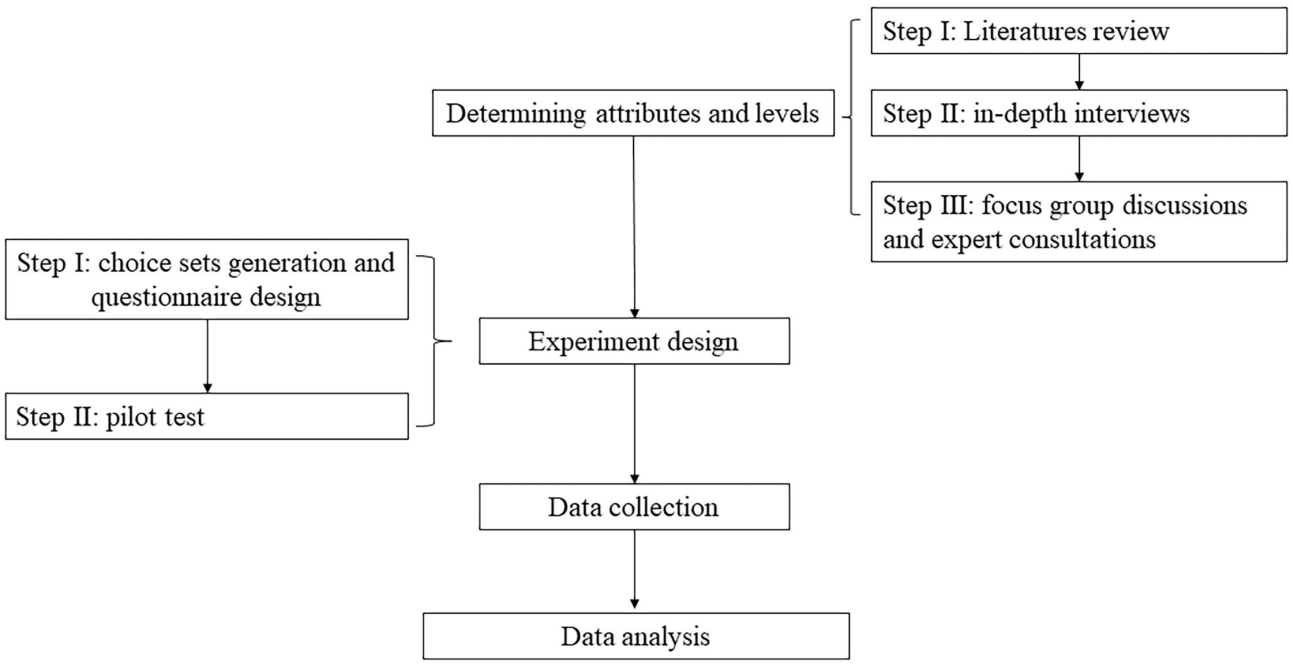

FIGURE 1 | The process of DCE.

and levels until they reached a consensus. Next, one-to-one expert consultations in Deyang city, Sichuan province, were conducted face to face. Experts included a health department staff member, a psychologist, and a doctor, all with more than 10 years of work experience, who were asked to add new attributes and revise inappropriate attributes, which ensured that the potential attributes and corresponding levels were appropriate under the current policy and medical background. Then, 15 respondents who participated in the focus group discussion were contacted *via* WeChat (a Chinese online social network similar to Facebook) and were asked to vote for each attribute with "most," "somewhat," and "least." According to the number of "most" votes, the attributes were sorted. In the field of health care, the number of attributes in most DCEs is 4–9, and the median number of attributes is 5 (24). Therefore, the top five attributes were included in this study, and their levels were developed, which are method, form, frequency, provider, and duration (refer to **Table 1** for details).

Experimental Design

Step I: Choice Set Generation and Questionnaire Design

In our study, three attributes have four levels, one attribute has three levels, and one attribute has two levels. According to the full factorial design, 384 ($4^3 \times 3 \times 2 = 384$) possible scenarios were generated, which in turn generated 1,47,072 (384×383) possible choice sets. The existence of too many choice sets results in respondents' high cognitive burden and consumes considerable labor, material resources, and time (25). Therefore, the fractional factorial design was needed to reduce choice sets down to a manageable level. In a DCE, the commonly used fractional factorial design mainly includes orthogonal design and efficiency design. The Ngene 1.2 USER MANUAL & REFERENCE GUIDE (http://www.choice-metrics.com) shows that an efficient design always outperforms an orthogonal design in the case of any information about the prior parameters (even if this information involves only the sign of the prior parameter), where the sign of the parameter can be known by reasoning alone, and a slight positive or negative value can improve the design. In our study, a D-efficient design was carried out in the Ngene software to generate the choice sets, in which a slight prior parameter value was added for each attribute and was adjusted several times to minimize the D-error value. Finally, 16 different choice sets composed of attributes and levels were generated. In the field of health care, the choice sets of a DCE usually total 8 (26). Thus, the 16 choice sets were randomly divided into two versions to further reduce the burden on respondents. To test the corresponding consistency, the second choice set in each version was repeatedly included as the ninth choice.

At the beginning of the questionnaire, the purpose of this study, the contents of the questionnaire, and the requirements for filling in the questionnaire were introduced. The first part of the questionnaire is a general data questionnaire, which includes sociodemographic characteristics such as gender, age, income, level of education, and classification of population. The second part is the DCE questionnaire, which contains nine choice tasks, each of which contains two alternatives and one exit item. In this section, the attributes and levels are described, and an example of a choice set is provided (e.g., refer to **Box 1**). Then, respondents were asked to select their most preferred option in each choice set.

Step II: Pilot Test

A pilot test was conducted among 50 respondents (25 respondents in each of the two versions). Most respondents who

TABLE 1 | Attributes and levels.

Attributes	Level	Description
Method	Face to face	A visit to a provider of psychological intervention where you would have a psychiatric evaluation and discussion about your mental and psychological issues.
	Phone	At a scheduled time, a provider of psychological intervention telephones you and you have a discussion about your mental and psychological issues and provides guidance and interventions on these issues.
	Social network platform	At a scheduled time, a provider of psychological interventions uploads mental health articles and videos on the Internet platform, or provides psychological guidance and interventions through social platforms such as WeChat and QQ.
Form	One to one	During the psychological intervention, a provider speaks to you individually about your feeling or opinions, or ask you questions about your mental and psychology, and provides guidance and interventions to you.
	One to many	During the psychological intervention, a provider speaks about public mental and psychology feeling, and provides guidance and interventions to other people besides you at the same time.
Frequency	Twice per week	Psychological interventions were provided twice a week.
	once per week	Psychological interventions were provided once a week.
	Once every 2 weeks	Psychological interventions were provided once every 2 weeks.
	No fixed time	Psychological guidance and interventions can be provided when you need them.
Provider	Psychologist	People who majors in psychology studies the human mind and tries to explain why people behave in the way that they do.
	Medical staff	Doctors or nurses who have undergone additional training in Psychological assessment, counseling and interventions
	Family and friends	Your family and friends who have received trainings about psychological knowledge.
	Volunteer	People who volunteer to participate in the prevention and control of COVID-19 and have undergone additional training in psychological assessment, counseling and intervention.
Duration, hours	<0.5	The duration of each psychological intervention was less than half an hour.
	0.5–1	The duration of each psychological intervention is between half an hour and an hour.
	≥1	The duration of each psychological intervention was more than 1 h.

BOX 1 | Description and an example of choice set.

You will be asked to answer nine questions about hypothetical psychological intervention Programs. Each questions contains two alternatives and an exit option for you to choose and each question can only choose one option. The features of the psychological intervention programs will differ in the following five aspects:
Method: How you mental health information and psychological guidance.
Form: In what from does the provider provide you will psychological intervention.
Frequency: How often appointments of psychological intervention would be.
Provider: Who provides you for psychological interventions.
Duration: Duration of each psychological intervention.
An example of choice set

Attributes	Programme A	Programme B
Method	Social network platform	Face to face
Form	One to one	One to many
Frequency	Random	Once every two weeks
Provider	Psychologist	Medical staff
Duration (h)	0.5–1	≥1

Which programme do you prefer:
Programme A Programme B Unwilling to receive psychological intervention.

participated in the pilot test considered the question length of the questionnaire to be "acceptable," "easy to understand," and "appropriate," and "the text is clear and easy to understand"; we revised the wording to improve the clarity of the questionnaire based on feedback from some of the 50 participants.

Participants

Nationwide convenience sampling was used to recruit eligible participants. Individuals with reading and comprehension abilities were considered potential participants of our study. At the same time, people with cognitive impairment, people who could not complete the survey due to certain reasons, people affected by psychiatric illnesses, and people who were unwilling to participate in this study were excluded. According to Johnson (27) and Orme (28), the calculation formula of the minimum sample size N is as follows:

$$n > 500c/(t \times a)$$

In this equation, t is the number of choice sets faced by an individual (excluding the choice set repeatedly included), a is the number of alternatives in each choice set (excluding exit items), and c is the number of analysis cells (when considering the main effect, c is equal to the maximum level number of any attribute). The minimum sample size needed in each version of the questionnaire is 125 ($t = 8$, $a = 2$, $c = 4$). We plan to mark the two versions of the questionnaire with 1 and 2. Considering that 30% of the recovered questionnaires may be invalid, the total

sample size is 358 participants to ensure that sufficient data are included in the analysis and to obtain wide representativeness.

Data Collection

Data were collected by conducting a questionnaire survey, which was performed by trained researchers. Participants were provided with hard-copy questionnaires as a priority, and for those participants who were not convenient to obtain a hard copy, electronic questionnaires were provided *via* WeChat or email. All questionnaires were completed by the participants themselves. In the questionnaires distributed, the versions were random, and the number of each version was the same. The data collection period was from 20 August 2020 to 25 November 2020.

Data Analysis

Data were double entered into Epidata 3.1 and transferred to Stata 15.0 for processing and analysis. Descriptive statistics were reported for participants' sociodemographic characteristics. A mixed logit model was used to evaluate the preferences of participants for the different levels of the psychological intervention attributes. The use of a mixed logit model makes it possible to explore the preference heterogeneity of respondents (29–31) and allows for multiple observations from each respondent who was presented with nine choice sets. All models included main effects without interaction terms. All variables were coded as dummy variables to better reflect their influence on respondents' preferences.

The main output of the mixed logit model is an estimation of the proportion of respondents who prefer each attribute level compared with the reference level for each attribute. For instance, for the attribute "method," the proportion of respondents preferring to intervene through social network platforms compared with face-to-face intervention can be estimated. A negative (positive) parameter sign indicates that the attribute level is not preferred (preferred) to the reference level of the attribute.

Adverse mental health status during the COVID-19 pandemic, such as stress, anxiety, and depression, has been affected by educational attainment (32). People with different educational attainment levels may have different needs for psychological interventions. Furthermore, the psychological pressure placed on people with different exposures to COVID-19 may also be different; thus, their needs for psychological intervention may also be different. Therefore, subgroup analysis was conducted based on levels of education and classifications of the population.

The sum of the model coefficients for each combination of attribute levels is the preference score (V_j), which is also known as the indirect utility score. P_j represents the probability that each combination of attribute levels is the most preferred scenario, the calculation formula of which is as follows:

$$P_j = \frac{exp(V_j)}{\sum_{k=1}^{J} exp(V_k)}$$

where $j = 1, \ldots, J$. In this article, only the top five scenarios with the highest rankings are considered.

Ethical Considerations

This study was approved by the University Ethics Committee and all other relevant organizations. Before the investigation began, the purposes of the study were explained to participants, and their informed consent was obtained. Furthermore, all information was anonymized, all data were used for research purposes only, and participants had the right to withdraw from the study at any time.

Validity and Rigor

Two people cross-checked the questionnaire for quality control to ensure the validity of the data. Invalid questionnaires were defined as follows and were excluded: questionnaires that (1) had not been completed, (2) failed the consistency test, (3) had the same options checked in the entire questionnaire, and (4) had regularly checked items in the questionnaire.

RESULTS

Characteristics of Respondents

A total of 1,200 people accessed the survey, 92 of whom did not complete the questionnaire and 63 of whom did not pass the consistency test. Finally, 1,045 people were included in the analysis, and the response rate was 87.08%. Among the 1,045 participants, 507 were men (48.52%), 538 were women (51.48%), and the majority of the respondents were between 20 and 59 years old (74.06%, which is equal to the sum of the proportions of those aged 20–39 and 40–59 years, which is 36.94 and 37.12%, respectively). The urban population accounted for 64.50%, and 53.11% of the respondents had a secondary school education (including junior high school and high school). Most people belonged to the third and fourth classifications, accounting for 34.74 and 34.35%, respectively. More details are presented in **Table 2**.

Discrete Choice Experiment Results

In **Table 3**, the mixed logit estimates for the total sample are reported. We found that all attributes have a significant influence on preferences for psychological interventions during the COVID-19 pandemic. The results show that the public demonstrated the strongest positive preferences for social network platforms, one-to-one form, twice-per-week visits (followed by alternating with no fixed time), family and friends as providers (followed by alternate medical staff and psychologists), and the duration for 0.5–1 h (followed by ≥1 h; all $p < 0.01$). The statistical significance of the SD coefficients for all but two of the attribute levels (phone and duration ≥1 h) confirm the existence of preference heterogeneity for most attributes.

Since it is assumed that the coefficients of all attribute levels are normally distributed, the mixed logit estimates relating to the mean coefficient and SD for each attribute level were applied to calculate the distribution of preference heterogeneity. For example, the coefficient (SD) of the "family and friends" level is 1.139 (0.856), indicating that 91% of respondents exhibited a preference for psychological interventions provided by family and friends. Similarly, the results showed that 80% of respondents

TABLE 2 | Respondent characteristics.

Characteristics	Respondent (n = 1,045)
	N (%)
Gender	
Male	507 (48.52)
Female	538 (51.48)
Age, years	
<20	133 (12.73)
20–39	386 (36.94)
40–59	388 (37.12)
≥60	138 (13.21)
Highest level of education	
Primary school and below	126 (12.06)
Junior high school	241 (23.06)
Senior high school	314 (30.05)
College degree and above	364 (34.84)
Classification of population	
First classification†	120 (11.48)
Second classification‡	203 (19.43)
Third classification§	363 (34.74)
Fourth classification	359 (34.35)
Location	
City	674 (64.50)
Country	371 (35.50)
Job	
Student	139 (13.30)
Office clerk	118 (11.29)
Famer	109 (10.43)
Individual operation	241 (23.06)
Medical staff	140 (13.40)
Civil servant	61 (5.84)
Teacher	87 (8.33)
Retirement	56 (5.36)
Other	94 (8.99)
Income (¥)	
<2,000	187 (17.89)
2,000–4,000	233 (22.30)
4,000–6,000	405 (38.76)
6,000–8,000	136 (13.01)
8,000–10,000	43 (4.11)
≥10,000	41 (3.92)

† *The first classification includes patients with infected COVID-19 and medical staff and managers at the front line of epidemic prevention.*

‡ *The second classification includes people who are quarantined at home or people with fever who visit hospitals.*

§ *The third classification includes people related to the first and second classifications, such as their family members, colleagues and friends, and those involved in the rear rescue response, such as onsite commanders, organization and management personnel, and volunteers.*

¥ *The fourth classification includes all populations affected by the COVID-19 except the first, second and third classification.*

would prefer to be provided with psychological interventions through social network platforms.

TABLE 3 | Mixed logit estimates for total sample (n = 1,045).

Attributes (reference level)	Level	Coefficient (S.E)	SD (S.E)
Method (face to face)	Phone	0.0530 (0.0649)	0.183 (0.201)
	Social network platform	0.882** (0.0732)	1.098** (0.0991)
Form (one to many)	One to one	0.209** (0.0544)	0.612** (0.0708)
Frequency (once every 2 weeks)	Once per week	0.0703 (0.0714)	0.583** (0.106)
	Twice per week	0.952** (0.0896)	1.498** (0.108)
	No fixed time	0.408** (0.0771)	0.719** (0.130)
Provider (volunteer)	Family and friends	1.139** (0.0710)	0.856** (0.0987)
	Medical staff	0.551** (0.0631)	0.772** (0.0899)
	Psychologist	0.389** (0.0664)	0.361* (0.148)
Duration, hours (<0.5)	0.5–1	0.802** (0.0745)	0.851** (0.0904)
	≥1	0.470** (0.0649)	0.158 (0.224)
Sample		1,045	
Log likelihood		−6440.3195	
Number of observations		25,080	

*$p < 0.05$, **$p < 0.01$.

The results of the subgroup analysis showed that the population with a primary school degree had a statistically significant preference for psychologists as providers, which is different from the population with a high school degree and college degree or above. Furthermore, the most important attribute level of the population with a primary school degree is that the duration of each intervention is 0.5–1 h (coefficient 1.064), while for the population with a middle school degree and college degree or above, the most important attribute level is that the frequency is twice per week (coefficients 1.530 and 1.409, respectively). When comparing the preferences of different population classifications, the most important attribute level of each population classification is that the frequency is twice per week. Different from other population classifications, the first classification showed a strong preference for psychologists as providers. Moreover, for the duration of each intervention ≥1 h, the preference of the first and second classification populations was not statistically significant, while that of the third and fourth classification populations was significant (refer to **Table 4** for details).

Predicting Choice Probabilities for Different Psychological Intervention Scenarios

Supplementary 1 presents the 5 most valued psychological intervention scenarios to illustrate respondents' preferences for the factors in combination. The most ideal scenario is a one-on-one psychological intervention provided by family and friends through social network platforms, for which the frequency is twice per week and for which the duration of each intervention is 0.5–1 h. In addition, the public would

TABLE 4 | The results of subgroup analysis.

(A) Group by educational level

Attributes (reference level)	Level	Primary school and below		Junior or Senior high school		College degree and above	
		Coefficient (SE)	SD (SE)	Coefficient (S.E)	SD (SE)	Coefficient (SE)	SD (SE)
Method (face to face)	Phone	0.689** (0.12)	0.00168 (0.201)	0.653** (0.0635)	0.395** (0.122)	0.900** (0.0832)	0.474** (0.146)
	Multimedia	0.914** (0.251)	0.00096 (0.358)	0.793** (0.121)	0.181 (0.217)	0.899** (0.154)	0.516** (0.128)
Form (one to many)	One to one	0.248* (0.0978)	0.0662 (0.546)	0.299** (0.0518)	0.386** (0.101)	0.372** (0.0691)	0.527** (0.11)
Frequency (once every 2 weeks)	Twice per week	0.800** (0.249)	0.00387 (0.204)	1.530** (0.122)	0.181 (0.267)	1.409** (0.153)	0.0729 (0.201)
	once per week	0.908** (0.142)	0.0154 (0.235)	0.562** (0.0702)	0.320* (0.149)	0.576** (0.0898)	0.310 (0.179)
	No fixed time	−0.275 (0.389)	1.294** (0.189)	1.294** (0.189)	0.263 (0.236)	1.033** (0.24)	0.0675 (0.546)
Provider (volunteer)	Psychologist	0.493* (0.238)	0.00368 (0.231)	0.0519 (0.116)	0.0193 (0.195)	0.0741 (0.152)	0.474** (0.168)
	Medical staff	0.0454 (0.262)	0.0668 (0.439)	1.010** (0.13)	0.00653 (0.223)	1.245** (0.164)	0.0372 (0.264)
	Friends and family	0.873** (0.307)	0.686** (0.22)	1.237** (0.145)	0.181 (0.271)	1.094** (0.182)	0.497** (0.161)
Duration, hours(<0.5)	0.5-1	1.064** (0.258)	0.0198 (0.181)	0.608** (0.124)	0.385** (0.119)	0.559** (0.156)	0.245 (0.204)
	≥1	0.559** (0.176)	0.0328 (0.302)	0.263** (0.0834)	0.266 (0.169)	0.159 (0.107)	0.172 (0.267)
Sample	N/A	126		555		364	
Log likelihood	N/A	−862.41486		−3708.3811		−2402.8721	
Number of observations	N/A	3,024		13,320		8,736	

(B) Group by classification of population

Attributes (reference level)	Level	First classification		Second classification		Third classification		Fourth classification	
		Coefficient (SE)	SD (SE)	Coefficient (SE)	SD (SE)	Coefficient (SE)	SD (SE)	Coefficient (SE)	SD (SE)
Method (face to face)	Phone	0.906** (0.14)	0.382 (0.284)	0.784** (0.105)	0.347 (0.213)	0.836** (0.0757)	0.000668 (0.295)	0.614** (0.0756)	0.218 (0.223)
	Multimedia	1.103** (0.264)	0.00296 (0.177)	0.683** (0.195)	0.0181 (0.288)	1.144** (0.147)	0.249 (0.203)	0.722** (0.15)	0.232 (0.21)
Form (one to many)	One to one	0.362** (0.106)	0.157 (0.551)	0.372** (0.0875)	0.420**(0.158)	0.326** (0.0621)	0.279* (0.159)	0.234** (0.0651)	0.457** (0.116)
Frequency (once every two weeks)	Twice a week	1.191** (0.262)	0.0644 (0.385)	1.811** (0.206)	0.520** (0.201)	1.472** (0.147)	0.00019 (0.288)	1.147** (0.149)	0.0898 (0.271)
	once a week	0.951** (0.157)	0.368 (0.32)	0.449** (0.118)	0.31 (0.251)	0.618** (0.0858)	0.115 (0.421)	0.749** (0.0908)	0.494** (0.135)
	No fixed time	−0.318 (0.396)	0.0331 (0.333)	1.388** (0.309)	0.0183(0.311)	1.196** (0.224)	0.00174 (0.225)	0.846** (0.233)	0.119 (0.406)
Provider (volunteer)	Psychologist	1.003** (0.254)	0.012 (0.282)	0.153 (0.194)	0.000363 (0.181)	0.227 (0.141)	0.0746 (0.303)	0.113 (0.146)	0.411* (0.181)
	Medical staff	0.226 (0.284)	0.536* (0.264)	1.325** (0.213)	0.0423 (0.307)	1.085** (0.161)	0.456** (0.158)	0.524** (0.162)	0.288 (0.21)
	family and Friends	1.115** (0.318)	0.393 (0.321)	1.539** (0.238)	0.351 (0.261)	0.916** (0.176)	0.277 (0.231)	0.990** (0.182)	0.512** (0.156)
Time, hours (<0.5)	0.5-1	0.781** (0.278)	0.137 (0.519)	0.485* (0.201)	0.293 (0.203)	0.831** (0.15)	0.0323 (0.336)	0.755** (0.156)	0.136 (0.194)
	≥1	0.363 (0.187)	0.317 (0.334)	0.0917 (0.135)	0.0168 (0.18)	0.220* (0.103)	0.311 (0.181)	0.359** (0.107)	0.381* (0.157)
Sample	N/A	120		203		363		359	
Log likelihood	N/A	−781.91903		−1330.121		−2350.5265		−2504.1709	
Number of observations	N/A	2,880		4,872		8,712		8,616	

*$p < 0.05$, **$p < 0.01$.
SD, standard deviation; SE, standard error.

prefer to increase the duration of each intervention from 0.5–1 to ≥1 h rather than change the method, frequency, and provider. However, with the same duration of each intervention (0.5–1 h), the rankings also showed that the public would accept alternating methods, frequencies, and providers.

DISCUSSION

To the best of our knowledge, this is the first study to explore the public's preferences for psychological interventions during the COVID-19 pandemic. In our study, the characteristics of psychological intervention programs were described by the method, form, frequency, provider, and duration. Our results demonstrated that family and friends were the most preferred providers. Furthermore, the public's preference for providers and duration was influenced by its level of education and classifications. The most ideal scenario is a one-on-one psychological intervention provided by family and friends through social network platforms, the frequency of which is twice per week, and the duration of each intervention is 0.5–1 h. Apart from the program outlined above, the public would also accept alternating social network platforms with phone calls, alternating frequencies such as twice per week with no fixed time, or alternating providers like family and friends with medical staff if the duration was not changed (0.5–1 h).

In China, the providers of psychological interventions are mostly mental health professionals (33). For example, psychological intervention teams, such as psychological intervention supervisors, psychological consultants, and psychiatrists, were established to prevent, deal with, and evaluate the potential and real mental crisis of injured people from the Lushan earthquake (34). However, in our study, most of the public (91%) during the COVID-19 pandemic has had increased preferences for family and friends as providers. This finding seems to verify the conclusion of a South Korean study, which showed that the response of patients with COVID-19 to their families is different from that of other populations (35). The reasons behind this finding may be as follows: on the one hand, COVID-19 is usually spread from person to person *via* respiratory droplets, which are expelled by speaking, sneezing, or coughing. The high risk caused by contact with strangers changes people's reactions to strangers. People are familiar with their family and friends and know with whom they have been in contact, which to some extent reduces the risk of infection. On the other hand, people who are anxious or depressed are often reluctant to seek psychological intervention due to the associated stigma (36, 37). In the study of Mythili et al. (38), one-third of respondents sought guidance for relatives and friends' psychological problems, which seems to indicate that it is feasible to provide psychological guidance to people's relatives and friends and make them a provider of psychological intervention.

At the same time, subgroup analyses revealed that the population with a low education level and the first classification population (mainly including patients with COVID-19 and medical staff and managers at the frontline of pandemic prevention) showed a strong preference for psychologists. We were unable to analyze the role of psychologists in a population with a low education level based on the current data. The study suggested that patients infected with COVID-19 and without psychiatric disorders may develop several psychiatric symptoms, including anxiety, fear, depression, and insomnia, after treatment with antiviral drugs (39). This finding may explain why psychologists are preferred by patients.

Medical staff and managers at the frontline of pandemic prevention interact directly with potentially positive or positive patients with COVID-19. They are not only working extremely hard, but they are also struggling to treat a new viral disease that is not well-understood. This situation creates a unique psychiatric burden. For instance, this study demonstrated that general distress was present in 72% of frontline healthcare workers, followed by symptoms of insomnia (34%), anxiety (45%), and depression (50%) (6). The management and scheduling of people, property, and materials are one of the main tasks for managers, such as government personnel and health administration departments, to respond to health emergencies. However, the WHO pointed out that due to the prevalence of COVID-19, the world is facing a chronic shortage of personal protective equipment, such as ventilators and masks, which brings about challenges to the work of frontline managers and may bring about an enormous psychiatric burden for managers. This psychiatric burden may lead to medical staff and managers' preferences for psychologists.

In terms of intervention methods, people are more willing to accept interventions through social network platforms or by phone than face-to-face interventions. Traditional face-to-face psychological intervention increases the risk of COVID-19 infection. Psychological interventions by telephone or through social network platforms can improve social security. One study confirmed that telehealth services are as effective as are face-to-face health services (40). In addition, Ning Wei et al. have achieved good results through internet-based integrated intervention for psychological intervention in patients with COVID-19 (41). The experience reported by Zhang et al. provides the basis for remote intervention, in which the providers of psychological interventions responded to the psychological crisis during the COVID-19 pandemic through WeChat, Huayitong, and psychological hotlines (1). The research of Mythili et al. shows that it is feasible to use a telephone to carry out psychological intervention among the public (38). Thus, social network platforms or phones should be feasible and effective in providing psychological interventions for the public during the COVID-19 pandemic with the development of 4G and 5G networks and the popularization of smartphones. The specific strategies and implementation of interventions through social network platforms or by phone should be further studied and evaluated.

The expansion of the built-up area of social network platforms lacks uniformity. For example, there are more urban internet users than rural internet users, and the number of urban users who use mobile phones to access the internet is 44% more than rural users (42), whereas almost every home in China has a telephone. Our study results showed that when ensuring the duration of each intervention (0.5–1 h), social network platforms can be alternated with phone calls, twice per week can be alternated with no fixed time, or family and friends can be alternated with medical staff. Thus, for the region or population that did not meet the most ideal scenario, our study provided choice probabilities that are predicted to be accepted by the public.

Based on the findings of our research and currently available literature, the following recommendations are made for providing psychological interventions during the COVID-19 pandemic:

1. Psychological intervention providers should include family and friends, medical staff, and psychologists. Psychological knowledge training should be carried out for people with high cognitive levels so that they can publicize psychological knowledge, guide family members and friends, and prevent the occurrence of psychological problems among the public. Psychological knowledge training for medical staff should be strengthened, and self-psychological training should be improved for people with fever or suspected infection. The ability to regulate and initiate psychological interventions should be considered, and psychologists should provide psychological guidance or interventions to people with cognitive impairment and those infected with COVID-19.
2. Remote intervention is the first choice, and network platform intervention should be effectively combined with telephone intervention.
3. One-on-one psychological interventions should be provided, the frequency of which is twice per week and the duration of which is 0.5–1 h. One-to-one intervention should be the main method, twice per week, for 0.5–1 h each time.

The findings of this study provide a reference for the formulation and revision of psychological intervention policies during the COVID-19 pandemic and the establishment of psychological intervention procedures for public health emergencies. The strengths of our study are that the sample not only is large in number ($n = 1{,}045$) but also was recruited from across China, which improves the objectivity of the results. This study also has certain limitations. First, like other DCEs, this study did not include all attributes. The attributes that were not included may also be very important and may affect the results to a certain extent. Second, our sampling method is convenience sampling rather than random sampling, which means that our results cannot be generalized to the whole population. Fortunately, our sample is not only large in number ($n = 1{,}045$) but also recruited from across the country, which alleviates this limitation to some extent. Third, in the subgroup analysis, there were certain differences in the number of people in each group, which may be due to a certain sampling bias, which in turn limits our interpretation of the results. Finally, because there are currently no studies on the preferences of the general public for psychological interventions, we cannot better compare the differences between what was available before the COVID-19 pandemic and what is currently available during the COVID-19 pandemic.

CONCLUSIONS

The public's preferences for psychological interventions during the COVID-19 pandemic are affected by the method, form, frequency, provider, and duration. People with different levels of education or different classifications of the population have different preferences. Some suggestions for psychological interventions were put forward to provide references for the formulation of psychological intervention policies and the establishment of psychological intervention procedures in response to public health emergencies.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding authors.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the School of Nursing of Jilin University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

H-QL: conceptualization, methodology, writing—reviewing, editing, and writing the original draft. S-XL: writing—reviewing and editing and proofreading. HX: data collection and data analyses, writing—reviewing, and editing. HY: data collection and data analyses, and writing—reviewing. X-YZ: conceptualization, methodology, writing—reviewing, and supervision. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

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Perceived Stress Positively Relates to Insomnia Symptoms: The Moderation of Resilience in Chinese Pregnant Women During COVID-19

Hongyu Zou[1,2†], Zhen Tao[1†], Yongjie Zhou[1], Zhiguo Zhang[3], Chunyan Zhang[1], Linling Li[3], Jiezhi Yang[4], Yanni Wang[5], Wei Huang[1] and Jianhong Wang[1]**

[1] Shenzhen Mental Health Center/Shenzhen Kangning Hospital, Shenzhen, China, [2] School of Psychology, South China Normal University, Guangzhou, China, [3] School of Biomedical Engineering, Health Science Center, Shenzhen University, Shenzhen, China, [4] Shenzhen Health Development Research Center, Shenzhen, China, [5] Department of Maternal, Child and Adolescent Health, School of Public Health, Lanzhou University, Lanzhou, China

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Edited by:
Xenia Gonda,
Semmelweis University, Hungary

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Xiaoyun Guo,
Shanghai Jiao Tong University, China
Loredana Lucarelli,
University of Cagliari, Italy

***Correspondence:**
Wei Huang
174580987@qq.com
Jianhong Wang
wangjianhong0755@163.com

†These authors share first authorship

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Background: The government's COVID-19 pandemic response lockdown strategy had a negative psychological and physical impact on individuals, which necessitated special care to pregnant women's mental health. There has been no large-scale research on the underlying relationship between perceived stress and insomnia symptoms in pregnant Chinese women up to this point. During the COVID-19 pandemic, we wanted to see if there was an association between perceived stress and insomnia symptoms, as well as the moderating impact of resilience for Chinese pregnant women.

Methods: This cross-sectional study examined 2115 pregnant women from central and western China using multi-stage sampling methodologies. A systematic questionnaire was used to collect information on sleep quality, perceived stress, and resilience using the Insomnia Severity Index, Perceptual Stress Scale, and Connor and Davidson Resilience Scale. To assess the moderating influence of resilience, hierarchical regressions were used.

Results: During the COVID-19 pandemic, 18.53% of respondents ($N = 2115$) reported experiencing sleeplessness. In pregnant women, perceived stress was positively linked with insomnia symptoms ($p < 0.001$). Furthermore, resilience significantly attenuated the influence of perceived stress on insomnia symptoms in Chinese expectant mother ($\beta_{interaction} = -0.0126$, $p < 0.001$).

Conclusion: Pregnant women with strong resilience were less influenced by perceived stress than those with poor resilience. The findings of this study might give empirical proof that health care professionals should identify the relevance of reducing perceived stress in pregnant women with poor resilience and provide better treatment and support when necessary.

Keywords: perceived stress, sleep quality, resilience, pregnant women, moderation effect

HIGHLIGHTS

- During the COVID-19 pandemic, according to the present study 18.53% of 2,115 pregnant women are having sleeplessness.
- We evaluated the influence of pregnant women's perceived stress and resilience on sleep quality during the fast spread of the COVID-19 pandemic.
- Resilience were negatively correlated with perceived stress and insomnia severity, while perceived stress was positively correlated with insomnia severity, indicating that higher perceived stress was associated with lower resilience and higher insomnia severity, whereas higher resilience was associated with lower insomnia severity.
- Resilience during COVID-19 may moderate the relationship between stress and insomnia symptoms, paving the way for future mental health treatments in public health emergencies.

INTRODUCTION

COVID-19 made its debut in December of 2019. It has resulted in a worldwide health catastrophe that is catastrophic. By the end of June 2021, there had been more than 17,277,958 confirmed cases globally, resulting in 3,711,711 fatalities. Coronavirus infection not only poses a serious threat to one's physical well-being, but it also has a number of long-term consequences, such as cognitive impairment, persistent tiredness, and discomfort (1). As a result, its influence on mental health, such as the high frequency of stress, anxiety, and depression, has been widely discussed (2). Researchers are paying increasing attention to the influence of social isolation under the Chinese government's home isolation policy to contain the spread of the virus. A related study has looked at the mental health of children who have been subjected to quarantine (3) and found that it is crucial to address the increasing anxiety and depressive symptoms in youngsters (4). Admittedly, only a few studies have focused on the insomnia symptoms of pregnant women during the pandemic in china's context (5, 6).

Because the transition to parenthood is already accompanied by numerous obstacles, including changes in psychological functioning, pregnant women may be at a higher risk of developing mental health problems during the pandemic. Pregnant women were considered to be more vulnerable to uneasy feelings. They are dealing with a variety of issues and stress, including constant nausea, exhaustion, and regular aches (7). Approximately 84% of women will experience stress throughout the antennal period of childbirth as a result of prior medical issues and sociocultural influences (8). Furthermore, most unfavorable life changes during pregnancy, such as financial difficulties, the death of a close family member, or worldwide events like the COVID-19 pandemic, can cause stress in the mother. Fear of contracting coronavirus and increased pressure to avoid negative health consequences for oneself or one's children can have a variety of negative consequences for mothers and children, including obstetric complications (9), lower birth weight (10), child development delays (11), postpartum depression and other mental health risks (12) all of which can lead to poor child outcomes (13). Therefore, it is necessary to actively pay close attention to pregnant women's mental health throughout the outbreak.

Additionally, during the pandemic, pregnant women are more likely to have sleep issues. According to many studies, approximately one-third of pregnant women in the United States reported receiving less sleep during the COVID-19 epidemic (14). On the other hand, any change in a pregnant woman's sleep quality may have an impact on her feelings about labor pains and taking on the maternal role. In addition, sleep deprivation is connected to negative maternal outcomes such as daily dysfunction, weariness, and lower psychological relaxation among pregnant women (15). It may also have a role in the initiation, aggravation, and recurrence of mood disorders (16). Given the detrimental consequences of poor sleep quality, identifying the causes of sleep disruption is critical, with the objective of improving sleep quality in expectant mother as a possible therapy goal.

Pregnant women were more vulnerable to stress than women who were not pregnant. The lack of access to expected prenatal care as a result of the lockdown policy might further exacerbate the problem. A high degree of perceived stress has been associated to a higher risk of unfavorable cardiac outcomes and a higher likelihood of cardiac-related death (17). Furthermore, Ko et al. proposed that sleep quality was influenced by perceived stress (18, 19). In a negative sense, the sleep quality of pregnant women might be linked to the stress level they obtained (20), which could be jeopardized by the looming infectious illness pandemic in response (21, 22). Based on an animal research, long-term stress exposure promotes undesired sleep structural alterations, including reduced slow-wave sleep and increased rapid eye movement (REM) sleep (23). Sleep quality is negatively influenced by a person's history of exposure to stressful life events, according to cross-sectional findings–both subjectively reported and objectively evaluated (24). For example, job stress might considerably increase the probability of experiencing irregular sleep disruption (25). To further, the deleterious effects of prenatal mother stress on poor sleep quality may be connected to an increased cortisol waking response and an overactive hypothalamus-pituitary-adrenal (HPA) axis (26, 27), all of which can have a variety of negative effects on sleep (28).

Resilience has been investigated as a possible moderator of the effect of stress exposure and negative consequence. People who have a higher level of resilience have a better psychological adjustment (29). In view of Rutter's proposed protective mechanism for psychological resilience, resilience should serve a protective role in reducing undesirable chain reactions (30). Resilience has been shown to protect against stress during prior viral pandemics. It was discovered that resilient individuals exhibited lower levels of SARS-related concern than those who did not survive the pandemic (31). Contrary to popular belief, resilience has a positive link with sleep quality. According to a recent study, resilience training helps medical students manage occupational stress throughout their clinical year (32). Among those who scored high on resilience had a decreased

chance of displaying poor sleep quality or using sleep medicines in the past month among HIV-positive people (33). As a result, it is suggested that resilience should be a crucial adjustment element for sleep quality even under stressful settings.

Amongst the small number of studies concerning the psychological outcomes of the lockdown policy during COVID-19, research on the association between perceived stress and sleep quality among pregnant women in China has not been conducted following the outbreak of COVID-19. The goal of this study was to see how perceived stress and resilience of pregnant women affected sleep quality when they were suffering from the COVID-19 pandemic. We further hypothesized that resilience during COVID-19 may moderate the association between stress and sleep quality, which might point to future avenues for psychological healthcare interventions during similar public health emergencies.

MATERIALS AND METHODS

Settings and Study Population

Between March 30th and April 26th, 2020, a cross-sectional survey was conducted utilizing a multi-stage sampling approach to recruit participants. For the first stage, Wuhan (Hubei Province's capital), Beijing, and Lanzhou (Gansu Province's capital) were chosen for the following reasons. To begin, participants from Wuhan City and another area might represent pregnant women who are more and less affected by the lockdown policy in this situation, respectively. Second, Hubei (Central China), Beijing (North China), and Gansu (Western China) are not contiguous, therefore the province-wide lockdown measures in Hubei will not have a spillover impact. We chose a regional mother and child health care facility in each Chinese city in the second round. The underlying reason is that professional mother and child health care services are concentrated in each city's regional hubs. Meanwhile, the income-related discrepancy in the healthcare-seeking process was generally overlooked by more than 95% of healthcare insurance coverage (34). As a result, regional clinics are the first choice for most women to seek prenatal care. We picked a regional mother and child health care center in each location to collect data from scattered populations. Convenience sampling was used in the third stage to enroll individuals from these two sites. We gave healthcare providers in charge of prenatal checkups at the study locations a QR code that led to an online questionnaire. When eligible pregnant women came in for their prenatal checkups, these healthcare providers offered them to participate in the study. Over 90% of Asian women had a gestation duration of fewer than 41 weeks, according to reports (35), which implies that the majority of Chinese women having a gestation period of more than 40 weeks would be those who were hospitalized and awaiting birth in China's context. Women who were up to 40 weeks pregnant or less were included (similar inclusion criteria were used by Özkan et al.) (36); and resided in the local community throughout the COVID-19 pandemic, since the goal of this study was to look into pregnant women's experiences at home instead of in a hospital facility. People with a history of mental illnesses were not allowed to participate. In this study, the gestational weeks of pregnant women ranged from 1 to 40 weeks, with an average gestational week of 26.19 weeks. 98% pregnant women are partnered, 2% pregnant women without partner. In line with the Declaration of Helsinki, the Ethics Committee for Scientific Research of the Chinese Academy of Sciences' Institute of Psychology granted ethical permission, permission number was H20003. All subjects gave written informed permission to participate in the study during the final recruitment.

Measures

Insomnia Severity Index

The Insomnia Severity Index (ISI) is an instrument widely used to assess the severity of insomnia symptoms. The ISI has demonstrated good reliability with a Cronbach's alpha of 0.9 (37). In the present study, the Cronbach's alpha was 0.93. The scale has been used to assess pregnant women's subjective sleep quality (38). Furthermore, compared to other scales, this one has fewer components and is more convenient. Scores vary from 0 to 28 on the ISI worldwide scale. A higher score indicates a poorer quality of sleep. A total score of 0∼7 means "no insomnia symptoms," while a total score of 8∼14 means "mild insomnia symptoms," the overall score of 15∼21 means "moderate insomnia symptoms," 22∼28 means "severe insomnia symptoms."

Perceived Stress Scale

The Perceived Stress Scale (PSS) is the most often used psychological tool for assessing stress perception. It is a metric for how stressful certain situations in one's life are regarded (39). The PSS was graded on a 5-point Likert scale ranging from not at all (0) to highly (4) depending on how often they occurred in the month leading up to the survey and is intended to capture how unpredictable and unmanageable respondents' lives are. The PSS scores are calculated by inverting the scores on four positive items, such as 0 = 4, 1 = 3, and 2 = 2. The overall score was then computed. The higher the score on the scale, the higher the subject's stress level. The lower the score on the scale, the less stressed the participants are. This scale has high validity and reliability, according to studies from several countries (40, 41). Cronbach alpha evaluated the scale's internal consistency at 0.85 (42). Cronbach's alpha was 0.72 in this research.

Resilience Scale

Resilience is the ability to recover from adversity, conflict, failure, and even positive events (43). The Connor and Davidson Resilience Scale (CD-RISC) (44)was used to assess resilience (including tenacity, strength, and optimism), which measures personal attributes that enable people to flourish despite being exposed to stress and trauma. The Connor-Davidson Resilience (CD-RISC-10), a 10-item measure derived from a 25-item scale. Each item is assessed on a 5-point Likert-type scale (from 0 to 4), with higher scores suggesting a higher level of resilience. The CD-reliability RISC-10's and validity are further demonstrated by its extensive use in a Chinese population (45). In this study, the Cronbach's alpha of the CD-RISC was 0.93.

Covariates

A total of 2,115 people were recruited in this study. Structured questionnaires were utilized by trained research workers to gather social-economic data as well as lifestyle information and other specific characteristics. Age, level of education (high school/college/undergraduate/post-graduate), annual household income (RMB 80,000/80,000−300,000/> 300,000), financial loss during COVID-19 (no financial loss/20,000/20,000−49,999/50,000), and whether they were infected with COVID-19 alone or in relatives and friends were all socioeconomic status variables. History of physical disease, mental diagnosis, drug use, smoking (never smoking/already stopped smoking/continuing smoking), and drinking behaviors (never drink: never drink alcohol in life/already quit drinking) were among the health behavior factors. The number of births, vomiting during pregnancy, daily monitoring of the fetus (Pregnant women answered these questions by recalling their daily attention to fetal movement during pregnancy and based on the actual situation), abdominal pain during pregnancy, pregnancy's influence on mobility (meaning that pregnancy may cause difficulty going to different locations), worries and fears about childbirth, and car accidents were all pregnancy-related variables.

In this study, smokers were defined as adults who had smoked 100 cigarettes in their lifetime and currently smoke cigarettes every day (daily) or some days (nondaily). Alcohol users were characterized as people who drank more than five drinks on a regular basis (rather than just sometimes). The occasional, light, and infrequent users were excluded from the study.

Statistical Analysis

Using SPSS version 25.0, descriptive analysis, correlation analysis, Mann–Whitney tests, and Kruskal–Wallis tests were performed after data collection. PROCESS version 3.5 was used to create the moderating model.

Harman's single-factor test was used to assess the common method variance in this study. The findings revealed that no one factor could account for the bulk of variation (the maximum component only explained 36.57 % of total variance), indicating that there was no common technique bias in this research. All results in this study indicated univariate non-normality for all measured variables. The variations in sleep quality, resilience, and perceived stress were tested using Mann–Whitney and Kruskal–Wallis tests in relation to categorical socio-demographic factors. The direction and magnitude of the correlations between perceived stress, resilience, and insomnia severity were also determined using Pearson Perceived stress was considered as the independent variable. Insomnia Severity was considered as the dependent variable. To see if resilience mitigated the connection between perceived stress and insomnia severity, researchers used SPSS 25.0 to run multiple linear regressions. We used simple slope analyses to compute the strength of the link between perceived stress and insomnia symptoms scores with high (1 SD above the mean) and low (1 SD below the mean) levels of resilience scale scores to assist interpret the interaction. To decrease multicollinearity, all continuous variables were centered before the analysis, and the interaction term was calculated using the centered variables.

RESULTS

Participants' Demographic Characteristics

In total, 2115 Chinese pregnant women were investigated. Education, annual household income, financial loss during COVID-19, whether they are afflicted with COVID-19, and/or whether they have COVID-19 family and acquaintances, smoking, drinking, number of births, vomiting during pregnancy, daily monitoring of the fetal abdominal discomfort, pregnancy's impact on mobility, anxiety and fears about birthing, and caregiver status are among the general demographic information included in the study. **Table 1** shows the correlation between Insomnia Severity and these variables.

During the COVID-19 pandemic, according to the present study 18.53% of 2,115 pregnant women are having sleeplessness,. The participants were 30.52 years old on average (*SD* = 9.67, range 19–47). 55.00% of the respondents had at least a bachelor's degree and 31.35% had a low average yearly household income (≤80,000 RMB), and 84.92% were primiparas. 2% pregnant women were single mothers and 98% with partner. The majority of those who were affected by the lockdown policy did not drink alcohol or smoke. Furthermore, the majority of pregnant women surveyed reported nausea and vomiting, stomachaches, daily observed fetal activity, were cared for, and had anxieties or anxiety about delivering. In general, those who were in Wuhan had already stopped drinking and smoking, suffered from nausea and vomiting during pregnancy, had daily fetal movement monitored, were concerned about childbirth, expected to have their first child, resulted in a greater financial loss, and had stomachache had a larger chance of experiencing insomnia symptoms than their peers. Furthermore, those who were in Wuhan and suffered from nausea and vomiting during pregnancy, were impacted by pregnancy on action, were not taken care of, were concerned about childbirth, had less education, were expecting to have their first child, had less annual household income, and had more financial loss as a result of COVID-19 were more likely to have lower resilience scores than their counterparts. Finally, those in Wuhan who suffered from nausea, vomiting, and stomachaches during pregnancy, did not daily monitor fetal movement, were impacted by pregnancy on action, were not taken care of, were concerned about childbirth, had less education, expected to have their first child, had less annual household income, and had more financial loss due to COVID-19 had a higher risk of perceiving stress than their counterparts.

The Correlation Relationship Between Perceived Stress, Resilience, and Insomnia Severity

Table 2 shows a Pearson correlation analysis of perceived stress, resilience, and insomnia severity. It was discovered that

TABLE 1 | Demographic status of the sample.

Variables (n = 2115)	Insomnia Severity		Resilience		Perceived Stress	
	Z/t	p	Z/t	p	Z/t	p
Age (years)	0.002	0.928	0.034	0.114	−0.023	0.289
From Wuhan (Yes = 0, No = 1)	−6.157	< 0.001	−3.742	< 0.001	−3.431	0.001
Drinking	11.350	0.003	5.180	0.075	2.097	0.350
Smoking	10.095	0.006	0.668	0.716	5.058	0.080
Nausea and vomiting during pregnancy	20.825	< 0.001	15.161	0.002	18.866	< 0.001
Daily attention to fetal movement	−2.857	0.004	−1.896	0.058	−2.972	0.003
Impact of pregnancy on action	141.740	< 0.001	26.881	< 0.001	22.471	< 0.001
Be taken care of	1.428	0.490	15.145	0.001	50.589	< 0.001
Any worries or fears about childbirth	−10.600	< 0.001	−7.117	< 0.001	−8.415	< 0.001
Degree of Education	6.440	0.092	63.549	< 0.001	85.410	< 0.001
First Child	−3.216	0.001	−3.283	0.001	−3.071	0.002
Annual Household Income	1.043	0.594	49.368	< 0.001	109.648	< 0.001
Financial Loss in COVID-19 (RMB)	40.047	< 0.001	27.326	< 0.001	32.138	< 0.001
Stomach ache	25.120	< 0.001	5.468	0.141	1.847	0.605
Relatives or friends are infected with covid-19	−0.292	0.771	−0.070	0.944	−0.257	0.797

The p-values were tested using the Pearson Correlation, Mann–Whitney tests, and Kruskal–Wallis tests.

resilience scores were negatively correlated with perceived stress ($r = -0.470$, $p < 0.001$) and insomnia severity ($r = -0.270$, $p < 0.001$), while perceived stress was positively correlated with insomnia severity ($r = 0.357$, $p < 0.001$), indicating that higher perceived stress was associated with lower resilience and worse sleep quality (higher insomnia severity), whereas higher resilience was associated with better sleep quality (lower insomnia severity).

The intensity of insomnia is related to perceived stress and resilience. Relationships between perceived stress and insomnia severity mediated by resilience are represented by regression lines (1 *SD* above and below the mean, two-way interaction). Slopes of low resilience ($\beta = 0.337$, $p < 0.001$) and high resilience ($\beta = 0.1392$, $p < 0.001$) are both significant.

Moderating Effects

Regression analyses were used to see if resilience might mitigate the negative consequences of perceived stress. **Table 3** shows the results of the regression analysis. To control the effect on the variables and to increase the overall R^2 to increase the power of the statistical test, Drinking, Smoking, Nausea and vomiting during pregnancy, Daily attention to fetal movement, impact of pregnancy on action, Be taken care of, Any worries or fears about childbirth, Degree of education, First Child, Annual household income, Financial loss in COVID-19 and Stomachache were controlled as covariates in the regression analysis. Perceived stress was found to be a positive predictor of insomnia severity in **Table 3**. The interaction term between perceived stress and insomnia severity was found to be significant, suggesting that the relationship between perceived stress and insomnia severity varied depending on resilience.

We displayed the relationship between perceived stress (1 *SD* above or below the mean) and insomnia severity at different degrees of resilience to better understand the nature of the interaction (**Figure 1**). According to simple slopes testing, the association between perceived stress and

TABLE 2 | Correlations among study variables (N = 2115).

Variables	Mean	SD	1	2	3
1. Perceived Stress	13.60	5.69	–	–	–
2. Resilience	29.90	7.84	−0.469**	–	–
3. Insomnia Severity	4.39	4.53	0.360**	−0.272**	—

$^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

TABLE 3 | Regression analysis examining the role of Perceived Stress in predicting Insomnia Severity.

Insomnia Severity	β	SE	Z	Two-tailed p-value
Covariates				
Drinking	−0.345	0.284	−1.215	0.225
Smoking	0.246	0.225	1.090	0.276
Nausea and vomiting during pregnancy	0.255	0.150	1.706	0.088
Daily attention to fetal movement	0.716	0.230	3.113	0.002
Impact of pregnancy on action	1.264	0.167	7.562	$p < 0.001$
Be taken care of	0.117	0.174	0.670	0.503
Any worries or fears about childbirth	0.900	0.194	4.637	$p < 0.001$
Degree of education	0.100	0.110	0.868	0.386
First Child	−0.425	0.247	−1.720	0.086
Annual household income	0.214	0.154	1.390	0.165
Financial loss in COVID-19	0.226	0.077	2.924	0.004
Stomachache Predictors	0.467	0.154	3.025	0.003
Perceived Stress	0.238	0.0183	13.000	$p < 0.001$
Resilience	−0.044	0.0315	−3.286	0.001
Interaction				
Perceived Stress and Resilience	−0.013	0.002	−6.034	$p < 0.001$

FIGURE 1 | Interaction of Perceived Stress Scores and Resilience Scores on Insomnia Severity Scores. PSS means Perceived Stress Scale, ISI means Insomnia Severity Scale.

insomnia intensity was statistically significant at various levels of resilience. The interaction between perceived stress and resilience was significant and negative on insomnia severity in the moderation model ($\beta = -0.126$, $p < 0.001$), implying that resilience mitigated the relationships between perceived stress and insomnia severity. Subgroup analysis conducted for the moderation of perceived stress and insomnia severity indicated that their effects differentiated the high resilience and low level of resilience. Pregnant women with low levels of resilience and high levels of perceived stress predicted higher insomnia severity ($\beta = 0.337$, $p < 0.001$). Pregnant women with high levels of resilience and high perceived stress also predicted higher insomnia severity ($\beta = 0.1392$, $p < 0.001$). Furthermore, the effect of perceived stress-related insomnia severity was less pronounced in the high resilience group than in the poor resilience subgroup.

DISCUSSION

The present study used hierarchical regression analysis to confirm the moderating impact of resilience on the relationship between perceived stress and sleep quality in Chinese pregnant women during COVID-19. Sleep quality, in particular, was found to be inversely related to stress perception. Furthermore, 18.53% of the individuals in this research reported having insomnia. Contrary to prior literature, the figure, 18.53%, is explicitly smaller compared to estimates of Chinese pregnant women prior to COVID-19, which was 49.4% (46). **Table 1** also shows that women with nausea and vomiting were more likely to have poor sleep quality, replicating FitzGerald and Davis' prior results that women with moderate/severe pregnancy-related nausea and vomiting were more likely to have sleep disturbance than those with none/mild sickness (47, 48). Such findings might be explained that the lockdown strategy enhanced pregnant women's resilience, therefore reducing the impact of perceived stress on sleep quality. To elaborate, family bonding might be reinforced even more when family members spent more time together, supported one another, and faced hardships together. Meanwhile, for pregnant women, their partners' mental health, the availability of social networks, and the companionship of family and friends all contribute to psychological resilience and emotional stress reduction.

During COVID-19, there was also a substantial negative association between felt stress and sleep quality, according to the current study. These findings back up previous findings from a study with pregnant women. Since the COVID-19 outbreak in December 2019, researchers have documented the pandemic's negative impacts on mental health, as well as the anticipated complicated impact on pregnant women. Hayase observed that in pregnant women, shorter sleep duration and increasingly worse sleep quality were linked to increased subjective stress (45). According to Carney et al. worrisome thoughts might prevent people from going asleep due to a lack of relaxation, interfering with circadian rhythms (49). Harvey also indicated that during the pre-sleep phase, stress enhanced cognitive and somatic arousal, affecting total sleep quality (50). According to the previous studies, a decrease in perceived stress was related to a significant improvement in sleep quality (51), this suggests that controlling and reducing prenatal mother stress might be an effective way to improve sleep quality.

The outcomes of the present study confirmed the moderation effect of resilience on perceived stress and insomnia symptoms. It indicated that increased resilience was significantly associated with improved sleep quality in pregnant women during COVID-19, which was consistent with previous research (52). The findings revealed that the association between stress and insomnia symptoms is less for persons with high levels of resilience than for those with low levels of resilience. To illustrate, individuals with high resilience have favorable characteristics (e.g., high cope self-efficacy, optimistic emotions, realistic optimism, and cognitive flexibility) that might enable them to positively get used to and keep good sleep quality when they are

confronted with acute or chronic stress (53). The moderation impact of resilience on stress and sleep quality demonstrated that pregnant women with more perceived stress and less resilience, subsequently, had poorer sleep quality. In contrast, pregnant women with less perceived stress and greater resilience, subsequently, had more favorable sleep quality. Because of the severe pandemic in Wuhan, individuals in Wuhan felt more stressed and had less resilience than those in other places, as seen in **Table 1**. As a result, individuals had increased sleeplessness symptoms. The current findings are consistent with a previous study, which found that the severity of perceived stress was negatively correlated with resilience, which was associated to psychological and physical health, including sleep quality. This finding is consistent with prior research indicating resilience is a protective feature that aids people in adapting to poor environmental quality (54). The existing literature has attached sleep quality with psychological resilience from a neurobiological perspective (55, 56). One potential explanation is that high resilience could sustain the HPA axis at an optimum level of activation; that is, high enough to get adjusted to danger but not so high as to trigger superfluous fear, anxiety, and depression, thus enabling the resilient individual to prevent psychosomatic disorders like sleep disturbance (57).

Further research is needed in this area in the future to better understand the molecular and psychological mechanisms. Resilience's moderating effect on perceived stress and sleep quality provides fresh insight into the components that influence sleep quality. Resilience, in particular, might be considered a component to be addressed in sleep quality enhancement programs for pregnant women (58, 59). On the other hand, local community and government agencies should provide more psychological service to individuals to cope with their stress. Pregnant women would feel more secure, and additional psychological support measures might help them feel less worried. As a result, even if they have a low degree of resilience, they may be able to have decent sleep.

LIMITATION

There are certain limitations to this study that should be mentioned. For starters, the cross-sectional design made study difficult to confirm the causal link between resilience, stress, and insomnia symptoms. To determine the causal influence of perceived stress on insomnia symptoms during pregnancy, longitudinal studies are required. Second, the current study only used self-report ratings, which might contribute to methodological variability (CMV). More study using a variety of approaches to measure sleep quality is needed. Third, We did not analyze the influence of the presence of partners on the mental health of pregnant women in this study because the majority of the pregnant women polled were pregnant women with partners. Future research should consider the crucial function of partners in our transition from individual to parent.

Nonetheless, there were a few positive aspects to this research. In COVID-19 pregnant women in China, this was the first study to indicate that resilience moderates the association between perceived stress and sleep quality, and the sample size was large: 2115 pregnant women were studied. These findings contribute to a better understanding of the relationship between resilience, perceived stress, and insomnia symptoms in pregnant women, and offer a new direction to develop interventions to advance sleep quality.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee for Scientific Research of the Chinese Academy of Sciences' Institute of Psychology. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HZ and ZT were responsible for writing-original draft preparation, reviewing and editing, methodology, and analyzed the data. YZ, ZZ, and LL were responsible for statistical analysis and manuscript revision. CZ, JY, and YW were responsible for data acquirement. WH and JW were responsible for study design and supervision. All authors have given final approval for its publication.

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A Positive Legacy of Trauma? The Role of Perceived Social Support on Mental Health Among Earthquake Survivors During the COVID-19 Outbreak

Dongfang Wang[1], Shuyi Zhai[2], Jiaqiao Chen[1], Yao Chen[1], Shiming Hua[1], Chengchen Wang[1], Fang Fan[1] and Xianchen Liu[3]*

[1] Guangdong Key Laboratory of Mental Health and Cognitive Science, Ministry of Education Key Laboratory of Brain Cognition and Educational Science, Centre for Studies of Psychological Applications, School of Psychology, South China Normal University, Guangzhou, China, [2] Faculty of Medicine, McGill University, Montreal, QC, Canada, [3] Center for Public Health Initiatives, University of Pennsylvania, Philadelphia, PA, United States

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***Correspondence:**
Fang Fan
fangfan@scnu.edu.cn

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Background: People with prior experience of severe trauma may be particularly vulnerable in the face of the COVID-19 pandemic. However, little is known about mental health problems among prior trauma survivors during the pandemic outbreak.

Methods: A total of 362 Wenchuan earthquake survivors were assessed using Patient Health Questionnaire, Generalized Anxiety Disorder Scale, as well as Multidimensional Scale of Perceived Social Support, as part of an online survey between February 3 and 10, 2020.

Results: Our results showed that 6.6 and 4.7% of the participants experienced depression and anxiety during the COVID-19 outbreak, respectively. Perceived social support was negatively associated with depressive and anxiety symptoms. Earthquake exposure has no direct effect on current depressive and anxiety symptoms, but it would moderate the direct relationship between perceived social support and psychological symptoms.

Conclusions: Our findings suggested that trauma exposure may lead to salutogenic outcomes. The protective effect of perceived social support on psychological symptoms was greater in people with a higher level of trauma exposure than in a lower one.

Keywords: perceived social support, depression, anxiety, trauma exposure, COVID-19

BACKGROUND

Numerous studies have shown that the COVID-19 pandemic leads to the development of mental health problems in public (1, 2). For some special groups, such as psychiatric patients (3), frontline healthcare workers (4), and even patients infected with COVID-19 (5), their mental health is even more likely to be affected by the pandemic. However, little attention has been paid to the mental health of another high-risk group during the pandemic: survivors of prior trauma.

Theoretically, prior trauma exposure and subsequent posttraumatic stress (PTS) symptoms may intensify one's vulnerability when facing additional stressors. By draining one's resources (6, 7) and coping capacity, trauma exposure and PTS symptoms heighten one's sensitivity to stress (8, 9). One late study in a sample of 976 adults indicated that history of trauma exposure and resultant PTS were associated with an elevated risk for psychological distress following COVID-19 (10). This finding leads us to suspect that whether individuals who experienced natural disaster (e.g., earthquake) could have greater risks of poor mental health during the COVID-19 pandemic.

Considered as an important disaster preparedness resource, social support is linked to better mental health outcomes for survivors after disasters (11). More specifically, it has been proposed that stronger social support can predict better mental health functioning (12, 13), enhance resilience to stress, and help protect against developing trauma-related psychopathology (14). Meanwhile, people who give and receive social support before the occurrence of disasters are significantly less likely to develop mental health problems (e.g., depressive symptoms) during the post-disaster time compared to those without support (15).

On the other hand, perceived social support is distinct from received social support, which is a better predictor of mental health and support utilization than other measures (16). People suffering from a greater degree of disaster-related traumatic stressors are more likely to seek and receive greater amount of actual support, which consists of a significant indirect path to reduce distress. Greater received support predicted greater perceived support over time, and greater perceived support in turn predicted greater reductions in distress over time, although perceived support tends to decrease over time (17–21). Furthermore, the level of perceived social support was negatively impacted by disaster-related stressors as well as subsequent life stressors in the aftermath of disasters (22). Accordingly, what about prior trauma survivors' perceived social support while facing a subsequent traumatic events such as the COVID-19 pandemic?

In the light of the foregoing discussion, we conducted the present study to examine the level of perceived social support and the prevalence of mental health problems among Wenchuan earthquake (2008) survivors during the COVID-19 outbreak. Three specific objectives were as follows: (a) to investigate depression and anxiety prevalence rates among 362 earthquake survivors during the pandemic outbreak; (b) to examine the effect of perceived social support in relation to depression and anxiety; and (c) to explore the differences in the relationship between perceived social support and mental health among survivors who suffer from different levels of earthquake exposure severity. It was hypothesized that perceived social support would be negatively associated with depression/anxiety. Earthquake exposure severity would moderate the direct association between perceived social support and mental health. Specifically, people suffering from greater degree of earthquake exposure are more likely to perceive greater social support, leading to fewer mental health problems.

TABLE 1 | Sample characteristics and trauma exposure.

Variables	Characteristics	*N*	%
Socio-Demographic			
Sex	Female	125	34.5
	Male	237	65.5
Age [years, M (SD)]	26.41 (0.65)		
Marital status (married)	Married	148	40.9
Family income (monthly)	<5,000 RMB	179	49.4
	5,000–10,000 RMB	122	33.7
	>10,000 RMB	61	16.9
History of mental disorders	Yes	3	0.8
Chronic physical illness	Yes	3	0.8
Smoking	Yes	71	19.6
Alcohol intake	Yes	134	37.0
Pandemic-Related factors			
Confirmed or suspected cases in the community or village	Yes	5	1.4
Relatives or friends being infected with COVID-19	Yes	7	1.9
Exposure to media coverage of the	<1 h/day	115	31.8
COVID-19	1–2 h/day	204	56.4
	>3 h/day	43	11.9
Earthquake exposure[a] [M (SD)]	11.22 (2.77)		
Family member injured or	Injured	54	14.9
killed/missing	Killed or missing	42	11.6
House damage	Moderate	176	48.6
	Severe	158	43.6
Property loss	Moderate	263	72.7
	Severe	75	20.7
Directly witnessed the disaster	Yes	178	49.2

[a] *Measured in November 2008.*

METHODS

Participants and Procedure

The 8.0-magnitude earthquake occurred on May 12, 2008, in Wenchuan county of Sichuan province, which has been the strongest earthquake over the past 50 years in China. The earthquake was devastating: 69,197 died, 374,176 were injured, and 18,222 were missing. Meanwhile, at least 4.8 million residents were left homeless due to their houses being destroyed by the earthquake. Fan et al. conducted a longitudinal study of mental health among adolescent survivors exposed to the Wenchuan earthquake in May 2008 (23). A total of 1,573 Wenchuan earthquake survivors completed assessments of mental health at 6 months after the earthquake (sampling time: November 2008) (23). Among these participants, 410 completed the web-based survey during the COVID-19 outbreak (sampling time: from February 3 to 10, 2020), and the response rate was 26.1%. To control the quality of the survey responses, exclusion criteria included was that "missing information >25%" and "response time <5 min." Finally, 362 participants were included in the subsequent analyses. The chi-square test and *t*-test were used

to compare the participants who participated in the web-based survey during the COVID-19 outbreak with those whose did not in major variables at baseline. There was no significant difference in age ($t = -1.05$, $p = 0.292$) and earthquake exposure ($t = -0.79$, $p = 0.431$) between these two groups. Men were less likely to participate ($\chi^2 = 15.90$, $p < 0.001$), mainly because they were more likely to drop out at school age. Among participants, 93.6% ($N = 339$) of the survivors lived in Sichuan Province during the survey period, which was a low infection risk area with <1,000 cumulative confirmed cases during the COVID-19 outbreak (24).

Researchers sent the informed consent and a specific web link or quick response (QR) code to participants through their contact information (e.g., QQ, WeChat, or SMS). Participants completed the online survey by clicking the questionnaire link or scanning the QR code of the questionnaire with mobile phones. This study was entirely voluntary; interested participants needed to sign an electronic informed consent form before the survey and could quit at any time. The ethics board of the South China Normal University (SCNU-PSY-2020-01-001) examined and approved the project. Participants were also provided psychological counseling from the School of Psychology, South China Normal University. If needed, participants can also assess free online psychological counseling service ("Xin-Qing"Hotline) from the School of Psychology of South China Normal University.

Measures

Sample Characteristics and Trauma Exposure

Sample characteristics included sex, age, marital status, family income, history of mental and physical illness, history of smoking, and alcohol use.

The main two trauma exposures in this study are Wenchuan earthquake and COVID-19 pandemic-related factors. Earthquake exposure was assessed using four items (25): I1: death, injury, and/or missing of family members; I2: house damage; I3: property loss; I4: witness or hearing of tragic scenes. Each item was rated on a five-point Likert scale with 1 representing the lowest level of exposure and five representing the highest. Summing up scores on all items generates a total score, indicating overall severity of earthquake exposure.

Pandemic-related factors were assessed using three questions: Q1: Are there confirmed or suspected cases in your community or village? (1 = yes, 0 = no); Q2: Do you have relatives or friends who have been infected with COVID-19? (1 = yes, 0 = no); and Q3: How much time are you exposed to news and information about COVID-19 on social media? (1 = <1 h/day, 2 = 1–2 h/day, 3 = >3 h/day).

Perceived Social Support

The Multidimensional Scale of Perceived Social Support (MSPSS) was used to assess participants' perceived social support (26). It consisted of 12 items addressing the following three domains: family, friends, and significant others. Each item was scored on a 7-point scale ranging from 1 (very strongly disagree) to 7 (very strongly agree), with a range of 12–84. A higher total score indicated greater level of perceived social support. Degree of social support can be determined by the following cuto? scores: 12–48 low social support, 49–68 moderate social support, and 69–84 high social support. The Chinese version of MSPSS was reported to have good reliability and validity (27). It also had satisfactory internal consistency in this study (Cronbach' $\alpha = 0.95$).

Depressive Symptoms

The 9-item Patient Health Questionnaire (PHQ-9) was used to assess participants' depressive symptoms over the past 2 weeks (28). Each item was answered on a 3-point Likert scale (0 = not at all, 1 = several days, 2 = more than half the days, and 3 = nearly every day), with higher scores indicating higher levels of depressive symptoms. The cutoff point of 10 was usually used for demonstrating clinically significant depression (29). The Chinese version of PHQ-9 has been reported to have good reliability and validity in the Chinese sample (30). In the current sample, Cronbach's α for PHQ-9 was 0.89.

Anxiety Symptoms

The 7-item Generalized Anxiety Disorder (GAD-7) was used to measure participants' anxiety symptoms over the past 2 weeks (31). Responders should provide a response for each item using a 6-point scale ranging from 0 (not at all) to 3 (nearly every day). Summing up scores on all items would generate a total score indicating the overall severity of anxiety symptoms. A preliminary study suggested that a cutoff score of 10 is the optimal threshold to indicate clinical level of anxiety (32). The scale of the Chinese version has demonstrated satisfactory psychometric properties in the Chinese population (33). In the present study, GAD-7 also demonstrated high internal consistency, with the Cronbach's α being 0.93.

Data Analyses

All statistical analyses were conducted using SPSS, version 23.0, and $p < 0.05$ were considered statistically significant for all two-tailed tests. Descriptive statistics were calculated for sample characteristics, pandemic-related factors, and earthquake exposure. To assess the differences between levels of perceived social support in relation to PHQ-9 and GAD-7, χ^2-test and one-way ANOVA were used, as appropriate. Pearson correlations were examined among earthquake exposure, MSPSS, PHQ-9, and GAD-7. Meanwhile, PROCESS was used to examine the mediation hypotheses, with 5,000 iterations to estimate the effect size of models (34). Harman's one-factor test was conducted to examine common method variance before regression analysis (35). The moderation effect was tested: MSPSS score was entered as the predictor, earthquake exposure was entered as the moderator, and PHQ-9 or GAD-7 score was entered as the outcome. Simple slopes were calculated for high, medium, and low levels of earthquake exposure (using the mean score and cutoffs either one standard deviation above or below the mean), to determine the level at which perceived social support starts to have a significant correlation with earthquake exposure. Sample characteristics and pandemic-related factors were also included in the current analyses as covariates.

TABLE 2 | Characteristics of participants enrolled to the study according to perceived social support status.

		Perceived social support status			*p*	Cramer's *V*
		Low *N* = 52, 14.4%	Moderate *N* = 156, 43.1%	High *N* = 154, 42.5%		
Sex [*N* (%)]	Female	31 (13.1)	96 (40.5)	110 (46.4)	$\chi^2 = 4.27$	0.109
	Male	21 (16.8)	60 (48.0)	44 (35.2)		
Age [years, M (SD)]		26.36 (0.61)	26.40 (0.66)	26.43 (0.65)	$F = 0.27$	$\eta^2 = 0.022$
Marital status (married) [*N* (%)]	Married	19 (12.8)	65 (43.9)	64 (43.2)	$\chi^2 = 0.48$	0.036
	Unmarried	33 (15.4)	91 (42.5)	90 (42.1)		
Family income (monthly) [*N* (%)]	<5,000 RMB	24 (13.4)	80 (44.7)	75 (41.9)	$\chi^2 = 1.29$	0.042
	5,000–10,000 RMB	17 (13.9)	50 (41.0)	55 (45.1)		
	>10,000 RMB	11 (18.0)	26 (42.6)	24 (39.3)		
History of mental disorders [*N* (%)]	Yes	0 (0)	1 (33.3)	2 (66.7)	$\chi^2 = 0.91$	0.050
	No	52 (14.5)	155 (43.2)	152 (42.3)		
Chronic physical illness [*N* (%)]	Yes	1 (33.3)	2 (66.7)	0 (0)	$\chi^2 = 2.44$	0.082
	No	51 (14.2)	154 (42.9)	154 (42.9)		
Smoking [*N* (%)]	Yes	15 (21.1)	35 (49.3)	21 (29.6)	$\chi^2 = 7.09^*$	0.140
	No	37 (12.7)	121 (41.6)	133 (45.7)		
Alcohol intake [*N* (%)]	Yes	39 (17.1)	98 (43.0)	91 (39.9)	$\chi^2 = 4.22$	0.108
	No	13 (9.7)	58 (43.3)	63 (47.0)		
Confirmed or suspected cases in the community or village [*N* (%)]	Yes	0 (0)	2 (40.0)	3 (60.0)	$\chi^2 = 1.10$	0.055
	No	52 (14.6)	154 (43.1)	151 (42.3)		
Relatives or friends being infected with COVID-19 [*N* (%)]	Yes	3 (42.9)	3 (42.9)	3 (14.3)	$\chi^2 = 5.37^*$	0.122
	No	49 (13.8)	153 (43.1)	153 (43.1)		
Exposure to media coverage of the COVID-19 [*N* (%)]	<1 h/day	17 (14.8)	51 (44.3)	47 (40.9)	$\chi^2 = 1.73$	0.049
	1–2 h/day	27 (13.2)	90 (44.1)	87 (42.6)		
	>3 h/day	8 (18.6)	15 (34.9)	20 (46.5)		
Earthquake exposure [M (SD)]	–	11.62 (2.73)	11.27 (2.92)	11.04 (2.62)	$F = 0.89$	$\eta^2 = 0.049$
PHQ-9 [M (SD)]	–	5.87 (5.43)	3.45 (3.81)	1.60 (2.41)	$F = 29.32^{***}$	$\eta^2 = 0.178$
Depression[a] [*N* (%)]	Yes	11 (45.8)	11 (45.8)	2 (8.3)	$\chi^2 = 24.84^{***}$	0.262
	No	41 (12.1)	145 (42.9)	152 (45.0)		
GAD-7 [M (SD)]	–	4.17 (4.63)	2.61 (3.39)	1.10 (2.01)	$F = 21.30^{***}$	$\eta^2 = 0.126$
Anxiety[b] [*N* (%)]	Yes	8 (47.1)	9 (52.9)	0 (0)	$\chi^2 = 21.26^{***}$	0.242
	No	44 (12.8)	147 (42.6)	154 (44.6)		

MSPSS, Multidimensional Scale of Perceived Social Support; PHQ-9, Patient Health Questionnaire; GAD-7, Generalized Anxiety Disorder Scale.

[a]*Depression calculated using the PHQ-9, with a clinical cutoff score of 10.*

[b]*Anxiety calculated using the GAD-7, with a clinical cutoff score of 10. *P <0.05; **P <0.01; ***P <0.001.*

RESULTS

This sample consisted of 362 Wenchuan earthquake survivors, 125 men and 237 women. Their age ranged from 25 to 28 years old, with the average age of 26.41 (SD = 0.65) years; 1.4% participants lived in the community or village with confirmed or suspected cases, and 1.9% reported that their relatives or friends have been infected with COVID-19. Other sample characteristics and trauma exposure are listed in **Table 1**.

Of the 362 participants, 24 (6.6%) had depression, with a mean PHQ-9 score of 3.01 (SD = 3.87). A total of 17 (4.7%) were shown to be positive for anxiety, with a mean GAD-7 score of 2.20 (SD = 3.29). In terms of perceived social support, only 14.4% ($N = 52$) had a low level, while 42.5% ($N = 154$) had a high level. The mean score of MSPSS was 63.98 (SD = 12.10).

Demographic characteristics along with the outcomes of interest were presented in **Table 2**, stratified by different levels of perceived social support. Compared to low perceived social support, participants who perceived a high level of social support were reported to have lower PHQ-9 and GAD-7 scores, as well as significantly lower proportion of depression and anxiety. Correlation analysis further showed MSPSS scores being negatively associated with PHQ-9 ($r = -0.41$, $p < 0.001$) and GAD-7 ($r = -0.37$, $p < 0.001$) scores. In addition, earthquake exposure was not associated with MSPSS ($r =$

TABLE 3 | Regression coefficients from analyses of moderating effect of earthquake exposure on the relationship between perceived social support and mental health status.

	b	SE	*t*	*p*	95% CI
Model 1[a]					
MSPSS	−0.40	0.05	−8.10	<0.001	−0.49, −0.30
EE	0.05	0.05	1.01	0.313	−0.05, 0.14
MSPSS × EE	−0.14	0.05	−2.86	0.005	−0.24, −0.04
Low EE	−0.28	0.06	−4.40	<0.001	−0.41, −0.16
Moderate EE	−0.38	0.05	−7.81	<0.001	−0.48, −0.29
High EE	−0.54	0.07	−7.93	<0.001	−0.67, −0.40
Model 2[b]					
MSPSS	−0.38	0.05	−7.70	<0.001	−0.48, −0.28
EE	0.04	0.05	0.66	0.511	−0.06, 0.13
MSPSS × EE	−0.14	0.05	−2.76	0.006	−0.24, −0.04
Low EE	−0.27	0.07	−4.16	<0.001	−0.40, −0.14
Moderate EE	−0.37	0.05	−7.42	<0.001	−0.47, −0.27
High EE	−0.52	0.07	−7.57	<0.001	−0.66, −0.39

Models both adjusted for sample characteristics (e.g., sex and age) and pandemic-related factors.
MSPSS, Multidimensional Scale of Perceived Social Support; EE, earthquake exposure; OR, odds ratio; CI, confidence intervals.
[a]*PHQ-9 score was the outcome.*
[b]*GAD-7 score was the outcome.*

−0.07, $p = 0.177$), PHQ-9 (r =0.07, $p = 0.186$), and GAD-7 (r =0.06, $p = 0.282$) scores.

As shown in **Table 3**, the moderation model with PHQ-9 score as outcome was significant with $F_{(14,347)} = 7.40$, $p < 0.001$, accounting for 23.0% of the total variance. Perceived social support had a negative main effect on depressive symptoms ($b = -0.40$, SE = 0.05, 95% CI = −0.49, −0.30). While earthquake exposure did not directly affect depressive symptoms ($b = 0.05$, SE = 0.05, 95% CI = −0.05,0.14), it moderated the relationship between perceived social support and depressive symptoms, $b = -0.14$, SE = 0.05, 95% CI = −0.24, −0.04, indicating that the indirect effect of perceived social support on depressive symptoms significantly differed at various levels of earthquake exposure. With simple slope analyses, a significant negative relationship between perceived social support and depressive symptoms was found at low ($b = -0.28$, SE = 0.06, 95% CI = −0.41, 0.16), moderate ($b = -0.38$, SE = 0.05, 95% CI = −0.48, −0.29), and high levels of earthquake exposure ($b = -0.54$, SE = 0.07, 95% CI = −0.67, −0.40) (see **Figure 1A**).

The moderation model with GAD-7 score as the outcome was also significant with $F_{(14,347)} = 6.40$, $p < 0.001$, accounting for 20.5% of the total variance. Similar to the results of depressive symptoms, earthquake exposure moderates the relationship between perceived social support and anxiety symptoms ($b = -0.14$, SE = 0.05, 95% CI = −0.24, −0.14). Simple slope analyses also found a significantly positive relationship between perceived social support and anxiety symptoms at low ($b = -0.27$, SE = 0.07, 95% CI = −0.40, −0.14), moderate ($b = -0.37$, SE = 0.05, 95% CI = −0.47, −0.27), and high ($b = -0.37$, SE = 0.07, 95% CI = −0.66, −0.39) level of earthquake exposure (see **Figure 1B**). These findings indicated that earthquake exposure is a moderator of perceived social support and mental health among earthquake survivors during the COVID-19 outbreak.

DISCUSSION

To our best knowledge, this was the first study to examine the mental health status of prior natural disaster survivors during the COVID-19 outbreak. Our findings suggested that earthquake survivors did not confer any increase in the prevalence of depression and anxiety during the outbreak phase of the pandemic. Meanwhile, higher prior earthquake exposure experience strengthens the protective effect of individual's perceived social support.

This study found that only 6.6% of the participants reported having depression and 4.7% reported having anxiety. In order to understand the meaning of our results, they are compared with data of the same type (the PHQ-9/GAD-7 cutoff of 10 or higher) on national and international surveys during the pandemic outbreak. Based on previous research, depression and anxiety rate in the current sample was lower than that of a similar study measuring Chinese adult citizens (12% depression, 7.1% anxiety) between February 9 and 20, 2020 (36). Several web-based studies found that the percentage of Chinese general public with depression was 13.6% between February 11 and 16, 2020 (37), and anxiety rate was 22.6% between January 31 and February 2, 2020 (38). Meanwhile, the general population from Jordan reported 32.1% depression and 22.8% anxiety between March 22 and 28, 2020 (39). Ettman et al. observed that the prevalence rate of depression was 27.8% in U.S. general adults during the COVID-19 outbreak (March 31–April 13, 2020) (40). Compared to these studies that have taken place in a similar phase of the outbreak, lower levels of depression and anxiety symptoms were observed in earthquake survivors.

Our study also found a higher level of perceived social support in earthquake survivors when compared to that of general college students in China during the same period (February 3–10, 2020). Our results showed that perceived social support of the present sample (mean score = 63.98, SD = 12.10) was higher than the level of college students (mean score = 59.8, SD = 11.7) living in the moderate-risk (Guangdong Province) and low-risk aeras (Jiangxi Province) (41). In the current sample, 42.5% of participants could be classified into the high social support group (scores from 69 to 84), which seemed to be significantly higher than the rate in the Lebanese public (20.8%) during the outbreak of COVID-19 with a consistent demarcation (42). Earthquake survivors having higher perceived social support in our study may be due to the solid financial and emotional support from both the government and the civilians in China (43), such as house reconstruction and better healthcare. In addition, perceived social support was observed to have a significant negative association with anxiety and depression. Higher levels of perceived social support were related to lower level of depression and anxiety outcomes, which was in line with previous literature (42, 44). It has been proposed that such social support could predict better mental health functioning and be regarded as a

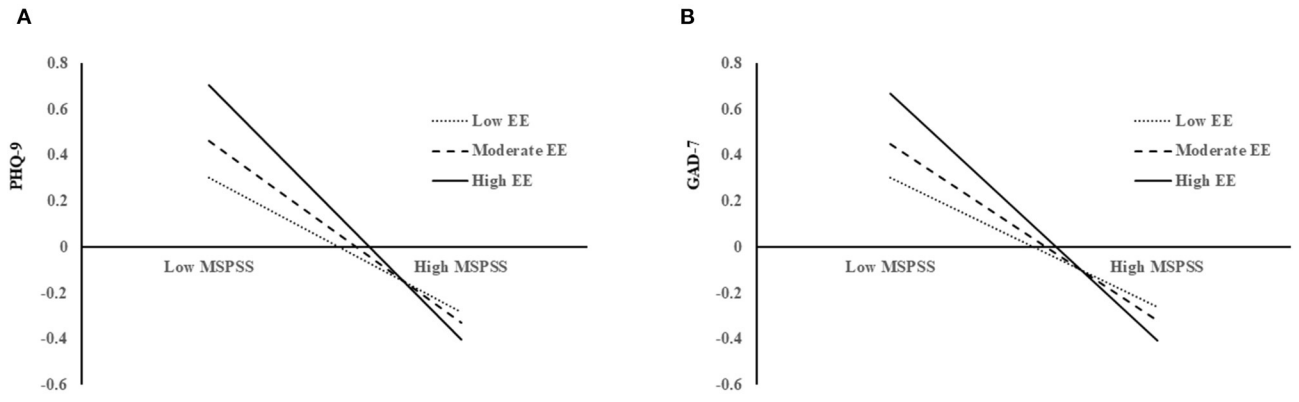

FIGURE 1 | Simple slope analyses. **(A)** The interaction between perceived social support and depression as moderated by earthquake exposure and shows that perceived social support was negatively associated with depression better with higher earthquake exposure. **(B)** The interaction between perceived social support and anxiety as moderated by earthquake exposure and shows that perceived social support was negatively associated with anxiety better with higher earthquake exposure. MSPSS, Multidimensional Scale of Perceived Social Support; EE, earthquake exposure; PHQ-9, Patient Health Questionnaire; GAD-7, Generalized Anxiety Disorder Scale.

protective factor against the onset of new mental health problems (12, 45). More specifically, social support could also enhance resilience to stress and reduce the development of trauma-related psychopathology (14).

Interestingly, prior earthquake exposure did not exhibit a direct effect on current depressive and anxiety symptoms, but it moderated the relationship between perceived social support and psychological symptoms. The effect of perceived social support on depression or anxiety significantly differed at varying levels of prior earthquake exposure. Specifically, social support had a stronger protective effect on mental health among survivors who had greater earthquake exposure. Although scholars proposed that trauma was a vital risk factor for individuals' mental health issues (46), prior trauma exposure might also have salutogenic effects. Recent evidence found that people with high trauma exposure were more likely to experience posttraumatic growth (PTG) (47), which denoted the tendency to report a positive transformation in the aftermath of a trauma exposure (48). Scrutinizing the empirical literature also found that participants with higher PTSD symptoms were more likely to grow from the impact of the trauma (49, 50). Theoretically, PTG might indicate perceived change rather than reflect actual growth (51). It could also be understood as a motivated positive illusion that served a protective function (52). We speculated that these improved personal resources and qualities [e.g., resilience (53)] that precipitated from past adversities acted as active protective factors that could be set in motion as one facing adversities again (e.g., COVID-19 pandemic).

Finally, several limitations must be considered. First, the present study was conducted on a sample of trauma survivors who experienced the 2008 Wenchuan earthquake. Before the disaster, they were both students of junior and senior school (Grades 7–12). Therefore, generalizations of our findings to sufferers of other traumatic experiences or of different age groups need to be done with caution. Second, there was a high attrition rate in the present study, which may lead to affect the accuracy of results. The time interval between the two surveys was more than 11 years, resulting in a high attrition rate. Although no significant differences were found for earthquake exposure between participants who followed up and those lost to follow-up, the results need to be interpreted with caution. Third, depression and anxiety variables relied on self-report questionnaires, which might cause potential reporting bias in the data collection. Meanwhile, other important factors that might affect the study findings, such as PTG or actual support, were not examined. In addition, depression and anxiety among the current sample needed to be further assessed longitudinally. Mental healthcare should still be provided to those prior trauma survivors at risk in the aftermath of the pandemic.

CONCLUSION

In conclusion, this study described the unique contribution of prior trauma exposure in explaining trauma-related symptoms among earthquake survivors during the COVID-19 outbreak. Earthquake survivors seemed to perceive higher levels of social support and exhibit lower mental health problems. They might also have a faster decline in mental health problems if they have been involved in greater prior trauma.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Board of the South China Normal University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

DW, FF, and XL: conceptualization. DW: methodology, formal analysis, and writing—original draft. DW, JC, YC, SH, and CW: data curation. SZ, FF, and XL: writing—review and editing. All authors contributed to the article and approved the submitted version.

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Intensive Care Unit Nurses in Iran: Occupational Cognitive Failures and Job Content

*Fatemeh Mehri, Amin Babaei-pouya and Mansoureh Karimollahi**

Department of Intensive Care Unit, Ardabil University of Medical Sciences, Ardabil, Iran

Background: Nurses in intensive care units (ICU) are under a lot of stress because of special conditions caused by the work environment and the high level of knowledge and skills required to work in these units, which can lead to cognitive failures. This study aimed to investigate the relationship between occupational cognitive failures (OCF) and job content (JC) in nurses in the ICU of Ardabil hospitals in 2020.

Methods: The present study was a descriptive-analytical cross-sectional study that was conducted in 2020. The study population included nurses working in the ICU of hospitals in Ardabil, from which 267 people who were eligible to enter the study were selected. OCF and JC questionnaires were used to collect data. Data were analyzed using SPSS software 23.

Results: OCF with work records in the ICU, total work records, and work records in the COVID-19 and non-COVID-19 units are significantly associated. OCF was inversely related to the JC subscales of skill discretion and decision authority. And directly related to other subscales of JC.

Conclusions: Develop job ability, reduce repetitive tasks, create diversity in work, create opportunities for creativity, have the authority and freedom to make decisions, facilitate work with new technologies, have enough time to do work, have a friendly work environment with colleagues, support by the supervisor, improving posture, especially for the upper body, feeling job security can help to reduce the cognitive failure of nurses.

Keywords: job cognitive failures, job content, nurse, ICU, Iran

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Jianhua Sun,
Peking Union Medical College Hospital (CAMS), China

****Correspondence:***
Mansoureh Karimollahi
karimollahi@gmail.com

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BACKGROUND

Errors in the provision of health services are unsafe behavior and in some cases irreparable phenomenal. The nursing error means a failure to meet the standards of care that most of these errors occur when caring for patients so that annual nursing errors lead to increased length of hospital stay and increased medical costs (up to 9.14%) and even the death of thousands (1, 2). Annually, 44,000 to 98,000 people in the United States die due to medical errors, and deaths from preventable accidents in hospitals exceed the number of deaths attributed to vehicle accidents (3).

Nurses who are adapted to working conditions reduce errors and cognitive failures by focusing properly on their tasks. However, night work, long shifts, and unpredictable activities increase their fatigue can reduce their performance and physical capacity, and increase the likelihood of cognitive failures. Chronic drowsiness and fatigue are factors that affect the cognitive function of nurses and

cause patient care to be dismissed and not done properly or be delayed (4). Cognitive failure is simple mistakes in daily activities, such as forgotten commitments and difficulty concentrating, that can lead to human error (5). Cognitive failures occur daily in the process of information processing in the stages of perception, memory, and motor actions, and human errors due to cognitive failures may occur in one of three stages of perception, memory, and motor actions (6). The results of several studies have shown that occupational cognitive failure (OCF) can lead to decreased safety in job performance (7, 8).

Cognitive failures as mind-related errors are related to the job content (JC) subscale. Job content refers to the evaluation of psychological and social stress factors including skill discretion, decision authority, psychological job demand, physical exertion, physical isometric loads, job insecurity, supervisor support, and coworker support (5). The existence of JC refers to factors that are controlled by the person in his job, such as performance, cognition, and independence, which are directly related to the job (5) and are strongly influenced by work stress. Among nurses, especially nurses in ICU, the increased workload is one of the most important causes of stress that increases cognitive failures, reduces the quality of care and patient safety (9). If people's abilities do not match their job conditions, it causes job stress and increases cognitive failures (4). Nurses who did not have good general health will not be able to provide better physical and mental care to patients, and this will increase mistakes and occupational accidents, which will ultimately affect the nurse and the patient (8).

According to our literature review, the relationship between OCF and JC of nurses has not been studied. In addition, since a significant number of people lose their lives due to medical errors (3) and one of the factors affecting medical errors is OCF and JC; Identifying the factors affecting OCF and JC in nurses can be an important step to reduce medical errors of nurses. Therefore, the present study was conducted to determine the relationship between OCF and JC in nurses of ICU of Ardabil educational and social security centers. The results of such studies can be of great help in improving and controlling the health status of patients and nursing staff.

METHODS

Study Design and Participants

The present study was a descriptive-analytical cross-sectional study that was conducted in 2020. The study population included nurses working in intensive care units (ICU) of hospitals in Ardabil, from which all 267 people who were eligible to enter the study were selected. The study protocols were designed according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement, and it is approved by the Ardabil University of the medical sciences ethics committee.

Inclusion and Exclusion Criteria

The inclusion criteria were the nurses with a bachelor's degree and higher, having the experience of working in the ICU for at least 6 months, having no history of severe mental illnesses, not receiving any treatment for serious diseases, and consent to participate. The exclusion criteria, having no will to continue the participation.

Sample Size Calculation

According to enrolling all eligible individuals into the study, this is considered a consensus sampling.

Data Collection

Data collection tools included a three-part questionnaire. The first part included a demographic information sheet (age, gender, and work records, level of education, marital status, work shift, employment status, and history of mental disorders), the second part included the OCF Questionnaire and the JC Questionnaire.

OCF Questionnaire

The OCF Questionnaire was designed by Hassanzadeh Rangi et al. (10). This questionnaire has 30 questions and its answer range is of the 5-point Likert type, which is "I strongly disagree" with grade 1, "I disagree" with grade 2, "I have no opinion" grade 3, "I agree: with grade 4, and "I completely agree" with grade 5. Based on this questionnaire, the obtained scores are collected, and then the rate of OCF is judged based on the sum of scores. The minimum score is 30 and the maximum score is 150. A score between 30 and 60 indicates low cognitive failure. A score between 61 and 90 indicates moderate cognitive failure, and a score above 90 indicates high cognitive failure. Hassanzadeh et al. reported a content validity of 0.70 and its reliability by Cronbach's alpha method of 0.96 (10). in the study, Athar et al. this questionnaire by had used for hospital nurses (7).

JC Questionnaire

JC Questionnaire has been developed by Kazarak et al. to measure JC (11). Factor validity of this questionnaire has been confirmed by the developers. Also, its reliability has been reported by Cronbach's alpha coefficient method for skill discretion 0.43, decision authority 0.64, psychological job demand 0.60, physical exertion 0.65, physical isometric loads 0.85, job insecurity 0.32, supervisor support 0.87, and coworker support 0.76 (12, 13).

The guide to the JC questionnaire includes the number of items, calculation formula, maximum and minimum, and average scores are given in **Table 1**.

Interviews and Data Collections

After explaining the objectives of the research and the demand for cooperation in researching the nurses in the first session, emphasis was placed on accuracy and honesty in completing the questionnaires and it was ensured that the information obtained would be completely confidential. According to the census sampling method, the questionnaires were provided to all nurses working in ICU with frequent visits in different shifts. Due to the busy work of the nurses in these units, to encourage them to cooperate and increase the accuracy in answering the questions, after distributing the questionnaire, they were asked to complete the questionnaires during their free time. The questionnaire was received in the same shift or at the time of re-visit.

TABLE 1 | Guidance content questionnaire guide.

Variable	Number of items	Formula	Minimum score	Maximum score	Average score (cut point)
Skill discretion	6	[Q1 + Q3 + Q4 + Q5 + Q6 + (5-Q2)] × 2	12	48	30
Decision authority	3	[Q7 + Q9 + (5-Q8)] × 4	12	48	30
Psychological job demand	5	[(Q10 + Q11) × 3 + 15-(Q12 + Q13 + Q14)] × 2	12	48	30
Physical exertion	3	[Q15 + Q16 + Q17]	3	12	7.5
Physical isometric loads	2	[Q18 + Q19]	2	8	5
Job insecurity	3	[Q20 + Q22 + (5-Q21)]	3	12	7.5
Supervisor support	4	[Q23 + Q24 + Q25 + Q26]	4	16	10
Coworker support	4	[Q27 + Q28 + Q29 + Q30]	4	16	10

TABLE 2 | Demographic and basic characteristics of the participants.

Variables	Categories	No	%
Age (years)	Younger than 30	64	24
	30–39	136	50.9
	Older than 39	67	25.1
Gender	Female	246	92.1
	Male	21	7.7
Marital status	Married	210	78.7
	Single	57	21.3
Education	Bachelor's	247	92.5
	Master's degree	8	3
	PHD	12	4.5
Employment Status	Full-time	155	58.1
	Part-time	47	17.6
	Apprentice	37	13.8
	Contract based	28	10.4
Unit	Dialysis	28	10.5
	NICU	46	17.2
	ICU of emergency room	34	12.7
	ICU of COVID-19	93	34.8
	ICC of heart surgery	44	16.5
	CCU	22	8.2
Shift type	Fixed	28	10.5
	With rotations	239	89.5
History of non-severe mental illness	Yes	6	2.3
	No	261	97.7

TABLE 3 | Mean and standard deviations of job content and OCF scores.

Variable		Mean	SD	Minimum	Maximum
Job content	Skill discretion	34.28	7.96	12	48
	Decision authority	34.61	5.4	12	48
	Psychological job demand	46.67	9.49	12	48
	Physical exertion	8.29	2.72	3	12
	Physical isometric loads	4.87	1.94	2	8
	Job insecurity	7.06	1.42	3	12
	Supervisor support	10.06	3.83	4	20
	Coworker support	10.49	3.75	4	16
OCF		83.41	19.96	30	150

Statistical Analysis

Continuous variables were demonstrated as M ± SD, and categorical variables were described in count and percentage. Initial analyses did not show outliers, as assessed by a boxplot. The variables were confirmed for normal distribution with the Kolmogorov Smirnov test ($p > 0.05$); Also, the hypothesis of homogeneity of variances (sphericity hypothesis) was tested using the Mauchly test. The test results showed that the assumption of the equality of variance is established ($p > 0.05$). To evaluate the independence of categorical variables, a Chi-square test was used. The association between categorical and continuous variables was assessed using an independent samples t-test and one-way ANOVA. The correlation between continuous variables was investigated with Pearsons's coefficient. The statistical analysis was done using SPSS version 23 (SPSS Inc. Chicago, IL). A $p < 0.05$ was considered statistically significant in all tests.

RESULTS

The results showed that the mean age of the subjects was 34.6 ± 6.3 years. Most of the participants in this study were female (92.1%); The average work record was 10.45 ± 6.15 years. Other demographic information is present in **Table 2**.

As shown in **Table 3**, the M ± SD and range for scores of each subscale of JC and OCF are described.

Work records in the ICU, total work records, and work records in the COVID-19 and non-COVID-19 units are significantly associated with OCF and Skill discretion. In other words, with increasing work records, decision authority also increases.

Work in the COVID-19 ICU has a significant relationship with the psychological job demand, Physical exertion, and Physical isometric loads. In other words, the nurses who worked in the COVID-19 ICU experienced more psychological job demands, Physical exertion, and Physical isometric loads (**Table 4**).

TABLE 4 | Association between JC, OCF, and characteristics of participants.

Variable	Categories	OCF, Mean (SD)	*P*-value	Skill discretion, Mean (SD)	*P*-value	Decision authority, Mean (SD)	*P*-value	Psychologicl job demand, Mean (SD)	*P*-value	Physical exertion, Mean (SD)	*P*-value
Age (y)	Younger than 30	84.59 (19.29)	0.245	34.78 (7.55)	0.450	35.03 (3.98)	0.043*	47.84 (7.71)	0.319	8.26 (2.64)	0.487
	30–39	84.3 (19.3)		34.51 (7.92)		35.05 (5.22)		47.12 (10.36)		8.43 (2.66)	
	Older than 39	79.37 (21.56)		33.18 (8.498)		33.07 (6.47)		45.43 (9.28)		7.93 (2.95)	
Gender	female	82.83 (18.54)	0.345	33.71 (7.01)	0.548	34.61 (4.10)	0.996	46.88 (9.59)	0.767	8.22 (2.74)	0.436
	male	82.83 (18.63)		34.43 (8.22)		34.61 (5.70)		47.29 (9.21)		8.54 (2.64)	
Unit	COVID-19 ICU	86.95 (15.53)	0.022*	36.96 (6.79)	0.001*	35.23 (5.94)	0.144	48.53 (8.26)	0.041*	9.35 (2.82)	0.001*
	Non-COVID-19	81.49 (18.34)		32.81 (8.19)		34.29 (4.09)		46.13 (9.49)		7.68 (2.82)	
Work records (y)	Less than 7	79.1 (19.95)	0.001*	32.52 (8.16)	0.001*	33.46 (5.13)	0.013*	47.56 (8.65)	0.408	8.32 (2.72)	0.642
	7–15	83.29 (16.73)		33.87 (7.72)		34.59 (5.51)		47.23 (9.96)		8.41 (2.61)	
	More than 15	89.89 (17.34)		37.33 (7.39)		36.27 (5.49)		45.51 (9.80)		8.00 (2.96)	
Work recoeds in ICU (y)	Less than 5	80.11 (18.98)	0.002*	31.76 (7.42)	0.001*	34.51 (5.49)	0.781	47.64 (9.52)	0.233	8.11 (2.66)	0.260
	5 and more	87.23 (17.16)		36.68 (8.02)		34.71 (5.32)		46.26 (9.46)		8.48 (2.77)	

Variable	Categories	Physical isometric loads, Mean (SD)	*P*-value	Job insecurity, Mean (SD)	*P*-value	Supervisor support, Mean (SD)	*P*-value	Coworkers support, Mean (SD)	*P*-value
Age (y)	Younger than 30	5.01 (1.94)	0.678	6.98 (1.28)	0.371	10.10 (3.92)	0.782	10.48 (3.67)	0.412
	30–39	4.88 (2.00)		7.19 (1.58)		10.10 (3.69)		10.69 (3.60)	
	Older than 39	4.71 (1.84)		6.89 (1.19)		9.70 (4.03)		9.94 (4.10)	
Gender	female	4.88 (1.94)	0.881	6.99 (1.41)	0.124	9.89 (3.79)	0.186	10.34 (3.70)	0.236
	male	4.88 (1.94)		7.34 (1.42)		10.71 (3.96)		11.03 (3.90)	
Unit	COVID-19 ICU	5.46 (1.87)	0.001*	7.22 (1.49)	0.205	10.65 (3.83)	0.084	10.78 (3.82)	0.363
	Non-COVID-19	4.58 (1.87)		6.98 (1.37)		9.75 (3.81)		10.34 (3.72)	
Work records (y)	Less than 7	4.95 (1.89)	0.439	7.17 (1.39)	0.705	10.52 (3.96)	0.398	10.67 (3.72)	0.654
	7–15	4.95 (2.05)		7.01 (1.51)		9.77 (3.64)		10.55 (3.56)	
	More than 15	4.58 (1.78)		7.00 (1.29)		9.96 (4.02)		10.10 (4.19)	
Work recoeds in ICU (y)	Less than 5	4.87 (1.96)	0.997	7.00 (1.42)	0.448	10.33 (3.87)	0.262	10.81 (3.64)	0.153
	5 and more	4.87 (1.92)		7.14 (1.43)		9.78 (3.79)		10.15 (3.85)	

**Statistically significant.*

A one-way ANOVA or t-test was used as appropriate.

TABLE 5 | Correlation coefficients with Pearsons' r between JC subscales and OCF.

Variables	OCF	Skill discretion	Decision authority	Psychological job demand	Physical exertion	Physical isometric loads	Job insecurity	Supervisor support	Coworker support
OCF	1	−0.597**	−0.217**	0.520**	0.737**	0.542**	0.478**	0.783**	0.713**
Skill discretion		1	0.319**	0.196**	0.387**	0.447**	0.200**	0.540**	0.381**
Decision authority			1	0.283**	0.077	0.072	0.043	0.071	0.035
Psychological job demand				1	0.331**	0.276**	0.243**	0.388**	0.428**
Physical exertion					1	0.443**	0.558**	0.588**	0.428**
Physical isometric loads						1	0.227**	0.336**	0.383**
Job insecurity							1	0.556**	0.293**
Supervisor support								1	0.830**
Coworker support									1

*Significant at $p < 0.05$.
**Significant at $p < 0.01$.

According to the results of **Table 5**, OCF was inversely related to the JC subscales of skill discretion and decision authority, and directly related to other subscales of JC.

DISCUSSION

Most of the nurses working in the ICU had moderate levels of OCF. A review of literature in this area reveals different levels of occupational cognitive failure in nurses. The mean of cognitive failure in our study was higher than the mean reported in the study of Yousefzadeh et al. in nurses (1) and was consonant with the mean reported in the study of Mohammadi et al. in nurses. (14) and the study of Waltz et al. (15). Reisen (1997) has stated that job failure can be more due to failure in planning (mistakes) and implementation (cognitive failures). The work environment and the job of individuals, in general, can be the cause of occupational errors and cognitive failures in the individual (16), This is because the workload of nurses, especially nurses in the ICU, may cause problems and errors in the field of patient care because the ICU is a complex and stressful work environment (17), patients are more stressed (18), which may lead to occupational cognitive failures.

Nurses working in ICU in this study had high levels of skill discretion, decision authority, psychological job demand, physical exertion, supervisor support, and coworker support; on the other hand, the level of job insecurity and physical isometric loads was low.

According to the review of studies conducted in this regard, the results of the study of Gholami et al. (19) which was performed on 500 nurses of teaching hospitals in Hamadan, showed that the average component of freedom of decision is 64.67; psychological job demand 22.36; Social support 71.22; Job physical needs were 15.99 and job insecurity was 7.53, which was close to our study. Individuals' JC refers to factors that are self-controlled such as performance, cognition, independence, which are directly related to the individual's job (11) and affect the work stress of individuals. In general, job characteristics such as supervisor support for employees, job security, job independence, and the existence of a warm and friendly environment are among the factors that can affect the work aspects of people and lead to increased JC (20).

OCF was inversely related to the subscales of skill discretion and decision authority, and directly related to other subscales of JC. The skill discretion was directly related to all subscales of JC, and the decision authority was directly related only to the psychological job demand. The psychological job demand was directly related to all realms of JC. Also, the subscales of physical effort, isometric physical load, job insecurity, lack of supervisor support, and lack of coworker support were directly related to all subscales of JC except the decision authority subscale.

The results of the study of Hassanzadeh Rangi et al. (8) indicate a positive relationship between cognitive failures and workplace accidents which was consistent with the results of Park et al. (21), which showed a direct relationship between job stress and cognitive failure in nurses. However, it was not consistent with the results of the study of Barzideh et al. (22) which showed that there is no relationship between job stress and some job problems of nurses.

Work records in the ICU, and total work records, were significantly associated with OCF. In other words, nurses who worked in the ICU have experienced more job failures, and job failures also increase with increasing work records.

The study of Yousefzadeh et al. (1) showed that there was a significant correlation between cognitive failures with shift work, work records, and work departments (emergency, ICU); it also showed that there was no correlation between OCF and gender, the number of patients monitored, shift hours and rest hours. Moreover, the study of Mohammadi et al. (14) showed that there was no significant relationship between gender and job failures. However, the results of the study by Park et al. (21) showed that there was a significant relationship between nurses' gender and job failures.

It can be stated that the work records of the person in the COVID-19 ICU have caused stress and psychological pressure on medical team members, especially nurses, and dealing with critically ill patients also increases their fear, anxiety (22, 23).

Because cognitive failures as mind-related errors are directly related to job stressors, job stress is rooted in a person's inability

to perform their duties (5) and is strongly influenced by the work environment.

The results showed that among the subsets of skill discretion, decision authority, psychological job demand, physical exertion, physical isometric loads were significantly associated with work records. These results were in line with the findings of Alacacioglu et al. and Kanai-Pak et al. (24, 25).

Working in the ICU requires that the staff, especially the nurses in these units, have the ability to use skills and have a great deal of decision-making power. As Apker et al. (26), ICU nurses have the ability to make quick and accurate decisions. In the ICU, teamwork is very important, when inexperienced nurses are placed next to professional nurses, they can increase their professional skills (26).

ICU is a complex and stressful work environment that is due to the critical nature of hospitalized patients, advanced devices and equipment used in the unit, and the need for speedy action of nurses in inpatient care. The nature of the ICU inevitably affects the cooperation and communication of nurses and causes the need for active participation in patient care, nurses 'respect for each other, and increasing nurses' trust and expertise (17). As the results of the present study showed, there was a significant relationship between work records, work in the ICU, and COVID-19 ICU with decision authority, physical exertion, psychological job demand, and other components.

Also, there was no significant relationship between head nurse support, coworker support, and job insecurity with any of the demographic characteristics of nurses. The results of the study by Yaser et al. (27) showed that there was no significant relationship between cognitive involvement with gender, education, age, work records, social responsibility, and type of unit in nurses. It can be stated that the majority of nurses studied were formally and contractually employed, so they were safe in their jobs. Accordingly, no significant relationship was observed between job insecurity and any of the demographic variables (27). The results indicate the fact that there is an inverse relationship between job security and stress and work pressures, especially work in the ICU. Accordingly, the attention of officials to the type of employment, employment conditions, and security that they provide for this important and sensitive segment of the health and medical system in terms of work, can provide the basis for providing better services.

Also, the result obtained in coworker support with demographic characteristics was inconsistent with the findings of Moore et al. (28). The results of Moore et al.'s study showed that there was a significant relationship between social interaction and cooperation with demographic characteristics (age, gender, education, work history) of nurses (28).

The results of the study showed that OCF was inversely related to skill discretion and decision authority, and directly related to psychological job demand, physical exertion, physical isometric loads, job insecurity, supervisor support, and coworker support.

The results suggest that paying attention to skill discretion, decision authority, psychological job demand, physical exertion, physical isometric loads, job insecurity, supervisor support, and coworker support can reduce OCF, and also consequently improve their productivity.

CONCLUSION

The quality of nurses' activities is very important for patient safety, reducing the length of hospital stay and ultimately productivity. Human resource management should be done to reduce OCF.

To reduce the cognitive failure of nurses, the need to develop job ability, reduce repetitive tasks, create diversity in work, create opportunities for creativity, as well as have the authority and freedom to make decisions can help.

Other important things to reduce nurses' OCF are facilitating work with new technologies, having enough time to do work, having a friendly work environment with colleagues, supporting by supervisor and colleagues, improving posture, especially for the upper body, feeling job security.

For future studies, it is recommended to conduct a case study (using a control group) on the factors affecting OCF (Participant Characteristics, Professional ranks, Hospital level, Years of prior nursing experience...).

LIMITATION

The limitations of this study include the limited statistical population of this study with nurses in intensive care units, which can be problematic in generalizing the results to other nurses. As well as the small number of male samples can affect the research results and should be considered in interpreting the findings.

One of the strengths of this study is the appropriate sample size and considering the dimensions of JC and their relationship with OCF.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of Ardabil University of Medical Sciences. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

FM: data collection, analyzing data, and writing manuscript. MK and AB-p: research idea, research design, and writing manuscript. All authors contributed to the article and approved the submitted version.

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BRIEF RESEARCH REPORT
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"I Think the Mental Part Is the Biggest Factor": An Exploratory Qualitative Study of COVID-19 and Its Negative Effects on Indigenous Women in Toronto, Canada

Jerry Flores[1]*, *Kristen Emory*[2], *Xuan Santos*[3], *Angela Mashford-Pringle*[4], *Kati Barahona-Lopez*[5], *Keston Bozinovic*[2], *Jennifer Adams*[2], *Coco Chen*[1], *Yandy Zuo*[1] *and Diana Nguyen*[2]

[1] Department of Sociology, University of Toronto, Mississauga, ON, Canada, [2] School of Public Health, San Diego State University, San Diego, CA, United States, [3] Department of Sociology and Criminology and Justice Studies, California State University San Marcos, San Marcos, TX, United States, [4] Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada, [5] Department of Sociology, University of Wisconsin-Eau Claire, Eau Claire, WI, United States

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***Correspondence:**
Jerry Flores
jerry.flores@utoronto.ca

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This article explores the unique and understudied experiences of Indigenous women living in Toronto, Canada during the first year of the COVID-19 pandemic. The purpose of this study is to better document the impacts of COVID-19 on the mental health and wellbeing of Indigenous women in Toronto, Canada to better understand unmet needs, as well as lay the groundwork for more targeted research and potential interventions based on these needs. Using in-depth semi-structured interviews with thirteen Indigenous women, we shed light on the negative effects this pandemic has had on this population. We find that COVID-19 has negatively affected people's mental health, substance use and access to health services. This research speaks to the growing body of work that discusses the harmful effects of COVID-19 generally and how this pandemic has specifically affected Indigenous peoples.

Keywords: COVID-19 pandemic, Indigenous, qualitative study, urban, Toronto (Canada)

INTRODUCTION

The COVID-19 pandemic has had widespread negative effects on communities across the world (Levy Economics Institute, 2020). Additionally, COVID-19 has exacerbated existing inequalities (Hu, 2020). This is especially true for the most marginalized peoples (Luna, 2020). Currently, there is little research related to how COVID-19 has negatively affected these communities. Even less research looks at how COVID-19 has negatively affected Indigenous peoples in various ways (Howard-Bobiwash et al., 2021). Scientific evidence regarding the impact of COVID-19 on people's lives is limited and still emerging; the evidence that does exist often does not include an in-depth assessment of the impact on Indigenous populations. Lack of inclusion of Indigenous populations in scientific inquiry is particularly concerning as without documentation health equity concerns can go unnoticed by public health professionals as well as governmental offices in charge of funding population health work. There is consistent emerging evidence that in addition to the physical symptoms of COVID-19, the pandemic is also negatively impacting the mental health of populations across the globe (Dong and Bouey, 2020; Fiorillo and Gorwood, 2020; Passos et al., 2020; Sheridan Rains et al., 2021). This negative impact may be exacerbated for

historically marginalized populations, making it all the more vital that their perspectives are heard and addressed. They study of women (women of color in particular) is especially important given that research demonstrate that they have disproportionately suffered from mental and physical health issues compared to men since the start of this pandemic (Gomez-Aguinaga et al., 2021; Luo and Sato, 2021; Ornelas et al., 2021; Priebe Rocha et al., 2021).

The current study is an attempt to bridge this gap in the literature and provide a foundation for future scientific inquiry. Using in-depth semi-structured interviews with 13 Indigenous women in the Greater Toronto Area, we address the following questions in this paper: how did the first year of the COVID-19 pandemic affected the mental health of the 13 Indigenous women participants in Toronto, Canada? Furthermore, how has it negatively affected our participants' mental health and patterns of substance, alcohol, and tobacco use? The following paper shows how COVID-19 has adversely affected 13 Indigenous women. In the following sections, we review work on mental health and BIPOC (Black Indigenous People of Color) populations, mental health, and its effects on substance abuse among Indigenous peoples. We then discussed the methodological approach used in this paper and our main findings, which we divided into three small sections. We follow this with a discussion of our results and their implications for Indigenous peoples and future work related to COVID-19 and this community.

Mental Health and Black, Indigenous, and People of Color Communities

To better understand the impact of COVID-19 on the mental health of Indigenous women in Canada, it is important to understand the larger social context of mental health and related health equity concerns among diverse and often historically marginalized communities. Black, Indigenous, and People of Color (BIPOC) populations in the aggregate often experience disparate mental, physical, social, and economic risk factors and health outcomes, often due to structural and systemic inequity (Gee and Ford, 2011). Mental health is a particular concern as it impacts and is impacted by so many aspects of the human health and wellbeing experience.

Adverse mental health in the general global population was notably elevated during the COVID-19 pandemic (Czeisler et al., 2020). Subsequently, many people began or increased substance use to cope with economic stress, loneliness, and anxiety surrounding the virus in conjunction with pre-existing daily stressors (Czeisler et al., 2020). Communities that were previously at risk before the pandemic became particularly vulnerable during the pandemic due to social and health inequities (Abrams and Szefler, 2020). There was a notable increase in usage of alcohol (Pollard et al., 2020), nicotine and tobacco (Giovenco et al., 2021), opioids (Niles et al., 2021), and marijuana, along with other psychoactive substances (Borgonhi et al., 2021).

For communities of color, especially communities that are historically marginalized and colonized like the Black (Millett et al., 2020), Latinx (Macias Gil et al., 2020), and Indigenous (BIPOC) communities (Yellow Horse et al., 2020), their mental health was negatively impacted by intergenerational trauma, ongoing police violence (DeVylder et al., 2020), oppression related to poverty and racism, and the devastating burden of COVID-19 in these communities. For example, Black respondents reported increased rates of substance use and suicidal ideation (Czeisler et al., 2020). Hispanic/Latinx respondents reported a higher prevalence of anxiety disorder and depressive disorder symptoms, COVID-19 related trauma- and stressor-related disorder (TSRD), increased substance use, and suicidal ideation (Czeisler et al., 2020).

Indigenous communities in the US, American Indians/Alaska Natives (AI/AN), have had disproportionately higher rates of substance abuse (Dickerson et al., 2011; Statistics Canada, 2011; Wolfe et al., 2018; Gonzalez et al., 2019), which likely increased during COVID-19 in conjunction with other adverse mental health conditions. In addition, LGBTQ+ populations face the risk of worse COVID-19 health outcomes due to higher rates of comorbidities, working in affected industries as essential workers, being more likely to be low-income/affected by poverty, experiencing stigma or discrimination due to gender identity or sexual orientation, and lack of access to insurance and healthcare (Dawson and Golijani-Moghaddam, 2020). These inequities may also put LGBTQ+ populations at increased risk of stress and adverse mental health (Dawson and Golijani-Moghaddam, 2020).

As a whole, the impact of the COVID-19 pandemic has disproportionately affected BIPOC communities (Cheung, 2020). While they are systemically underrepresented in both research and government data collection, there is still clear evidence that racism is a risk factor for COVID-19 mortality (Wallis, 2020). Canadian health researchers have confirmed that structural inequalities related to race and gender, including healthcare, labor, and community affluence, influence the disproportionate impact of COVID-19 (Slaughter, 2020). Three key social issues have been identified as contributors to the interrelationship between racism and COVID-19 in Canada, leading to inequitable health outcomes in BIPOC communities: the healthcare system, occupation, and living conditions within the home and the community (Learning Network, 2021). Bias toward marginalized groups, including Indigenous populations, has been documented as a recurring problem in Canada's healthcare system, which results in lower quality of care, leaving communities vulnerable to potential cases of COVID-19 (Skosireva et al., 2014; Morris et al., 2019; Wylie and McConkey, 2019).

These contributing factors are further stratified among gender, especially since BIPOC women are overrepresented in jobs with a higher risk of exposure to COVID-19 while generally being in lower-paying positions (Learning Network, 2021). These systemic contributors to health inequity combined with higher rates of unemployment, incarceration, and substance use in BIPOC communities compound the harmful effects of COVID-19, often leading to more severe morbidity outcomes and higher rates of mortality (Dickerson et al., 2011). Further impacting the health outcomes related to COVID-19, it has been well documented that factors like low socioeconomic status, limited access to resources, and stigmatization can affect the likelihood

that a person will experience poor mental health or engage in substance use.

Mental Health and Corresponding Substance Use Among Indigenous Populations

The historical trauma of being oppressed by the Canadian government and being forced to civilize, assimilate, and eliminate their cultures has been detrimental to the mental health of Indigenous people (Boksa et al., 2015). Social determinants such as social exclusion, discrimination, poverty and unemployment have always played a significant role in the mental health challenges faced by the Indigenous population (Boksa et al., 2015). These mental health challenges worsened due to the COVID-19 pandemic. For example, Statistics Canada conducted a crowdsourcing data collection consisting of 1,400 Indigenous participants. The crowdsourced data showed that six in ten Indigenous participants reported experiencing a decline in their mental health since the onset of physical distancing due to COVID-19 (Statistics Canada, 2020). Compared to Indigenous men, Indigenous women reported experiencing higher stress and anxiety due to "multiple caregiving burdens, risks of gender-based violence, and economic vulnerabilities" (Statistics Canada, 2020, p. 4). Among the participants, 46% of Indigenous women and 32% of Indigenous men described their days during COVID-19 as being "quite a bit stressful" or "extremely stressful" and reported having symptoms of anxiety (Statistics Canada, 2020). Overall, higher proportions of Indigenous participants reported having poor mental health and higher stress and anxiety than non-Indigenous people. The COVID-19 pandemic exacerbated this dynamic.

METHODS

In March of 2020 the COVID-19 pandemic was in full swing. During this time the University of Toronto put a halt to all in person interviews and data collection. This meant that the ethnographic research we were conducting with Indigenous women in Toronto had to pause. During this time we began to wonder about the challenges Indigenous women faced during the pandemic? Given this interest and a small grant provided by the Sociology department at the University of Toronto Mississauga we decided to ask Indigenous women about their experiences during COVID-19. We decided to conduct follow-up interviews with individuals included in our larger study on Missing and Murdered Indigenous women in Toronto. In other words, we had established relationships with our participants and reached out again after the start of the COVID-19 pandemic. These relationships made including them in this study less challenging.[1] This is especially important given the negative history between researchers and Indigenous peoples in Canada and across the world (Wilson, 2008). When conducting research involving Indigenous people in Canada, it is crucial to be aware and cognizant of the traumatic history and ongoing harm and exploitation researchers can inflict on this community. We attempted to not contribute to this negative history during this research. Additionally, while we focused on women we already knew, we were also open to speaking with people other individuals who are respondents suggested we include.

During a period of 6 months, we conducted a series of semi-structured qualitative interviews with Indigenous women living in Canada.[2] We initially reached out via email or text message to gauge the interest of potential participants. Thirteen individuals returned our correspondence. We then conducted a series of hour-long interviews via phone and video call which took place during one of the various lockdowns that occurred in the city. Most of the interviews took place during the day and we used handheld records to document our conversations. We allowed respondents to choose their preferred method of communication for these interviews. During these calls, two researchers were present. One asked interview question, and another took field notes. After conducting these interviews, we mailed all participants a $50 gift card. Additionally, we informed them that they could change their mind about participating in this study and still keep their compensation.

All the women in this study self-identified as Indigenous from various nations in Canada. They ranged in age from 22 to 60. Most were experiencing economic hardship during the time, which was largely related to COVID-19. All research in this study was approved by the ethics board at our respective universities and received consent/assent from the interviewees. Fieldnotes and interviews were transcribed verbatim by authors. The authors then used *Dedoose,* a qualitative data analysis software package, to code these documents. During the coding process we looked for patterns or recurring themes in our interviews in notes. We then grouped these patterns into larger "themes." Themes that appeared the most became the foundation of the findings we describe later in the paper. This method of analyzing, organizing and coding ethnographic data follows the process described in Emerson et al. (1995). Apart from what we share in this paper women's problems with finances, home schooling children and themselves as well as access to transportation also emerged as a prominent theme and will form the basis of a separate publication. We included a **Table 1** with participants demographic information at the end of this document.[2] This is information our participants shared during the interviews.

Reflexivity

Reflexivity allows scholars to connect their experiences of oppression and privilege to their research activities (Rios, 2011; Flores, 2016; Flores et al., 2019). It reveals the tenuous lines involved during empirical research that include relations between researcher and self, researcher and participants, and researchers and their readers/audiences (Doucet, 2008). Both authors share a background in ethnographic training and a commitment to

[1]While we prefer doing interviews and fieldwork in person. Doing virtual fieldwork was not particularly challenging. We believe this was the case given our existing relationships with women we interviewed.

[2]All of the women we interviewed self-identified as Indigenous. For the parts of this chart were information is not available "N/A" this was due to respondents not sharing this specific information for personal reasons, reasons related to anonymity or they simply did not want to share this information.

TABLE 1 | Participants information.

Name	Ethnicity/nation	Age	Socioeconomic status	Education	Number of children
Susan	Algonquin	61	N/A	College graduate	0
Ciara	N/A	36	Middle	College graduate	4
Jenny	White Fish River First Nation	50	Low	N/A	2
Lina	N/A	54	Low	N/A	0
Gina	N/A	23	Low	University graduate	2
Alice	Ojibway	35	Low	Partial high school	6
Jennifer	Métis	40	Middle	University graduate	3
Patty	N/A	27	N/A	Partial high school	0
Laura	Six Nations	57	N/A	College graduate	3
Erin	N/A	60	Low	Partial high school	3
Robin	N/A	N/A	Low	High school graduate	1
Lana	First Nations	N/A	Low	Partial university	2
Jill	Mi'kmaq	25	Upper	University graduate	0

social justice. Additionally, the first author is an Indigenous Latino from working class background and the second author is white from a middle-class background. Despite this, we know we occupied a privileged position doing this work and attempted to be as sympathetic and helpful as possible. This included providing a list of local resources along with the compensation our participants received. Additionally, we had multiple organizations who had previously agreed to provide services if a crisis emerged. Throughout the analysis, we strived to represent women's narratives and ways of knowing, conscious of our privilege and with an unwavering commitment to their voices. Additionally, we shared our professional experience as well as information about our lives. Answering any questions participants had about us, our university affiliation, or the goals of our research.

Benefits and Risks of Study Participation

This study was conducted during a particularly difficult time for research, during the early stages of the COVID-19 pandemic. As such, there are multiple potential benefits and risks for the Indigenous women who participated in this study. To mitigate potential risks interviews were conducted remotely in order to product participant and project staff health and reduce any potential for COVID-19 exposure. An additional benefit of this approach was that participants could more easily schedule interviews around their schedules as well as it mitigated the need to arrange transportation to an interview location. A primary benefit being the potential therapeutic nature of having a venue to express and talk about one's experiences during times of high stress such as during tumultuous time of COVID-19. Alternatively, this same potential benefit may be a potential risk for participants if discussing the experience surrounding COVID-19 were to trigger unpleasant or stressful thoughts.

RESULTS

We describe the major themes that appeared in our research below in three small sections. The first addresses the negative effects COVID-19 had on the women we interviewed. The second deals with our participants and their inability to access health care during this time. Finally, we discuss how extended lockdowns and this pandemic resulted in women's increase use of drugs, alcohol, and tobacco.

Mental Health

Out of the thirteen Indigenous women we spoke to, one of the most prominent themes that emerged was a general decline in individuals' mental health. Almost all the respondents we spoke with discussed how the COVID-19 pandemic, regional lockdowns, and the closure of schools and services negatively affected their mental health. This was exacerbated by women's gendered responsibilities like providing caretaker responsibilities and helping children with online education. Additionally, the women we spoke to discuss the multiple economic challenges associated with this pandemic and how it exacerbated their mental health. Two respondents said the following:

> *I think the mental part is that is a big factor. [I got laid off] and there's been months where it's like, oh, my God, my rent, you know, my rent's expensive, I pay, you know, quite a bit amount of money on rent, right? And then it's like, "What do I do? Do I sacrifice my rent? Because we're going to go on another shutdown again, I need to buy groceries."… and then my son's like, I just wish this COVID would go away. You know, my daughter, you know, 16 wants to get out and about but can't get out and about… they're both isolated. And some days are rougher and tougher in school, you know what I mean? And, it's hard to watch my son trying to do his, excuse me, try to do his work. And I don't have the proper skills to teach him how to tell time, how to do division and multiplication and stuff like that, right? So, I try my best.* (Jennine)
>
> *Everything's really scary. My anxiety level is sky-high every time I go out or anything. I already had issues with my anxiety.* (Laura)

Jennine and Laura summarize the multiple challenges they have experienced during COVID-19. Jennine specially describes how these challenges have created additional stress in her life, resulting in her declining mental health. Her status as a single mother

also exacerbated these challenges. While previously she could access support from her family, the COVID-19 pandemic has prevented this type of contact. This has resulted in her taking on the responsibility of homeschooling her children, providing meals, and engaging in other household responsibilities. She noted how the additional responsibilities and the inability to rest, was severely affecting her mental health. The recent loss of her job also exacerbated her mental health decline. Laura describes how this pandemic has exacerbated her existing anxiety issues which are severely triggered when leaving her home which presents the elevated risk of contracting this virus. Respondents also describe existing mental health issues like anxiety and post-traumatic stress disorder becoming worse during multiple lockdowns. Jennine, Laura and the experiences of other women in our study are consistent with other work dealing with Indigenous peoples. This small body of research demonstrates that Indigenous communities more so than other populations were adversely affected by the lockdown measures, physical distancing, and the pandemic as a whole (Statistics Canada, 2020).

There is evidence in the existing literature base that the qualitative findings on the impact of COVID-19 on mental health are not limited to the current study population. One cross-sectional study in Canada indicated an increased mental health concern burden among Indigenous participants surveyed, compared to white or Asian study participants (Lawal et al., 2021). Previous research has indicated that financial stresses and "food worry" exacerbate COVID-19 related health concerns among Canadians; food worry was associated increased odds of participants feeling anxious or worried as well as increased suicidal thoughts, even after controlling for other factors (McAuliffe et al., 2021). Taken together there is increasing evidence that the COVID-19 pandemic has and is continuing to impact the mental health and wellbeing of persons across the globe, with Indigenous populations being disproportionately vulnerable due to historical and structural inequities.

Access to Health Care

The women we spoke to mentioned having a difficult time accessing health care during the pandemic. This included difficulty physically going to healthcare providers and issues accessing medical care remotely. For example, our respondents mentioned difficulty using online-based medical care. Our respondents mentioned feeling awkward or lost during these phone appointment conversations.

> *And then you know, I mean, it was only a five-minute call. I find my doctors a little bit dimwitted and a bit rushed. So, you know… You're on the phone. You're trying to think. I booked an appointment with my doctor, I booked it in September. And my virtual interview or whatever interview over the phone was a month later.* (Jenny)
>
> *It's hard to go to the doctors and stuff like that. So, I'm- sometimes when I even have to go and see my doctor it's hard for me to get down there.* (Alice)
>
> *I have taken 2 COVID tests... so far. But that's just to make sure that I'm safe… did go to… the Aboriginal Bus that kind parked somewhere, and if you need a COVID test, you can just go there and you don't have to make an appointment and wait a couple of days. You just gotta find the bus, where it's that day.* (Jennifer).

Both Jenny and Asley discuss the challenges they had accessing healthcare. Jenny mentioned the general challenges of using remote health services. She felt uneasy using these services, and it seemed as if the physician was rushed and, in a hurry, to end the call. Alice was unable to access medical care given their limited access to technology. So, the only option was to access services in person. However, at the start of the COVID-19 pandemic, Alice could not receive medical attention in person. In her case, she had bronchitis which made it difficult to wear a mask. With masks restrictions in Toronto and no access to a medical note, she has been home bound for approximately a year. The inability to gain medical care also extended to accessing mental health services. Jennifer was able to access medical services but only by relying on an Indigenous based mobile van. Taking this approach, she was able to speak to someone in person and without needing an appointment. However, she first needed to find this bus which she did via social media or by contacting her networks. Women unfamiliar with these services faced similar changes to those of Jen and Alice. These findings are even more jarring given the widely accessible health care system in Canada.

Changing access to healthcare due to COVID-19, including difficulty seeing a doctor in person and increases in telemedicine may prove problematic in a variety of ways, for example, one commentary in the Journal of Substance Abuse Treatment indicated a series of challenges including increased prescription flexibility, which at times helpful, might contribute to the illicit and harmful use of certain controlled substances such as opioids (Wendt et al., 2021). Further, there is evidence of high prevalence of mental health concerns (moderate- to high depression, anxiety, stress, and low levels of wellbeing) among Indigenous populations in Bangladesh (Faruk et al., 2021). It is possible that similar results are to be found in Canada and globally.

COVID-19 and Increased Substance Use

Our respondents discussed an increase in the consumption of alcoholic beverages. This was directly tied to the COVID-19 pandemic, lockdown measures and spending extended periods indoors. Ciara mentioned the following: "I just started drinking really heavily. I drink about a 12 pack a day now." When we asked Jenny about how COVID-19 has affected her drinking, she said, "I think it was excessive." For multiple respondents, their drinking became so acute that they began having problems paying for everyday living expenses like food and rent. With the general lack of medical, mental health and rehabilitation treatment, these problems have gone unchecked.

The people we spoke to also began to use drugs at higher rates than before. Most respondents began to use cannabis more frequently compared to other drugs. However, some respondents reported using other drugs like pharmaceutical pills and heroin. When we asked if her drug use had increased, Alice said the following: *"Yes, yes, yes. I smoke marijuana a lot now." (all drug use) Yeah, it's definitely gone up. Two other respondents said shared this during an interview:*

> *Well at the beginning of the pandemic, or whatever I kind of hampered down. Like a couple of years ago, I've never been into weed or marijuana or whatever you wanna call it, it was never something typically and I was never into drugs my whole life… And*

at the beginning of this whole thing, there was nothing to do and there were edibles and I could smoke. Whereas, in the past I've used it from my insomnia. (Robin, Age-N/A)
I smoke marijuana and I feel like I smoke more of everything since the start (of covid). (Gina)

The respondents included in this study shared similar sentiments to Robin, Alice and Gina. Most noted an increase in the use of drugs, with marijuana being the most widely used. However, the individuals we spoke to also reported using drugs in combination with other substances like alcohol. The increase was directly tied to COVID-19 and lockdown measures in their respective region.

Finally, our respondents also mentioned an increased use of tobacco products. This mostly included prepackaged cigarettes. With the lack of social interaction and the increased monotony of staying home, the individuals we spoke to began to fill their time with smoking on a more regular basis.

Yeah, it's definitely gone up, definitely. I noticed especially at the beginning of the pandemic I was smoking – I don't usually smoke at work, and I was finding myself going on break at work and buying a pack of cigarettes. (Patty)

Alice shared a similar sentiment:

…all the money that I get [goes] to my drinking and my weed smoking and my cigarettes take up all that money. It's mostly food. Like I don't know where to go get food.

Most of our respondents discussed an increase in the use of tobacco products. While some used vapor pens or e-cigarettes, most smoked traditional cigarettes. Although this initial increase began due to stay-at-home orders, it continued as the pandemic progressed. Given the already precarious financial status of many of our respondents, they often began to experience economic hardships due to their increased tobacco and substance consumption. While the existing evidence in Canada is limited, there is This troubling finding is in concordance with a study from the United Kingdom (U.K.), which documented not only increases in alcohol consumption from before the pandemic among study participants, but also a statistically significant relationship between alcohol use and mental health (Jacob et al., 2021).

DISCUSSION

In agreement with the limited existing scientific data and anecdotal data, our qualitative research suggests that COVID-19 has had a profound impact on the Indigenous women interviewed in terms of stress levels, mental health, and wellbeing, as well as corresponding increases in their substance use. There is evidence of increased mental health concerns due to COVID-19 across the globe (Dong and Bouey, 2020; Fiorillo and Gorwood, 2020; Passos et al., 2020; Sheridan Rains et al., 2021). Further, there is emerging evidence that some women may be at increased risk for adverse mental health concerns related to COVID-19; particularly in relationship with maternal health, pregnancy and increased domestic violence concerns (Almeida et al., 2020; Ayaz et al., 2020; Salehi et al., 2020; Sediri et al., 2020; Sharma et al., 2020). Further, a letter to the editor addresses the disparate need to address increased mental health concerns among Indigenous populations globally due to the impact of the COVID-19 on already marginalized populations (Júnior et al., 2020). This, coupled with a study in Canada indicating increased mental health concerns associated with the pandemic among Indigenous populations compared to white and Asian populations (Lawal et al., 2021) indicates an increased need for both research and prevention efforts.

According to respondents, COVID-19 related Mental Health concerns were exacerbated by stressors related to school closures and economic concerns associated with the pandemic. In addition, some respondents (10) reported losing their jobs or resorting to being self-employed, adding to the stress of an already stressful time. This had a particularly strong impact for women participants, given gendered norms and expectations of child-rearing, leaving one respondent feeling that she must choose between her children's education and paying rent, as well as helping to manage her children's stress and mental health concerns regarding the pandemic.

Further, contributing to stress and economic concerns, study respondents reported having difficulty accessing health care services (including much needed mental health services), despite much of medical care going online during the pandemic. Further, pre-existing health concerns limited some participants' ability to participate in in-person care even when it was available due to mask restrictions and inability to breathe.

There is evidence that there is a lack of sufficient mental health services to address reported increased mental health concerns among Indigenous populations due to the COVID-19 pandemic (Júnior et al., 2020), increased resources are needed to combat this important public health concern. There is a continued call to leverage the COVID-19 pandemic to decolonize and improve Indigenous health in Canada and globally (Júnior et al., 2020; Richardson and Crawford, 2020).

Regarding substance use our findings were in agreement the limited available literature demonstrating an increase in substance use during the pandemic (Jacob et al., 2021), the female participants indicated increases in commercial tobacco, marijuana and alcohol consumption, even among those who either infrequently or did not use substances before the COVID-19 pandemic. These observations are in line with widely held theories on stress, coping and substance use.

A great strength of this study is that we utilized existing community relationships to quickly identify some critical COVID-19 related stress, mental health and increased substance use issues among Indigenous populations in the Greater Toronto Area. This study is not without limitations. Our small sample size ($N = 13$) and the qualitative nature of the project means that we are unable to generalize to wider Indigenous populations in the Greater Toronto Area or the rest of Canada. However, this qualitative study gives us preliminary evidence to move forward with future research and partnerships with Indigenous peoples to better understand the current and future impacts of COVID-19 on the mental health and wellbeing of Indigenous populations. Future mixed-methods work is needed to confirm generalizability

and better understand these concerns both qualitatively and quantitatively.

Documenting health equity issues is one of the first steps in addressing health disparities. The current study has important implications for future research and policy surrounding COVID-19 and Indigenous health in Canada. It points to a need for increased resources targeted toward Indigenous populations. In particular, the study's findings document a need for not increased culturally appropriate mental health and financial resources, and funding of said resources, targeted to meet the needs of Indigenous populations in Canada. Community leaders, public health professionals, government officials and advocates can use study findings to better address social and policy gaps surrounding COVID-19, mental health and underlying risk factors for Indigenous communities in Canada and globally.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because participants did not give permission for the data to be public. Requests to access the datasets should be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Toronto Research Ethics Board (RIS Human Protocol Number: 36345). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Suicidality Related to the COVID-19 Lockdown in Romania: Structural Equation Modeling

Anca-Livia Panfil[1], *Diana Lungeanu*[2*], *Simona Tamasan*[1], *Cristina Bredicean*[3,4], *Ion Papava*[3,5], *Daria Smirnova*[6,7†] *and Konstantinos N. Fountoulakis*[8,9†]

[1] Liaison Psychiatry, "Pius Brinzeu" County Emergency Hospital, Timisoara, Romania, [2] Department of Functional Sciences, Center for Modeling Biological Systems and Data Analysis, "Victor Babes" University of Medicine and Pharmacy, Timisoara, Romania, [3] Discipline of Psychiatry, Department of Neuroscience, NEUROPSY-COG Center for Cognitive Research in Neuropsychiatric Pathology, "Victor Babes" University of Medicine and Pharmacy, Timisoara, Romania, [4] Psychiatry Compartment, "Dr. Victor Popescu" Emergency Military Clinical Hospital, Timisoara, Romania, [5] "Eduard Pamfil" Psychiatry Clinic, "Pius Brinzeu" County Emergency Hospital, Timisoara, Romania, [6] International Centre for Education and Research in Neuropsychiatry (ICERN), Samara State Medical University, Samara, Russia, [7] Department of Psychiatry, Narcology, Psychotherapy and Clinical Psychology, Samara State Medical University, Samara, Russia, [8] 3rd Department of Psychiatry, School of Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece, [9] Mental Health Section, Research Institute, Panhellenic Medical Association, Thessaloniki, Greece

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***Correspondence:**
Diana Lungeanu
dlungeanu@umft.ro

† These authors share senior authorship

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Background: Suicidality is a serious public health concern at a global scale. Suicide itself is considered to be preventable death; worldwide, suicide rates and their trends are under constant scrutiny. As part of the international COMET-G cross-sectional study, we conducted a national level investigation to examine the individual disturbances (such as anxiety, depression, or history of life-threatening attempts) and contextual factors (such as adherence to conspiracy theories or Internet use) associated with suicidality related to the COVID-19 lockdown in a lot of Romanian adults.

Participants and Methods: One thousand four hundred and forty-six adults responded to an anonymous on-line questionnaire, with mean age ± standard deviation of 47.03 ± 14.21 years (1,142 females, 292 males, 12 identified themselves as non-binary). Data were analyzed using descriptive statistics and structural equation modeling (SEM).

Results: Univariate analysis showed strong significant correlation between anxiety and depression scorings among the respondents (Spearman R = 0.776, $p < 0.001$). Both the suicidality scorings and the Internet use correlated fairly with anxiety and depression, with two-by-two Spearman coefficients between R = 0.334 and R = 0.370 ($p < 0.001$ for each). SEM analysis substantiated the emotional disturbances, previous life-threatening attempts, and younger age as significant predictors for suicidality. The patterns of reality reading (including religious inquiries, Internet use, and beliefs in conspiracy theories) did not reach the statistical significance as influential factors in the suicidality of these respondents. There was no covariance between the Internet use and belief in conspiracy theories.

Conclusion: The study confirmed the suicidality risk initially hypothesized as being associated with the history of life-threatening attempts, increased depression within the

younger population, and higher anxiety during the first year of the COVID-19 pandemic and its related lockdown. National strategies for effective interventions at various levels of the healthcare system should be developed.

Keywords: suicide, suicidal ideation, SEM, anxiety, depression, self-harm behavior

INTRODUCTION

Suicidality is a serious public health concern at the global scale, affecting millions of people, their families, and society itself (1). The term "suicidality" includes suicidal ideation (SI, such as serious thoughts about taking one's own life), suicide plans, and suicide attempts (2). Significant resources and efforts have been focused on a better understanding of its underlying etiology, assessing the risks, and designing effective solutions at different levels of interventions (3). Suicide itself has been linked to the well-documented psychopathological risk predictors (such as suicidal behavior, history of self-harm and suicidal attempts), but there also are wide variations in suicidality indicators and suicide rates across countries and cultural environments (2, 4–13). Compared to other parts of the world, Europe is characterized by relatively high suicide rates, namely 10.5 (8.3–13.6) per 100,000 people per year (11, 12, 14). Depression has been acknowledged as a major risk factor for suicidality (15) and several studies have pointed toward anxiety as a major risk factor as well (16, 17). Demographic factors (e.g., young age, male gender, or ethnicity), social status (e.g., low income, income inequality, unemployment, low education, and low social support), social changes, neighborhood (e.g., inadequate housing, overcrowding, or violence), and adverse environmental events (e.g., climate change, natural catastrophe, war, conflict, and migration) were also linked to suicidality. Surprisingly, reported global trends for suicide rates and suicidal behavior demonstrated a stability not only before, but also in the early months of the COVID-19 pandemic (18).

On the other hand, the COVID-19 pandemic onset had a disruptive impact on societies, with global devastating consequences (19). As more and more countries instituted total lockdown, various reports pointed out that such measures exacerbated mental health issues, although the interventions were acknowledged as necessary and effective in stopping the spread of the virus (20–22). Some researchers focused on segments of the population at a higher risk, such as the youth or the frontline healthcare workers (23–26). Furthermore, the general population experienced exacerbated anxiety, with additional symptoms of depression, psychosis, panic attacks, trauma and suicidal ideation that seemed to exceed the experience in the previous SARS and MERS outbreaks (27). There were case reports of unusual neuropsychiatric manifestations like catatonia (28), but results regarding the rates of suicide behavior, attempts, ideation, and self-harm during the COVID-19 pandemic have varied and have been inconclusive (18, 29). The dramatic societal changes, serious environmental incidents, and a rise in family violence have been registered among the most influential factors highly correlated with the suicide risks during the period and after the COVID-19 total lockdown (30–32). Consequently, there were several warnings issued regarding the mental health in general (33) and suicidality in particular (34). In extraordinary times, such as the COVID-19 pandemic and the associated lockdown, suicide was rather unpredictable, with questionable dynamic rates. The suitable timeframe for assessing causal psychological changes and factors' inter-relationships arouse controversy over the gauging limitations, although memory-based retrospective assessment on behavioral and complex emotionality would offer the means to circumvent the distorting irrelevant momentary details and grant a respite for the emotions to settle and restructure (35).

Suicidality in Romania

In 2019, Romania reported an age-standardized suicide rate of 7.3 per 100,000 people per year, thus falling under the global age-standardized suicide rate of 10.5 per 100,000 people per year (14). Reported trends for suicide rates had been constantly decreasing since 2012, though with a consistent difference between sexes (i.e., females had a much lower rate than men) (36). To our knowledge, data on suicide risk factors in Romanian adult population has been scarce and of suboptimal quality.

On 16 March 2020, a state of national emergency was declared in Romania and total lockdown was instituted for 60 days, which brought a considerable burden of mental health consequences. A large community of migrant workforce in the Western Europe (over three million citizens), who massively returned home when the pandemic began, made Romania unique among the countries in European Union. Additional hurdles challenged the implementation of the protective measures: intrinsic weaknesses of the national healthcare system (e.g., aging infrastructure, low national health expenditure, and reported corruption), and one of the most religious populations in Europe (37, 38). Most Romanians identify themselves as Orthodox Christian, a highly conservative denomination, which was slow to react during this crisis (39). Notwithstanding these characteristics, psychological investigations in this period have reported the general population as being stable (40, 41), although actual information on suicide and suicidality is still too little.

Objective of the Study

In this paper we report the results of a national sub-set analysis comprised in the international COMET-G study (*COVID-19 MEntal health inTernational for the General population*) and based on the data from the Romanian population. In the pandemic context, the COMET-G study (22) aimed at investigating levels of depression, changes in anxiety, distress, suicidal ideation, and spreading of conspiracy theories in relation with a number of personal and interpersonal variables. Some

national level findings have already been reported (21, 23, 42–45) along with the comprehensive report of the international study (22).

The specific target of this national level investigation was to examine the individual and contextual factors associated with suicidality in the Romanian adult population in the context of the COVID-19 pandemic related lockdown, which provoked major societal turmoil.

The main objective was to investigate the association of suicidality with individual proximal disturbances (such as anxiety and depression) and a history of life-threatening events. We also hypothesized the following secondary aims to be scrutinized: (a) contextual factors such as adherence to conspiracy theories propagated through the classical media and the Internet would play a significant role in suicidality; in addition, traditional cultural factors such as religiosity would also influence the individual pattern of reality reading and subsequent suicidal ideation; (b) socio-demographic factors (such as age and level of education) would play a role in suicidality.

Figure 1 illustrates the main objective and the secondary aims of this analysis. The conceptual framework included: suicidality, emotional disturbances, life threatening attempts and reality reading patterns. Suicidality refers to the "*risk of suicide, usually indicated by suicidal ideation or intent, especially as evident in the presence of a well-elaborated suicidal plan*" (46). Emotional disturbances comprise of three theoretical dimensions: emotional disturbances, emotion intensity/regulation disturbances, and emotion disconnections (47). Emotion intensity/regulation disturbances were mostly captured in the COMET-G study. Life threatening attempts encompassed the suicide attempts and the history of self-harm. Reality reading patterns would arise from the philosophical debate over the nature of conscious experience (48). The notion of indirect realism was extended to the reality perception in regard to the arising conspiracy theories, Internet use, and change in religiosity during the unfolding pandemic.

MATERIALS AND METHODS

Participants and Procedures

The study followed the cross-sectional COMET-G study protocol (22). The anonymous questionnaires (available in the **Supplementary Material 1**) gathered demographic data, general health data, previous psychiatric history, current symptoms of anxiety, depression and suicidality, and data regarding the changes caused by the lockdown in sleep patterns, sexual life, family relationships, finances, eating behavior, physical exercising, and religiousness/spirituality. Beliefs regarding the COVID-19 outbreak, perceived efficacy of the lockdown measures, and conspiracy theories were also investigated.

The international questionnaire was translated into Romanian according to established standards (49). Independent translation and back translation were conducted by two Romanian- English speaking authors. Following the Delphi technique, a panel of professionals agreed upon the final version that was deployed.

Retrospective data were collected online from 1 June to 23 December, 2020 (total lockdown had been instituted in Romania from 16 March until 15 May, 2020). Participants were instructed to give answers referring to their state and mindset during the total lockdown. No identification information was collected. Participants were able to access the survey and complete their responses only after reading and acknowledging the information regarding the study (i.e., the cover story): aim of the research, organizations involved and their contact information, and planned use of collected data. This acknowledgment served as the on-line form of informed consent. Announcement and advertisements were placed on social media, and distributed *via* e-mail and other instant messaging Apps.

Ethical approval (no. 194/ 4 June, 2020) was issued by the Ethics Committee of the "Pius Brinzeu" County Emergency Clinical Hospital, in Timisoara, Romania.

Instruments for Data Collection, Measures

Symptoms of anxiety were evaluated with State-Trait Anxiety Inventory (STAI), the S-Anxiety scale (STAI-Y1) (50). The STAI consists of 20 items that evaluate the respondent's current feelings on a 4-point Likert type scale. It is often employed for general and clinical populations (51) and had been used in Romania (52, 53).

Depression was evaluated with the Center for Epidemiological Studies-Depression Scale (CES-D), a popular and widely used instrument, based on self-reporting (54–56). It consists of 20 items that cover affective, psychological, and somatic symptoms (57), and had also been applied in Romanian population (56, 58–60).

Suicidality was evaluated with the Risk Assessment Suicidality Scale (RASS) (61), a self-assessment instrument. The last two RASS items were separately analyzed: RASS_11, "*Have you ever hurt yourself in any way deliberately, during your whole life so far?*"; RASS_12, "*Have you ever attempted suicide, during your whole life so far?*". Each statement employed a 4-point Likert-type scale: 1 = not at all, 2 = a little bit, 3 = much, 4 = very much. An additional RASS-related item was included: "SI (Suicidal ideation) change," "*How much has your tendency to think about death and/or suicide changed, compared to before the outbreak of COVID-19?*". This instrument used a 5-point range: 2 = Very much increased, 1 = Increased a bit, 0 = Neither increased, nor decreased, −1 = Decreased a bit, −2 = Very much decreased. RASS had not been previously adapted for the Romanian population. Therefore, a confirmatory factor analysis (CFA) was conducted to verify its validity, based on the originally reported factors: "fear," "intention," and "life" (61).

Three additional Likert-type scales (designed for this study and included in the **Supplementary Material 1**) measured the extent of Internet use, belief in conspiracy theories, and the individual's religiosity. These scales underwent only face analysis prior to their deployment. CFA was conducted for the variables of Internet use and beliefs in conspiracy theories, which have been taken together as contributors to the patterns of reality reading.

Definition of Latent Variables Based on the Manifest Exogenous Variables

Suicidality (*S*) was inferred from the total score of the first 10 items of RASS (*RASS tot*) and from the change in suicidal ideation (*SI change*). Observable emotional disturbances (*ED*) were measured by the total score for STAI-Y1 (*STAI tot*) and total

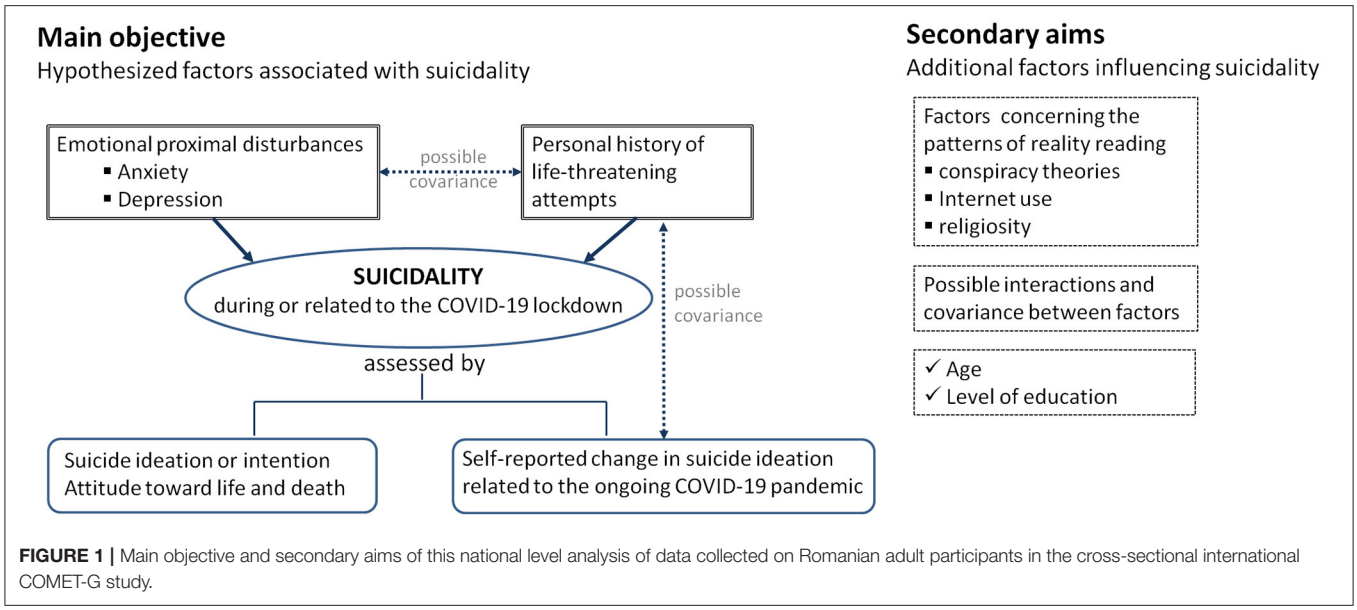

FIGURE 1 | Main objective and secondary aims of this national level analysis of data collected on Romanian adult participants in the cross-sectional international COMET-G study.

score for CES-D (*CES tot*). Life threatening attempts (*LTA*) was a latent variable based on the items of RASS_11 (*RASS 11 self-harm*) and RASS_12 (*RASS 12 suicide*). Reality reading patterns (*RRP*) were inferred from the change in individual's religiosity or spirituality inquiries (*Relig increase*), belief in conspiracy theories (*Consp theories*), and *Internet use*.

Data Analysis

Descriptive and Exploratory Statistics

Scale scores were treated as rank variables and described by the median (Inter Quartile Range). Descriptive statistics included the observed frequency counts (percent) for categorical variables or particular scales' selected items of interest. Normality of numerical variables was tested with the Shapiro-Wilk statistical test; these variables were described by the sample's mean and standard deviation (SD) when normally distributed, or by the sample's median (Inter Quartile Range–IQR) accordingly. The actual reliability of scale measurements was assessed based on the Cronbach's alpha: values >0.8 were considered to indicate good internal consistency, but scales with very few items were not discarded solely based on this coefficient. Cronbach's alpha actual values were reported for each scale with more than one item. The Harman's single factor method was applied to examine the amount of common method variance affecting the multi-item scales which had not undergone previous validation, other than face validation during the development stage. Harman's single factor method indicates possibly problematic common method bias (62). Separate application of the CFA marker technique to quantify the actual common method variance was unsuitable for scales taken in isolation, with possible additional issues related to the post-hoc choice of the marker (63). Non-parametric Spearman correlation approach was used to explore the covariances between various scales' scores employed in this study.

All reported probability values were two-tailed. A 0.05 level of significance was set, and highly significant values were also marked. Data were analyzed with the statistical software IBM SPSS v. 20.0 (Armonk, New York, USA) and the software packages R v. 4.0.5 (https://cran.r-project.org/).

Structural Equation Modeling and Confirmatory Factor Analysis

Based on the study specific target, structural equation modeling (SEM) was employed to investigate the structural connections between latent variables underlying the actual scores measured in the collected data. SEM was the method of choice for this analysis for its mathematical and statistical characteristics, i.e., a combination of model's structural features defined by equations, followed by their estimation across the available data based on the matrix algebra and generalized linear models. SEM is commonly used in the fields of social and psychological sciences for identifying hypothesized latent variables, which cannot be directly observed and measured. It also allows a simultaneous statistical estimation procedure, rather than separately estimating each part of a model, an approach which is believed to increase the overall accuracy (64).

We started with a nucleus model based on the main objective and its associated research hypotheses regarding the individual proximal disturbances (i.e., anxiety and depression) combined with a history of life-threatening attempts which would increase the suicidality related to the lockdown, thus including the endogenous latent variables of *ED*, *LTA*, and *S*. This model comprised previously validated scales as exogenous variables. In the following step, based on the secondary aims, we added the additional latent variable *RRP* in the model, which included the one-item change in individual's religiosity or spirituality inquiries, and the two multi-item scales for belief in conspiracy theories and Internet use (all three with only face validation). Furthermore, to this extended model we

added two additional variables describing socio-demographic individual characteristics as potential independent predictors in the regression with *S* as an outcome. This approach yielded three SEM models, reflecting the results with reference to the main objective and the two secondary aims, respectively.

For all observed variables included in the models, the min-max rescaling was applied in order to preserve the shape of the original distributions and to retain the importance of outliers. The features would range as [0, 1] for all observed variables except for the change in suicidal thoughts, which was rescaled in the range [−1, 1] such that "no change" would correspond to a nil score. For model fitting, the maximum likelihood (ML) with robust estimators was used, with adjustments for non-normality of some variables (64, 65). The non-linear box-constrained optimization using PORT routines (NLMIB) was employed as the optimization method. When defining the SEM models, we placed the focus on the theoretical basis and meaningfulness of the variables' inter-relations. Nevertheless, the models were compared regarding their fit statistics and the Akaike information criterion (AIC). The Vuong's closeness test based on likelihood ratio was applied for determining the statistical significance of the change in AIC values.

The CFA and SEM models' goodness of fit indices and their corresponding [cut-off] values were: model Chi-square test and the resulting *p*-value, [< 0.05]; Comparative Fit Index (CFI), [> 0.90]; Root Mean Square Error of Approximation (RMSEA), [<0.08 for a good fit, and up to 0.1 for marginal fit]; Standardized Root Mean Square Residual (SRMR), [<0.08].

The levels of statistical confidence and significance were 0.95 and 0.05, respectively, except for the RMSEA fit index, for which the confidence was explicitly specified to be 0.90. All reported probability values were two-tailed. We conducted the analysis with the statistical packages R v. 4.0.5 (including "*lavaan*" v. 0.6-9, "*semPlot*" v. 1.1.2, and "*nonnest2*" v. 2020-07-05).

TABLE 1 | Confirmatory factor analysis (CFA) for the first 10 items of the RASS scale based on the three factors originally identified (fear, intention, and life) and the newly developed scales for belief in conspiracy theories (7 items) and Internet use (3 items).

CFA model for the RASS scale			
Fear= ∼ RASS_1 *Intention = ∼ RASS_5 + RASS_6 + RASS_7 + RASS_8* *Life = ∼ RASS_2 + RASS_3 + RASS_4 + RASS_9 + RASS_10*			
Fit indices			
Chi-square test	**CFI**	**RMSEA**	**SRMR**
417.374 (df = 33) $p < 0.001$	0.941	0.090 90% CI (0.082; 0.098)	0.047
CFA model for the variables of the beliefs in conspiracy theories and the Internet use			
Consp = ∼ X.81_J1_ConspTheo_1 + X.82_J2_ConspTheo_2 + X.83_J3_ConspTheo_3 + X.84_J4_ConspTheo_4 + X.85_J5_ConspTheo_5 + X.86_J6_ConspTheo_6 + X.87_J7_ConspTheo_7 *Internet = ∼ X.88_K1_Internet_1 + X.89_K2_Internet_2 + X.90_K3_Internet_3* *Consp ∼∼ Internet*			
Fit indices			
Chi-square test	**CFI**	**RMSEA**	**SRMR**
3992.427 (df = 45) $p < 0.001$	0.910	0.085 90% CI (0.077; 0.093)	0.055

Items are coded according to the COMET-G protocol as they are presented in the ***Supplementary Material 1****.*

RESULTS

Confirmatory Factor Analysis and Harman's Test for the Scales at Their First Deployment in Romanian Population

CFA was conducted for the first 10 items of the RASS scale based on the three factors originally identified: fear, intention, and life. Results are presented in **Table 1**. All indices proved a good fit, except for the RMSEA, which was marginal. **Figure 2** illustrates the CFA path diagram and factors' loadings, confirming the balanced contribution of all items to the overall score, with reversed effect for items #3 and #9. The actual RASS scale measurements were confirmed as consistent with scale's hypothesized construct.

For the belief in conspiracy theories and Internet use, the Harman's single factor method resulted in 47.84 and 48.21%, respectively, of variance explained by one factor in exploratory factor analysis. These results on forced one factor model (namely less than 50% each) supported the further inclusion of the two scales in a SEM model. **Table 1** also includes the CFA results for these two scales. Similarly to the 10-item RASS scale, the fit indices were good, except for the RMSEA, which was marginal.

Descriptive Analysis of Socio-Demographic Characteristics, Self-Reported Health Data and Mental Disturbances of the Respondents

One thousand, four hundred and forty-six ($N = 1{,}446$) adults responded to the anonymous questionnaire: 1,142 were females (aged 46.83 ± 14.16 years), 292 were males (aged 47.64 ± 14.36 years), and 12 self-identified as "non-binary" (aged 51.58 ± 15.45 years). Details of the respondents' socio-demographic information, and data regarding education and employment are presented in **Tables 2A**,**B**, respectively. Additional self-reported health related data were included in **Supplementary Material 2**.

Table 3 presents the descriptive statistics for the scales' scoring totals, and the corresponding values of Cronbach's alpha for individual scales or RASS sub-scales (i.e., as they resulted from the CFA). Lower values of internal consistency can be noted for the three-item "Internet use" (alpha = 0.456). For the three individual RASS items (O11, O12, and O13), the median (IQR)

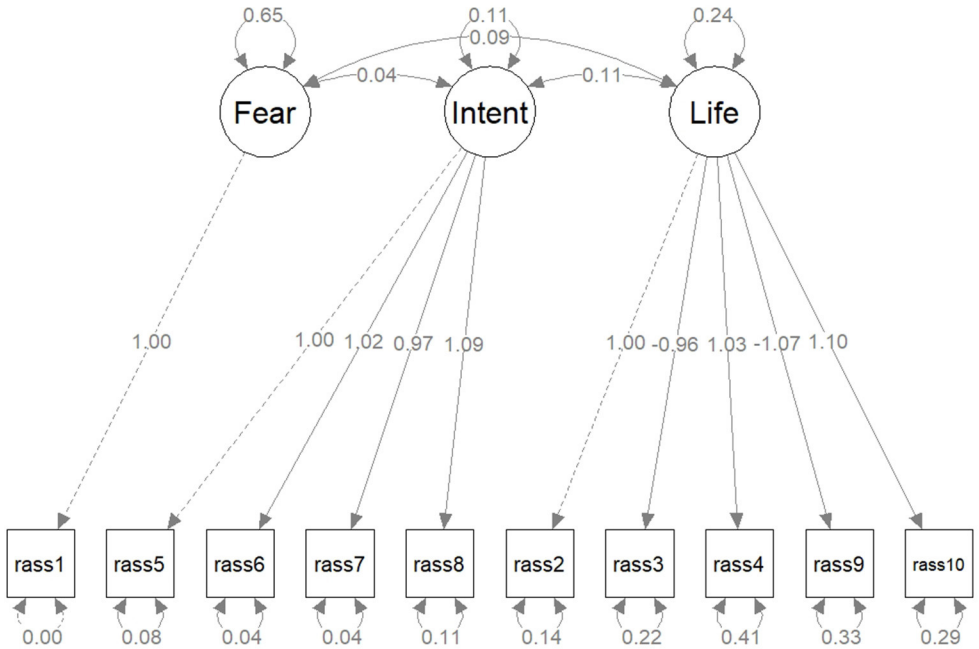

FIGURE 2 | The path diagram for the confirmatory factor analysis for the first 10 items of the RASS scale, based on the three factors originally identified: fear, intention, and life. Latent variables are drawn in circles and manifest variables are drawn in squares. The edge labels indicate the parameter estimates.

statistics were all nil. **Table 4** shows the distribution of the scores for these individual items and also includes the scoring distribution for the change in religious/spiritual inquiries, where the actual spread over the whole range is apparent.

Correlation between the scale scorings is presented in **Table 5**. The strong correlation between STAI and CES-D is noteworthy, although all scorings (except for the belief in conspiracy theories) were significantly two-by-two correlated. The belief in conspiracy theories showed a very weak or no relation to anxiety, depression, suicidality and Internet use.

Structural Equation Models

Table 6 shows the SEM models along with their statistical fit indices. We started with the nucleus Model 1, with reference to the main objective, which included three latent variables (*ED*, *LTA*, and *S*) and a regression (*ED* and *LTA* as predictors for S). In Model 2, we added an additional latent variable (*RRP*), which was included in the regression, as well. Model 3 kept the same latent variables, and also incorporated age and education as independent predictors in the regression. For all three models, we also investigated meaningful covariance. According to the Vuong's statistical test and the AIC, each model gave successively better description of the variables inter-relations, when compared to the previous one. For all three models, the fits indices reflected good reliability.

Table 7 presents the parameters for the SEM model 3 in detail. *ED* and previous *LTA* were significant predictors for *S*, while the *RRP* were not. In addition, the participants' age was a significant predictor (with negative regression coefficient), but the level of education was not. It is important to note the significant covariance between each of the three latent variables considered as predictors in the regression, namely *ED*, *LTA*, and *RRP*; there was a significant negative covariance between the previous *LTA* (RASS_11 and RASS_12 items) and the reported change in SI during the COVID-19 pandemic lockdown. There was no covariance between Internet use and beliefs in conspiracy theories.

Figure 3 shows the path diagrams for the SEM model 3. The latent variables are drawn in circles; the manifest variables are drawn in squares.

The parameters of the SEM model 1 and model 2, and their corresponding path diagrams are presented in **Supplementary Material 3**.

DISCUSSION

The present study on a lot of 1,446 Romanian adult participants in the international cross-sectional COMET-G study included persons aged between 19 and 84 years, with a mean of 47.03 years. More than 50% of the 1,446 respondents self-declared an increased level of religiosity and spiritual inquiries during the COVID-19 lockdown in the pandemic outbreak. Eighty-one percent self-reported no suicidality change, but more than 11% reported increased suicidal ideation during the lockdown. More than 10% of the 1,446 respondents admitted having a history of self-harm and more than 7% reported previous suicide attempts. In the structural models of suicidality, emotional disturbances and previous life-threatening attempts acted as significant predictors, while the patterns of reality reading were not.

TABLE 2A | Socio-demographic characteristics of the respondents.

Variable	Total *N* = 1,446	Female *N* = 1,142	Male *N* = 292	Non-binary *N* = 12
Age (years)				
mean ± std.dev.	47.03 ± 14.21	46.83 ± 14.165	47.64 ± 14.36	51.58 ± 15.45
(min–max)	(19–84)	(19–84)	(19–80)	(21–82)
Residence	*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
Rural area–village	262 (18.1%)	218 (19.1%)	40 (13.7%)	4 (33.3%)
Town (<20.000 inhabitants)	189 (13.1%)	148 (13%)	39 (13.4%)	2 (16.7%)
Town (20.000–100.000 inhabitants)	347 (24%)	278 (24.3%)	68 (23.3%)	1 (8.3%)
City (100.000–1 million population)	471 (32.6%)	357 (31.3%)	113 (38.7%)	1 (8.3%)
City > 1 million population	70 (4.8%)	62 (5.4%)	8 (2.7%)	–
Capital city	107 (7.4%)	79 (6.9%)	24 (8.2%)	4 (33.3%)
Marital status	*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
Single	224 (15.5%)	176 (15.4%)	46 (15.8%)	2 (16.7%)
Married (or in a civil partnership)	860 (59.5%)	657 (57.5%)	200 (68.5%)	3 (25%)
Divorced (or estranged)	98 (6.8%)	84 (7.4%)	14 (4.8%)	–
Live with someone without an official relationship	155 (10.7%)	128 (11.2%)	25 (8.6%)	2 (16.7%)
Widower	84 (5.8%)	80 (7%)	2 (0.7%)	2 (16.7%)
Other	25 (1.7%)	17 (1.5%)	5 (1.7%)	3 (25%)
Household people	*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
1	195 (13.5%)	166 (14.5%)	26 (8.9%)	3 (25%)
2	522 (36.1%)	401 (35.1%)	119 (40.8%)	2 (16.7%)
3	373 (25.8%)	294 (25.7%)	76 (26%)	3 (25%)
4	235 (16.3%)	187 (16.4%)	46 (15.8%)	2 (16.7%)
5	121 (8.4%)	94 (8.2%)	25 (8.6%)	2 (16.7%)
Children	n (% of N)	n (% of N)	n (% of N)	n (% of N)
0	416 (28.8%)	326 (28.5%)	88 (30.1%)	2 (16.7%)
1	494 (34.2%)	403 (35.3%)	87 (29.8%)	4 (33.3%)
2	414 (28.6%)	323 (28.3%)	88 (30.1%)	3 (25%)
3	79 (5.5%)	59 (5.2%)	19 (6.5%)	1 (8.3%)
4	43 (3%)	31 (2.7%)	10 (3.4%)	2 (16.7%)

Young age was also a significant predictor for suicidality. The construct of suicidality was based on the RASS total scoring and the change in suicidal ideation. Of the two, the change in suicidal ideation played a more consistent role. For emotional disturbances, both STAI-Y1 total scoring (anxiety) and CES-D total scoring (depression) contributed in a similar way. Previous life-threatening attempts were observed in terms of two items of the RASS scale regarding the self-harm and previous suicide attempts, both contributing to life-threatening attempts in almost equal terms. The patterns of reality reading encompassed the adherence to conspiracy theories, Internet use, and change in spirituality inquiries. The Internet use had the highest estimate and the conspiracy beliefs the lowest, although both had high statistical significance for reality reading patterns. Although the SEM models 2 and 3 which included them were significantly better compared to the nucleus model, their contribution to the suicidality proved insignificant. They might only indirectly contribute through their significant covariance with the emotional disturbances.

We compared the socio-demographic characteristics for our responders with the officially reported data on the general population of Romania (66–69): median age of 43.2 years, rural residence of 43.6% in the general population (compared to 18.1% among the respondents), 61.1% married (59.5% in our data set), 4.84% unemployed (1.1% in our data set), 51.4 % females (78.9% in our data set). Summing up, compared to the general population of Romania, the respondents in the present study were of similar age, higher urban representation, similar marital status, higher employment status, and higher female representation. In particular, the dissimilarities in females' proportion and unemployment rates could have an impact on the models' validity, due to their previously reported effect on suicidality. Despite these concerns, the rate of Internet users in Romania is high and 12 million people use social media in Romania, a country with 19.18

TABLE 2B | The respondents' education and employment data.

Variable	Total *N* = 1,446	Female *N* = 1,142	Male *N* = 292	Non-binary *N* = 12
Education	*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
Elementary school	46 (3.2%)	35 (3.1%)	6 (2.1%)	5 (41.7%)
High school (9–12 yrs)	366 (25.3%)	265 (23.2%)	99 (33.9%)	2 (16.7%)
Bachelor degree	652 (45.1%)	521 (45.6%)	128 (43.8%)	3 (25%)
University	89 (6.2%)	78 (6.8%)	11 (3.8%)	–
MA (MSc) degree	254 (17.6%)	216 (18.9%)	37 (12.7%)	1 (8.3%)
PhD	39 (2.7%)	27 (2.4%)	11 (3.8%)	1 (8.3%)
Employment	*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
Civil servant	463 (32%)	398 (34.9%)	63 (21.6%)	2 (16.7%)
Private clerk	314 (21.7%)	222 (19.4%)	88 (30.1%)	4 (33.3%)
Self-employed/freelancer	91 (6.3%)	67 (5.9%)	23 (7.9%)	1 (8.3%)
Retired	284 (19.6%)	215 (18.8%)	66 (22.6%)	3 (25%)
Unemployed	16 (1.1%)	10 (0.9%)	6 (2.1%)	–
Housekeeper	56 (3.9%)	55 (4.8%)	1 (0.3%)	–
Disability pension	21 (1.5%)	17 (1.5%)	4 (1.4%)	–
Allowance for health reasons	5 (0.3%)	4 (0.4%)	–	1 (8.3%)
University or college student	123 (8.5%)	100 (8.8%)	23 (7.9%)	–
Other	73 (5%)	54 (4.7%)	18 (6.2%)	1 (8.3%)
Health sector	*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
No	1,099 (76%)	837 (73.3%)	252 (86.3%)	10 (83.3%)
Doctor	67 (4.6%)	58 (5.1%)	9 (3.1%)	–
Nurse	201 (13.9%)	182 (15.9%)	19 (6.5%)	–
Other healthcare profession	55 (3.8%)	47 (4.1%)	6 (2.1%)	2 (16.7%)
Administrative staff in hospital	9 (0.6%)	6 (0.5%)	3 (1%)	–
Other hospital staff	15 (1%)	12 (1.1%)	4 (1%)	–

million citizens (66, 70), therefore we confidently chose the on-line means to promote the COMET-G study. Although the respondents' sample was not totally representative for the general population, the number of respondents was high, compared to other countries cited in the COMET-G project (22).

Suicidality and self-harm history are widely acknowledged as substantial predictors for suicidal risk (71, 72), but the evidence is largely based on data from high-income countries (18). Data regarding the Romanian population is particularly scarce. In our models, previous life-threatening attempts proved to be significant predictors for suicidality. An intriguing finding was that both factors – suicide attempts and self-harm history – were negatively correlated with the change in suicidal ideation, albeit the correlation was weak (but statistically significant).

There are published reports of decreased suicidal ideation in association with the pandemic outbreak in Europe and the United States (18, 73, 74). Suicidal ideation might decrease when people are confronted with immediate potentially existential dangers, such as the risk of illness and the sense of incertitude during the COVID-19 pandemic. There are established observations of this phenomenon in other situations of immediate threats, like the First World War or terrorist attacks (75, 76). Depression was long seen as a suicide-related factor, but the effect of anxiety has not been separately investigated until recently (77, 78). The context of the COVID-19 pandemic might have also mediated a more direct connection between the increased anxiety and suicidality, as it unmasked and developed multiple anxiety-generating factors such as the fear of contamination, general insecurity, fear for the loved ones' health, and subject's overexposure on the media. What seems especially intriguing in this specific context is that the suicide rates were stable and suicidality was reported as decreasing; in a context when the general rates of the risk factors for suicidality (such as depression, anxiety, contextual and social vulnerabilities) increased in most of the reports on the COVID-19 pandemic and the contribution of these factors is well-established in the literature, alerts for constant vigilance regarding the suicidal dynamic were issued (18).

Age is usually inversely correlated with suicidal risk (4), and our SEM model 3 also put younger people at a higher risk. Studies on Romanian population showed a significant rise in suicide for young people and the elderly, even before the pandemic crisis (79). Lower education levels is typically seen as a general risk factor for suicidality, but it loses influence when adding other dominant factors, such as preexisting mental health issues, ancestry information, and demographic factors (7, 80, 81). In our SEM model 3, the level of education was not a significant predictor for suicidality. On the other hand, this lack of education significance in our model might be due to the

TABLE 3 | Descriptive statistics and internal consistency of scale scorings for STAI, CES, RASS, belief in conspiracy theories, and internet use.

Scale Median (IQR)	Total *N* = 1,466	Female *N* = 1,142	Male *N* = 292	Non-binary *N* = 12
STAI total				
Sum (F1, F2,..., F20)				
Cronbach's alpha = 0.922 (20 items)				
STAI total	48 (39–55)	49 (40–56)	43 (36–52)	43.50 (29–53)
CES total				
Sum (G1, G2,..., G20)				
Cronbach's alpha = 0.927 (20 items)				
CES total	12 (6–24)	13 (6–24)	10 (4–19)	9.5 (2.5–26)
RASS total				
Sum (O1, O2,..., O10)				
RASS fear = {O1}				
RASS intention = {O5, O6, O7, O8}, Cronbach's alpha = 0.894 (4 items)				
RASS life = {O2, O3, O4, O9, O10}, Cronbach's alpha = 0.825 (5 items)				
RASS total	6 (6–8)	6 (6–8)	6 (6–7)	6 (6–7)
Consp total				
Sum (J1, J2,..., J7)				
Cronbach's alpha = 0.677 (7 items)				
Consp total	8 (4–12)	8 (4–12)	8 (4–12)	14 (10.5–18)
Internet total				
sum (K1, K2, K3)				
Cronbach's alpha = 0.456 (3 items)				
Internet total	4 (3–6)	5 (3–6)	4 (3–6)	3.5 (1.5–7)

Items are coded according to the COMET-G protocol as they are presented in the ***Supplementary Material 1****.*

disequilibrium in the level of education among the respondents: fewer than 30% of them did not graduate a form of post-high-school education. As these data were somewhat incongruous and unforeseen in the pandemic context, further investigations for long-term consequences in stationary societal circumstances are necessary, accompanied by national policies aimed at this public health issue.

There is a consensus that most people are quite resilient in face of negative changes or potentially traumatic events (82–84). Onset of societal or economic instability (for example, a recession) may have unstructured effects on suicide rates (85, 86). Nevertheless, vulnerability factors (such as previous mental health issues, suicide attempts, a history of self-harm, male sex, age, unemployment and belonging to disadvantaged social groups) may influence the life-long mental health risks, and indeed play an important role in the suicidality dynamics (77, 87–89). Religion generally plays a protective role regarding suicide (90), while religious turmoil is associated with a greater suicidal risk (91), albeit moderated by specific cultural differences (92). Responses to the COMET-G questionnaire showed that self-reported change in spiritual inquiries may have acted as a signal that previously successful coping mechanisms might have been exhausted, and the increased religiosity could thus be viewed as an attempt to regain emotional balance. Conspiracist ideation is also grounded on psychological mechanisms (93) and tends to increase during times of crises (94). Moreover, current media misinformation seems to generate a specific dynamic that exacerbates and promotes conspiracy thinking (95). These mechanisms were initially hypothesized to also work in the Romanian adult population, but in our structural models the conspiracy beliefs did not correlate with the degree of Internet use and did not demonstrate a significant influence on suicidality. This might be explained by the methodology we used that raises issues of consistency and common method bias for the variables related to the reality reading patterns. Both findings need further investigation and additional channels for proliferation of conspiracy theories should be considered. Specific scales, thoroughly validated, are also needed for clarification.

The pandemic context calls for consideration of new factors related to suicide. This implies that measures already established as being protective might require reconsideration and adjustment in the near future. For example, anxiety disorder and anxiety related distress emerged as a significant suicidality factor in the present study, thus needing deeper scrutiny in further research. We put forward a particular need for consolidation of the presently proposed structural models of suicidality.

Worldwide, several different studies have proposed vulnerability models for mental health issues (21, 42, 96) while suicide-related studies of the Romanian population

TABLE 4 | The scorings' distributions for the individual items on suicidality change, personal history of self-harm, and increase in religious/spiritual inquiries.

	RASS N (%)	Total *N* = 1,466	Female *N* = 1,142	Male *N* = 292	Non-binary *N* = 12
Subjective changes in suicidality (O11_Suicidality change)		*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
	−2	90 (6.2%)	67 (5.9%)	23 (7.9%)	–
	−1	20 (1.4%)	15 (1.3%)	4 (1.4%)	1 (8.3%)
	0	1,171 (81%)	918 (80.4%)	244 (83.6%)	9 (75%)
	1	105 (7.3%)	93 (8.1%)	12 (4.1%)	–
	2	60 (4.1%)	49 (4.3%)	9 (3.1%)	2 (16.7%)
History of self-harm (O12_RASS_11)		*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
	0	1,299 (89.8%)	1,020 (89.3%)	268 (91.8%)	11 (91.7%)
	1	77 (5.3%)	65 (5.7%)	12 (4.1%)	–
	2	41 (2.8%)	32 (2.8%)	9 (3.1%)	–
	3	29 (2%)	25 (2.2%)	3 (1%)	1 (8.3%)
History of suicide attempts (O13_RASS_12)		*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
	0	1,339 (92.6%)	1,055 (92.4%)	275 (94.2%)	9 (75%)
	1	79 (5.5%)	65 (5.7%)	12 (4.1%)	2 (16.7%)
	2	23 (1.6%)	19 (1.7%)	4 (1.4%)	–
	3	5 (0.3%)	3 (0.3%)	1 (0.3%)	1 (8.3%)
Changes in religiousness/spirituality (P1_RelSpir)		*n* (% of N)	*n* (% of N)	*n* (% of N)	*n* (% of N)
	0	672 (46.5%)	482 (42.2%)	185 (63.4%)	5 (41.7%)
	1	419 (29%)	352 (30.8%)	65 (22.3%)	2 (16.7%)
	2	203 (14%)	171 (15%)	31 (10.6%)	1 (8.3%)
	3	152 (10.5%)	137 (12%)	11 (3.8%)	4 (33.3%)

Items are coded according to the COMET-G protocol as they are presented in the ***Supplementary Material 1****.*

TABLE 5 | Associations between the scales total scorings on anxiety, depression, suicidality, conspiracy beliefs and Internet use.

		STAI total	CES-D total	RASS total	Conspiracy total	Internet total
STAI total	R	1.000	**0.776****	**0.358****	0.085**	**0.334****
	p	.	<0.001	<0.001	0.001	<0.001
	N	1,446	1,446	1,446	1,446	1,446
CES-D total	R	**0.776****	1.000	**0.355****	0.119**	**0.370****
	p	<0.001	.	<0.001	0.000	<0.001
	N	1,446	1,446	1,446	1,446	1,446
RASS total	R	**0.358****	**0.355****	1.000	−0.019	0.211**
	p	<0.001	<0.001	.	0.477	<0.001
	N	1,446	1,446	1,446	1,446	1,446
Conspiracy total	R	0.085**	0.119**	−0.019	1.000	0.177**
	p	0.001	<0.001	0.477	.	<0.001
	N	1,446	1,446	1,446	1,446	1,446
Internet total	R	**0.334****	**0.370****	0.211**	0.177**	1.000
	p	<0.001	<0.001	<0.001	<0.001	.
	N	1,446	1,446	1,446	1,446	1,446

*Statistical significance **p < 0.01.*

N, number of observations; p, statistical significance; R, Spearman coefficient of correlation (non-parametric). Statistically significant R values over 0.3 are in bold.

have found it as atypical and therefore faced difficulties in applying models from other Eastern European Countries (97). Romania presents with a set of challenges regarding the medical system and with several cultural and socio-economic particularities, some of which are widely acknowledged as associating with higher suicidal risk. However, the national suicide rates have slightly declined over the past years, recently falling below the annual global age-standardized suicide rate (14). Precaution was recommended in regard to the pandemic consequences (98), but recent results showed a degree of psychological stability during the lockdown in Romanian population, and studies have indicated no change in suicide rates for some regions of Romania (99). However, little overall data is available, so the present results may bring valuable contribution toward moving forward with the novel understanding of suicidality.

TABLE 6 | The structural equation modeling of the multivariable relationships between the mental health indicators, beliefs and life changes.

SEM models	Fit indices			
	Chi-square test	**CFI**	**RMSEA**	**SRMR**
Model 1 *ED = ~ STAI total + CES total* *Suicidality = ~ RASS total + SI change* *LTA = ~ RASS_11 + RASS_12* *SI change~~ RASS_11 + RASS_12* *Suicidality ~ ED + LTA*	11.272 (df = 4) $p = 0.024$	0.997	0.035 90% CI (0.012; 0.061)	0.010
Model 2 *ED = ~ STAI total + CES total* *Suicidality = ~ RASS total + SI change* *LTA = ~ RASS_11 + RASS_12* *RRP = ~ Religion and spirituality + Conspiracy theories + Internet use* *SI change~~ RASS_11 + RASS_12* *Internet use ~~ Conspiracy theories* *Suicidality ~ ED + LTA + RRP* Vuong's test: z = 6.244; $p < 0.001$ (in favor of Model 2, compared to Model 1) 95% CI of AIC difference (−812.220; −414.567)	130.038 (df = 18) $p < 0.001$	0.959	0.066 90% CI (0.055; 0.076)	0.040
Model 3 *ED = ~ STAI total + CES total* *Suicidality = ~ RASS total + SI change* *LTA = ~ RASS_11 + RASS_12* *RRP = ~ Religion and spirituality + Conspiracy theories + Internet use* *SI change~~ RASS_11 + RASS_12* *Internet use ~~ Conspiracy theories* *Suicidality ~ ED + LTA + RRP + Age + Education* Vuong's test: z = 2.227, $p = 0.013$ (in favor of Model 3, compared to Model 2) 95% CI of AIC difference (−35.591; 1.475)	305.938 (df = 34) $p < 0.001$	0.906	0.074 90% CI (0.067; 0.082)	0.058

Limitations

The main limitation of this investigation is that the proposed SEM models of suicidality were generated based on anonymous self-reported data, which were retrospectively collected in regard to the COVID-19 lockdown, within a limited time window and based on natural self-selection of respondents. Its cross-sectional design with no previous baseline and no follow-up prevented us from obtaining the risk estimates. Nevertheless, the SEM procedure in data analysis allowed the combination of the structural features with a general linear model for regression, and increased the overall accuracy and subsequent reliability of the findings.

The common method bias (CMB) implied by the cross-sectional design and the one time single-administration questionnaire (with its associated actual effect of the common method variance, CMV) is a major concern that cannot be overlooked. On the other hand, appropriate procedural measures were taken and carefully observed to limit the shared variance and control the method biases: different scales (such as those corresponding to predictors and criterion constructs) were included in non-adjacent sections, separated by questions collecting factual data (e.g., about diet or physical exercising); the scales included both positively and negatively (i.e., reverse) worded items; the wording was kept clear, concise and accurate; at the beginning of the questionnaire, respondents were provided comprehensive information on the COMET-G study and were assured of the anonymity; different scale formats were alternated, such as 4-point and 5-point Likert-type scales, or even dichotomy items.

In addition to these preventative measures, we explored the CMB possible impact on the performance of the measuring instruments and subsequent results by the post-hoc statistical techniques. Moreover, the approach with three SEM models (the nucleus including only previously validated scales and widely acknowledged constructs) and the stability of these nuclei regression coefficients' estimates (i.e., proximal predictors) across the three models proved the robustness of the results: significant and balanced interrelationship between the nuclei constructs (i.e., emotional disturbances and previous life-threatening attempts on the one hand, and suicidality on the other hand). We acknowledge that CMV, as a systematic error variance, could have a confounding influence on empirical results and produce potentially misleading conclusions, but this issue was improbable in our case. In our data set, there was a weak and insignificant relationship between the beliefs in conspiracy theories and the use of Internet – an actual CMB issue should have resulted in a stronger relationship.

TABLE 7 | The parameters of SEM Model 3 examining the relationships between anxiety, depression, life-threatening attempts, suicidality, religion/spirituality, conspiracy theories, Internet use scorings, age, and education.

Model 3 parameters		Estimate (Std. err.)	z-value	*p*-value
Latent variables:				
ED = ~	STAI total	1		
	CES total	1.209 (0.044)	27.356	<0.001**
Suicidality = ~	RASS total	1		
	SI change	1.568 (0.261)	6.001	<0.001**
LTA = ~	RASS_11	1		
	RASS_12	0.753 (0.103)	7.341	<0.001**
RRP = ~	Religion and spirituality	1		
	Conspiracy theories	0.664 (0.125)	5.309	<0.001**
	Internet use	1.228 (0.227)	5.413	<0.001**
Regression:				
Suicidality ~	ED	0.168 (0.027)	6.251	<0.001**
	LTA	0.316 (0.063)	5.047	<0.001**
	RRP	0.036 (0.052)	0.678	0.497
	Age	−0.049 (0.013)	−3.865	<0.001**
	Education	0.014 (0.012)	1.142	0.253
Covariances:				
SI change~~	RASS_11	−0.007 (0.003)	−2.401	0.016*
	RASS_12	−0.007 (0.002)	−3.207	0.001**
Internet use ~~	Conspiracy theories	−0.00019 (0.002)	−0.088	0.930
ED ~~	LTA	0.007 (0.001)	6.423	<0.001**
	RRP	0.010 (0.002)	5.696	<0.001**
LTA ~~	RRP	0.002 (0.001)	3.457	0.001**

*Statistical significance *p < 0.05; **p < 0.01.*

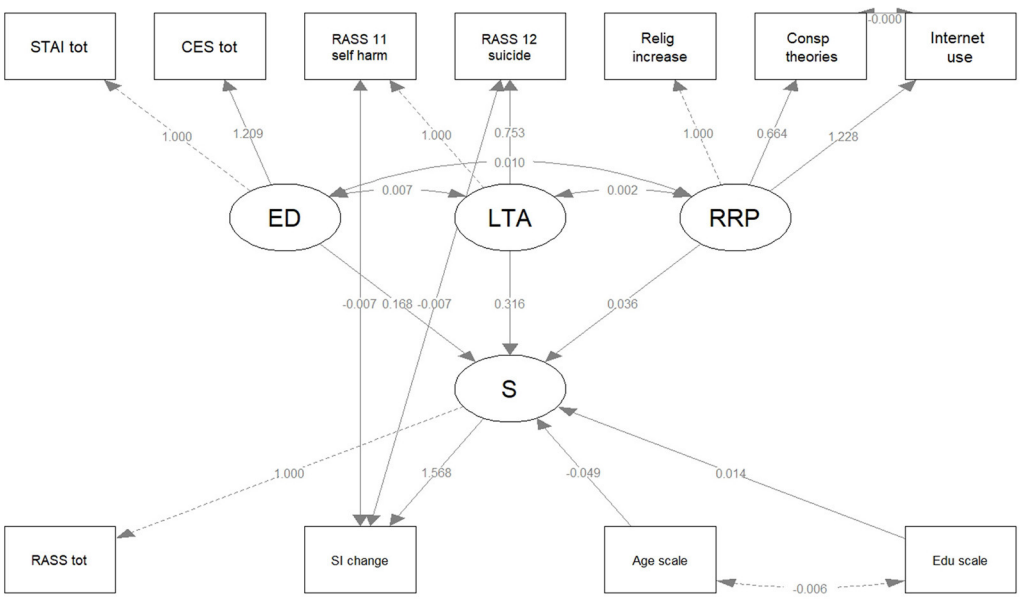

FIGURE 3 | The path diagram for the SEM Model 3. Latent variables are drawn in circles and manifest variables are drawn in squares. The edge labels indicate the parameter estimates. CES tot, Center for Epidemiologic Studies Depression Scale (CES-D), 20-item total; ED, Emotional Disturbances; LTA, Life Threatening Attempts; RASS 11 self-harm, 4-point score of RASS 11; RASS 12 suicide, 4-point score of RASS 12; RASS tot, Risk Assessment Suicidality Scale (RASS), 10-item total; S, Suicidality; SI change, Suicidal Ideation change; STAI tot, State-Trait Anxiety Inventory (STAI), 20-item total.

Additional concerns might arise from employing scales not previously applied in the Romanian population, such as the RASS scale. Not only was the translation endorsed following a Delphi technique, but the CFA did support the original structure of the scale. The scales comprised in the construct of reality reading patterns proved to be less consistent and this issue should be addressed more carefully in the future. In addition, certain recall bias was possibly included in the answers.

Furthermore, this cross-sectional survey of self-reported perceived changes selectively recruited respondents who habitually navigate on the Internet, so the response rate was difficult to estimate, and acceptable rate was also problematic to anticipate or gauge. Moreover, this approach in questionnaire distribution led to a certain bias toward the population favorable toward on-line instruments, and this might have affected their appreciation toward the information and communication technology, thus the inconsistency on the scale of Internet use (it might have been too simplistic for many respondents).

The lack of follow-up imposes limits on the proposed models' external validity. An additional caveat regarding the validity originates in the pronounced gender disequilibrium among the respondents, which presumably reflect the degree of Internet engagement, but would affect the models' cross-gender validity for the rate of suicide completion is greater among males.

CONCLUSION

Suicidality has specific particularities for each country, region, or cultural context and environment, and the results we report bring evidence toward improving the insights into the Romanian population. Suicidality also has a context related inner dynamic, but affective disturbances, history of suicide attempts and self-harm remain the main factors related to suicide risk even in the special context of the COVID-19 pandemic in Romania. The final suicidality construct we developed also related to the COVID-19 lockdown, for this was specifically mentioned in the cover story of the questionnaire.

Our results confirmed anxiety and depression as significant proximal predictors in suicidality. In spite of every effort we made to answer the secondary aims of this study, the issue of quantifying the reality reading patterns' influence on suicidality remains open and must yet be further investigated.

Because suicide has a disastrous impact on the immediate family, it brings trans-generational mental health vulnerability. This investigation contributes to a better understanding of suicidality in a specific context, and may thus serve as a guide for assessing risks and identifying effective interventions.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Pius Brinzeu County Emergency Clinical Hospital, in Timisoara, Romania. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.818712/full#supplementary-material

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ABBREVIATIONS AND NODES IN SEM MODELS

- *Age scale,* age on a 6-group scale of adult age;
- *CES tot*, Center for Epidemiologic Studies Depression Scale (CES-D), 20-item total;
- *Consp theories*, 7-item total of belief in conspiracy theories;
- *ED, Emotional Disturbances*, latent variable describing self-reported fear, anxiety, depression;
- *Edu scale*, level of education on a 5-item scale;
- *Internet use*, 3-item total of Internet use;
- *LTA, Life Threatening Attempts*, latent variable describing suicide-related personal history;
- *RASS 11 self-harm*, 4-point score of RASS 11 ("Have you ever harmed yourself in any way deliberately, during your whole life so far?");
- *RASS 12 suicide*, 4-point score of RASS 12 ("Have you ever attempted suicide, during your whole life so far?");
- *RASS tot*, Risk Assessment Suicidality Scale (RASS), 10-item total;
- *Relig increase*, 4-point score of increase of religious/spiritual inquiries ("Over the last two-three weeks, my religious/spiritual inquiries have been increased.");
- *RRP, Reality Reading Patterns*, latent variable describing personal vulnerabilities related to social and spiritual issues;
- *S, Suicidality*, latent variable describing suicidality;
- *SI change, Suicidal Ideation change*, 5-point score of change in suicidal ideation;
- *STAI tot*, State-Trait Anxiety Inventory (STAI), 20-item total.

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Anxiety and Coping Stress Strategies in Researchers During COVID-19 Pandemic

Patrícia Batista[1,2]*, *Anabela Afonso*[3,4], *Manuel Lopes*[5,6], *César Fonseca*[5,6], *Patrícia Oliveira-Silva*[1], *Anabela Pereira*[7]* and *Lara Pinho*[5,6]*

[1] Universidade Católica Portuguesa, Research Centre for Human Development, Human Neurobehavioral Laboratory, Porto, Portugal, [2] Universidade Católica Portuguesa, CBQF – Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Porto, Portugal, [3] Department of Mathematics, School of Science and Technology, University of Évora, Évora, Portugal, [4] Center for Research in Mathematics and Applications (CIMA), Institute for Advanced Studies and Research, Évora, Portugal, [5] S. João de Deus School of Nursing, University of Évora, Évora, Portugal, [6] Comprehensive Health Research Centre (CHRC), Évora, Portugal, [7] Education and Psychology Department, Campus Universitário de Santiago, University of Aveiro, Aveiro, Portugal

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Edited by:
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International University of Business Agriculture and Technology, Bangladesh

***Correspondence:**
Patrícia Batista
pbatista@ucp.pt
Lara Pinho
lmgp@uevora.pt
Anabela Pereira
anabela.pereira@uevora.pt

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The current COVID-19 pandemic has affected the whole world, leading to changes in one's personal and working life. Researchers have undergone extensive changes in their roles, mainly in the area of health care, with research into the virus now the priority.

Aim: To assess the anxiety, depression, stress, fears, and coping strategies of Portuguese researchers during the COVID-19 pandemic.

Participants and Methods: A total of 243 researchers, with an average age of 37.9 ± 9.6, participated in an online questionnaire. The study was performed between 1 June 2021 and 11 August 2021. The questionnaire included depression, anxiety, and stress (DASS-21), fear of COVID-19 scale (FCV-19S), and coping inventory for stressful situations (CISS).

Results: The findings suggest being female and younger seem to be related to more significant fears. Singles and younger researchers showed higher values of stress, depression, and anxiety. Research areas, such as medical and health sciences, presented higher levels in the DASS-21 depression and stress scale ($p < 0.05$). Also, the results showed a moderate or moderate strong significant positive linear relationship between the scales ($p < 0.001$): DASS-21 stress, DASS-21 anxiety, and DASS-21 depression ($r > 0.70$); CISS-21 emotional-oriented with DASS-21 stress ($r = 0.683$), DASS-21 depression ($r = 0.622$), and DASS-21 anxiety ($r = 0.557$); and emotional fear and cognitive fear ($r = 0.652$).

Conclusion: The findings of this study support the growing concern for the psychological well-being of researchers and the need for intervention with more extensive and diverse studies.

Keywords: COVID-19, researchers, anxiety, depression, stress, fear, coping strategies

INTRODUCTION

In December 2019, new pneumonia caused by a virus (SARS-CoV-2) of the coronavirus family emerged. It is thought to have originated in China, in Wuhan, and quickly spread worldwide (1–3). In March 2020, the World Health Organization (WHO) declared the existence of a pandemic situation. At that time, SARS-CoV-2 was already one of the biggest challenges to world health (2). The increasing number of infections and death related to the COVID-19 disease led to increased concern by health organizations, governments, and society.

These concerns have been substantially exacerbated by extensive media coverage and continuous social media (mis)information, factors that generate fear, anxiety, social panic, and suicide risk (4–6). The need to know more about the disease and the virus, the need for scientific evidence to make decisions, the constant search for strategies, and methodologies to combat the problem have caused science to evolve at an unprecedented pace, namely in the field of vaccine development (7, 8).

At this moment, society renewed recognition of the role of science in fighting the pandemic. Across the world, most governments repeated in most press conferences: "We are following the science" (9). This is one step in the recognition that science/scientific knowledge is necessary for the prevention and search for solutions when we face contemporary challenges. However, the crucial steps are funding/economic investment into research projects and hiring human resources (10–12).

In the most several areas, these professionals who work for science and the increase in knowledge also had to readap not only in personal terms but also at the work level. While some research work can be done at home, such as article writing, scientific research, others require data collection, field presence, laboratory trials, and clinical trials (13). For instance, computational research and review studies about several thematic, such as rethinking psychology and the microbiota-gut-axis (14), may not have been much affected (15). However, much of research within the basic sciences involves laboratory work or clinical research, for example, studies that aimed to evaluate adverse event profiles of drugs in advanced prostate cancer and which require recruitment of participants for evaluation (16), were very much affected because they had to be suspended (15). These are two simple examples of scientific work of extreme importance but using different research methodologies.

Scientists do distinct work ranging from research, planning experiments, collecting and analyzing data, writing papers, writing fundraising proposals, teaching, clinical practice, administrative, and editorial activities. Not surprisingly, many studies have already shown that most of the pandemic-related decisions have magnified disparities among these researchers (13, 17–19). For instance, the research work and the time devoted to it were massively affected during the pandemic. Many researchers had to readapt their schedules and commitments, and in some cases, change their working methods because the access to field/laboratory work was restricted by confinement measures (13, 20–22). Many clinical trials were suspended due to the need for social isolation and multiple research groups felt the need to change their research projects and/or develop new ones, focusing on strategies to respond to the pandemic (13, 20). Teleworking and supporting children and dependents were other necessary readjustments (15, 23–25).

Although the pandemic affected the researchers' work in general, some researchers were more affected than others depending on their research areas, careers, and gender. There are already some publications in this sense, which report that the areas of biological sciences, biochemistry, and chemistry were more affected compared to the areas of mathematics and computer sciences (13). Similarly, studies have shown that early-career researchers (13, 26, 27) were also more conditioned by the pandemic, as well as the female gender (28, 29).

These labor and personal struggles in several areas are factors that increase the level of stress and anxiety and impact mental health significantly. However, few studies have been carried out at the level of this professional class, to understand the impact of the pandemic on the researchers' mental health, with particular emphasis on the anxiety during the lockdown (30).

Several studies have been exploring the anxiety of health professionals (31–35), academics (2, 36, 37), and the general population (38, 39). The levels of depression and anxiety were significantly higher during the outbreak and there was a need to study this topic. However, the concern with researchers is scarce (40–42) and it is urgent to cover this gap. Some studies, just prior to COVID-19, have been reported that researchers present high levels of stress (40, 43, 44). This shows that this problem existed even before COVID-19 and needs to be addressed.

On the other hand, in the attempt to resilience this problem it is necessary to implement adequate prevention or rehabilitation strategies. It is important to know positive and protective strategies to deal with this problem. Several studies have been carried out to develop and/or apply strategies to fill this gap in the population in general and in specific groups, in particular, but once again, the literature is scarce at the level of the researcher group. For example, in health professionals, several strategies were outlined, as include work-hour regulation programs, and the implementation of strategies to reduce the pressure of difficult decision-making (39). Some authors suggest interventions by the employer to improve the mental health of workers, such as providing the development of self-efficacy, resilience, promotion of social support, and guaranteeing quality and safe care (33, 45, 46).

Getting to know researchers better, motivating them, and promoting physical and mental well-being will bring benefits to their health, as well as to their role as researchers, contributing to the increase of scientific knowledge, fundamental for the improvement of the quality of life of our population. Thus, considering the health challenges for this understudied professional group, the aim of this study is to assess the levels of anxiety, depression, stress, fears, and coping strategies in Portuguese researchers during the COVID-19 pandemic. This knowledge is central to the development of intervention plans for these professionals, in the future.

METHODS

Study Design and Participants

The target population was researchers working and living in Portugal. Inclusion criteria were to be a researcher in any scientific area and agree to participate in the online survey. This was a quantitative cross-sectional study that used a convenience sample ($n = 243$) of the Portuguese population recruited *via* e-mail (on professional networks). All participants gave their voluntary and informed consent, which was obtained electronically before recording any data from the participants.

Measures

Data Collection

From 1 June 2021 to 11 August 2021, survey data were collected through an online questionnaire. The survey was constituted of 60 questions that took around 10 min to be completed. The questionnaire covered socio-demographic and professional information (e.g., age, sex, marital status, academic qualifications, research area, and professional activity), health-related data (general health perception and history of COVID-19 diagnosis), depression anxiety stress scale (DASS-21), fear of COVID-19 scale (FCV-19S) and coping inventory for stressful situations (CISS-21). Before the application, the questionnaire was validated by a senior researcher's panel, and then, it was transposed to Qualtrics software for final validation.

The online platform QualtricsTM software (Provo, UT, USA) was chosen because of the facilitation in the distribution and completion of surveys, according to the recommendations imposed on social distance. In addition, only the researchers directly involved in the study could access the data, thereby maintaining the confidentiality of research subjects and research data (47, 48).

This study was approved by the ethical committee, and data confidentiality was ensured by assigning a code to each participant. No identifiable data were collected from the participant.

Depression Anxiety Stress Scale (DASS-21)

The DASS-21 was a scale developed to explore the symptoms of depression, anxiety, and stress. In this study, we used the scale validated for the Portuguese population (49). The DASS-21 instrument comprises 7-item for each subscale. The responses were collected on a 4-point scale of severity/frequency that assesses the extent to which the individual experienced each state in the previous week.

Fear of COVID-19 Scale (FCV-19S)

The FCV-19S was developed with the intent to identify and early intervene, psychologically, in people with high values of fear of COVID-19 (50). Ahorsu et al. (50) have proposed this scale, with 7-items, that assesses distinct physiological reactions of fears related to COVID-19. In this study, we used the Portuguese version of the Coronavirus Anxiety Scale (CAS) (51).

Coping Inventory for Stressful Situations (CISS-21)

The CISS-21 was developed by (52) by a psychometrically valid and reliable self-reporting instrument to identify and assess coping skills (51, 53). There are two versions (21-items and 48-items), but the shorter version has been the most widely used (51, 53). In this specific case, we use the Portuguese version already validated by Pereira and Queirós (54).

Statistical Analysis

Descriptive statistics were used to describe the study sample. The Pearson linear correlation was used to assess the linear correlation between age and scale, as well as between scales. The Shapiro–Wilk test was used to assess normality. The Levene test was used to assess variance homogeneity. The *t*-test was used to assess significant differences in scales by gender or type of contract. The Wilcoxon Mann–Whitney was used when the normality assumption was violated. To compare the scales by marital status or research area, the analysis of variance was used: the *F* test when both normality and homoscedasticity assumptions were verified, the Kruskal–Wallis test when only normality assumption was violated, or the Games–Howell test when the assumption of homogeneity of variances was violated.

Multivariate linear regression analyses were performed using the scores of the questionnaires as dependent variables, and gender, age, marital status, type of contract, and research area as the exploratory variables. These models allowed us to assess associations and check for confounders. It was used the forward

TABLE 1 | Sociodemographic and health characteristics.

Variável	Categorias	*n*	%
Sex	Male	74	30.5
	Female	169	69.5
Marital status	Single	122	50.2
	Non-marital partnership	42	17.3
	Married	68	28.0
	Widower	3	1.2
	Separated/ divorced	8	3.3
Academic Qualifications	Undergraduate	10	4.1
	Master's Degree	110	45.3
	PhD	123	50.6
Type of contract	Research fellow	144	59.3
	Researcher with contract	99	40.7
Research Area	Medical and Health Sciences	27	11.1
	Exact Sciences	18	7.4
	Natural and Agricultural Sciences	82	33.7
	Engineering and Technology	30	12.3
	Social Sciences	53	21.8
	Humanities	16	6.6
	Other	17	7.0
General health perception	Poor/Low	21	8.6
	Good	163	67.1
	Very good	59	24.3
Has been/is infected with COVID-19	No	225	92.6
	Yes	18	7.4

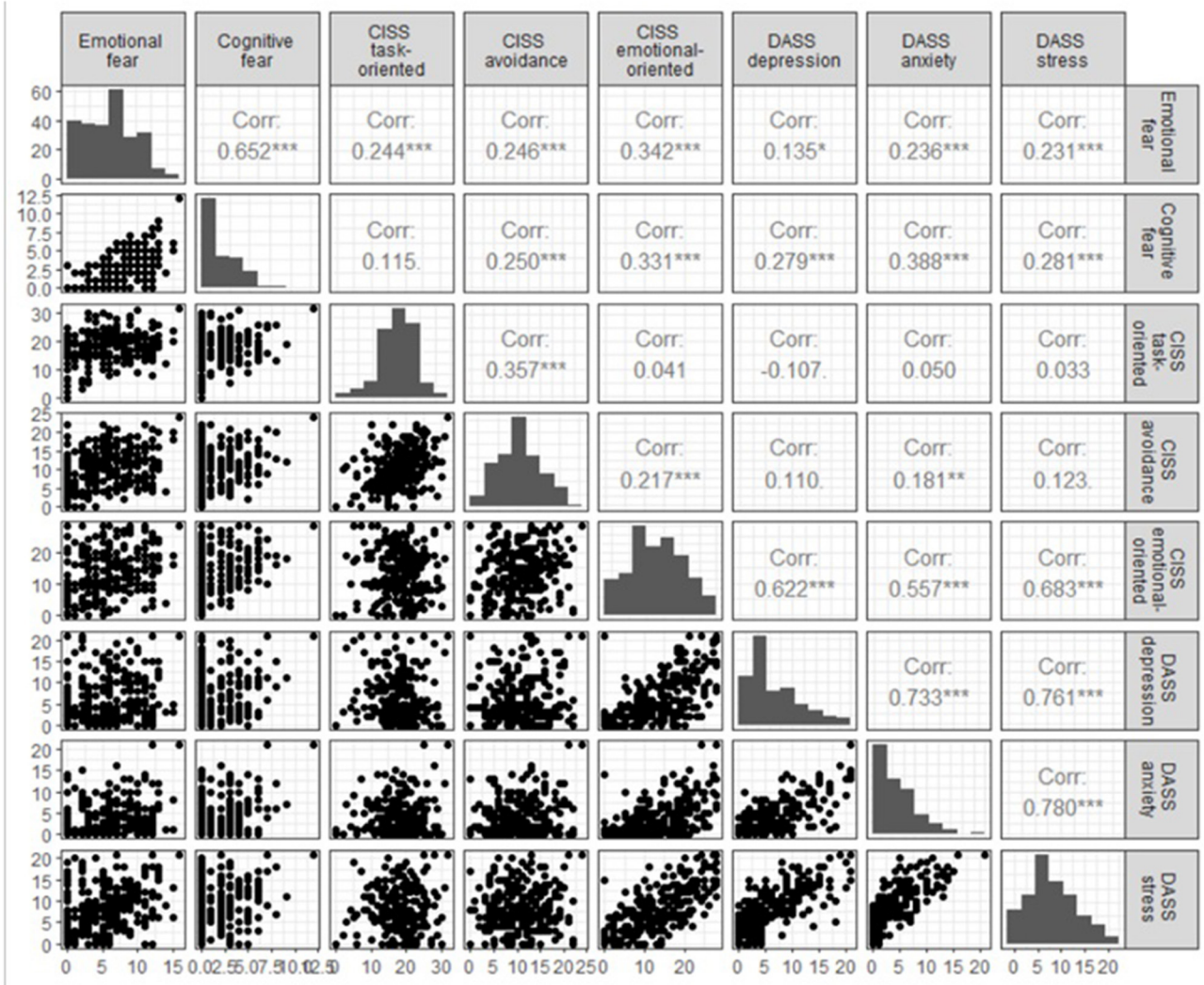

FIGURE 1 | Empirical distribution of scales and Pearson's linear correlation coefficient between the scales $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.001$.

and backward methods to select the variables. Normality and homoscedasticity assumptions were checked.

R program version 4.0.4 (R Core Team, Austria) for Windows was used to perform the statistical analyses. A significance level of 0.05.

RESULTS

Sociodemographic and Health Characteristics

The sample used consisted of 243 participants, 69.5% female. The participants' age ranged between 21 and 72, being an average age of 37.9 ± 9.6 years. When analyzing the professional activity, 40.8% presented a contract with the institution/center of research, 44.1% presented no contract (research fellowship), and 15.2% answered "other situation." The study included participants from various research areas, with the majority being in the "Natural and Agricultural Sciences" (33.7%) and the "Social Sciences" (21.8%).

Most of the participants perceive their health as good (67.1%) and 7.4% have been infected with COVID-19.

Table 1 shows the sociodemographic and health characteristics of the sample.

When the scales selected for this study were analyzed, the low values stand out for the cognitive fear scale [Med = 0, IQR = (0, 3)], DASS-21 depression [Med = 4, IQR = (2, 9)], and DASS-21 anxiety [Med = 3, IQR = (1, 6)] (**Figure 1**). In the CISS-21 task-oriented (18.13 ± 5.67) and CISS-21 avoidance (10.58 ± 5.10) scales, intermediate values predominate. In the CISS-21 emotional-oriented (13.47 ± 7.39), emotional fear (5.95 ± 3.98), and DASS-21 stress (8.16 ± 5.09) scales there is great heterogeneity in the values observed. On the CISS-21 emotional-oriented scale there appears to be a similar frequency of responses across the range of possible values (uniform distribution).

TABLE 2 | Pearson's correlation coefficient (*r*), and *p*-value (*p*), between age and scales.

Scale	R	*P*
Emotional fear	−0.080	0.213
Cognitive fear	−0.171	0.008
DASS-21		
Depression	−0.336	<0.001
Anxiety	−0.374	<0.001
Stress	−0.340	<0.001
CISS-21		
Task-oriented	0.051	0.428
Avoidance	−0.161	0.012
Emotion-oriented	−0.352	<0.001

The results showed a moderate or moderate strong significant positive linear relationship between the scales ($p < 0.001$, **Figure 1**):

- DASS-21 stress, DASS-21 anxiety, and DASS-21 depression (all $r > 0.70$);
- CISS-21 emotional-oriented with DASS-21 stress ($r = 0.683$), DASS-21 depression ($r = 0.622$), and DASS-21 anxiety ($r = 0.557$),
- Emotional fear and cognitive fear ($r = 0.652$).

Analysis of Scale by Sociodemographic Characteristics

The differences between the scales and some variables, such as gender, age, professional activity, and research area, were studied.

Genders

Significant differences were only detected on the emotional fear scale between women and men ($W = 5{,}160$, $p = 0.030$); women [Med = 6, IQR = (3, 9)] had higher values than men [Med = 4.5, IQR = (2, 8)]. In the remaining scales, there were no significant differences between genders ($p > 0.05$).

Age

When age and scales were compared, there was a significant but weak negative linear relationship between age and the scales CISS-21 emotional-oriented, DASS-21 depression, DASS-21 anxiety, and DASS-21 stress (**Table 2**, $p < 0.001$). These data were indicators of the existence of a tendency for the higher values of these scales to be associated with younger researchers and for the lower values of these scales to be associated with older researchers.

The negative linear relationship between age and the cognitive fear and CISS-21 avoidance scales, although significant, is almost insignificant.

Marital Status

For the marital status analysis, the widowed and separated/divorced categories were joined, since there are only three widowers. We detected that cognitive fear, emotional-oriented CISS-21, and all the DASS-21 scales differ significantly between marital status (all $p < 0.05$, **Table 3**). Single people had higher values than married people on all these scales (all $p < 0.05$).

Type of Contract

No significant differences were found on any scale by type of contract of the researchers (all $p > 0.05$).

Research Area

There were significant differences in DASS-21 depression ($p = 0.020$) and DASS-21 stress ($p = 0.042$) scales between research areas (**Figure 2**). Researchers in the medical and health sciences had higher scores than those in the social sciences on the DASS-21 depression scale ($p < 0.1$). The multiple comparisons test did not detect which pairs of research areas significantly differed in the DASS-21 stress scale, but by the graphical analysis, researchers in the social sciences area seem to have lower values than those in other areas.

All the adjusted models for the several scores of the questionnaires allowed us to check the inexistence of confounders in most of the bivariate analyses presented in the previous sections on the emotional fear scale. However, the explanation power of the adjusted models was small (in all, $R^2_{\text{Adj}} < 0.2$). The adjusted models for scores in emotional fear and CISS task-oriented did not fit the data. Older researchers had significantly lower scores in cognitive fear, CISS avoidance, CISS emotional-oriented, DASS depression, DASS anxiety, and DASS stress. The multivariate models revealed that women had significantly lower scores than men only in DASS depression ($b = -0.362$, $p = 0.006$). Also, researchers in exact sciences ($b = -0.811$, $p = 0.021$) and in agriculture and natural sciences ($b = -0.585$, $p = 0.020$) had significantly lower scores in cognitive fear than researchers in medical and health sciences.

DISCUSSION

This study seeks to understand the anxiety, stress, and depression researchers' perception during the pandemic period and the coping strategies that they were developed.

Sociodemographic and Professional Characteristics

Regarding sex, differences are only observed in the emotional fear scale where women have higher values than men. Another author concludes that the higher fear reported by female gender can be explained by their higher sensitivity to stress when compared to the male gender (55). However, in our study, there are no differences in anxiety, stress, and depression between the sexes. These results are not consistent with most studies that report that women have higher levels of stress, anxiety, and depression (33, 55–57). These results may be due to having a sample of only researchers who may have a different response to these variables. It is important to note that regarding gender balance, women

TABLE 3 | Median (1st quartile, 3rd quartile), or mean and standard deviation, for each scale by marital status of the researchers and *p*-value from analysis of variance [(1)parametric ANOVA, (2)Kruskal–Wallis test, (3) Games–Howell test].

Scale	Single	Maried	Non-marital partnership	Separated/divorced/widowed	*p*
Emotional fear	6 (3, 9)	5 (3, 8.25)	5 (3, 10)	5 (3, 7.5)	0.546(2)
Cognitive fear	1^{b} (0, 3)	0^{b} (0, 2)	2^{ab} (0, 3)	0^{ab} (0, 3)	(3)
CISS task-oriented	19 (15, 22)	19 (15.75, 22)	18 (14.25, 21)	17 (16, 19.5)	0.806(2)
CISS avoidance	11.14 (5.21)	10.06 (4.47)	10.17 (5.21)	9.27 (6.84)	0.367(1)
CISS emotional-oriented	15^{b} (9, 20)	10^{a} (7, 15.25)	15^{ab} (9, 19.75)	12^{ab} (5.5, 16)	0.001(2)
DASS depression	6.5^{b} (3, 11)^{a}	3^{a} (1, 5.25)	4^{ab} (2, 9)	4^{ab} (2,5)	0.001(2)
DASS anxiety	4^{b} (1, 6)	3.5^{a} (1, 6.75)	3.5^{ab} (1, 6.75)	0^{a} (0, 3)	0.001(2)
DASS stress	9^{b} (6, 13)	6^{a} (3.75, 8.25)	7^{ab} (6, 11)	4^{a} (3, 8.5)	0.001(2)

Medians or means not sharing superscript letters, in the same row, differ significantly at $p < 0.05$ as indicated by the post-hoc test.

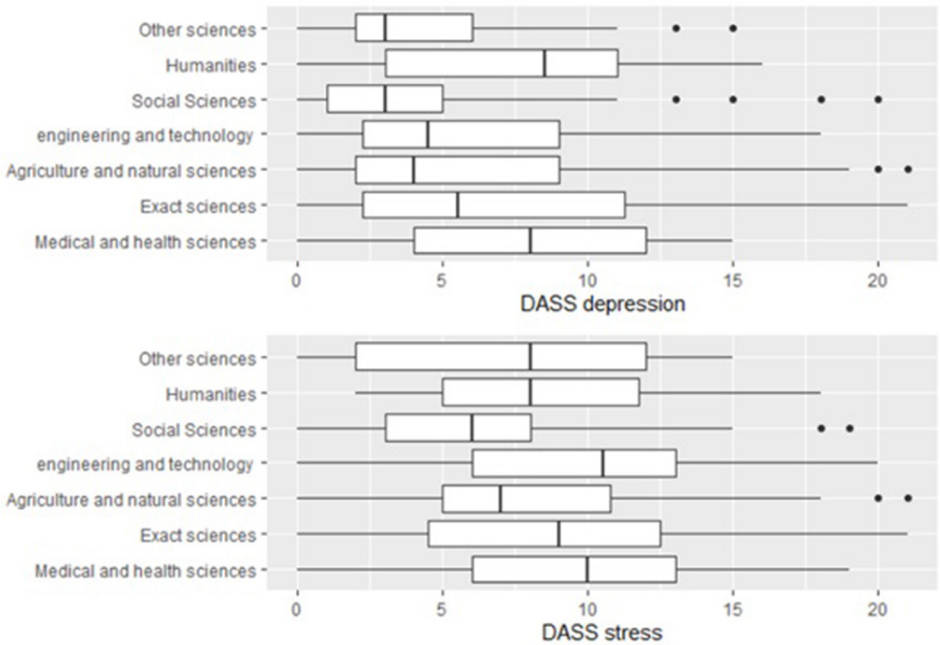

FIGURE 2 | Empirical distribution of DASS-21 depression and DASS-21 stress scales by research area of the researchers.

tend to be overrepresented in this profession as well as among such frontline service workers (58).

Younger researchers showed higher values of stress, depression, anxiety, and fears related to COVID-19 when compared to older researchers. Studies in the general population support these results by confirming that younger age groups are more vulnerable to symptoms of stress, depression, and anxiety (59, 60). As well as, when analyzing the fear toward COVID-19, the older researchers showed lower levels (55). However, it may be that older people may consider that they have little to lose as they have already had relatively long lives and had a stable labor situation. For their part, the younger people are worried about the future consequences and economic challenges caused by the pandemic, as they are the most affected by their employment stability, may watch and listen to much more negative news on social media (2, 61, 62). Nevertheless, additional evidence is needed to examine such speculation.

Single participants had higher scores of stress, depression, and anxiety than those who are married. Other studies have obtained similar results (59). Studies suggested that being married can be a protective factor for stress and anxiety (63).

Researchers in the medical and health sciences have higher levels of depression than those in the social sciences. Although we do not have identical studies with researchers from different fields to compare these results, several studies indicate the high prevalence of stress, anxiety, and depression in health care workers (64). Medical and health sciences researchers have had to change their research projects to give priority to pandemic-related research. Also, being their field, they are

more awake to the pandemic health consequences, so these factors may be contributing to higher levels of depression. Social science researchers also have lower stress scores than researchers from other areas. Perhaps researchers in the social sciences are more prepared for changes in society, since they study social and collective behaviors, and this is the reason for lower stress levels. However, more studies are needed to draw conclusions.

Anxiety, Stress, and Depression

In our study, analyzing the results of the DASS-21, we found that stress is the dominion with the highest mean (8.16 ± 5.09), followed by depression (6.01 ± 5.37), and anxiety (3.88 ± 4.09). These results are like a study in an Indian population with respect to the order of severity of the domains (65). However, the Indian study obtained higher values for the 31 researchers in the sample in all domains: stress (14.71 ± 9.89), depression (10.65 ± 8.72), and anxiety (9.81 ± 6.88).

Coping Stress Strategies

The results showed that there is a significantly positive and moderately linear relationship between the anxiety levels and emotional-oriented coping strategies, i.e., general researchers with low (/high) anxiety values also have low (/high) emotional-oriented coping strategies. However, there is no significant linear relationship between the anxiety levels, and the task-oriented and avoidance coping strategies. These results corroborate another study that showed that depressive symptoms were positively correlated with emotional coping (66). We also verified that the stress levels are significantly positively and moderately linearly related to the emotional-oriented coping strategies, but it is not linearly related to the task-oriented and avoidance coping strategies. The depression levels are significantly related in a positive and moderate linear fashion with the emotional-oriented coping strategies and in a very weak negative linear fashion with the task-oriented coping strategies, but it is not linearly related to the avoidance coping strategies.

The task-oriented coping strategies were not supported but the relationship between the use of the emotional-oriented coping strategies was found. Although some studies report that emotion-focused and problem-focused strategies play role in reducing and increasing mental health (67), the unexpected event of COVID-19 pandemic can be may have triggered a more intense emotional response, indicating the need for further studies on this pandemic. But, their use can be inappropriate (66).

In this study, we did not find the results shown in other studies that showed that people that experienced psychological distress who used more task coping strategies experienced low levels of depression, anxiety, and stress (68).

The cognitive and emotional fears of COVID-19 pandemic situations also influence coping strategies or defensive mechanisms (69). In Huang and collaborators' study, it was found that fears were significantly positively related to problem-focused coping and emotion-focused coping. Therefore, the more problem-focused coping, the more fear (46). When analyzing the FCV-19S scale the data by emotional fear scale showed significantly related in a very weak positive linear way with CISS-21 emotional-oriented, task-oriented, and avoidance domains. On the order hand, the cognitive fear scale is significantly related in a very weak positive linear fashion to the emotional-oriented and avoidance coping strategies. There is no significant linear relationship between cognitive fear and task-oriented coping strategies.

Limitations

This study presents some limitations, such as the cross-sectional nature of the study, which conditioned the monitoring of the effects and strategies adopted. Longitudinal studies are needed. Also, the methodology adopted, an online survey, may contribute to non-response bias in the study results. On the other hand, we do not know how many researchers there are in Portugal, because there are several contracting modalities, and many researchers are not in the career and presenting research grants (without contractual ties). So, it was not possible to calculate the sample size to ensure that the sample was representative.

CONCLUSION

The findings of this study support the growing concern for the psychological well-being of researchers and the need for intervention. Being a female seems to be related to greater fears. Research areas, such as medical and health sciences, presented higher depression and stress levels. Also, significant differences were found between depression and emotional-oriented coping strategies, and the type of contract. The anxiety, depression, and stress levels were significantly related positively to emotional-oriented coping strategies.

This study intended to assess the levels of anxiety, depression, stress, fears, and coping strategies in Portuguese researchers during the COVID-19 pandemic. There is a gap in the literature in terms of scientific studies on these professionals, and this knowledge is central to the development of intervention plans for these professionals, in the future. However, this study suggests more extensive and diverse studies on the improvement of mental health and the reduction of anxiety/depression and stress in researchers. It is fundamental to investigate and intervene to promote the health of these professionals and their work performance, highlighting the importance of coping strategies. It is important to prioritize essential competencies, set goals, and coping strategies that increase health and performance.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Comissão de Ética da Universidade de Évora. The patients/participants

provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

PB, LP, and AP were responsible for the concept and design of the study, interpretation of results, writing, and critical review of the manuscript. PB and LP were responsible for data collection and analysis and writing—the original draft. PB, LP, and CF were responsible for the interpretation of the results. AA was responsible for statistical analysis. AP, PO-S, and ML were responsible for writing, reviewing, and editing the manuscript. All authors contributed to the article and approved the submitted version.

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Investigating Frontline Nurse Stress: Perceptions of Job Demands, Organizational Support, and Social Support During the Current COVID-19 Pandemic

Haneen Ali[1]*, *Yasin Fatemi*[2], *Duha Ali*[2], *Mohammad Hamasha*[3] and *Sa'd Hamasha*[1]

[1] Department of Industrial and Systems Engineering and Health Services Administration Program, Auburn University, Auburn, AL, United States, [2] Department of Industrial and Systems Engineering, Auburn University, Auburn, AL, United States, [3] Department of Industrial Engineering, Faculty of Engineering, The Hashemite University, Zarqa, Jordan

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Xenia Gonda,
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Kohei Fujita,
National Hospital Organization Kyoto Medical Center, Japan

***Correspondence:**
Haneen Ali
hba0007@auburn.edu

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Background: While frontline nurses employ coping alternatives to help deal with occupational stress resulting from unprecedented challenges during the COVID-19 pandemic, their access to necessary resources is unclear.

Objective: This study aims to explore nurses' mental health in Alabama hospitals during the COVID-19 outbreak and investigate the impact of organizational and community support on nurse stressor levels, physio-psychosocial responses, and coping strategies employed.

Methods: A cross-sectional survey was developed to bridge our understanding of stress, support, and coping mechanisms and distributed to nurses working with COVID-19-infected patients in hospital settings in Alabama. A total of 232 frontline nurses responded to 79 items in four domains (stressors, physio-psychosocial symptoms, coping, and support) between May 6, 2020, and June 30, 2020. A two-way ANOVA, regression analysis, and mediation of effects were used to analyze the data.

Results: This study found that both social support and use of coping strategies contributed to the reduction of physio-psychosocial symptoms. Differences were found in how older frontline nurses perceived the efficacy of social support and certain coping strategies. This study provides further evidence of the importance of organizational support in addressing the harmful physio-psychosocial symptoms experienced by nurses.

Keywords: nursing staff, COVID-19, supervisor support, social support, coping strategies

CONTRIBUTION OF THE PAPER

What Is Already Known

- The COVID-19 pandemic has impacted the health and psychological wellbeing of nursing staff working with infected patients.
- While additional support is crucial during pandemics, little is known about the impact of organizational resources and supervisor and community support on nurses' stress levels, physio-psychosocial responses, and coping strategies.

What This Paper Adds

- An understanding of nursing staff stressors, resulting physio-psychosocial symptoms, and coping mechanisms employed.
- An understanding of the impact of social support and coping support on the reduction of physio-psychosocial symptoms.
- A better understanding of how the generational context affects nurses' perceptions of various approaches and levels of support.

BACKGROUND

Frontline Nurse Challenges

As of August 21, 2021, the number of COVID-19 cases in the United States had reached over 37 million confirmed cases and over 625,000 deaths, with more than 788,000 healthcare professionals infected, and more than 3,000 dead (1). The COVID-19 pandemic has significantly impacted healthcare professionals' psychological health (2–4). Evidence suggests that during the pandemic, nurses struggle with psychological problems and suffer adverse mental and emotional symptoms, such as depression and stress (2, 5, 6). Previous studies reported sources of stressors and the emotions of nursing staff resulting from the pandemic (2, 7–9), others reported the psychosocial impact and coping strategies employed by nurses (2, 6, 9, 10). Other studies reported the effects of work stress on nursing staff burnout (8, 11–15). However, only few studies investigated the effects of organizational and community support in addressing the adverse psychological effects of COVID-19, and its relationship to the coping strategies deployed by the nursing staff (16–19).

The pandemic in Alabama provides frontline nurses with challenges, not only due to a greater workload from infections, but also additional adverse psychological effects that local hospitals may be ill equipped to address (2, 20, 21). Failure to address these problems could negatively impact healthcare workers and cause short- and long-term psychological injuries (22, 23).

Support from workplaces, friends, family, and colleagues could balance and sustain this emotional stress and provide nursing staff with coping mechanisms that safeguard their wellbeing and mental health (6, 24). Organizational resources are designed to help reduce uncertainty caused by shortages, such as personal protective equipment (PPE), ventilators, medical countermeasures, and health care providers (2, 20, 25). Organizational support is meant to reducing mental and psychological health deterioration resulting from the pandemic. Organizational support can involve providing mental health resources and a clear flow of information, which can alleviate uncertainty and fear (26, 27). Studies suggest that nurses' fears and anxiety symptoms could be addressed through strong, clear communication with nursing staff and regular updates on the COVID-19 outbreak (2, 20, 25). Studies have also found that nurses tend to feel more emotionally exhausted when they do not receive adequate supervisory support (2, 20, 28). Supervisor support plays a crucial role in reducing frontline nurse stress resulting from working in a hectic environment, which may lead to emotional exhaustion and can affect their health and wellbeing (2, 20, 29).

Social support from family and friends can reduce emotional exhaustion and stress and protect against physio-psychosocial symptoms (9, 30). It has been reported that social relationships and support from friends have a mediating effect on stress and physio-psychosocial symptoms, and can help mitigate the stress and anxiety from working as a frontline nurse (2, 5, 20, 24, 30, 31). Social support is reported to help nurses by allowing them to relate personal experiences to each other (2). This interpersonal and self-affirming aspect of social support may help explain how nurses in Alabama use transference as a coping strategy, despite never using psychological counseling (2). Organizational and social support could reduce occupational stress and improve psychological wellbeing by providing a protective layer against anxiety, stress, and depression, and impact the coping mechanisms employed by nursing staff (5, 20, 30).

Stress-Symptom-Support-Coping Framework

Figure 1 illustrates this study's proposed framework, which examines a diverse array of coping mechanisms and the resulting approach nurses take to address sources of stress and physio-psychosocial symptoms. Coping mechanisms are not considered positive or negative, but rather "effective" or "ineffective" at reducing the psychosocial symptoms and stressors experienced by the nurse (32). Scholars familiar with stress and coping studies will note the similarities to studies by researchers such as Folkman et al. (33), specifically the concept that organizational support can theoretically influence other domains simultaneously (24, 34, 35). These models suggest that the psychosocial symptoms and stressors experienced by nurses, mediated by organizational support, influence how nurses cope with their stress. As coping mechanisms are effectively a nurse's sense-making process when working in a stressful environment, this model relates stress appraisal as an ongoing process that connects stressors and symptoms to appropriate coping mechanisms. Because nurses can anticipate the impact of stressful experiences based on previous experiences, the model considers how nurses pursue coping strategies before experiencing physio-psychosocial symptoms.

This paper seeks to bridge our understanding of stress, support, and coping mechanisms by examining frontline nurses in Alabama (2, 10, 20, 33). It aims to explore nurses' mental health in Alabama hospitals during the COVID-19 outbreak and the impact of organizational and social support on

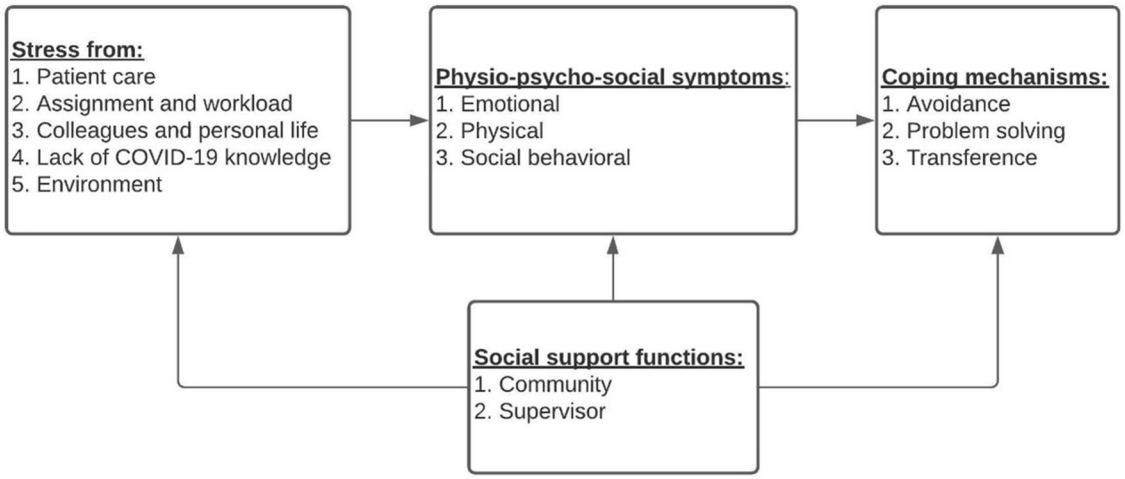

FIGURE 1 | Stress-symptom-support-coping framework for frontline nurses during the COVID-19 pandemic.

nurse stress levels, physio-psychosocial responses, and coping strategies employed.

METHODS

A cross-sectional survey was developed and distributed to nurses working with COVID-19-infected patients in hospital settings in Alabama. A total of 232 frontline nurses responded over the period of May 6, 2020–June 30, 2020. Nurses were invited to participate through information posted about the study on social media platforms, such as LinkedIn, and by encouraging nurses to share information about the study. An online link to the survey was shared with nurses who showed interest. The study's inclusion criteria specified only Alabama nurses working directly with COVID-19 patients in the 3 months prior to the data collection start date.

Ethical Considerations

This study was approved by the Ethics Committee of XX University in accordance with the Declaration of Helsinki (IRB protocol reference: 20–238 EX 2005). Participants were notified about the aims of the project and the risks that might be associated with the survey on the first page, and a consent form was provided. Participants were notified that no identifiable information would be collected, and they agreed to participate in the study by completing the survey, and participants were compensated for their time if they choose to continue and take the survey ($20).

Questionnaire Development

Principal items were developed based on a questionnaire designed by Lee et al. (36) to investigate medical staff during the 2003 SARS epidemic. Further, pandemic-specific questions were taken from an instrument by Cai et al. (37) that was used to examine frontline nurses in China. Finally, the questionnaire is a continuation of instruments created by Ali et al. (2) and Cole et al. (20), who investigated major psychological stressors and organizational resources that impact the stress and turnover intentions of frontline nurses in Alabama.

A total of 79 items were developed for the four domains: stressors, physio-psychosocial symptoms, coping, and support, see **Figure 1**. This list of questions was distributed to a group of experts in the field with research experience (four ICU nurses, two general nurses, two nursing faculty, one public health expert, and two nurse managers). After 1 week, a virtual focus session was conducted with a group of experts to discuss the preliminary list of items. In response to the experts' feedback, the social support items were revised for clarity.

The questionnaire instrument included *demographic and work-related questions* (9 items). *Stress from working as a frontline nurse* was captured using 29 items divided into five constructs: stress from taking care of patients, stress from assignments and workload, stress from colleagues and personal life, stress from a lack of knowledge about COVID-19, and stress from the environment. *Frontline nurse perceptions of physio-psychosocial symptoms* were captured using 15 items divided into three constructs: emotional symptoms, physical symptoms, and social behavioral symptoms. *Nurse perceptions of social support* was captured using 14 items divided into two constructs: community/social support and supervisor support. Finally, *coping strategies employed by nurses* were captured using 12 items divided into three constructs: avoidance, problem solving, and transference. The perception items were measured on a five-point Likert scale (from strongly disagree to strongly agree). A questionnaire template is provided in this study.

The survey instrument was pilot tested with 15 nurses working in local nurses who were invited through personal connections. Reliability was assessed using Cronbach's alpha, which reflects the interrelatedness among the items in each construct. A Cronbach's alpha of the constructs' values was within the acceptable range ($\alpha > 0.70$; see **Table 2**).

Operationalization of Domain Constructs

Stressors

Stress From Taking Care of Patients

Stress related to taking care of COVID-19 patients is well documented (2, 20, 24, 37). These questions are designed to capture aspects of stress resulting from working directly with patients infected with COVID-19.

Stress From Assignments and Workload

The COVID-19 pandemic requires nurses to provide various levels of healthcare to highly infectious patients. These assignments and tasks may not directly involve COVID-19, but are certainly impeded by the social distancing requirements and patient acuity resulting from the patient's infection (2, 20, 24, 37). This construct is used to capture the stress resulting specifically from patient assignment and the resulting workload.

Stress From Colleagues and Personal Life

Frontline nurses are not only afraid of working with COVID-19 patients, they are also afraid of getting their colleagues infected (2, 20, 24, 37). These questions are used to assess stress related to the fear of COVID-19 infections that negatively impact their colleagues and personal lives.

Stress From a Lack of Knowledge About COVID-19

Specific factors can exacerbate the difficulty of providing treatment (2, 20). However, due to the lack of information during the initial months of the pandemic, nurses experienced periods of time when information was scarce, healthcare standards were rapidly changing, and media coverage provided pessimistic outlooks on health capacity (2, 20). Questions related to this construct were designed to capture the uncertainty nurses felt in relation to stress from a lack of knowledge during the pandemic.

Stress From the Environment

Constant media coverage of certain topics, such as PPE shortages and ventilator shortages, may cause nurses to feel more anxious about their next or current shift (2, 20, 24). Items related to this construct were designed to capture the stress caused by nurses who perceived gaps in their work environments.

Physio-Psychosocial Symptoms

Emotional Symptoms

The fear, anxiety, and stress reported by nurses during the pandemic have been well documented (2, 20). This construct was designed to capture the mental and emotional experiences of working as a frontline nurse during the pandemic.

Physical Symptoms

Studies related to nurse occupational stress suggest that high levels of stress can cause adverse physical symptoms (2, 20). Intense anxiety, insomnia, poor diet, and headaches can all be triggered or exacerbated by stressful experiences related to working during the pandemic (2, 20, 24, 37). This construct was designed to capture the adverse physical symptoms reported by frontline nurses.

Social Behavioral Symptoms

Due to the social distancing requirements of the COVID-19 pandemic, there is both public and professional pressure to avoid becoming infected. This causes nurses to fear becoming infected, as they might pass on the virus by working as an asymptomatic carrier (2, 20, 24, 37). This construct was designed to capture the perception of adverse social conditions while working as a frontline nurse.

Support

Supervisor Support

Supervisor support is defined as the informal support and professional guidance frontline nurses receive from their supervisors to cope with stressful situations (38). This construct was designed to capture the extent to which supervisor support contributes to the reduction of stress and physio-psychosocial symptoms.

Community Support

Community support is defined as the organized or informal support received by frontline nurses from family members, friends, neighbors, religious organizations, community programs, cultural and ethnic organizations, and other support groups or organizations outside their workplace (24). This construct is used to measure the extent to which frontline nurses rely on social support from outside the hospital to mitigate physio-psychosocial symptoms.

Coping

Avoidance

Avoidance refers to a coping strategy used by frontline nurses to distance themselves from the source of their stress (2, 6, 24, 31, 33, 35, 39). Avoidance is used to measure the extent to which frontline nurses attempt to avoid rather than engage with their sources of stress.

Problem Solving

Problem solving refers to the coping strategy that involves frontline nurses engaging in a series of deductive steps to understand how to address and mitigate the source of their stress (2, 6, 24, 31, 33, 35, 39). Problem solving is used to measure the extent to which frontline nurses attempt to "figure out" and address their stress as a coping strategy.

Transference

Transference refers to a coping strategy that involves frontline nurses engaging in interpersonal communication with a professional therapist (2, 6, 24, 31, 33, 35, 39). Transference is used to measure the extent to which frontline nurses attempt to seek psychological therapy to address their stress as a coping strategy.

RESULTS

The statistical analysis included descriptive statistics of the demographic factors examined in the survey. Next, a two-way ANOVA, Pearson's correlations of the constructs, and regression analysis were used to analyze the domains and constructs.

Finally, the direct and indirect effects of the domains tested were analyzed to determine the influences of social support and coping mechanisms on occupational stress and associated physio-psychosocial symptoms.

Descriptive Statistics of Demographic Variables

Table 1 provides the descriptive statistics of the demographic variables. The results show that respondents were relatively young, with 43.5% ($n = 101$) under 30 years old. They suggest that slightly over half 50.9% ($n = 118$) of nurses were less experienced while 10.8% ($n = 25$) were senior. Further, there is a roughly even proportion of married nurses at 47.0% ($n = 109$) compared to the 44.8% ($n = 104$) who have never married. It should be noted that 68.1% ($n = 158$) of our respondents had at least one child, while roughly 31.9% ($n = 78$) had no child. Overall, most nurse respondents were female 90.9% ($n = 211$). Lastly, a third of the nurse respondents specialized as general nurses (30.6%; $n = 71$), making up the largest single specialization in the sample.

TABLE 1 | Descriptive statistics.

	Respondents	Percent ($N = 232$)
Age		
1 = < 30	101	43.5
2 = > 30	48	20.7
3 = > 40	29	12.5
4 = > 50	54	23.3
SD	1.21	
Gender		
1 = M	21	9.1
2 = F	211	90.9
SD	0.288	
Ethnicity		
1= White	211	90.9
2 = African American (non-Hispanic)	21	9.1
SD	0.288	
Marital status		
1 = Married	109	47
2 = Divorced	19	8.2
3 = Single (never married)	104	44.8
SD	1.92	
Have children?		
1 = No	158	68.1
2 = Yes	78	31.9
SD	0.467	
Seniority		
1 = < 10 years of experience	118	50.9
2 = > 10 years of experience	89	38.4
3 = > 15 years of experience	25	10.8
SD	0.677	
Specialty		
1 = General nurse	71	30.6
2 = ICU	64	27.6
3 = OR	35	15.1
4 = ER	30	12.9
5 = Other	32	13.8
SD	1.399	
Shift		
1 = Morning	158	68.1
2 = Evening	74	31.9
SD	0.467	

ANOVA: Analysis of Demographic Variables and Constructs

Appendix 1 (see Section 1) provides the results of the two-way ANOVA between the demographic variables and the domain constructs.

Stressors

Stress From Taking Care of Patients

The analysis of variance between the demographic variables and stress from taking care of patients showed that gender ($p < 0.01$), having children ($p < 0.01$), and specialty ($p < 0.01$) were all statistically significant predictors of patient care-related stress for frontline nurses. Nurses between the ages 41–50 ($p < 0.01$) and nurses with over 10 years of experience showed significantly lower stress levels ($p < 0.05$). In general, more than 65% of the nursing staff reported high stress levels due to taking care of patients infected with COVID-19.

Stress From Assignments and Workload

Gender ($p < 0.01$), marital status ($p < 0.01$), and specialty ($p < 0.05$) all demonstrated significant relationships with stress from assignments and workload. Nurses aged 31–40 ($p < 0.01$), nurses aged 30 and younger ($p < 0.01$) and nurses who had no children reported significantly higher stress levels ($p < 0.05$). Nurses with more than 10 years of experience showed significantly lower mean stress levels ($p < 0.05$), and more than 80% of respondents reported high stress levels due to assignments or workload in general.

Stress From Colleagues, Staff, and Personal Life

It was found that marital status ($p < 0.01$), having children ($p < 0.01$), and specialty ($p < 0.05$) were all significantly related to stress from colleagues, staff, and personal life. Female respondents showed significantly higher mean stress levels ($p < 0.01$). Nurses aged 50 and older ($p < 0.01$) and nurses with over 10 years of experience reported lower stress levels ($p < 0.01$). Overall, around 70% of respondents reported higher stress (>3) resulting from worry or concern about colleagues or family members.

Stress From a Lack of Knowledge About COVID-19

It was found that gender ($p < 0.01$), seniority ($p < 0.01$), and specialty ($p < 0.01$) were all significantly related to stress from a lack of knowledge about COVID-19. Nurses that were never married reported significantly higher mean stress levels ($p < 0.01$). Nurses aged 41–50 reported significantly lower mean stress levels ($p < 0.01$). Overall, around 70% of nurses in the study reported stress levels higher than 3 on the Likert scale.

Stress From the Environment

It was found that seniority ($p < 0.01$), and specialty ($p < 0.01$) were statistically significant predictors of stress from the environment. Female nurses showed significantly higher stress levels than their male counterparts ($p < 0.01$). Nurses aged 50 and older ($p < 0.01$), as well as married nurses ($p < 0.01$), reported significantly lower stress levels. Around 77% of nurses in the study reported a high level of stress resulting from their environment.

Physio-Psychosocial Symptoms

Emotional Symptoms

The analysis of variance between the demographic variables and emotional symptoms showed that gender ($p < 0.01$), marital status ($p < 0.01$), seniority ($p < 0.01$), specialty ($p < 0.01$), and shift ($p < 0.05$) were all statistically significant characteristics of frontline nurses. Nurses aged 50 and older reported significantly lower emotional symptoms ($p < 0.01$).

Physical Symptoms

It was found that age ($p < 0.01$), seniority ($p < 0.01$), specialty ($p < 0.01$), and shift ($p < 0.05$) were all related to physical symptoms. Female nurses (3.33, $p < 0.01$) and nurses who were never married (3.46, $p < 0.01$) reported significantly higher mean physical symptom levels.

Social Behavioral Symptoms

It was found that marital status ($p < 0.01$), seniority ($p < 0.01$), and specialty ($p < 0.01$) were all related to frontline nurse social behavioral symptoms. Nurses aged 50 and older reported significantly lower mean social behavioral symptoms ($p < 0.05$). Nurses aged 31–40 years ($p < 0.05$) and female nurses reported significantly higher mean social behavioral symptom levels ($p < 0.01$).

Coping

Avoidance

The analysis of variance between the demographic variables and avoidance as a coping strategy showed that gender ($p < 0.01$) and specialty ($p < 0.01$) were significant predictors. Nurses aged 50 and older reported significantly lower mean avoidance usage (0.35, $p < 0.01$).

Problem Solving

It was found that specialty ($p < 0.01$) was significantly related to frontline nurses' tendency to use problem solving as a coping strategy. Nurses aged 31–40 ($p < 0.01$), respondents who had never been married ($p < 0.01$), and female respondents ($p < 0.01$) showed significantly higher mean problem-solving usage.

Transference

It was found that age ($p < 0.05$), marital status ($p < 0.05$), specialty ($p < 0.05$) having children ($p < 0.05$), and shift ($p < 0.05$) were all statistically significant predictors of frontline nurses' tendency to use transference as a coping strategy. Nurses with over 10 years of experience reported significantly lower mean transference usage ($p < 0.01$).

Support

Supervisor Support

The analysis of variance between the demographic variables and supervisor support found that specialty ($p < 0.05$) was a statistically significant predictor of frontline nurses' supervisor support. Nurses aged 30 and younger ($p < 0.01$) and nurses with morning shifts reported significantly higher mean levels of supervisor support ($p < 0.05$). Respondents that had been divorced showed significantly lower mean levels of supervisor support ($p < 0.05$). Overall, only 37% of the respondents reported receiving support from their supervisors.

Community Support

It was found that specialty ($p < 0.05$) and shift ($p < 0.05$) were statistically significant predictors of reliance on community support. Nurses aged 50 and older ($p < 0.01$), and nurses who had been divorced showed higher levels of community support ($p < 0.05$). Nurse respondents with more than 10 years of experience reported significantly lower mean levels of community support ($p < 0.01$). In general, around 44% of nurses reported a high level of community support.

ANOVA: Analysis of Demographic Variables and Domains

Appendix 1 (see Section 2) provides the results of the two-way ANOVA between the demographic variables and domain scores.

Stressors Domain

The analysis of variance between the demographic variables and the stressors domain showed that gender ($p < 0.01$), marital status ($p < 0.01$), and specialty ($p < 0.01$), were all statistically significant predictors of stress for frontline nurses. Nurses aged 41–50 ($p < 0.01$), nurses aged 50 and older ($p < 0.01$), and nurses with more than 10 years of experience reported significantly lower levels of stress ($p < 0.01$).

Physio-Psychosocial Symptoms Domain

It was found that specialty ($p < 0.01$), and shift ($p < 0.05$), were all statistically significant predictors of frontline nurse physio-psychosocial symptoms. Nurses aged 50 and older ($p < 0.01$), nurses who had been divorced ($p < 0.01$), and nurses with over 10 years of experience ($p < 0.01$) reported significantly lower mean levels of physio-psychosocial symptoms.

Coping Domain

It was found that specialty ($p < 0.01$), and shift ($p < 0.05$), were statistically significant predictors of frontline nurse coping habits. Nurses aged 31–40 ($p < 0.01$) and female respondents ($p < 0.01$) reported significantly higher mean use of coping strategies. Nurses that were divorced ($p < 0.01$) and nurses with over 10 years of experience reported significantly lower mean coping strategy usage ($p < 0.01$).

Support Domain

It was found that nurses aged 31–40 ($p < 0.01$) and nurses with over 10 years of experience showed significantly lower mean levels of support ($p < 0.05$). Nurses who had never married reported significantly higher mean levels of support ($p < 0.01$).

TABLE 2 | Pearson correlations between domain constructs.

		M	SD	∞	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Stress from patients	3.27	0.92	0.732	1												
2	Stress from workload	3.63	0.66	0.81	0.656**	1											
3	Stress from personal life	3.53	0.89	0.769	0.644**	0.715**	1										
4	Stress from lack of knowledge	3.53	0.82	0.856	0.692**	0.655**	0.575**	1									
5	Stress from environment	3.62	0.83	0.782	0.590**	0.596**	0.686**	0.653**	1								
6	Emotional symptoms	2.7	0.95	0.887	0.515**	0.514**	0.522**	0.613**	0.573**	1							
7	Physical symptoms	3.31	0.76	0.708	0.502**	0.376**	0.552**	0.465**	0.560**	0.655**	1						
8	Social behavioral symptoms	2.41	0.96	0.774	0.427**	0.395**	0.472**	0.336**	0.544**	0.508**	0.507**	1					
9	Supervisor support	2.71	0.75	0.76	0.05	0.121	0.064	0.035	0.082	−0.065	−0.117	−0.092	1				
10	community support	2.8	0.64	0.794	−0.008	0.029	−0.197**	0.006	−0.067	−0.11	−0.166*	−0.152*	−0.017	1			
11	Coping strategy avoidance	1.03	0.94	0.78	0.258**	0.348**	0.428**	0.295**	0.397**	0.248**	0.119	0.262**	−0.029	−0.059	1		
12	Coping strategy problem solving	2.67	1.34	0.699	0.433**	0.333**	0.428**	0.606**	0.606**	0.450**	0.424**	0.424**	0.028	−0.130*	0.389**	1	
13	Coping strategy transference	1.84	0.74	0.72	0.009	0.085	0.078	0.007	−0.165*	0.133*	0.161*	0.138*	−0.042	−0.109	0.013	0.016	1

*M, Mean; SD, Standard deviation; α, Cronbach's Alpha reliability. *p < 0.05 and **p < 0.01.*

Correlation Analysis

Pearson correlations were checked (**Table 2**) to investigate the correlations between this study's domain constructs. With the largest correlation coefficient, stress from nurses' personal lives correlated significantly and positively with stress from task workload ($r_{(4)} = 0.715$, $p < 0.001$). Stress from a lack of knowledge correlated significantly and positively with stress from workload ($r_{(4)} = 0.692$, $p < 0.001$). Stress from the environment correlated strongly and positively with stress from personal life ($r_{(4)} = 0.686$, $p < 0.001$), stress from patients correlated significantly and positively with stress from workload ($r_{(4)} = 0.656$, $p < 0.001$), and stress from lack of knowledge correlated significantly and positively with stress from workload ($r_{(4)} = 0.655$, $p < 0.001$).

Regression Analysis of Demographic Variables and Domains

Appendix 1 (see Section 3) provides the regression analyses of demographic variables and domain scores.

Stressors Domain

Age was found to be statistically significant in two ways: stress was highest among nurses aged 31–40 years old ($p < 0.01$) and lowest among nurses aged 41–50 years old ($p < 0.05$). Being female corresponded to a significant increase in stress, by almost a whole unit ($p < 0.01$). Respondents who reported being divorced had significantly lower stress ($p < 0.01$), while never having married corresponded with high stress ($p < 0.01$). Nurses with more than 10 years of work experience reported higher stress ($p < 0.01$), and lower stress levels were reported by nurses who worked in the operating room ($p < 0.05$), emergency room ($p < 0.05$), and other ($p < 0.01$).

Physio-Psychosocial Symptoms Domain

Physical and psychosocial symptoms were higher among nurses aged 31–40 years old ($p < 0.01$) and lower among nurses aged 41–50 years old ($p < 0.05$). Being female corresponded to significantly higher (more than one unit) symptoms ($p < 0.01$). Divorced nurses reported less symptoms ($p < 0.01$). Nurses who had more than 10 years of work experience reported more symptoms ($p < 0.01$), while those with <15 years of experience had lower symptoms ($p < 0.01$). Nurses working in operating rooms ($p < 0.01$), and "other" specialties ($p < 0.01$) had significantly lower symptoms, and working the night shift was related to higher physio-psychosocial symptoms ($p < 0.05$).

Coping Domain

Around 67% of nurses reported using at least one avoidance coping mechanism, 84% reported using problem-solving coping techniques, and 95% reported a form of transference coping mechanism. However, no one of the respondents reported seeking help from a psychologist as a coping mechanism. Nurses working in operating rooms ($p < 0.05$), emergency rooms ($p < 0.05$), and other ($p < 0.01$) reported lower use of coping strategies, as did nurses working on the night shift ($p < 0.05$). Being female corresponded to a significantly higher (more than one unit) usage of coping strategies ($p < 0.01$), as did being African American ($p < 0.01$). Being divorced corresponded with significantly lower use of coping strategies ($p < 0.01$). Overall, single (never married) nurses reported a significant and higher use of coping mechanisms ($p < 0.01$), and more problem solving coping.

Social Support Domain

The perceived importance of social support was lower among nurses aged 31–40 ($p < 0.01$) and higher among nurses aged 41–50 ($p < 0.05$). Nurses with more than 15 years of work had significantly and married nurses reported significantly higher social support ($p < 0.05$).

Mediational Analyses

Table 3 reports the results for the direct and indirect effects of support on nurses' coping strategies. **Figure 2** provides an illustration of the framework in light of the empirical results.

TABLE 3 | Bootstrapping results for the direct and indirect effect of domains.

Direct effect	*coeff*	*se*	*t*	*p*-value	*LLCI*	*ULCI*
Support→Stressor	0.0298	0.0935	0.3183	0.7505	−0.1544	0.2140
Support→Symptoms*	−0.3140	0.0691	−4.5457	<0.001	−0.4501	−0.1779
Stressor→Symptoms*	0.7480	0.0487	15.3569	<0.001	0.6520	0.8439
Support→Coping	−0.3104	0.2344	−1.3242	0.1868	−0.7724	0.1515
Symptoms→Coping*	0.5918	0.2148	2.7550	0.0063	0.1685	1.0150
Stressor→Coping*	1.2207	0.2256	5.4117	<0.001	0.7762	1.6651

Level of confidence for all confidence intervals in output: 95%.

Indirect effect	*Effect*	*BootSE*	*BootLLCI*	*BootULCI*
Support→Stressor→Coping	0.0363	0.1186	−0.1917	0.2766
Support→ Symptoms→Coping*	−0.1858	0.0693	−0.3302	−0.0601
Support→Stressor→ Symptoms→ Coping	0.0132	0.0451	−0.0827	0.1032

*N = 232; LL, Lowe limit; UL, Upper limit; *p < 0.05.*

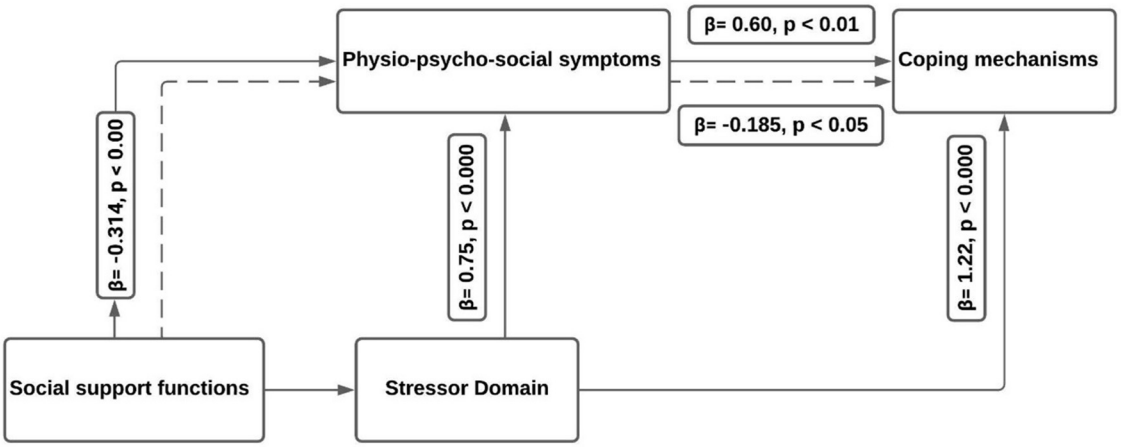

FIGURE 2 | Revised framework for frontline nurse stress, symptom, support, and coping.

Direct Effect

This analysis shows the direct relationship between independent and dependent variables. **Table 3** shows that there is no direct effect between the independent variable (support) and dependent variable (coping strategies) ($P = 0.1868$). In other words, the "c" coefficient is not statistically significant. It also reports that the direct effect between support and symptoms is $\beta = -0.3140$ ($P < 0.001$). In other words, "m1" coefficient is statistically significant. It demonstrates that direct effect between mediators (stressor and symptoms) is $\beta = 0.7480$ ($P < 0.001$). The direct effect between mediators (Symptoms and stressor) and coping strategies are $\beta = 0.5918$ ($p = 0.1685$) and $\beta = 1.2207$ ($P < 0.001$), respectively. So, "b1" and "b2" coefficients are statistically significant.

Indirect Effect

This part of the results tests the indirect relationship between independent and dependent variables. The symptom is the only mediator who mediates the relationship between support and coping strategies. The indirect effect is equal to−0.1858 with a 95% bootstrap confidence interval; that is, the indirect effect is statistically significant at alpha 0.05 ($P < 0.05$).

DISCUSSION

This study aimed to investigate the relationships between frontline nurse stress, physio-psychosocial symptoms, and coping behaviors employed by nursing staff during the COVID-19 pandemic. Additionally, this study aimed to examine the relationships between coping strategies and social support on adverse symptoms and their related stressors. The study's results ultimately reflect the age and occupational differences in how frontline nurses perceive and engage in support and coping to reduce physio-psychosocial symptoms. Furthermore, the results reflect how certain stressors and symptoms are associated with specific coping behaviors. Finally, the results suggest a causal

relationship in which nurses appraise their stress prior to symptoms and choose their coping strategies based on the symptoms felt.

Age and Specialty: Frontline Nurse Stress, Coping, and Support

This study found that factors related to aging significantly contributed to stress from personal life, emotional symptoms, physical symptoms, and social symptoms. For example, being over 50 years old was associated with a significant positive relationship with social support. It seems clear from this data that age differences at least partially determined frontline nurses' preferences in how they coped with occupational stress factors. This finding is consistent with Ali et al. (2). This is perhaps why older nurses preferred social relationships and transference over more individual forms of coping, such as problem-solving (6, 33, 35, 40). Overall, these results indicate that age differences influence how nurses perceive the efficacy of coping strategies and social support.

According to the results of this study, the specialty was found to be a significant demographic factor affecting stress, symptoms, and coping strategy usage. The results show that nurses in specialties such as OR, ER, and pediatrics reported having significantly lower stress, physio-psychosocial symptoms, and use of coping strategies than general nurses. Interestingly, specialties such as ICU and OR reported requiring substantially more support than general nurses. These findings suggest that specialties requiring less patient exposure result in greater stress levels, which is consistent with Ali et al. (2) and Cai et al. (37).

Specialties involving more technical procedures, such as OR, and those involving more uncertain and volatile patients, such as ICU, seem to require more social support (2, 24).

Gender: Frontline Nurse Stress, Coping, and Support

The results indicated that female nurses have significantly higher stress and Physio-psycho-social emotional symptoms than male nurses. Female nurses reported a higher level of anxiety, sadness, and depression, but a higher score for problem-solving techniques was reported by female nurses. In general, female nurses indicated higher use of coping strategies than their male counterparts. This is consistent with Ali et al. (2) and Huang et al. (41), who reported that female nurses are more likely to suffer from psychological problems and report a higher level of stress (42, 43). This might be because female nurses spend more time and effort communicating and providing mental support to patients and their life and family responsibilities (41, 42). In addition, female nurses reported a higher community and organizational support level. This observation might be because females generally have more social responsibilities and engage in social and family activities more than males. Also, related to Hamdan-Mansour et al. (44), female nurses report significantly higher stress. Therefore, they may be more in need of community and organizational support.

Seniority: Frontline Nurse Stress, Coping, and Support

Although stress seems problematic for all nurses' specialties, little is known about nursing seniority differences. López-López et al., (45) reported that professional seniority variables contribute to burnout and stress development in nurses. More experienced nurses have reported less stress levels, which may be related to having more years of training and dealing with patients' related stress. In addition, these nurses reported significantly lower mean levels of physio-psychosocial symptoms and needed support.

This study shows that nurses with over ten years of experience reported significantly lower mean coping strategy usage. With experience, nurses may have developed greater emotional and mental resilience out of job necessity (2). Younger nurses reported a higher level of organizational and social support. They are mostly less experienced and request more support from supervisors due to a lack of confidence than their counterparts. In addition, Kath et al., (46) declared age had a significant positive relationship with autonomy. Another reason could be that the younger nurses work with an older ones (46). These could be the reasons for reporting more support levels among younger nurses. In contrast, Laal and Aliramaie, (47) reported that junior and senior staff had no difference in applying positive or negative responses to cope with stress.

Marital Status: Frontline Nurse Stress, Coping, and Support

In general, all nurses reported using a sort of problem-solving coping strategy. More than 62% of younger nurses reported thoughts of leaving their job. In contrast, single nurses reported using avoidance coping strategies more than married ones. In conclusion, married nurses were indicated to have lower stress levels during the COVID-19 pandemic. This is consistent with Ali et al. (2) findings. Unsurprisingly, transference coping strategies were considered more by married nurses. This could be related to the support they receive from their partners and the ability to transfer and redirect the stress to their partner.

These results help to understand better why nurses feel the need for additional social and organizational support in light of greater uncertainty and why some specialties require more support than others in pandemic circumstances. However, further research into the differences among nurses' perceptions of support, in general, is needed to highlight potential gaps in how current and future nurses perceive the efficacy of social support.

Stressors, Physio-Psychosocial Symptoms, Support, and Coping

Figure 2 provides an updated framework that considers the insights from the bootstrapping results. As expected, stressors have a significant direct effect on harmful Physio-psychosocial symptoms. Further, harmful symptoms have a significant positive impact on the need for coping strategies. The direct effects provide a practical illustration of the ways stress leads

to symptoms and how symptoms lead to coping strategies. Additionally, it suggests that nurses can appraise their stress more quickly than scholars have theorized, as stress and symptoms (24, 33). Finally, greater social support may reduce nurses' reliance on coping strategies.

CONCLUSION

This study found that both social support and physio-psychosocial symptoms contributed to the use of coping strategies. This study reveals that nurses who experience a higher level of stress are more likely to experience poor physio-psycho-social symptoms and negatively cope with the stress. This study demonstrates that organizational and social support could reduce stress intensity and improve the physio-psycho-social status by reducing the harmful symptoms.

This study provides further evidence of the importance of organizational support in helping alleviate the harmful physio-psychosocial symptoms experienced by nurses. The study helped identify unique patterns related to nursing support during the pandemic. However, this study lacked sample diversity, such as gender. Gender-related findings could not be generalized because of the relatively small sample size of male participants in this study.

DATA AVAILABILITY STATEMENT

The raw data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Auburn University IRB Review Committee (IRB protocol reference: 20–238 EX 2005). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HA and DA designed the study and collected the data. HA, YF, and SH analyzed the collected data and MH helped with the data analysis. All authors drafted the manuscript, made necessary changes and revisions to the manuscript, and approved the final version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.839600/full#supplementary-material

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Health Action Process Approach (HAPA) as a Framework to Understand Compliance Issues With Health Protocols Among People Undergoing Isolation at Emergency Hospital for COVID-19 Wisma Atlet Kemayoran and RSCM Kiara Ultimate Jakarta Indonesia

Khamelia Malik[1,2], Nurmiati Amir[1], A. A. A. A. Kusumawardhani[1], Petrin Redayani Lukman[1], Rhapsody Karnovinanda[1], Leslie Melisa[1], Lidya Purnama Dewi[1] and Agnes Lasmono[1]**

[1] Department of Psychiatry, Faculty of Medicine, Cipto Mangunkusumo National Referral Hospital, Universitas Indonesia, Jakarta, Indonesia, [2] Neuroscience and Brain Development Research Cluster, Faculty of Medicine, Indonesia Medical Education and Research Institute, Universitas Indonesia, Jakarta, Indonesia

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***Correspondence:**
Khamelia Malik
khameliapsi@gmail.com
Agnes Lasmono
agnes.lasmono@hotmail.com

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Introduction: This study aims to identify the psychosocial determinants and examine the mediation mechanisms of the compliance with COVID-19 health protocols among people undergoing isolation in health facilities that specifically treat COVID-19 cases in Jakarta, Indonesia.

Methods: This is a cross-sectional study which used socio-cognitive approach, known as the Health Action Process Approach (HAPA), to understand the complexity of issues related to compliance with health protocols. A total of 1,584 subjects participated in this study, including 865 men and 719 women over the age of 18 years old during the data collection period (October 19–26, 2020). The data were collected using questionnaire that was developed by a team of experts from the Faculty of Medicine, Universitas Indonesia—Dr. Cipto Mangunkusumo General Hospital, and survivors. The data that has been collected were then analyzed using Structural Equation Modeling, a multivariate data analysis technique.

Results: The final research model in this study fulfills the criteria for a good model fit. This study found that individuals who have strong self-efficacy regarding their ability to implement behaviors and overcome obstacles will have stronger intent to comply in the future. The study also found that stronger intent will lead to stronger planning, and planning was found mediating intention and compliance with health protocols.

Conclusion: This research model is comprehensive and useful in understanding compliance with health protocols among people undergoing isolation in health facilities for COVID-19 (Wisma Atlet and RSCM Kiara Ultimate). Having intent (related to the risk perception, outcome expectancies, and self-efficacy) and having a plan can

positively influence the behavior of people undergoing isolation, resulting in better compliance to health protocols. The understanding gained from this study can be used to improve strategies related to compliance with health protocols against COVID-19 in the communities.

Keywords: Health Action Process Approach, COVID-19, compliance with health protocols, isolation in health facility, Indonesia

INTRODUCTION

The COVID-19 pandemic that has occurred over the last 2 years around the world presented great challenges not only to health workers, but also to the economy, government, education, and many other sectors in society (1, 2). Based on the latest data from WHO as of the time of writing (April 13, 2022), there have been 499,119,316 confirmed cases of COVID-19, with a total of 6,185,242 deaths. Indonesia has recorded 6,036,909 confirmed cases of COVID-19 and 155,746 deaths (3). The high transmission rate of COVID-19 continues to be a concern, especially the Delta and Omicron variant which was found to have a much higher transmission rate than the first strain encountered at the beginning of the pandemic. Due to its high transmission rate, various interventions to prevent the transmission of COVID-19 are also continuously being developed. These include physical distancing, self-isolation, quarantine, and health protocols. Vaccination program has also been implemented and is one of the main strategies currently used to control the COVID-19 pandemic. Although the vaccination program will run continuously until the transmission rate in the community decreases, prevention strategies in the form of health protocols, such as regularly washing hands, wearing masks, maintaining distance, avoiding crowds, as well as limiting mobility and interaction, still need to be carried out regularly. The CDC also recommends that vaccinated people should continue to comply with health protocols to prevent transmission (4, 5). Dewi and Probandari (6) also found a significant association between compliant behavior to health protocols, such as wearing masks and physical distancing outside the home and at the workplace, and the COVID-19 rapid test results.

Due to the importance of health behavior in the prevention of disease, various forms of health promotion continue to be conducted to achieve behavior change in terms of compliance with health protocols at the community level. However, community compliance level to the health protocols remains low in Indonesia. Based on a survey on community compliance with health protocols conducted by AC Nielsen with UNICEF, in six major cities in Indonesia, there were only 31.5% of respondents who performed all health protocol behaviors (including wearing masks, maintaining distance, and washing hands) in a disciplined manner. Others performed two of the three health protocol behaviors (36%), one of the three health protocol behaviors (23.2%), or did not comply with the health protocols at all (9.3%) (7). Fuady et al. (8), who conducted a study in Indonesian youths, also found that despite having good knowledge and attitude, in practice the results were significantly different. Fuady et al. (8) found that in Indonesian youth, the non-compliance rate to the health protocols was high, suggesting that knowledge and attitude alone are not enough to make a person perform health behaviors, particularly related to preventive strategies against COVID-19.

To achieve effective behavioral changes, it is necessary to identify the behavioral determinants that can be potentially modified and used as targets for intervention. Common obstacles that often keeps people from doing behavioral changes, let alone doing it consistently, are whether or not there is an intention to do the behavior and the gap between having intent and doing the behavior. A socio-cognitive approach, known as Health Action Process Approach (HAPA), can be used to understand the mechanism for someone to have intents and understand the gap between intent and behavior. HAPA helps to bridge and look for more specific determinant factors on how intent emerges into sustained behavioral change. HAPA distinguishes the two processes leading to health behavioral change, namely the pre-intentional motivation process and the post-intentional volitional process. In the motivational phase of HAPA, three socio-cognitive components influence the emergence of intent to change behaviors. The three components consist of expectations of the desired outcome, self-efficacy to make behavioral changes, and perception of personal risk. Expectations of the desired outcome may be in the form of social, physical, or emotional outcome expectancies. Self-efficacy is a person's belief in his capacity to perform the desired behavior. Risk perception is the identification and interpretation of a person's health risks, whether as specific diseases or non-specific conditions. In the volitional phase, two main components implicate the change after the intent emerges, which include planning and self-efficacy (both for maintaining behavior and recovery). Planning consists of two things: planning for actions, such as when, where, and how to act, and planning for coping that will be performed if there are obstacles encountered. Self-efficacy in the volitional phase includes a person's belief in one's capacity to maintain new behaviors through various coping mechanisms in dealing with the obstacles, as well as to reconduct the expected behavioral change if one fails. Moreover, there is action control that may also influence the behavioral changes, which is a self-regulatory strategy done when the behavior has already taken place and been continuously evaluated (9–15).

This study used HAPA to understand the complexity of compliance issues to health protocols. Previously, HAPA has also been used in several studies on health behaviors related to COVID-19, such as study conducted by Lao et al. (16) that

found both motivation and volitional factors included in HAPA might improve compliance with several health protocols related to COVID-19, i.e., wearing facemask and handwash. Hamilton et al. (17) also used HAPA to assess social distancing behavior during the pandemic, and found that both processes from HAPA can be used to understand the behavior. Beeckman et al. (14) who also used HAPA as the framework for the study found the same results. Another study by Duan et al. (15) also identified some social-cognition determinants by integrating the theory of planned behavior, health knowledge, and HAPA on three health behaviors related to COVID-19. The study found that intents might be predicted by motivational self-efficacy, attitude and subjective norms, while behaviors might be predicted by health knowledge and action control, and also mediated by planning from volitional self-efficacy (15).

Although several studies have been found examining HAPA on health behaviors related to COVID-19, until this writing was made, no studies were found examining HAPA in the specific population, namely people who are undergoing isolation in health facilities, especially in Indonesia. In Indonesia, the government has provided some isolation facilities where people might undergo isolation and were guaranteed that they will receive masks, available handrub, be supervised continuously, and share appropriate rooms with some distance with other people. With the condition that all the supplies needed were available, this study tried to learn about the mechanism related to the compliance behavior in that specific population. Therefore, this study was conducted, aiming to identify the psychosocial determinants and examine the mediation mechanisms of the compliance with COVID-19 health protocols among people undergoing isolation in health facilities that specifically treat COVID-19 cases in Jakarta, Indonesia. The understanding are important to be known and may be used in developing future programs that targeted the compliance with health protocols of COVID-19 more specifically.

In this study, it was hypothesized that in people undergoing isolation in health facilities related to COVID-19 where the facilities needed where provided, there can be found direct association between self-efficacy in taking actions, outcome expectancies, and risk perception with intents. Moreover, this study also hypothesized that having intents has direct association with planning, planning has direct association with compliance to health protocols, and self-efficacy in maintaining behavior has a direct association with compliance and planning. Moreover, this study also hypothesized that planning mediate intention and compliance to health protocol.

MATERIALS AND METHODS

Study Design

This is a cross-sectional study, that used HAPA to understand the process leading to behavior change, i.e., compliance with health protocols. There were eight hypotheses tested in this study, as listed in **Figure 1** below, including H1: Self-efficacy in taking actions has a direct association with intents; H2: outcome expectancies have a direct association with intents; H3: risk perception has a direct association with intents; H4: intents have a direct association with planning; H5: planning has a direct association with compliance; H6: Self-efficacy in maintaining behavior has a direct relationship with planning; H7: Self-efficacy in maintaining behavior has a direct association with compliance. Furthermore, this study also hypothesized that planning will mediate intention and compliance to health protocol, filling the intention-behavior gap in this community (H8).

Participants

This study included individuals who had been confirmed of having COVID-19, and were undergoing isolation at the health facilities for COVID-19 in Jakarta, Indonesia (Wisma Atlet Kemayoran and Kiara Ultimate RSCM Jakarta) during the data collection period (October 19–26 2020). The inclusion criteria for this study was all people who were undergoing isolation at the health facilities for being confirmed of having COVID-19. The exclusion criteria was the subjects who were in a bad condition that affecting their understanding about the study and having difficulties filling out the distributed questionnaire. The *a-priori* sample size was determined based on the calculation formula for Structural Equation Modeling (SEM), with anticipated effect size 0.1, desired statistical power level 0.8, number of latent variables 7, number of observed variables 5, and probability level 0.05. Based on the calculation formula (19), the minimum sample size required to detect the effect is 1,808 samples, with a minimum of 805 samples for the model structure. In this study, subjects who met the inclusion and exclusion criteria were included until the time limit was over (the data collection period for this study was limited to 8 days). As many as 1,584 subjects completed the study, including 865 men and 719 women over the age of 18 years old.

Procedures

The medical staffs worked in Wisma Atlet Kemayoran and Kiara Ultimate RSCM Jakarta were included to explain about the study to the respondents during the data collection period. The respondents who were selected based on the inclusion and exclusion criteria listed above were being informed about the aim of the study, steps to fill the questionnaire distributed, and the confidentiality issues. All of the participants who agree to join in this study have given the permission by signing in the online form of the informed consent form. The questionnaire in this study was distributed using an electronic form, following the regulations of the health facility where the study was conducted, to avoid COVID-19 transmission. When completing the questionnaire, respondents were accompanied by the research team.

Research Instrument

To test the hypotheses, a survey questionnaire adapted from the questionnaire made by Schwarzer (11) was used in this study. The questionnaire was developed by a team of experts from the Faculty of Medicine, Universitas Indonesia—Dr. Cipto Mangunkusumo General Hospital, and survivors. The development was conducted by first creating, distributing, and collecting data using a pre-test questionnaire, followed by modifications to develop a formal questionnaire which was then distributed for study data collection. The developed

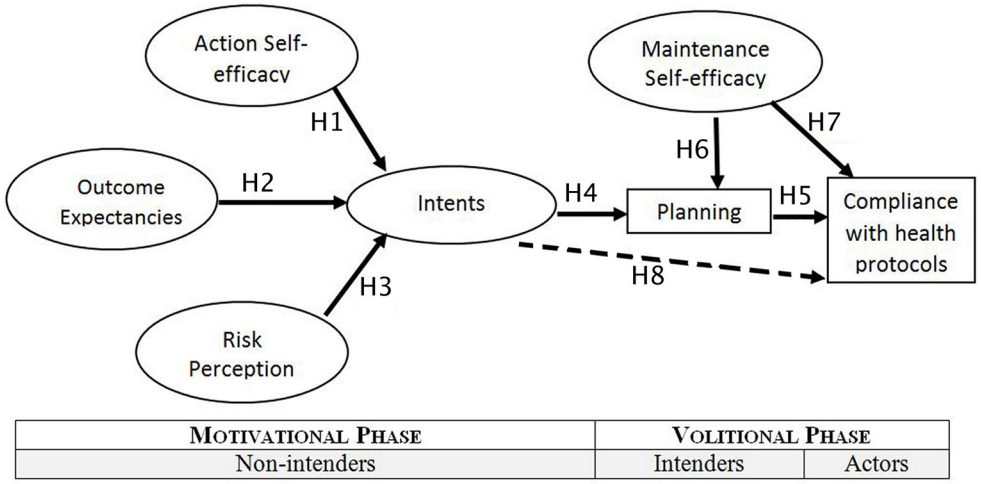

FIGURE 1 | Hypothesis model in this study, adapted from Schwarzer (18), with permission.

questionnaire contains several questions on how often respondents follow quarantine guidelines and is scored using a 5-point Likert scale. Score is calculated based on the respondents' answers, with a score of 1 given if the respondent answered 'never' up to a score of 5 if the respondent answered 'always' on the statement item for the behavior. The distributed questionnaire consists of three parts, covering the characteristics of the interviewees (gender, age, and level of education), measurements of risk perception, outcome expectancies, self-efficacy, intent, planning, and compliance, as well as scores given by respondents (**Appendix A**). The questionnaire distributed may need ∼15–20 min to be fulfilled.

Statistical Analysis

This study used the SEM multivariate data analysis technique. There are two types of variables in structural equation modeling: latent and measured variables. Latent variables are variables that cannot be observed or measured directly. In this study, the latent variables that were assessed included risk perception, outcome expectancies, self-efficacy, intent, planning, and compliance. Measured variables, also known as indicators, are variables that can be observed or measured directly (20, 21).

The structural equation modeling consists of measurement/outer model and structural/inner model. The measurement model is used to explain the association between measured variables and latent variables, while the structural model describes the association between latent variables. In the structural/inner model, there are exogenous latent variables that can predict other variables and endogenous latent variables that are predicted by other variables and show their effects. An approach that can be used for SEM is Partial Least Squares (PLS) which is a path modeling approach without any assumptions about the data distribution. PLS-SEM has several advantages such as being suitable when the sample size is limited, when the data distribution is skewed/asymmetrical, as well as when the prediction accuracy is desired. The PLS-SEM approach can be performed using the SmartPLS application software (20–23). This study also assessed the relationship between demographic factors of the participants (education and sex variables) as control variables and the compliance behaviors.

Measurement/Outer Model

The analysis of the outer model is important because the validity and reliability of the association in the inner model are also determined by the outer model. The outer model analysis assesses internal consistency reliability, indicator/measured variable reliability, convergent validity, average variance extracted (AVE), and discriminant validity. Internal consistency reliability analysis based on the association between the variables observed in this study was performed using Cronbach's alpha and composite reliability measurements. A value closer to one indicates better reliability. In this study, Cronbach's alpha and composite reliability values of >0.7 are acceptable. Indicators with outer loading values >0.7 were accepted, while those <0.4 were omitted (24, 25).

Loading factor indicator, composite reliability, and AVE were observed to assess convergent validity. An AVE value >0.5 is considered adequate for convergent validity, and can also be used to assess discriminant validity. Assessment of discriminant validity was performed to ensure that the latent constructs used in this study are truly unrelated and do not measure the similar construct as other variables (24–26). In this study, discriminant validity was calculated using the Fornell and Larcker criterion and the Heterotrait-monotrait (HTMT) criterion from Henseler (26, 27). According to the Fornell-Larcker criterion, the latent variables should be better at explaining the variance of their indicator variable than other latent variables and are indicated by a larger square root of the AVE value. According to the HTMT criterion, a value closer to 1 indicates a lack of discriminant validity (25, 26).

TABLE 1 | Demographic characteristics and difference in perceived compliance to health protocol among subjects (n = 1,584).

Group	Descriptive		Compliance to health protocol	
	Frequency	%	Mean	SD
Age (years old)				
18–35	1,038	65.49	4.333	0.045
36–55	492	31.17	4.235	0.071
>55	54	3.68	4.122	0.223
Sex variables				
Man	865	55%	4.193	0.057
Woman	719	45%	4.262	0.051
Education				
Junior high school	150	9%	4.219	0.113
High school	970	61%	4.218	0.058
Bachelor's degree	405	26%	4.261	0.071
Master's/Doctoral degree	59	4%	3.791	0.215
Marital status				
Unmarried	666	42%	4.161	0.049
Married	847	53%	4.274	0.066
Divorced or widow/widower	71	5%	4.272	0.155

Structural/Inner Model

Analysis of the inner model quality includes an assessment of the coefficient of determination (R^2), path coefficient, and effect size (f^2). R-square (R^2) or the coefficient of determination is used to assess the predictive power of the model proposed in the hypothesis and see the combined effect of the exogenous variables on endogenous variables. The R^2 values range from 0 to 1, with a value closer to one indicating a better model (24).

Analysis of the path coefficient can describe the association between variables in the hypothesis. The path coefficient values range from −1 to +1, with a coefficient closer to 1 indicating a stronger association, whether the association is positive or negative. The significance can then be obtained through standard error using bootstrapping technique. P-Value of <0.05 indicates a significant prediction between independent and dependent variables. The effect size (Cohen's f^2) was determined by assessing the change in the coefficient of determination when a specific variable in the model was omitted, as well as by estimating two PLS path models (the complete model that fits the hypothesis and model with some exogenous variables that have been omitted). The effect size of each association was determined as follows: 0.02 (small effect), 0.15 (medium effect), and 0.35 (large effect) (24).

Goodness of Fit

The Goodness of Fit of the models can be measured by using SmartPLS (23). The measurements include Standardized Root Mean Square Residual (SRMR), Normal Fit Index (NFI), and Root Mean Square Theta (RMS_theta). SRMR shows how big the difference of root mean square between observed and expected correlations is. The recommended SRMR value is <0.10 or 0.08 in the conservative version. In this study, the SRMR value limit used was 0.08. The RMS_theta values (root mean square residual covariance) were also assessed with a value <0.12 indicating a well-fitting model, and a higher value indicating a lack of fit in the model. The expected NFI value is ≤1, with a value closer to 1 indicating a very good fit, and a value <0.9 usually representing an acceptable fit (28, 29).

Mediation Analysis

Mediation analysis was made to know the process or "how" the relation between the two variables, to better understand the mechanism the effect happens. In this study, mediation analysis were made with smartPLS with the variables: intention, compliance and planning (23, 30). The total effect, direct and indirect effect will be presented in the table with the coefficient and significance value.

Ethical Approval Statement

This study has obtained ethical clearance from the Faculty of Medicine, Universitas Indonesia on April 27, 2020, with reference number KET-444/UN2.F1/ETIK/PPM.00.02/2020.

RESULTS

Demographic Characteristics of Participants

Table 1 shows the demographic characteristics of the participants in this study. The participants consisted of 55% males and 45% females with the majority (61%) having completed secondary high school. Most of the participants were in the range of 18–35 years old (65.49%). The marital status of the participants were 53% married, 42% unmarried, and 5% divorced. For control variables, there were no significant relationship found to the compliance behaviors (P = 0.365 for education; P = 0.263 for sex variables).

TABLE 2 | Research variables and measurement indicators.

Variables	Missing	Min	Max	Mean	SD
Risk1	0	1	5	1.871	1.309
Risk2	0	1	5	2.153	1.401
Risk3	0	1	5	1.921	1.331
Risk4	0	1	5	2.174	1.449
Risk5	0	1	5	1.437	0.895
Expectancy1	0	1	5	4.643	0.931
Expectancy2	0	1	5	4.622	0.975
Expectancy3	0	1	5	4.621	0.952
Expectancy4	0	1	5	4.588	0.961
Expectancy5	0	1	5	4.542	0.981
EfficacyAction1	0	1	5	4.657	0.841
EfficacyAction2	0	1	5	4.559	0.919
EfficacyAction3	0	1	5	4.580	0.912
EfficacyAction4	0	1	5	4.612	0.893
EfficacyAction5	0	1	5	4.598	0.887
EfficacyAction6	0	1	5	4.448	0.981
EfficacyAction7	0	1	5	4.333	1.058
Intent1	0	1	5	4.722	0.757
Intent2	0	1	5	4.740	0.793
Intent3	0	1	5	4.658	0.846
Intent4	0	1	5	4.568	0.905
Intent5	0	1	5	4.679	0.835
Plan1	0	1	5	4.380	1.031
Plan2	0	1	5	4.388	1.043
Plan3	0	1	5	4.522	0.941
Plan4	0	1	5	4.613	0.899
Plan5	0	1	5	4.568	0.938
Plan6	0	1	5	4.398	1.035
Plan7	0	1	5	4.493	0.966
Plan8	0	1	5	3.965	1.245
EfficacyMaintn1	0	1	5	4.114	1.183
EfficacyMaintn2	0	1	5	4.088	1.169
EfficacyMaintn3	0	1	5	4.280	1.099
EfficacyMaintn4	0	1	5	4.526	0.958
EfficacyMaintn5	0	1	5	3.958	1.294
Adherence1	0	1	5	3.600	1.376
Adherence2	0	1	5	4.410	1.012
Adherence3	0	1	5	4.485	0.968
Adherence4	0	1	5	4.720	0.768
Adherence5	0	1	5	4.297	1.300
Adherence6	0	1	5	4.266	1.064
Adherence7	0	1	5	4.549	0.898
Adherence8	0	1	5	4.037	1.209

Research Variables

Table 2 describes the variables and the measurement indicators used in this study. There was no missing data during the data collection phase, with each variable having a minimum value of 1 and a maximum value of 5.

Measurement Model

Internal Consistency Reliability

Table 3 below shows the Cronbach's alpha and composite reliability value of the variables. For compliance, intent, outcome expectancies, planning, perception of risk, and self-efficacy in action and maintaining behaviors, all of the Cronbach's alpha and

TABLE 3 | Reliability and convergent validity of the whole measurement model.

	Cronbach's alpha	Rho_A	Composite reliability	AVE
Compliance behavior	0.877	0.879	0.907	0.621
Intention	0.932	0.932	0.949	0.787
Outcome expectancy	0.939	0.940	0.954	0.804
Risk perception	0.808	0.818	0.864	0.561
Self-efficacy for action	0.934	0.936	0.947	0.718
Self-efficacy for maintenance	0.869	0.877	0.906	0.658
Planning	0.941	0.943	0.951	0.711

composite reliability values are above the expected value (0.7), indicating good internal consistency.

Reliability Indicator

Table 4 shows the results of the indicator reliability of the measurement model as a whole with outer loading values of more than 0.7. Initial analysis found outer loading values that were below 0.7, thus did not fulfill the expected limits, and some variables were removed from the construction model. The variables removed include "adherence1" and "adherence5."

AVE and Convergent Validity

The AVE value was between 0.621 and 0.804, which is above the expected value (0.5). The composite reliability and AVE values show sufficient convergent validity in the measurement model created.

Discriminant Validity

Table 5 below describes the correlation between latent variables by comparing the square root of each AVE with the correlation coefficient of other latent variables. The square root of each variable's AVE in this study was larger than the correlation with other latent variables, thus the discriminant validity is accepted, based on the Fornell Larcker Criterion. The HTMT criterion was also used to calculate discriminant validity. In **Table 6** revealed an issue with collinearity between the latent variables intent, and self-efficacy for action, indicating that there is overlap between the two latent variables. There was no overlap between other items.

Structural Model

Determination Coefficient

Table 7 shows the determination coefficient or strength of the predictive model created for behavior, intent, outcome expectancies, planning, and risk perception. The model could explain the variations in 61.5% of compliance, 76.8% of intent, and 58.1% of planning.

Path Coefficient

Table 8 shows the path coefficient for all paths proposed in the study model. All seven path coefficients proposed in this study were significant. The results in **Table 8** show that and self-efficacy for action, outcome expectancies, and risk perception is related to intent, supporting H1 ($\beta = 0.705$; $P = 0.000$; T-value = 19.602), H2 ($\beta = 0.243$; $P = 0.000$; T-value = 6.467), and H3 ($\beta = 0.023$; $P = 0.048$; T-value = 1.981). Furthermore, intent has a significant effect on planning, and planning has a significant effect on compliance to with health protocols, supporting H4 ($\beta = 0.465$; $P = 0.000$; T-value = 11.533) and H5 ($\beta = 0.519$; $P = 0.000$; T-value = 11.435). Additionally, self-efficacy in maintaining behaviors was also found to have a positive effect on planning and compliance to health protocols which supports H6 ($\beta = 0.378$; $P = 0.000$; T-value = 10.062) and H7 ($\beta = 0.334$; $P = 0.000$; T-value = 7.590). Compared to results by Hamilton et al. (17), this study found the same results in how self-efficacy may predict intention and having intents predicted behavior [in Hamilton et al., (17) the results were $\beta = 0.314$, $P < 0.001$ and $\beta = 0.261$, $P = 0.026$, respectively]. However, Hamilton et al. (17) did not found that risk perception may predict intention significantly ($\beta = 0.150$, $P = 0.077$) (17).

The final path coefficient from compliant behaviors to health protocols is described in **Figure 2**. The figure was obtained from SmartPLS software (23). **Table 9** describes the direct, indirect and total effects of the variables in the HAPA model. The total effect of a latent variable on the HAPA model is the combination of direct and indirect effects. The results showed that self-efficacy action had the greatest direct effect on intention ($\beta_{total} = 0.705$, $P < 0.000$) and self-efficacy maintenance had the greatest total effect on compliance ($\beta_{total} = 0.531$, $P < 0.000$). Higher level of intention and self-efficacy maintenance gave rise to the higher level of planning, and planning also had a high effect on compliance ($\beta_{total} = 0.519$, $P < 0.000$). Self-efficacy action and intention had a moderate total effect on compliance ($\beta_{total} = 0.170$, $P < 0.000$ and $\beta_{total} = 0.241$, $P < 0.000$). Outcome expectancy had a small total effect on compliance ($\beta_{total} = 0.059$, $P < 0.000$).

Effect Size

Table 10 shows the effect sizes of H1-H7. A medium effect size was found for H2 (outcome expectancies to intents), H4 (intents to planning), H6 (self-efficacy in maintaining behavior to planning), and H7 (self-efficacy in maintaining behavior to compliance). A large effect size was found for H1 (from self-efficacy for action to intent) and H5 (planning to compliance).

Goodness of Fit

Table 11 shows the results of the model fit measurement, including the saturated model and estimated model. In this study, the SRMR value was 0.045 which is below the expected value of

TABLE 4 | Indicator reliability/outer loading.

	Compliance behavior	Intention	Outcome expectancy	Risk perception	Self-efficacy for action	Self-efficacy for maintenance	Planning
Adherence2	0.745						
Adherence3	0.801						
Adherence4	0.802						
Adherence6	0.817						
Adherence7	0.832						
Adherence8	0.726						
EfficacyAction1					0.829		
EfficacyAction2					0.818		
EfficacyAction3					0.871		
EfficacyAction4					0.866		
EfficacyAction5					0.879		
EfficacyAction6					0.853		
EfficacyAction7					0.811		
EfficacyMain1						0.785	
EfficacyMain2						0.818	
EfficacyMain3						0.872	
EfficacyMain4						0.845	
EfficacyMain5						0.728	
Expectancy1			0.877				
Expectancy2			0.890				
Expectancy3			0.903				
Expectancy4			0.916				
Expectancy5			0.897				
Intent1		0.870					
Intent2		0.903					
Intent3		0.910					
Intent4		0.861					
Intent5		0.891					
Plan1							0.818
Plan2							0.838
Plan3							0.859
Plan4							0.862
Plan5							0.871
Plan6							0.880
Plan7							0.878
Plan8							0.729
Risk1				0.766			
Risk2				0.754			
Risk3				0.731			
Risk4				0.757			
Risk5				0.735			

0.08. Therefore, it can be concluded that the model fulfills the criteria for a good model fit. The RMS_theta value also had a value below 0.109, indicating a well-fitting model. The NFI value was also close to 1, which indicates an accepted fit (28).

Mediation Analysis

The total effect which is the effect of having intents on compliance without the involvement of planning was significant (β = 0.716; P = 0.000). Moreover, further analysis also found that having intents also have a significant impact on compliance in the presence of planning as the mediator (β = 0.382; P = 0.000) and significant impact of having intents on compliance through planning (β = 0.334; P = 0.000). These results can be seen in **Table 12**. **Figure 3** shows that planning partially mediates an effect from intent to be compliant toward health protocols significantly.

TABLE 5 | Discriminant validity- Fornell-Larcker criterion.

	Compliance behavior	Intention	Outcome expectancy	Risk perception	Self-efficacy for action	Self-efficacy for maintenance	Planning
Compliance behavior	***0.788***						
Intention	0.713	***0.887***					
Outcome expectancy	0.535	0.686	***0.897***				
Risk perception	−0.080	−0.082	−0.126	***0.749***			
Self-efficacy for action	0.777	0.856	0.633	−0.106	***0.847***		
Self-efficacy for maintenance	0.683	0.631	0.510	−0.076	0.720	***0.811***	
Planning	0.744	0.704	0.503	−0.076	0.771	0.672	***0.843***

Bold and italics, the square root of AVE.

TABLE 6 | Discriminant validity—Heterotrait-monotrait ratio (HTMT).

	Compliance behavior	Intention	Outcome expectancy	Risk perception	Self-efficacy for action	Self-efficacy for maintenance	Planning
Compliance behavior							
Intention	0.786						
Outcome expectancy	0.588	0.734					
Risk perception	0.094	0.091	0.143				
Self-efficacy action	0.858	**0.915**	0.674	0.120			
Self-efficacy maintenance	0.779	0.694	0.559	0.095	0.794		
Planning	0.819	0.749	0.533	0.090	0.822	0.739	

Collinearity issue between the latent variables intent and self-efficacy for action, indicating that there is overlap between the two latent variables.

TABLE 7 | Determination coefficient (R^2).

	R square	R square adjusted
Compliance behavior	0.615	0.614
Intention	0.768	0.768
Planning	0.581	0.614

DISCUSSION

This study was conducted to fill the gap by trying to look more specifically about the behavioral change, i.e., compliance to health protocols, in people who are undergoing isolation in the health facilities for COVID-19 in Indonesia. The participants in this study include confirmed COVID-19 cases. Indrayathi et al. (31) found that COVID-19 test histories, either with PCR or rapid antibody test, and also knowing someone who had been confirmed positive or died from COVID-19 were related significantly with adherence to prevention measures. In people undergoing isolation which mean that they have been confirmed of having COVID-19, it may be suspected that they will be more comply to the health protocols. They will see their surroundings who are using full health protocols in the health facilities, in which human behavior will be influenced by the culture, including how they perceive other people will think about them, and also how they see people around them behaving (32). So, this condition in the health facilities may influence them to be more motivated and planning to comply to the behaviors. However, it was still unclear because they may also feel as they have experienced COVID-19, they will be more free and feel careless to comply. On the other hand, the health facilities where the isolation takes place were also providing the facilities needed, such as continuous observation, handrub, and they will be more exposed to information/education related to COVID-19. The behaviors assessed in the study including not going out to do activities outside the quarantine area, and it is a must in healthcare facilities. They will also separate themself or keep some distance from other people as the bed were organized to be in some safe distance. They will also have to wear a mask all the time when there are other people in the room, and the behaviors will

TABLE 8 | Result of final model hypothesis.

	Beta coefficients	Standard deviation	*T* statistics	*P*-value
H1: Self-efficacy for action → Intention	0.705	0.036	19.602	0.000
H2: Outcome expectancy → Intention	0.243	0.038	6.467	0.000
H3: Risk Perception → Intention	0.023	0.012	1.981	0.048
H4: Intention → planning	0.465	0.040	11.533	0.000
H5: Planning → compliance to protocol	0.519	0.045	11.435	0.000
H6: Self-efficacy for maintenance → Planning	0.378	0.038	10.062	0.000
H7: Self-efficacy for maintenance → Compliance to protocol	0.334	0.044	7.590	0.000

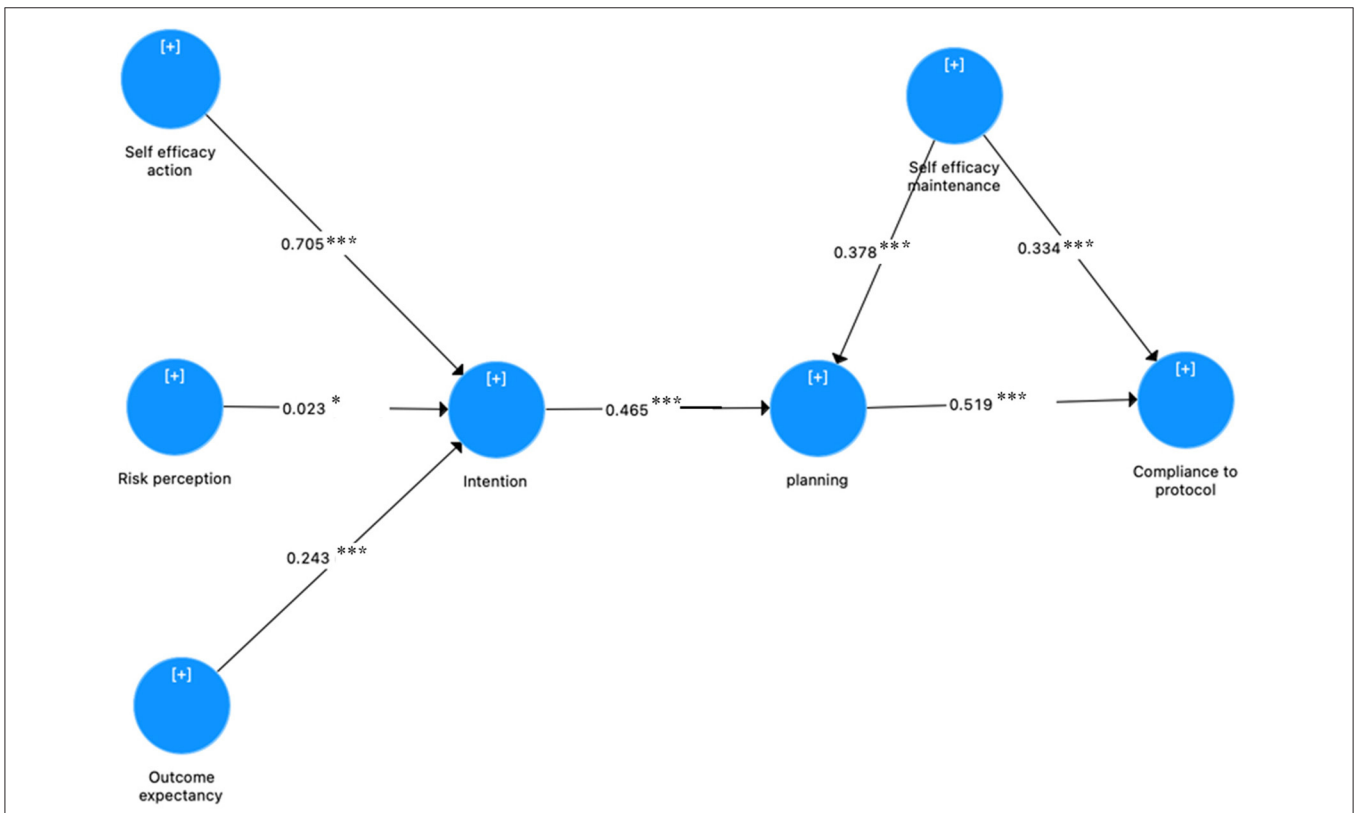

FIGURE 2 | Final model path coefficient (*indicating $P < 0.05$; ***indicating $P < 0.001$).

be confirmed and reminded when the medical staffs visit them in the daily round. In the health facilities, they will not also share personal tools with others as they may usually do in their daily life outside the isolation place and they will also be assessed daily for the body temperature and symptoms. This study was conducted to look more closely on the behavior changes in these conditions, aiming to provide information about the mediating mechanisms and determinants of compliance with health protocols in people who have been provided by the facilities needed.

This study found that the model proposed is a good fit, and may explain the determinants for behavioral changes among people undergoing isolation in COVID-19 healthcare facilities (Wisma Atlet and RSCM Kiara Ultimate), starting from one's risk perception to COVID-19 transmission, their expectation of the outcome, and their confidence of their own capability to comply, thus allowing them to form intent, plan, and start acting to comply to health protocols and to continuously maintain such compliance. Luszczynska et al. (33) who also used HAPA as the framework to assess compliance to handwashing behavior, found that risk perception and outcome expectancies were linked but only indirectly to the expected behavior. That study found that self-efficacy and self-monitoring or action control are more consistent in predicting expected health behavior (33). Unfortunately, in this study, the action control were not assessed. However, the results for the risk perception and outcome expectancies were also found to be the same in this study, and the self-efficacy's result is also consistent. Based on the results of this study, both forms of self-efficacy (to perform and maintain

TABLE 9 | The direct, indirect and total effects of the variables in the HAPA model.

Latent variables	Direct effects	Indirect effects							Total effects						
		SEA	RP	OE	IT	PL	SEM	CL	SEA	RP	OE	IT	PL	SEM	CL
Self-efficacy action	0.705***	–	–	–	–	0.327***	–	0.170***	–	–	–	0.705***	0.327***	–	0.170***
Risk perception	0.023*	–	–	–	–	0.011	–	0.006		–	–	0.023**	0.011	–	0.006
Outcome expectancies	0.243***	–	–	–	–	0.107***	–	0.113***	–	–	–	0.243***	0.113***	–	0.059***
Intention	0.465***	–	–	–	–	–	–	0.241***	–	–	–	–	0.465***	–	0.241***
Planning	0.519***	–	–	–	–	–	–	–	–	–	–	–	–	–	0.519***
Self-efficacy maintenance	0.334***							0.196***	–	–	–	–	0.378***	–	0.531***

SEA, self-efficacy action; RP, risk perception; OE, outcome expectancy; IT, intention; PL, planning; SEM, self-efficacy maintenance; CL, compliance.
**Indicates $P < 0.05$.*
***Indicates $P < 0.01$.*
****Indicates $P < 0.001$.*

TABLE 10 | *F*-square.

	Compliance to protocol	Intention	Planning
Intention			0.310
Outcome expectancy		0.152	
Risk perception		**0.002**	
Self-efficacy for action		1.283	
Self-efficacy for maintenance	0.159		0.206
Planning	0.384		

*Risk perception has a F2 effect size of 0.002, which is smaller than the Cohen's proposed lower limit of 0.02 (24). The low F2 effect size, combined with the near non-significance of the intention effect at **Table 8** indicated that risk perception and intention might have a linear relationship in our dataset.*

TABLE 11 | Goodness of fit—structural/inner model.

	Saturated model	Estimated model
SRMR	0.045	0.060
d_ULS	1.713	3.097
d_G	0.661	0.722
Chi-square	6615.444	6985.731
NFI	0.878	0.871
RMS theta	0.109	

behaviors) have a permanent effect on health behaviors and play an important role. In those with strong self-efficacy regarding their ability to perform the behavioral change, they also tend to have bigger intent toward compliance. This study also found that stronger intent will trigger stronger planning.

This result is also in-line with the statement from Bandura (34) regarding cognitive social theory in the effort to promote health and prevent diseases. Bandura (34) stated that among all determinants, confidence in self-efficacy plays an important role in personal change because it is needed to overcome obstacles faced in changing behaviors and becomes the foundation for self-motivation and action. This study is also in-line with a study of Isa et al. (35) that found inverse relation between self-efficacy scores to intent-behavior gap. They found in children with intention-behavior gap, they tend to have lower self-efficacy (35). Beeckman et al. (14) also found that self-efficacy were related to adherence to physical distancing as the behavior measured in the study, along with outcome expectancies, having intents and planning. However, in this study, the relation between outcome expectancies to compliance were not found to be large enough. Luc PT (36) which found no direct relation between outcome expectancies to intention in social entrepreneurial, suggested that outcome expectancies are flexible, related to others' support and recognition of the opportunities.

At the intender phase, an individual is already planning to change behaviors. Differ to study by Lao et al. (16) and Hamilton et al. (17) which found that planning did not mediate having intents to behavior change, this study found that planning mediate the two processes and may be used to understand the intention-behavior gap that often found when someone want to do behavior changes. After the behavior has been started, maintaining the behavior is almost as challenging as beginning to do the behavior (37, 38). It is unclear whether the changes in behavior can be maintained in the long term. However, self-efficacy in maintaining behavior are related to the compliance and is related to various factors, including personal factors such as age and level of education, as well as environmental factors such as obstacles and social support. To maintain self-efficacy for the long term, modifiable factors such as continuous social support are needed (39–41).

From the behavioral model proposed in this study, potential improvements can be identified in several points that have high benefits for change, thus the community can become more compliant toward health protocols to prevent COVID-19 transmission. With this knowledge, interventions can be implemented through various strategies targeted at increasing self-efficacy. Individuals who are doubtful toward self-efficacy can be given support and input through consultation. Those with low self-efficacy can be given a structured program to develop a strong sense of confidence in implementing or maintaining behaviors. Additionally, other strategies such as education, reflection on previous experiences, provision of behavior models, or interventions through mental imagery can also be performed. Programs to improve self-management abilities may also be beneficial, such as creating target behaviors that need to be

TABLE 12 | Mediation analysis.

Total effect (intention to compliance)		Direct effect (intention to compliance)		Indirect effects of intention on compliance				
Coefficient	***P*-value**	**Coefficient**	***P*-value**		**Coefficient**	**SD**	***T*-value**	***P*-value**
0.716	0.000	0.382	0.000	H8: I -> P -> C	0.334	0.039	8.506	0.000

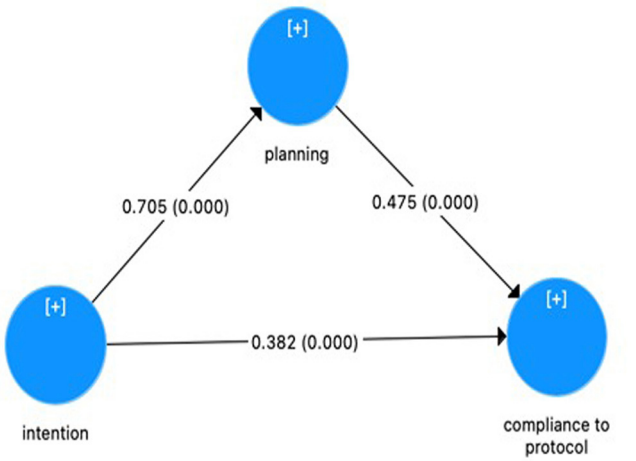

FIGURE 3 | Mediation analysis.

achieved, assessing the situation when the behavior has been performed, and obtaining feedback or appreciation for each behavior that is following the target. The intervention strategies can vary between individuals, depending on each individual's preparedness toward change (10, 34, 42).

Limitations

This study has some limitations. First, this study was limited to subjects undergoing isolation in healthcare facilities. Second, the instrument used in this study was self-reported, and it may affect the results because of the social desirability bias. The participants may also report their condition during their isolation (after being exposed to COVID-19) or report about their behavior usually before being exposed to COVID-19 and underwent the isolation in the facilities where the study was taken place. Third, the cross-sectional data used in this study also reduce the power of the study in forming a conclusion, as it may not give temporal relationship between the factors being hypothesized. With the cross-sectional study design, some recall bias may also be considered as limitation. Fourth, this study also did not portray the subject's past lifestyle or previous exposure to COVID-19 infection and/or other infectious diseases. Therefore, future studies may gather data longitudinally to investigate the effect of change and reciprocals between the construct models, comparing between individuals undergoing isolation in healthcare facilities and at home, and perform experimental studies that target changes in the HAPA construct individually. Future studies may also include more psychosocial determinants, such as psychosocial wellbeing, lifestyle, or social support, that were found related to difficulties in adherence behavior in a study conducted by Beeckman et al. (14). Moreover, although action control, which can be found in the original HAPA model suggested by Schwarzer et al. (12), was something crucial, but it was not included in the hypothesis or the path model in this study. This study also simplified the coping and action planning as "planning," which includes both action and coping planning (13, 18). More specific HAPA construct which include action control and specify planning into action and coping planning may also be done in the future research.

CONCLUSION

This study was conducted to fill the gap by trying to look more specifically about the behavioral change in the population who were undergoing isolation in health facilities related to COVID-19, especially in Indonesia. It can be concluded that intent, which related to the perception of risk, expected outcome, and self-efficacy has a positive influence on people undergoing isolation in healthcare facilities regarding their compliance with health protocols. Planning was also found mediates intention and compliance with health protocols. The understanding gained from this study can be used to improve strategies related to compliance with health protocols against COVID-19 in the communities, such as providing education, support, and consultation when needed.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

This study obtained ethical clearance from the Faculty of Medicine, Universitas Indonesia on 27th April 2020 under ethical clearance number KET-444/UN2.F1/ETIK/PPM.00.02/2020. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

KM, NA, AK, and PL conceptualized and designed. KM supervised the study and analyzed the data. KM, RK, LM, and LD collected the data. KM and AL wrote the manuscript and review. All authors have read and approved of the publication manuscript.

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APPENDIX

APPENDIX A | Overview of variables and psychometric data.

Variable	Mean score ($n = 1,584$)
Risk perception	
I think the rules during quarantine are too much, it's enough to just wear a mask	1.871
I think the reason for imposing quarantine on myself is not clear, there are still many people out there who are more deserving of quarantine	2.153
I went into quarantine because of social pressure, I was asked by people to do it while I didn't feel the need to do it myself	1.921
If asked to choose between doing quarantine or making a living, then I choose to make a living	2.174
I tend to disobey quarantine rules because they are too many and complicated	1.437
Outcome expectancies	
By doing quarantine I help the government reduce the number of COVID-19 infections in Indonesia	4.643
If I keep my distance or separate myself from family members, I am protecting my family from contracting COVID-19	4.622
By doing quarantine, I can rest and recover my health	4.621
By doing quarantine, I feel calm because it prevents other people from close contact and meeting	4.588
If I routinely monitor daily symptoms during quarantine, I can monitor my condition and seek medical help at the right time	4.542
Intention	
I am willing to obey the quarantine rules	4.722
I intend to always cover my nose and mouth when I cough or sneeze	4.740
I intend to use and clean my own personal tools such as cutlery, toiletries, bed sheets	4.658
I intend to always clean the surfaces of objects I touch such as cell phones, desks, door handles	4.568
I intend to always wash my hands with soap and running water or hand washing liquid after touching the face or object surface	4.679
Action Self-efficacy	
I'm sure I can do quarantine according to the required time	4.657
I'm sure I can undergo quarantine even though there are important obligations and responsibilities at this time	4.559
I feel sure I can wear a mask even if it's uncomfortable	4.580
I truly believe that I am capable of not sharing the usage of personal tools such as cutlery, towels and sheets with other people even though it is more difficult to do so	4.612
I seriously say I can always wash my hands with soap and running water or hand sanitizer, even if my hands become dry or sore	4.598
I'm sure that I can clean the surface of things that I often touch, such as tables, cell phones, doors	4.448
I certainly believe that I can monitor daily temperature, and cough and cold symptoms even though I have to fill the form	4.333
Planning	
I make a positive daily activity plan that can be done in quarantine	4.380
I make arrangements for the quarantine to be able to keep my distance or separate myself from other people	4.388
I plan to provide a mask and always wear a mask when there are other people in the room	4.522
I have a plan so that I don't forget to cover my mouth and nose when I cough or sneeze	4.613
I am planning a way to separate personal items such as cutlery, towels and bed linens so that they are separated from other people's belongings	4.568
I plan ways and schedules to clean the surfaces of objects that I touch frequently, such as tables, cell phones, doors	4.398
I have a plan on how to provide handwashing equipment and when to do it	4.493
I schedule to monitor the body temperature and symptoms daily, at 7 a.m. and 7 p.m.	3.965
Maintenance Self-efficacy	
I'm sure I can continue doing quarantine again although there are some reasons that holding me back	4.114
When I start not to go outside to do activities outside the quarantine place, I'm sure I can continue it even though some time ago there was a need that made me have to go out	4.088
I believe that I can start again to keep my distance or separate myself from family members, although I have been tempted to break it	4.280
I mean it, that from now on I can start to use mask again all the time whenever I meet other people, even though I have taken it off	4.526
I have ever forgotten to monitor daily symptoms, such as body temperature, fever, and cough; however, I'm sure I can keep doing it	3.958
Behavior	
I don't go out to do activities outside the quarantine area	3.600
I separate myself or keep my distance from other people	4.410
I wear a mask all the time when there are other people in the room	4.485
I cover my nose and mouth when I sneeze or cough	4.720
I don't share personal tools with others	4.297
I clean the surface of the things I touch	4.266
I wash my hands with soap and running water or hand sanitizer	4.549
I do daily monitoring such as body temperature and cough and cold symptoms	4.037

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Lockdown Policies, Economic Support, and Mental Health: Evidence From the COVID-19 Pandemic in United States

*Haitang Yao, Jiayang Wang and Wei Liu**

Business School, Qingdao University, Qingdao, China

During the COVID-19 pandemic, various lockdown policies were put in place by the governments in different countries and different levels, which effectively curbed the spread of the virus, but also cause substantial damage to the mental health of local residents. We use statistics provided by the Household Pulse Survey and OxCGRT between 23 April 2020 and 30 August 2021 to analyze the impact of lockdown on overall mental health levels in US states during the COVID-19 pandemic at the macro level. The results show that the lockdown policies implemented by the state governments lead to a deterioration in psychological conditions, and this relationship varies to some extent depending on the level of high-quality economic support, that the state governments implement to alleviate the symptoms of depression and anxiety associated with the lockdown. Therefore, we argue that although lockdown policies are necessary during the COVID-19 pandemic, further government efforts are needed to give high-quality economic and mental health support to mitigate the negative effects of lockdown on mental health.

Keywords: COVID-19, lockdown policies, mental health, anxiety, depression, economic support

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****Correspondence:***
Wei Liu
wei.liu@qdu.edu.cn

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INTRODUCTION

As of mid-December 2021, more than 27 million people worldwide have been diagnosed with pneumonia caused by COVID-19, resulting in more than 5.37 million deaths (1). In most countries severely affected by the pandemic, governments have taken measures to impose lockdowns and restrictions on outings to deter the uncontrolled spread of the virus, limit infections and deaths, and reduce the pressure on healthcare systems and healthcare providers. In the United States, most states and counties began implementing the lockdown policies in late March 2020, which were adopted by the local governments to reduce the spread of the virus under the pressure of unpredictable uncertainties posed by the pandemic (2).

In this study, what we concern about are the lockdown policies including stay-at-home orders, quarantine, social distancing, and isolation of confirmed patients associated with high risk. Studies have shown that government administration and public cooperation do lead to better control of pandemics like COVID-19 (3, 4). However, such lockdowns directly lead to reduction in social interaction and have negative impacts on individuals' mental health (5). For example, not only do people experience increased anxiety and stress about future income and employment (6), but they also face an immediate fear of infection, for themselves, their family or friends (7). Factors such as the incubation period of a pandemic and the time required for isolation may also lead to anxious

emotional reactions (8). Restrictions on activities, loss of daily life and reduced social activities also result in feelings of boredom, depression, and isolation (9).

Numerous studies have shown that the COVID-19 pandemic caused severe psychological problems in the population (10–12), and we focused our research on the impact of lockdown policies on mental health. Existing research has explored the psychological effects of lockdown at the individual level and demonstrated that the mental health of individuals is influenced by a number of factors, such as work status, income, gender, and relationship status (13), as well as the length of lockdown, how and where they are imposed (14). Scholars have also found that lockdown affects different individuals in different ways and to different degrees. Many of them have compared the level of various mental health indicators measured in cross-sectional surveys conducted in the general population (15), Child (16), adolescents (17), adults (18), older adults (19), new mum (20), university students (21), and college students (22). For example, Yildirim (19) identified the psychosocial status, attitudes, and experiences of individuals aged 65 and older confined in their homes during the COVID-19 outbreak in Turkey, and concluded that lockdown applied specifically to older adults forced them to establish new routines and made them aware of some values; however, they asserted that they were stigmatized and isolated, their fear of COVID-19 increased, and they were treated unfairly. Olson et al. (22) conducted a photographic survey of college students' experiences during lockdown and found that students frequently reported deterioration in mental health. Non-academic aspects of students' lives, such as work and home environments, contributed significantly to perceived stress.

However, from a higher perspective, the lockdown policies developed by policymakers must have had a significant impact on individuals' mental health, and we argue that the interregional heterogeneity of such policies is an important but currently overlooked key factor. In this study, we discuss the impact of lockdown policies on overall American mental health at the state level, to provide policy recommendations for state governments to balance lockdown policies and individuals' mental health during the COVID-19 pandemic. Stress process theory suggests that adequate resources (e.g., high-quality social support) can prevent or mitigate the effects of stress on mental health (23–25). In particular, economic support as a positive intervention can reduce the impact of negative events on individuals, and therefore we consider the possible impact of government economic support policies on mental health.

We investigate such impact based on the statistical analyses provided by the Household Pulse Survey and the Oxford Covid-19 Government Response Tracker (OxCGRT) from 23 April 2020 to 30 August 2021. To our knowledge, this is probably one of the first study to track the mental health-related effects of state government lockdown policies at the macro level. Compared to other short-term studies at the individual level, our study better conveys the true effects of the "lockdown," with the aim to provide a theoretical consideration for improving the adverse effects of lockdown policies on mental health and to contribute practical implications for improving individuals' mental health during the lockdown period.

METHODS

Sample and Data Sources

We used the National Center for Health Statistics (NCHS) and the Census Bureau's ongoing Household Pulse Survey as our primary data sources. To detect changes of individuals' mental health during the COVID-19 pandemic, the NCHS, in collaboration with the Census Bureau, set up this survey dataset, which includes individual-level information on age, gender, race and ethnicity, educational attainment, and location, administered electronically to adults aged 18 years and elder in each U.S. state through an Internet-based questionnaire supplemented by email and text messaging. The survey began on 23 April 2020 and continues to date. Based on the survey data, we collected data from April 23, 2020 to August 30, 2021 and created panel data with a 12-day statistical period with a total sample of 1,734. In addition, we added data on government lockdown policies adopted during the COVID-19 pandemic from the OxCGRT. Our state-level control variables, such as the number of hospital beds, was obtained from the Statista database; the average hourly wage was from the Federal Reserve Economic Database (FRED); GDP and unemployment rates were from the US Bureau of Labor Statistics; all other control variables were from the OxCGRT.

Measures

Dependent Variable

The dependent variable in this study is the degree of individuals' mental health. We used the estimates of depression and anxiety disorders published by the NCHS and the Census Bureau as proxies for measuring mental health, which has been shown to be an important measurement in previous studies (26–28). Higher estimates of depression and anxiety represent more severe mental health conditions.

Independent Variables

The independent variable is the government lockdown policies during the COVID-19 pandemic. We carefully selected the stringency index developed by the OxCGRT to measure the intensity of lockdown policies implemented by each state government (29). Specifically, the stringency index records the stringency of lockdown policies that restrict individuals' behavior, and is a composite measure consisting of eight restrictive indicators: school closures, workplace closures, cancellation of public events, restrictions on gatherings, public transport closures, stay-at-home requirements, restrictions on internal movement, and international travel controls.

Moderating Variables

In this study, the economic support policies adopted by the government during the COVID-19 pandemic are used as a moderating variable. This variable is also derived from the OxCGRT, from which we selected the economic support index to measure the intensity of economic support policies implemented by the government in each state (29). The index records the governments' economic policies and is also a composite measure that includes four indicators: income support, debt relief, fiscal measures, and international support.

Control Variables

We controlled for a number of regional pandemic and macroeconomic factors that may affect the estimates. We first controlled for the severity of the COVID-19 pandemic, measured as the number of confirmed cases in each U.S. state (30). The amount of available health care resources in each state may have an impact on individuals' mental health, and inadequate resources may cause panic and anxiety, thus we controlled for health care resources, measured as the natural logarithm value of the number of total hospital beds in each state. We then controlled for the intensity of vaccine policy implementation in each state, assigning values from small to large based on the range of people covered by vaccination (29). In addition, we controlled for some macroeconomic factors, including state GDP, average hourly wages, and unemployment rates for each state. Finally, we added regional dummies to control for unobserved heterogeneity across states.

Estimation Models

We mainly considered two dependent variables, depression and anxiety disorders, in this study, and therefore two regression equations were included in our estimation models. The first equation examines the effect of government lockdown policies on individuals' depression and the moderating role of government economic support. The second equation examines the effect on individuals' anxiety and the moderating role of government economic support. In summary, the following OLS models were developed for the baseline regressions:

$$\boldsymbol{Depression} = \boldsymbol{\alpha_0} + \boldsymbol{\alpha_1}\ \boldsymbol{Lockdown_{it}} + \boldsymbol{\alpha_2}\ \boldsymbol{Lockdown_{it}} \times \boldsymbol{Economic\ Support_{it}} + \sum \boldsymbol{Control_{it}} + \boldsymbol{\delta_t} + \boldsymbol{\mu_{it}}$$

where $i =$ state, $t =$ year, μ_{it} is the standard error term, and δ_t is the regional fixed effect.

$$\boldsymbol{Anxiety} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\ \boldsymbol{Lockdown_{it}} + \boldsymbol{\beta_2}\ \boldsymbol{Lockdown_{it}} \times \boldsymbol{Economic\ Support_{it}} + \sum \boldsymbol{Control_{it}} + \boldsymbol{\gamma_t} + \varepsilon_{it}$$

where $i =$ state, $t =$ year, ε_{it} is the standard error term, and γ_t is the regional fixed effect.

RESULTS

Descriptive Statistics and Correlation Results

Panel A of **Table 1** shows the descriptive statistics and correlation results for all variables, except for the region dummies. To ensure that multicollinearity did not affect the estimation results, we calculated the variance inflation factors (VIFs), which are indicators of covariance between predictors. The results show that the VIFs for all variables are below 5.21 (mean = 2.49), well below the generally accepted threshold of 10.0 (31). We also tested the correlation coefficients between the variables, with a maximum value of 0.598, which is less than the acceptable value of 0.700 (32). Therefore, multicollinearity is not an important concern in our study.

Empirical Tests

Panel B of **Table 1** presents the OLS estimation results of the government lockdown policies and individuals' mental health. Models 1–3 test the impact of government lockdown policies on depression. Model 1 is a baseline model only including control and moderating variables. In Model 2, we added the independent variable, government lockdown policies (*Lockdown*), and the results suggest a significantly positive relationship between government lockdown policies and depression ($\alpha_1 = 0.041$, $p < 0.01$), in line with our expectation. We argued that the government economic support can mitigate the depression brought about by the lockdown, representing a negative moderating role. As shown in Model 3, the coefficient on the interaction term between government lockdown policies and government economic support (*Lockdown* × *Economic support*) is negative and significant ($\alpha_2 = -0.007$, $p < 0.05$), which supports our expectation. To gain more insight into this interaction, we plotted these relationships in **Figure 1A** (33). The figure shows that the positive relationship between the lockdown and depression is weaker as the intensity of government economic support is high, and stronger as the intensity of government economic support is low.

Models 4–6 examine the impact of government lockdown policies on anxiety disorders. Model 4 is a baseline model only including control and moderating variables. Similarly, we added the independent variable (*Lockdown*) in model 5 to examine the relationship between government lockdown policies and anxiety disorders. The results show a significantly positive relationship ($\beta_1 = 0.034$, $p < 0.01$), in line with our expectation that lockdowns will lead to more severe mental health problems. Model 6 examines the moderating effect of government economic support, and the results show that the coefficient on the interaction term (*Lockdown* × *Economic support*) is negative and significant ($\beta_2 = -0.010$, $p < 0.05$), suggesting that the relationship between the lockdown and anxiety disorders is weakened by higher levels of government economic support. Similarly, we plotted the slope of the simple regression reflected in Model 6. **Figure 1B** depicts the slope of the relationship. As can be seen, the slope of the line associated with lower economic support is significantly higher than the line associated with higher economic support.

DISCUSSION

The aim of this study is to examine the impact of the intensity of the lockdown policies imposed by the state governments on the mental health of U.S. individuals during the COVID-19 pandemic. We investigated our analyses based on the following two questions: (1) do government lockdown policies lead to a worsening of individuals' mental health? (2) to what extent does the relationship between lockdown policies and mental health vary across states depending on the level of government economic support? Specifically, we find that government lockdown policies are associated with increases in

TABLE 1 | Estimation results.

(A) Descriptive statistics and correlations

Variables	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Depression	24.883	4.422	1.000						
(2) Lockdown	46.054	15.276	0.106	1.000					
(3) Beds	9.479	1.024	0.239	−0.084	1.000				
(4) Confirmed cases	11.319	1.884	0.133	−0.507	0.598	1.000			
(5) Earnings	28.154	3.224	−0.184	0.296	−0.037	0.120	1.000		
(6) Unemployment	7.693	3.441	0.028	0.500	0.124	−0.364	0.204	1.000	
(7) Vaccination	1.446	2	−0.333	−0.550	−0.006	0.571	0.056	−0.336	1.000
(8) Economic support	41.814	23.393	−0.085	0.316	−0.075	−0.152	0.352	0.195	−0.089

(B) OLS regression results of the relationship between lockdown and mental health

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Variables	**Depression**	**Depression**	**Depression**	**Anxiety**	**Anxiety**	**Anxiety**
Beds	0.058	0.074	0.192	−1.096**	−1.061**	−0.902*
	(0.374)	(0.381)	(0.386)	(0.455)	(0.460)	(0.464)
Confirmed cases	1.529***	1.627***	1.602***	2.043***	2.107***	2.074***
	(0.120)	(0.125)	(0.125)	(0.133)	(0.135)	(0.135)
Earnings	0.156	−0.084	−0.078	0.040	−0.151	−0.143
	(0.184)	(0.191)	(0.191)	(0.196)	(0.205)	(0.206)
Unemployment	−0.102**	−0.135***	−0.135***	−0.169***	−0.199***	−0.199***
	(0.044)	(0.045)	(0.045)	(0.046)	(0.047)	(0.047)
Vaccination	−1.614***	−1.498***	−1.478***	−2.287***	−2.185***	−2.158***
	(0.064)	(0.070)	(0.070)	(0.068)	(0.075)	(0.076)
Economic support	0.003	0.000	0.014	0.005	0.002	0.020**
	(0.006)	(0.006)	(0.009)	(0.007)	(0.007)	(0.009)
Lockdown		0.041***	0.043***		0.034***	0.036***
		(0.009)	(0.009)		(0.010)	(0.010)
Lockdown ×			−0.007**			−0.010**
Economic support			(0.004)			(0.004)
Constant	7.065	10.837*	9.344	21.129***	24.05***	22.04***
	(6.221)	(6.258)	(6.351)	(6.786)	(6.852)	(6.89)
Observations	1309	1305	1305	1309	1305	1305
R-squared	0.565	0.572	0.574	0.602	0.608	0.610
State dummies	Yes	Yes	Yes	Yes	Yes	Yes

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$; Standard errors are in parentheses.*

post-lockdown estimates of depression and anxiety disorders across states. Depending on the spread and infection of COVID-19, state governments have implemented different levels of lockdown policies. The most common types of lockdown are those requiring self-isolation and home quarantine of patients and close contacts, even urban closures in areas with severe outbreaks. Lockdowns appear to be the most effective way to deteriorate the spread of the virus, but it can lead to very serious mental health problems. It is well-documented that lockdowns trigger anxiety and insecurity (34, 35) and alter sleeping habits. During the lockdown, people sleep later than usual, stay in bed longer and sleep poorly (36). At the same time, anxiety and insecurity may be exacerbated by concerns about economic stress and major changes in daily life such as social isolation, possible viral infections, loss of loved ones, and home-schooling children (37). In addition to these phenomena, lockdowns can create social isolation and that people usually feel lonely after severe social isolation, and it is obviously that both loneliness and social isolation negatively affect mental health (38). Furthermore, we found that younger individuals in our sample were more likely to feel depressed and anxious than older ones, with emerging adults (aged 18–29) being the group most sensitive to the mental health impact of the COVID-19 pandemic. Emerging adulthood is a developmental period characterized not only by positive role transitions into full autonomy (e.g., living independently, entering the labor market, getting married), but also by high-risk behaviors such as heavy episodic drinking (39).

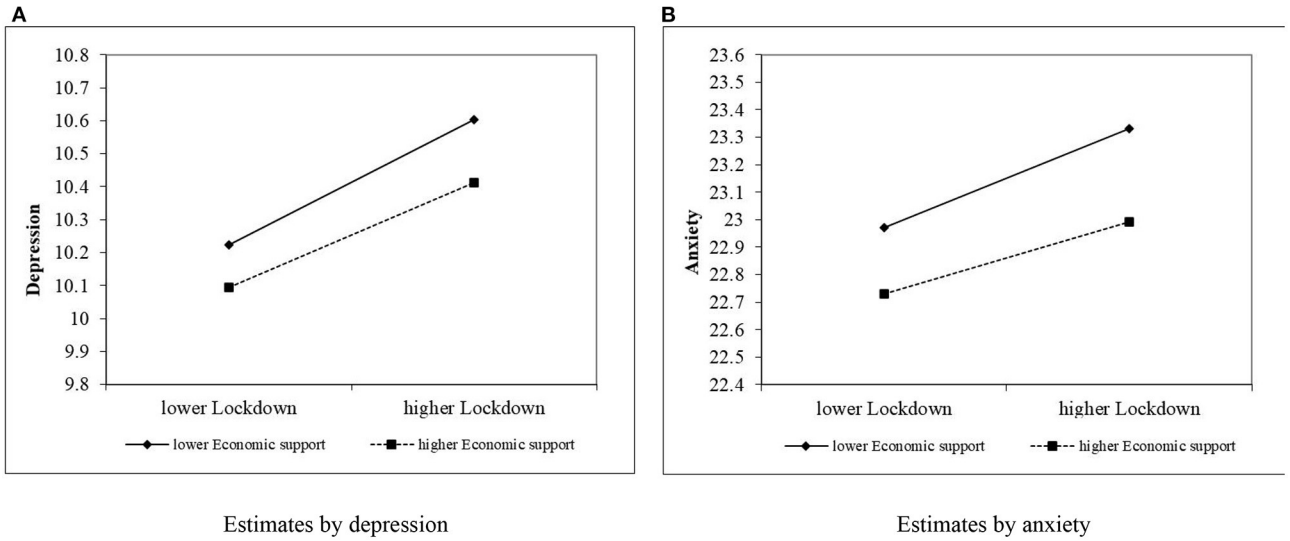

FIGURE 1 | Moderating effect of economic support on the relationship between lockdown and mental health. **(A)** Estimates by depression, **(B)** Estimates by anxiety.

Secondly, our study also shows that economic support from the government alleviates the symptoms of depression and anxiety associated with the lockdowns. Another important source of stress is economic hardship (40), and economic support as a positive intervention can mitigate the impact of negative events on individuals. Lockdown brings social isolation and anxiety, where any unexpected event such as illness or accident becomes a psychological threat and burden to individuals, while a wealthy economic base will greatly increase the individuals' ability to resist physical and psychological risk. In addition, the economic downturn caused by the COVID-19 pandemic leads to a period of economic instability during which people face unemployment and low income and develop negative perceptions about their future lives, which lead to anxiety and depression. It has been shown that a reduction in income is the greatest predictor of the development of psychological disorders during the recovery period after the SARS outbreak (41). Therefore, high-quality economic support from the government during the pandemic may enable individuals to escape from their psychological conflict-induced anxiety state, to better adapt to their environment and cope with stress, and to increase resilience.

CONTRIBUTIONS AND PRACTICAL IMPLICATIONS

This study makes several important contributions to the relationship between government lockdown policies and mental health during the COVID-19 pandemic. First, our study uses the data from the Household Pulse Survey and OxCGRT, takes the mental health values of all 50 states in the United States as the research samples, to examine the actual impact of government lockdown policies on mental health at the macro level, whereas most of the existing research on the relationship between lockdowns and mental health has been conducted at the individual level using first-hand survey data (7, 42, 43). Second, we found that most of the literature related to the pandemic lockdown to date has been dominated by short-term studies (8, 44), with a statistical time span of about 1 month, which does not allow for long-term tracking of the impact of lockdown policies implemented after the pandemic on mental health. Since our study covered nearly 2 years after the pandemic, we examined the impact of the government lockdown from 23 April 2020 to 30 August 2021, which better conveys the true effects of the lockdown than previous studies.

Furthermore, by exploring the relationship between the lockdown and mental health during the COVID-19 pandemic and the moderating effect of economic support, we aimed to provide a theoretical lens for ameliorating the negative impact of the lockdown on mental health and to provide practical strategies for improving the mental health of the population during the lockdown. On the one hand, from the government perspective, the implementation of lockdowns is necessary to deteriorate the spread of the pandemic (45). Although it can be effective in reducing the speed and extent of the pandemic, our study shows that it can be a significant threat to individuals' mental health. We have also demonstrated that government economic support can alleviate anxiety and depression, and we therefore suggest that the government should provide appropriate policy care for the isolated, such as income and debt support, unemployment subsidies for residents, and accelerate the establishment and improvement of an economic support system for the isolated to give them the courage to face the pandemic. Only with these measures can they face their study, work and life during the pandemic. On the other hand, from the individual's point of view, the quarantined can gain moral support and material care by confiding in or seeking help from colleagues, relatives and friends, thus enhancing their confidence in facing the

tremendous pressure brought by the pandemic and relieving negative emotions and psychological stress.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

There are several additional limitations to this study that need to be addressed. The first limitation relates to our measurement of regional mental health in the lockdown situation. We used only two measures of mental health, anxiety, and depression, in this study. Although these two measures are probably the most important indicators of mental health, subsequent studies will need to design and use tailored measures for psychosocial characteristics of different populations, such as loneliness and sleeping quality. In addition, due to the limitations of the dataset we used, we were unable to control for individual-level characteristics, which may have led to some bias in our results. Further research is expected to measure and compare in depth the effects of variables such as age, gender, education, work, and health conditions on mental health, providing more detailed and accurate information.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding authors.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.857444/full#supplementary-material

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Prevalence and Related Factors of Anxiety Among University Teachers 1 Year After the COVID-19 Pandemic Outbreak in China: A Multicenter Study

Wenning Fu[1], *Xiaotong Han*[2,3], *Yifang Liu*[1], *Li Zou*[7], *Jing Wen*[1], *Shijiao Yan*[2,4*†] and *Chuanzhu Lv*[5,6*†]

[1] School of Nursing, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, [2] Department of Emergency Medicine, Hunan Provincial People's Hospital/The First Affiliated Hospital, Hunan Normal University, Changsha, China, [3] Clinical Research Center for Emergency and Critical Care in Hunan Province, Changsha, China, [4] School of Public Health, Hainan Medical University, Haikou, China, [5] Emergency Medicine Center, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [6] Key Laboratory of Emergency and Trauma of Ministry of Education, Hainan Medical University, Haikou, China, [7] Department of Neurology, Zhongnan Hospital of Wuhan University, Wuhan, China

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***Correspondence:**
Shijiao Yan
2848036052@qq.com
Chuanzhu Lv
lvchuanzhu677@126.com

[†]These authors have contributed equally to this work

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Objectives: This study aimed to evaluate the prevalence of anxiety among university teachers 1 year after the onset of the coronavirus disease 2019 (COVID-19) pandemic and provide empirical evidence of psychological intervention.

Methods: A multicenter study was conducted to examine the prevalence of anxiety among 10,302 teachers in 21 Chinese universities from February 12 to April 23, 2021. The generalized Anxiety Disorder 7-item Scale (GAD-7) was used to assess symptoms of anxiety. Multivariate logistic regression models were used to analyze the relationship between potential influence and anxiety symptoms.

Results: The overall prevalence of anxiety was 40.0% 1 year after the onset of the COVID-19 pandemic, which was found to be higher in women than in men (41.32% vs. 38.22%; $p < 0.0001$). The multivariate logistic regression showed that being the female (*OR* = 1.207; *95%CI*: 1.103–1.318), age ≥60 years (*OR* = 2.004; *95%CI*: 1.128–3.560), being married (*OR* = 1.319; *95%CI*: 1.150–1.513), and poor family economic status (*OR* = 1.580; *95%CI*: 1.321–1.891) were significantly associated with anxiety. Participants with moderate, slight, or no impact of COVID-19 on life (*OR* for moderate, 0.557; *95%CI*, 0.508–0.611; *OR* for slight/no, 0.377; *95%CI*, 0.323–0.439) showed a reduced risk of anxiety compared to those who reported a significant effect.

Conclusions: Symptoms of anxiety were found in about two-fifths of Chinese university teachers 1 year after the outbreak of the COVID-19 pandemic. Our findings suggest that the government should improve the dynamic tracking of mental health and adopt long-term intervention strategies.

Keywords: COVID-19, university teachers, anxiety, China, mental health

INTRODUCTION

The Coronavirus disease 2019 (COVID-19) was first reported in China, becoming a global pandemic in March 2020 (1). However, it has not yet been completely controlled, even though it has been more than a year since the outbreak. COVID-19 and quarantine policies have spread anxiety throughout the population (2–4). According to the Global Burden of Disease Study (GBD) 2019, anxiety disorder is a disabling mental disorder and the leading cause of death (5). A previous study showed that approximately 34% of the general population reported moderate or above anxiety symptoms at the start of the pandemic in China (6).

Many countries adopted school closures as an effective measure to mitigate the spread of the pandemic (7). This accelerated shifts in educational approaches, leading to adverse effects on the mental health of teachers (8, 9). Prior to the COVID-19 pandemic, the prevalence of anxiety among teachers was only 4.98% in 2013 (10), which reached 13.67% in the first wave of the pandemic (February 4, 2020, to February 12, 2020) (11). As sociocultural populations, university teachers have borne the dual pressure of teaching and research and have been at a higher risk of psychological distress (10, 12). The spread of the pandemic might also change the psychological health status of university teachers. However, to the best of our knowledge, studies have not been conducted on the anxiety status of university teachers 1 year since the outbreak of the pandemic. Hence, this was the first and largest multicenter study to explore the prevalence of anxiety and related factors among teachers at 21 universities 1 year after the onset of the COVID-19 pandemic in China. Considering that humans would have to coexist with viruses for a long time, our study could provide clues for promoting the psychological health of teachers in this context.

METHODS

Sample and Data Collection

This multicenter study was conducted 1 year after the outbreak of the COVID-19 pandemic worldwide (February 12–April 23, 2021). The study was approved by the Haikou Research Ethics Committee of Hainan Medical University. In this study, the structure of the questionnaire included a cover letter, instructions, questions and answers, and coding. Questionnaires for the online survey were sent put anonymously using the Questionnaire Star (https://www.wjx.cn). All respondents signed an electronic informed consent form before participating in the study. In addition, logic checks were built into the background system to ensure the quality and integrity of the study. The answers to all valid questionnaires were automatically entered into a data file and then checked by two independent researchers. Participants were not allowed to answer the questionnaire repeatedly, and each device (such as a mobile phone or computer) was only eligible for one response per question. The informed consent page presented two options (yes/no). Only participants who chose "yes" were taken to the questionnaire page. The questionnaire included questions about general demographic characteristics, concerns about COVID-19, the impact of COVID-19 on life, social support, and anxiety symptoms.

The formula for estimating the sample size of the survey rate is $n = (Z_{\alpha/2}/\delta)^2\ \pi\ (1\text{-}\ \pi)$. According to literature reports, the prevalence of anxiety among Chinese adults over the age of 18 is 4.98% (10), that is, $\pi = 0.0498$, $Z_{0.05/2} = 1.96$, $\alpha = 0.05$, $\delta = 0.00498$, then $N = 7{,}330$. Taking into account the invalid questionnaires, the sample size was set at 10,500. Based on the calculation results of sample size, in this study, the sampling process included two stages. In the first stage, 21 universities in Hainan Province were randomly selected based on a simple random sampling principle. In the second stage, online questionnaires were sent to the faculty and staff of the 21 selected universities through the Department of Academic Affairs and other departments. The inclusion criteria were participants who: (1) aged 18 years and older; (2) university teachers; (3) have provided informed consent electronically prior to registration. Exclusion criteria were participants who: (1) have been suffering from baseline psychological diseases; (2) offered the questionnaire with logical errors. Finally, 10,302 valid questionnaires were collected, with a response rate of 98.11%.

Measurements

The Generalized Anxiety Disorder 7-Item Scale (GAD-7) was used to assess the degree of anxiety symptoms. The GAD-7 scale developed by Spitzer (13) was confirmed to have good factorial validity and reliability for the assessment of anxiety in the Chinese population (14). The scale contained seven items, with each item scored from 0 to 3, and the total scale score ranged from 0 to 21. According to the total score range, 0–4 points, 5–9 points, 10–14 points, and ≥15 points were considered as exhibiting no anxiety, mild anxiety, moderate anxiety, and severe anxiety, respectively. In the present study, the GAD-7 demonstrated high internal consistency (Cronbach's $\alpha = 0.94$).

Social support was assessed using the Multidimensional Scale of Perceived Social Support (MSPSS) (15). The scale consisted of 12 items, with response options ranging from 1 (very strongly disagree) to 7 (very strongly agree). The MSPSS is used to assess the quality of social support from family, friends, and significant others in three categories. The scoring rule was as follows: the total scores ranged from 12 to 84, with higher scores representing higher levels of social support. The MSPSS scores of 12–36, 37–60, and 61–84 were considered to be low, medium, and high-level support, respectively. The MSPSS showed good factorial validity and reliability among teachers (16). Cronbach's alpha for the MSPSS was 0.97 in this study.

Statistical Analysis

A descriptive analysis was conducted on the sociodemographic characteristics of teachers using frequency and percentage. The Chi-square test was used to compare demographic data, levels of social support, and prevalence of anxiety among the different groups. Additionally, multivariate logistic regression models were used to explore the influencing anxiety symptoms. All statistical analyses were performed using SPSS (version 21.0; SPSS Inc., Chicago, IL, USA). Furthermore, $p<0.05$ (double-tailed) was considered statistically significant.

RESULTS

General Sample Characteristics

A total of 10,302 university faculty and staff participated in the survey; of them 4,542 were men (44.09%) and 5,760 were women (55.91%). Most of them were aged 31–60 years (67.79%). In addition, some were aged ≤ 30 years (31.53%) and very few were aged ≥ 60 years (0.68%). In the level of social support, most perceived to have low support (71.11%), moderate support (27.74%), and high support (1.15%).

The Prevalence and Differences of Anxiety Among University Teachers 1 Year After the COVID-19 Outbreak

The prevalence of anxiety was 40.0% 1 year after the COVID-19 pandemic, and it was higher in women than in men (41.32% vs. 38.22%, $p < 0.05$). Additionally, the prevalence of anxiety among those who reported a quite impact of COVID-19 on their lives was 49.16%. The distribution of anxiety symptoms in the population is not random and there are differences. There were statistically significant differences in the prevalence of anxiety among university teachers of different ages, working years, self-perceived family economic status, and social support (all $p < 0.0001$). The prevalence of anxiety among teachers who reported a greater impact of COVID-19 on life was significantly higher ($p < 0.0001$). In addition, marriage and occupation were associated with the prevalence of anxiety ($p < 0.05$) (**Table 1**).

The Influential Factors Associated With Anxiety University Teachers 1 Year After the COVID-19 Outbreak

Screening positive for anxiety among university teachers was associated with being female, age >60 years, married, bad family economic status, 1–5 years of work, and a quite impact of COVID-19 on life. The multivariate logistic regression analysis showed that female teachers had a higher risk of anxiety symptoms (*OR* = 1.207; 95%*CI*: 1.106–1.318). Compared with teachers aged ≤30 years, those aged ≥60 years had a significantly higher risk of anxiety (*OR* = 2.004; 95%*CI*: 1.128–3.560). Additionally, there was a higher risk of anxiety in married teachers (*OR* = 1.319; 95%*CI*: 1.150–1.513) than in unmarried teachers. In addition, those who reported poor family economic status were associated with a higher risk of anxiety than those who reported good economic status (*OR* = 1.580; 95%*CI*: 1.321–1.891). However, teachers who had worked 11–20, 20–30 years, and longer than 30 years showed a lower risk of anxiety than teachers who had worked for 1–5 years. Those who reported a moderate, slight, or no impact of COVID-19 on their lives showed a reduced risk of anxiety compared to those who reported a quite impact (*OR* for moderate, 0.557; 95%*CI*, 0.508–0.611; *OR* for slight/no, 0.377; 95%*CI*, 0.323–0.439) (**Table 2**).

DISCUSSION

This multicenter study investigated anxiety symptoms among 10,320 teachers from 21 universities 1 year after the start of the COVID-19 pandemic. The results indicated that a significant proportion of the university faculty and staff had mental health problems, with 4,542 (40.0%) participants reporting anxiety symptoms. Previous studies confirmed that the prevalence of anxiety increased owing to COVID-19 (17, 18). The percentage of anxiety among university teachers in this study is close to 34.6% of that reported in a survey of university professors when the COVID-19 pandemic outbreak almost 1 year in Brazil (19). That is, anxiety symptoms seem to be very common among university teachers during the COVID-19. University teachers undertake the task of teaching and play the role of researchers (20). Owing to the COVID-19 pandemic, many university teachers could not continue their research projects. A study of teachers from kindergarten to university in China in the same period showed that 17.7% of teachers reported symptoms of anxiety, with a significantly higher percentage of university teachers reporting moderate and severe anxiety than teachers in other types of schools (21). Therefore, we suggest that the COVID-19 is a more significant psychological challenge for university teachers. Studies have shown that negative psychological emotions, such as stress and anxiety, have an impact on teachers' health (11, 22), leading to a decrease in their work enthusiasm and a decline in teaching quality (23). Simultaneously, anxiety is also an important cause of death among teachers (24). Therefore, a comprehensive investigation and intervention should be conducted on the mental health of university teachers in the current pandemic situation.

We also found that gender, age, marriage, economic status, years of work, and the degree of impact of COVID-19 on life were associated with anxiety. As in previous studies, women have been identified to be at a higher risk of mental health problems (11, 25). We believed that the possible mechanisms involved physical and psychological components. Influenced by gender chromosome genes and psychological characteristics, women are found to exhibit more self-blame in stressful events and show a tendency toward avoidance, depression, and other negative coping methods, which are closely related to the increase in anxiety symptoms in women (26). Additionally, we found that participants aged ≥60 years were more likely to have anxiety than those aged ≤30 years. First, older teachers had a higher risk of infection and poorer prognosis. Consequently, health stress and negative emotions were worse in older than in younger people, as confirmed in other studies (27, 28). Second, a recent study has confirmed that social networks could influence mental health in older adults who have struggled to reap the benefits of electronic social networks. COVID-19 has resulted in prolonged social isolation among older individuals, leading to aggravated anxiety symptoms (29). Interestingly, we found that the risk of anxiety among married university teachers was 1.319 times higher than that of unmarried teachers. Previous research also showed that married teachers appear to be under greater stress. They are required to take on more family responsibilities and worry more about parents and children influence the COVID-19 than unmarried teachers (22, 30). In addition, studies have shown that COVID-19 exacerbates teachers' job instability and increases the rate of layoffs, thus increasing the economic pressure on teachers (25, 31). This phenomenon was also reflected in our

TABLE 1 | The anxiety of university teachers 1 year after COVID-19 pandemic.

Variables	Total (*n*)	Anxiety (%)	*F*/*t* value	*P*-value
Gender				
Male	4,542	1,736 (38.22)	10.1610	0.0014
Female	5,760	2,380 (41.32)		
Age				
18–30	3,248	1,403 (43.20)	34.0309	<0.0001
31–40	3,653	1,473 (40.32)		
41–50	2,301	863 (37.51)		
51–60	1,030	350 (33.98)		
>60	70	27 (38.57)		
Ethnic group				
Ethnic Han	9,379	3,750 (39.98)	0.0381	0.8453
Others	923	366 (39.65)		
Years of work				
1–5	3,853	1,662 (43.14)	47.3024	<0.0001
6–10	1,923	785 (40.82)		
11–20	2,582	1,007 (39.00)		
21–30	1,278	452 (35.37)		
>30	666	210 (31.53)		
Marriage				
Not-married	3,173	1,311 (41.32)	11.0638	0.0114
Married	6,761	2,681 (39.65)		
Widowed	40	9 (22.50)		
Divorced	328	115 (35.06)		
Self-perceived family economic status				
Good	1,053	330 (31.34)	149.1549	<0.0001
Fair	7,544	2,894 (38.36)		
Bad	1,705	892 (52.32)		
Impact of COVID-19 on life				
Quite impacted	5,350	2,630 (49.16)	431.9809	<0.0001
Moderately impacted	3,752	1,218 (32.46)		
Slightly or not impacted	1,200	268 (22.33)		
Concern about COVID-19				
Quite concerned	9,615	3,844 (39.98)	0.0067	0.9347
Moderately concerned	663	261 (39.37)		
Slightly or not concerned	24	11 (45.83)		
Social support				
High	118	59 (50.00)	286.2510	<0.0001
Moderate	2,858	1,511 (52.87)		
Low	7,326	2,546 (34.75)		
Total	10,302	4,116 (39.95)		

study in that teachers with poor economic status had a higher detection rate of anxiety symptoms. Furthermore, the risk of anxiety was higher among teachers with <5 years of experience. The reasons for this may be attributed to the fact that new teachers who graduate from college and enter the workforce with low control over the content of their work (32). According to previous studies, teachers with more years of experience are more capable of solving problems independently in their daily work (33). Therefore, they have a higher ability to cope with the dual stress of the pandemic and the profession. Even though, there were differences in the risk of anxiety among university teachers in different occupation types, occupation type was not an influential factor in teacher anxiety. Thus, all teachers should be covered, whether they are in teaching positions, management positions, or others, when adopting psychological interventions for university teachers. The results of this study showed that the degree of impact of COVID-19 on life was an important influencing factor for university teachers. This is in line with a study conducted by Fu (4). Evidently, individuals whose lives are severely impacted by COVID-19, especially those who have lost family members, should be the focus of our subsequent intervention.

TABLE 2 | Multivariate logistic regression analysis of factors associated with university anxiety among university teachers.

Variables		*SE*	*Wald*	*P*	*OR*	*95%CI*
Gender						
Male	Reference					
Female		0.0447	17.6962	<0.0001	1.207	1.106–1.318
Age						
18–30	Reference					
31–40		0.0790	0.6344	0.4258	0.939	0.804–1.096
41–50		0.0982	0.1142	0.7354	1.034	0.853 1.253
51–60		0.1333	1.1396	0.2857	1.153	0.888–1.497
>60		0.2933	5.6145	0.0178	2.004	1.128–3.560
Years of work						
1–5	Reference					
6–10		0.0723	2.0983	0.1475	0.901	0.782–1.038
11–20		0.0764	3.8941	0.0485	0.860	0.740–0.999
21–30		0.1027	4.0097	0.0452	0.814	0.666–0.996
>30		0.1478	7.5007	0.0062	0.667	0.499–0.891
Marriage						
Not-married	Reference					
Married		0.0699	15.7075	<0.0001	1.319	1.150–1.513
Widowed		0.4025	3.0645	0.0800	0.494	0.225–1.088
Divorced		0.1412	0.0469	0.8286	1.031	0.782–1.360
Self-perceived family economic status						
Good	Reference					
Fair		0.0761	2.9402	0.0864	1.139	0.982–1.323
Bad		0.0915	25.0190	<0.0001	1.580	1.321–1.891
Impact of COVID-19 on life						
Quite impacted	Reference					
Moderately impacted		0.0473	153.0590	<0.0001	0.557	0.508–0.611
Slightly or not impacted		0.0787	154.0149	<0.0001	0.377	0.323–0.439
Social support						
High	Reference					
Moderate		0.1985	3.0424	0.0811	1.414	0.958–2.086
Low		0.1965	2.9217	0.0874	0.715	0.486–1.050

The relationship between social support and mental health was not conclusive for a long time (34, 35). Many scholars generally regarded social support as a protective factor for mental health; a lower level of social support is negatively correlated with anxiety symptoms (34). However, the findings of this study revealed a different viewpoint. This may be attributed to the following reasons: (1) the protective effect of perceived social support on university teachers was weak; and (2) the number of teachers with a high level of perceived social support was very small in this study, and more than half of the teachers had a low level of social support; therefore, the sample size should be increased to confirm the accuracy of the research conclusion. Nevertheless, further expansion of our study is needed to assess the stability and reliability of our results.

Strengths and Limitations

This study had several advantages. First, to the best of our knowledge, this is the first and largest multicenter survey of anxiety among university teachers conducted 1 year after the outbreak of the COVID-19 pandemic. Second, this study showed that nearly half of the university teachers had psychological problems. Considering the continued spread of the pandemic and the complexity of its psychological impact on teachers, this study could provide a valuable reference for the management of psychological problems among teachers in other regions and countries. However, our study had a limitation, in that it was a cross-sectional study and lacked longitudinal follow-up. Therefore, causality could not be established. Hence, further investigation is required on the long-term psychological effects of the pandemic on teachers. In addition, the universities included in this study were all public institutions, and the data collection did not collect information on teachers' anxiety at different levels, and there were some limitations in extrapolating the research results to different levels of teachers in more public and private universities.

CONCLUSION

About two-fifths of Chinese university teachers experienced anxiety symptoms 1 year after the start of the COVID-19 pandemic. Therefore, the government should focus on the mental health of teachers, particularly female and older teachers. In addition, we believed that dynamic and long-term psychological intervention measures should be taken to reduce the adverse psychological effects of the COVID-19 pandemic on teachers. These findings might be useful for providing a current anxiety profile of university teachers 1 year after the onset of the COVID-19 and pandemic for functioning as a reference point for further studies.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary materials, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Research Ethics Committee of Hainan Medical University in Haikou, China. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

WF, YL, and CL conceived and designed the study. LZ, SY, JW, XH, and WF participated in the acquisition of data. WF, XH, and SY analyzed the data. YL, XH, and CL gave advice on methodology. WF drafted the manuscript, XH, YL, and CL revised the manuscript. All authors read and approved the final manuscript.

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Neurological and Psychological Characteristics of Young Nitrous Oxide Abusers and Its Underlying Causes During the COVID-19 Lockdown

Gang Wu[1,2†], *Shanshan Wang*[2†], *Tingling Wang*[2], *Jiali Han*[2], *Anna Yu*[3], *Changqiang Feng*[1], *Yajing Wang*[2] *and Suzhi Liu*[2*]

[1] Department of Pharmacy, Taizhou Hospital of Zhejiang Province Affiliated to Wenzhou Medical University, Linhai, China,
[2] Department of Neurology, Taizhou Hospital of Zhejiang Province Affiliated to Wenzhou Medical University, Linhai, China,
[3] Department of Mental Health, Taizhou Hospital of Zhejiang Province Affiliated to Wenzhou Medical University, Linhai, China

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Xenia Gonda,
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Yantai Affiliated Hospital of Binzhou Medical University, China

***Correspondence:**
Suzhi Liu
liusz@enzemed.com

[†]These authors have contributed equally to this work and share first authorship

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Background: The COVID-19 pandemic has a serious impact on the mental health of the public due to its economic and social impact. And psychological effects have led to drug and alcohol abuse. After the city lifted the lockdown, we consecutively encountered several young nitrous oxide abusers admitted to hospital for neurological treatment.

Purpose: To inform physician decisions and social intervention, this observational study aimed at investigating the neurological and psychological characteristics of nitrous oxide abusers and its underlying causes during the COVID-19 lockdown.

Methods: The nitrous oxide abusers who sought neurological treatment at our hospital between May 2020 and June 2020 were enrolled. Clinical data including socio-demographic, physical examination, laboratory examination, electromyography and neuroimaging were collected. Their motivations for inhaling nitrous oxide, knowledge about the nitrous oxide abuse and the accompanying of family were investigated face to face. Psychological status was assessed by the Symptom Checklist 90 (SCL-90) psychological evaluation.

Results: Six nitrous oxide abusers were enrolled and the age was 22 ± 4.3. Clinical presentations included varying degrees of limb numbness and an ataxic gait. Laboratory examination revealed that all the patients did not have pernicious anemia, 4 patients had decreased vitamin B12 while 3 patients exhibited elevated homocysteine levels. MR of the spinal cord revealed that 4 patients had abnormal signals in the cervical spinal cord of high symmetry with splayed or inverted V sign after T2WI. Electromyogram (EMG) test showed 5 patients had peripheral nerve damage. The SCL-90 psychological evaluation results indicated that all patients had severe anxiety, depression and psychosis and they had severer psychological problems than ordinary citizens. Their motives for inhaling nitrous oxide are to relieve boredom, curiosity and buddy pressure. Their family spent <1 day per week to stay with them during city lockdown.

Conclusion: The enrolled patients caused by abuse of nitrous oxide presented with symptoms of subacute combined with spinal degeneration. They had more serious psychological problems related to the COVID-19 pandemic. These cases make us value the psychological problems of young people under the outbreak and take multi-layered measures from families, schools (companies), hospitals, and governments to address it.

Keywords: COVID-19, nitrous oxide, neurological, psychological, subacute combined degeneration of the spinal cord

INTRODUCTION

The COVID-19 pandemic and the ensuing lockdown have had a serious impact on the physical and mental health of the public (1, 2). And the psychological effects have led to drug and alcohol abuse (3). After the city lifted the lockdown, we consecutively encountered some young nitrous oxide abusers who were admitted to hospital for neurological treatment, which was a significant increase compared with the same period. It is important to characterize their neurological and psychological outcomes and explore the underlying causes in order to improve the clinical management during the COVID-19 pandemic period.

MATERIALS AND METHODS

Study Design and Participants

Patients attending Taizhou Hospital of Zhejiang Province for care due to nitrous oxide abuse were consecutively enrolled. Clinical data including sociodemographic characteristics, physical examination, laboratory examination, electromyography, neuroimaging, and psychological assessment were obtained. The duration and frequency of nitrous oxide use, the sources of laughter were inquired. Their motivations for inhaling nitrous oxide were investigated face to face. The family environment, siblings, interpersonal relationships, personality traits, financial conditions, and academic performance were investigated. The survey about the time their parents or family member spent to stay with them and knowledge about the nitrous oxide abuse was carried out. The history of physical illness and family history were recorded. After the city was unsealed, the first two nitrous oxide abuser came to the hospital for neurological treatment at the same time. We thought it might be a phenomenon and therefore started this observational study. The study was done between May 2020 and June 2020.

All data were anonymized to comply with the provisions of personal data protection. The participants have provided their consent to publish the observational study, and the consent procedure was approved by the Ethics Committee of Taizhou Hospital of Zhejiang Province. All procedures were performed according to the guidelines of the institutional ethics committee and the tenets of the Declaration of Helsinki were adhered to throughout.

Abbreviations: SCL-90, Symptom Checklist 90; EMG, Electromyogram; MRI, Magnetic Resonance Imaging; CMAP, Compound muscle action potential; SNAP, Sensory nerve action potential; SCD, Subacute combined degeneration of the spinal cord; COVID-19, Corona Virus Disease 2019; SARS-CoV-2, Severe Acute Respiratory Syndrome Coronavirus 2.

Magnetic Resonance Imaging (MRI)

An MRI scan of the cervical spine and brain was done to all patients. T1WI sequences included MRI sequences with and without gadolinium. Sagittal and axial images were obtained using T2-weighted MRI sequences. Data on the affected spinal cord segments (number of segments of the spine) and their positions on the sagittal image (cervical and thoracic vertebrae) were recorded.

Electromyogram (EMG)

Neurologic manifestations such as muscle weakness, sensory loss, and cognitive decline were recorded. Nerve conduction studies were performed on the median nerve, ulnar nerve, peroneal nerve, tibial nerve, and sural nerve depending on the clinical manifestations of patients. Compound muscle action potential (CMAP) amplitude, distal latency, sensory nerve action potential (SNAP) amplitude, and conduction velocity were detected using a full range functional EMG evoked potentiometer (Keypoint 9033A07, Denmark).

Psychological Assessment

Using Symptom Checklist 90 (SCL-90), the mental state of the patients and ordinary citizens was assessed by a professional psychiatrist. The severity of symptoms (normal, mild, moderate, partial severe, severe, degree from light to heavy) is determined by the number of standard deviations of the dimension score from the norm group mean.

Statistical Analyses

Data were analyzed by the Statistical Package for Social Sciences (IBM SPSS 16.0). Descriptive statistics and one-sample *t*-test were performed for data comparison between nitrous oxide abusers and ordinary citizens. Statistical significance was set at $P \leq 0.05$.

RESULTS

Sociodemographic and Laboratory Characteristics of the Patients

From May 2020 to June 2020, six patients with nerve damage caused by nitrous oxide inhalation were consecutively admitted to our hospital. As shown in **Table 1**, the mean age of the 6 patients was 22 ± 4.3, four were college students while two were high school graduates. The average duration of nitrous oxide

TABLE 1 | Sociodemographic and laboratory characteristics of the case series.

Case	Age	Sex	Education level	Duration of N2O Use (month)	Frequency of N2O Use		Vitamin B12 level (pg/ml)	Homocysteine (μmol/L)
					Before 3rd, Feb (/time, times/month)	After 3rd, Feb (/time, times/week)		
1	19	Male	College student	12	240–480, 4–5	240–480, 2–3	137.3	36.5
2	25	Female	High school	3	0	240–480, 1–2	262.7	7.9
3	28	Male	High school	3	0	240–480, 2–3	139.1	41.2
4	18	Female	College student	12	240–480, 4–6	480–720, 2–3	120.5	12*
5	22	Female	College student	3	0	480–720, 2–3	340.6*	10.5*
6	17	Female	College student	6	240–480, 3–4	240–480, 2–3	112.5	22

*N2O, nitrous oxide. *Values after 2 days medicine treatment.*

abuse was 6.5 ± 4.4 months. Three of them began inhalation of nitrous oxide after 3rd, Feb, the day the city began lockdown. They consumed 240–720 nitrous oxide per time and 1–3 times per week. Nitrous oxide is bought in recreation place or through friends. Most of the patients have decreased vitamin B12 and increased homocysteine.

Half of the patients were only children and half had one sibling. One had a poor interpersonal relationship with his family, and one was doting by his parents. All the patients did not live with their family and their parents or family members spent <2 h a day or 1 day per week to stay with or care for them during city lockdown. Their personality traits were either introverted, or withdrawn, or perverted. Five patients were in good economic condition and one was moderate. Five patients had moderate academic performance and one was lower. In addition, they didn't know that nitrous oxide abuse could lead abnormality of neurological function.

The patients stated that the reasons for nitrous oxide abuse were the lack of employment or study during the pandemic, a history of nitrous oxide abuse and relapse during the pandemic, boredom, curiosity and peer pressure.

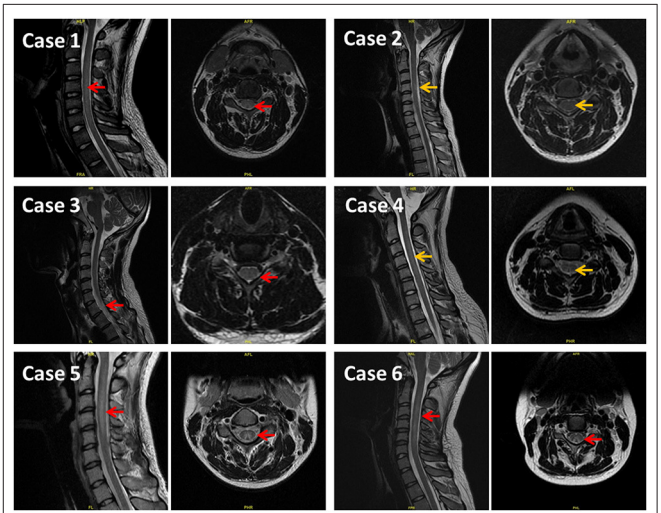

FIGURE 1 | Results of MR T2WI showing high symmetry signal in the cervical spinal posterior cord, presenting splayed or inverted V sign. On the left of each case is sagittal image and on the right is axial image. Red arrows indicate a clearly high signal. Yellow arrows indicate slightly higher or suspicious signals.

Neurological Characteristics of the Patients and Therapeutic Process

In the physical examine, all patients presented with limb numbness and varying degrees of walking instability. Varying degrees of sensory impairment and sensory ataxia were exhibited among the patients. There was no case of a positive pathological sign or obvious damage to the pyramidal tract. EMG examination showed peripheral nerve damage in patients except case 6. The abusers had multiple motor and sensory axonal damage and myelin sheath change, or motor nerve damage, or partial nerve damage. One case (case 4) had decreased muscle strength. Mild memory loss was documented in 2 patients (data not shown).

The imaging results showed that four patients had high symmetric signals with splayed or inverted V signs in the cervical spinal cord after MR T2WI. Case 4 exhibited a slightly high signal while case 1 did not exhibit any imaging abnormalities (see **Figure 1**). All the patients presented no symptoms caused by autoimmune encephalitis, intracranial infection, cerebrovascular disease, brain trauma, tumor, or other toxic/metabolic causes, etc. All were diagnosed with subacute combined degeneration of the spinal cord (SCD). The six patients had improved neurological outcomes after vitamin B12 and adenosine cobalamin therapies for 5–8 days and discharged. They were prescribed vitamin B12 on discharge and told to return do a follow-up check on time.

All the patients had no history of physical illness or family history.

Psychological Characteristics of the Nitrous Oxide Abusers

The SCL90 psychological evaluation results showed that the total score was 303.7 ± 43.1, each case was more than 250 points, and all cases had various psychological problems. The major severe psychological manifestations were anxiety, depression, hostility and psychosis (see **Table 2**).

To analyze the differences in the psychological status of nitrous oxide abusers and normal people, the SCL-90 score

TABLE 2 | The results of psychological assessment by Symptom Checklist 90 evaluation.

Case	Somatization		Obsessive-compulsive		Interpersonal sensitivity	
	Average score	Degree	Average score	Degree	Average score	Degree
1	2.92	Partial severe	3.4	Partial severe	3.78	Partial severe
2	2.5	Moderate	2.4	Mild	4	Partial severe
3	4.33	Severe	3.7	Partial severe	4.11	Severe
4	3.5	Severe	2.2	Mild	2.67	Mild
5	3	Partial severe	3.3	Partial severe	4	Partial severe
6	2.25	Moderate	2.7	Moderate	3.33	Moderate
Case	**Depression**		**Anxiety**		**Hostility**	
	Average score	Degree	Average score	Degree	Average score	Degree
1	4.15	Severe	3.8	Severe	4	Severe
2	3.31	Partial severe	4	Severe	3.5	Partial severe
3	4.62	Severe	4.2	Severe	4	Severe
4	3.62	partial severe	3.4	severe	4	severe
5	4.08	Severe	3.7	Severe	3.5	Partial severe
6	3.08	Partial severe	2.9	Severe	3.83	Severe
Case	**Phobic anxiety**		**Paranoid ideation**		**Psychoticism**	
	Average score	Degree	Average score	Degree	Average score	Degree
1	3.57	Severe	3.33	Partial severe	3.43	Severe
2	2.71	Partial severe	3	Moderate	3.2	Severe
3	4.14	Severe	3.67	Severe	4.2	Severe
4	1.57	Normal	2.5	mild	3.2	severe
5	3.86	Severe	3	Moderate	3	Partial severe
6	2.71	Partial severe	4	Severe	2.3	Moderate

of both groups was compared. The SCL-90 score of ordinary citizens under the level I emergency response was reported in a study which consisted sample size of 1,060 participants (1). It was noted that the SCL-90 scores of nitrous oxide abusers in anxiety, hostility, depression, interpersonal relationships, paranoia, psychosis and somatization were significantly higher than those of health controls, $P < 0.01$(**Table 3**), indicating that these young nitrous oxide abusers presented severer psychological problems than ordinary citizens of the same age. In view of this situation, all the patients were asked to go to the psychological department for check-up after discharge from hospital.

TABLE 3 | Psychological status of the case series according to SCL-90, compared to ordinary citizens during COVID-19.

Dimension	Case series ($n = 6$)	Ordinary citizens ($n = 1,060$)	*t*	*P*
Somatization	3.08 ± 0.75	1.81 ± 0.69	4.171	0.009
Obsessive-compulsive	2.95 ± 0.6	2.24 ± 0.75	2.887	0.034
Interpersonal sensitivity	3.65 ± 0.55	2.06 ± 0.73	7.019	0.001
Depression	3.81 ± 0.58	1.96 ± 0.70	7.856	0.001
Anxiety	3.67 ± 0.46	1.91 ± 0.71	9.287	0.000
Hostility	3.81 ± 0.25	1.86 ± 0.68	19.426	0.000
Phobic anxiety	3.09 ± 0.95	2.03 ± 0.74	2.738	0.041
Paranoid ideation	3.25 ± 0.54	1.93 ± 0.71	6.04	0.002
Psychoticism	3.22 ± 0.62	1.88 ± 0.69	5.331	0.003

DISCUSSION

Due to the COVID-19 pandemic and the lockdown that followed, public psychological problems cannot be ignored. In addition to the heightened mental stresses among patients and healthcare workers during the COVID-19 pandemic, the mental health of healthy people was also affected. There was a drastic increase in public fear, a decline in social and economic activities that triggered psychosocial sequelae. Quarantined individuals exhibited depression, fear, guilt and anger (4). Psychosocial stress due to social changes in response to COVID-19 infections enhanced mental problems (1, 2, 5). In their study, Cuiyan Wang et al. reported that a total of 53.4% of the respondents exhibited either moderate or severe psychological problems under impact of the pandemic, 16.5% exhibited moderate to severe depressive symptoms, 28.8% had moderate to severe anxiety symptoms while 8.1% had moderate to severe stress (6). The psychological

effects lead to drug and alcohol abuse (3, 7). And it is notable that these problems are more likely to happen among children and adolescents (8–10).

After the city lifted the lockdown, we consecutively encountered 6 nitrous oxide abusers who were hospitalized for neurological therapy within 1 month and they were all youth. It is notable that there were only 6 patients of nitrous oxide abuse were treated between October 2017 and December 2019 in our hospital and it cued the effect of the COVID-19 pandemic and the lockdown on public health especially the young. For physician decisions and social intervention, it was urgent to investigate the neurological characteristics and psychological state of them and the underlying causes of nitrous oxide abuse during the COVID-19 lockdown.

For more than 170 years, nitrous oxide has been used as an anesthetic in clinical practice. Its inhalation causes feelings of euphoria, involuntary laughter, distorted voices and mild hallucinations and it gradually becomes a popular way to relieve the pressures among the youth (11, 12). A global drug survey (GDS2014) conducted in 17 countries involving 74,864 patients confirmed that the prevalence of nitrous oxide use as a recreational drug in the UK and US was 38 and 29.4%, respectively (12). Incidences of nitrous oxide abuse in China are gradually increasing, with the majority of the abusers being the youth (11).

The adverse effects of exposure to nitrous oxide include slowed reaction rate, dizziness, nausea and vomiting. Inhalation of large quantities of nitrous oxide at a high pressure may lead to suffocation. Long-term adverse effects include nerve damage due to vitamin B12 deficiency, cobalamin reactive psychosis, and homocysteine accumulation (13). Vitamin B12 is an important cofactor of cellular methionine synthase. Extremely low levels of vitamin B12 leads to methionine consumption and homocysteine accumulation. Methionine consumption leads to a decrease in downstream S-adenosine, which is required for myelin production and maintenance. Deficiency in vitamin B12 leads to demyelination and gliosis of the central nervous system (especially the dorsal spinal cord), as well as demyelination of peripheral nerves. Homocysteine accumulation increases the risk of stroke and peripheral neuropathy (14).

Pernicious anemia and neurological damage caused by nitrous oxide are very common. Clinical manifestations of these conditions include paresthesia in limbs, gait instability or difficult walking, weakness, falls or balance disorders, Lhermitte's Sign and ataxia (15). Occasionally there is cognitive impairment and optic atrophy (14, 16). In this study, all the 6 nitrous oxide abusers presented with limb numbness and varying degrees of walking instability. Two patients presented with mild memory loss, 4 presented with increased T2 signal in cervical spinal cord, 3 presented with extensive peripheral nerve damage, while 1 exhibited mild anemia. In terms of treatment, the neurological symptoms could be ameliorated by in time vitamin B12 supplementary (13, 17). All the patients had improved neurological outcomes after vitamin B12 therapies and discharged.

Considering the impact of the COVID-19 epidemic on people's mental health (18), the psychological assessment was carried out. The results indicated varying degrees of anxiety, depression, hostility and psychosis and one case presented obvious suicidal tendency. The SCL-90 score of the 6 patients was significantly higher compared to that of healthy individuals. During COVID-19 pandemic and city lockdown, stressors such as university closures, social distancing, pessimism on the economic prospects are susceptible to lead development of mental health symptoms (18). Compared with the past, the increase in the number of hospitalizations caused by nitrous oxide abuse, and the increase of nitrous oxide dose or relapse reflected to a certain extent the impact of the COVID-19 pandemic on people's psychological status.

To explore the potential causes of nitrous oxide abuse during the COVID-19 lockdown, motivations for inhaling nitrous oxide, sociodemographic characteristics, family environment, siblings, interpersonal relationships, personality traits, financial conditions, and academic performance were investigated. The results showed that risk factors for nitrous oxide abuse included the lack of employment or study during the pandemic, a history of nitrous oxide abuse and relapse during the pandemic, boredom, curiosity and peer pressure, parental or family inconcern or doting, and possible good economic situation.

Although there were still many debates about the lockdown policy (19), it did inhibit the spread of the SARS-CoV-2 and reduce the absolute number of deaths (20). We should focus more on solving the problems caused by the city lockdown such as the psychological problems and take effective measures for the above potential causes. It should enhance the combination of meaning-based coping and spirituality processes to mitigate the adverse effects of coronavirus stress on wellbeing (21). Multi-layered interventional measures from families, schools, hospitals, and governments should be implemented as early as possible. It is worth emphasizing that the patients' family rarely communicated with them during the lockdown. Loneliness is strongly associated with mental health problems (22). Therefore, the company of the family appears to be extremely important (23). Indoor games, read and physical sports with the family are recommended. Despite of social distancing and school closures, on-line courses and virtual workshops where clinician-led mental health and psychosocial services such as stress control, drug abuse education are conducted should be encouraged. For those with obvious suicidal tendency, severe depression or other serious psychological problems, drug therapy intervention by psychiatrist needs to be involved (24). Lastly, government's measures should be taken to control the nitrous oxide flooding from the source such as recreation places (11).

Disadvantage of this study: nitrous oxide abuse not only leads to peripheral neuropathy, SCD and other physiological diseases (25–27) but also causes a series of abnormal mental symptoms, including personality changes, mood disorientations (such as anxiety, depression, mania), impulsive and aggressive behaviors, hallucinations, delusions and other psychotic symptoms (28). We failed to obtain the psychological assessment data of the patients before the pandemic and before they started abusing nitrous oxide. The causal relationships between the pandemic and psychological changes, and between nitrous oxide abuse and psychological changes could not be explained. The second

disadvantage is that the psychological status of the general population in the city was not obtained at the time of psychological assessment of the patients.

CONCLUSION

The nitrous oxide abusers during the COVID-19 pandemic and lockdown presented SCD neurological symptoms and more serious psychological problems than healthy controls. In addition to the neurological therapy, more attention should be payed to the mental health of them. These young cases make us value the psychological problems of young people under the outbreak and it is imperative to take multi-layered, three-dimensional measures from families, schools (companies), hospitals, and governments to address it.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of Taizhou Hospital of Zhejiang Province. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

GW, SW, and SL were involved in conception and design, case diagnosis, data analysis, data interpretation, critical review, and manuscript drafting for this article. TW, CF, AY, YW, and JH were involved in data collection. GW and JH contributed to manuscript revision. All authors reviewed and confirmed for this article. All authors contributed to the article and approved the submitted version.

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Determinants of Anxiety in the General Latvian Population During the COVID-19 State of Emergency

Jelena Vrublevska[1,2], Viktorija Perepjolkina[3], Kristine Martinsone[4], Jelena Kolesnikova[4], Ilona Krone[4], Daria Smirnova[5,6], Konstantinos N. Fountoulakis[7] and Elmars Rancans[1]*

[1] Department of Psychiatry and Narcology, Riga Stradins University, Riga, Latvia, [2] Institute of Public Health, Riga Stradins University, Riga, Latvia, [3] Faculty of Communication, Riga Stradins University, Riga, Latvia, [4] Department of Health Psychology and Pedagogy, Riga Stradins University, Riga, Latvia, [5] International Centre for Education and Research in Neuropsychiatry (ICERN), Samara State Medical University, Samara, Russia, [6] Department of Psychiatry, Narcology, Psychotherapy and Clinical Psychology, Samara State Medical University, Samara, Russia, [7] 3rd Department of Psychiatry, School of Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece

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Michele Fornaro, University of Naples Federico II, Italy

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Vivian Isaac, Flinders University, Australia

***Correspondence:**
Jelena Vrublevska
vrublevskaja@inbox.lv

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Background: The COVID-19 pandemic and its restrictive public health measures have seriously affected mental health of society. Social, psychological, and health-related factors have been linked to anxiety in the general population.

Aim: We investigate the association of various sociopsychological and health-related determinants of anxiety and identify the predicting factors for anxiety in the general population during the COVID-19 state of emergency from in Latvia.

Methods: We conducted an online survey using a randomized stratified sample of the general adult population in July 2020 for 3 weeks. Anxiety symptoms were measured using the State-Trait Anxiety Inventory (STAI-S). Sociodemographic, health-related, sociopsychological characteristics and suicidality were identified using the structured questionnaire. The statistical analysis included Pearson's chi-square test, *post hoc* analysis, and binomial logistic regression.

Results: The weighted study sample included 2,608 participants. The mean STAY-S score of the total sample was 22.88 ± 12.25. In the total sample, 15.2% (n = 398) of participants were classified as having anxiety. The odds ratio (OR) of having anxiety was higher in females (OR = 2.44; 95% CI 1.75–3.33) and people who had experienced mental health problems in the past (OR = 1.45; 95% CI 1.03–2.04), had suicide attempt in the past (OR = 1.68; 95% CI 1.08–2.59), were worried about their health status due to COVID-19 (OR = 1.64; 95% CI 1.36–1.16), were worried about stigmatization from others if infected with COVID-19 (OR = 1.18; 95% CI 1.03–1.35), were worried about information regarding COVID-19 from the Internet (OR = 1.24; 95% CI 1.08–1.43), persons who were lonely (OR = 1.90; 95% CI 1.54–2.34), and persons with negative problem orientation (OR = 1.26; 95% CI 1.06–1.51). Protective factors were identified as having good self-rated general health (OR = 0.68, 95 % CI 0.58–0.81), maintaining a daily routine (OR = 0.74, 95 % CI 0.61–0.90), having financial stability (OR = 0.66, 95 % CI 0.55–0.79), and having good psychological resilience (OR = 0.90, 95 % CI 0.87–0.94).

Conclusions: This is the first study to report a prevalence of anxiety in the general population of Latvia. Certain factors that predict anxiety, as well as protective factors were identified.

Keywords: anxiety, COVID-19, pandemic, general population, mental health, predictors

INTRODUCTION

Even before the COVID-19 pandemic, anxiety disorders were the leading causes of burden globally, despite the existence of intervention strategies aimed at reducing their effects (1). The COVID-19 pandemic has had a significant impact on public health, including mental and physical health (2). Moreover, anxiety has been reported as a common experience among COVID-19 patients, while the public's pandemic-related health concerns and fears of contracting COVID-19 serve as contributing factors to anxiety (2, 3).

A large-scale meta-analysis of 71 published papers revealed there was a 32.6% total prevalence of anxiety during the COVID-19 pandemic (4), while the prevalence estimates of anxiety differ remarkably across countries and populations (5). Meanwhile, people with mental health disorders may be considerably more affected by emotional reactions in the form of anxiety generated by the COVID-19 pandemic (6).

Many studies have suggested that anxiety during the COVID-19 pandemic is associated with certain sociodemographic characteristics, health-related factors (e.g., mental health problems and suicidality in the past), and sociopsychological factors (e.g., loneliness, poor relationship quality, changes in daily routine and behavior, low psychological resilience, and negative problem orientation) (7–14). Available research indicates that females and those of a younger age who lived in rural areas and had lower socioeconomic status had a higher risk of anxiety (7). Moreover, other social and economic factors, such as economical struggles, unemployment, being unmarried, having chronic diseases, sedentary behavior, and poor sleep quality, were associated with anxiety during the COVID-19 pandemic (6, 15, 16). The literature has also suggested that the COVID-19 pandemic has triggered feelings of fear as a response to the sense of extreme threat for both the community and individuals (8, 17, 18). Moreover, metacognitions, intolerance of uncertainty, and emotional dysregulation have all been linked to the fear of COVID-19 and anxiety (10).

Changes in daily life, loneliness, social isolation have had a huge impact worldwide, with serious psychological implications (18, 19). Loneliness can occur not only in the context of social isolation, but can even be felt when others are physically present, and has been linked to anxiety, implying that lonely persons are more vulnerable (11, 19). Meanwhile, the prolonged "stay-at-home" and confinement conditions have led individuals to be more engaged with technology use (20). The Internet, as a valuable source of health information, has become more widely used by the general population during the ongoing COVID-19 pandemic (12). However, repeated media exposure to pandemic-related material and extensive online searches for health-related information can intensify anxiety and develop a cycle of psychological discomfort that is hard to break (12). In addition, problem-solving is a broad coping technique that promotes and sustains general competence and adaptability. It can have positive and/or negative orientations, while the deficits of positively-orientated problem-solving show significant correlations with anxiety (21, 22). Finally, resilience is a dynamic process that involves adaptation in the face of adversity and refers to the tendency to retain stable, healthy functioning following a potentially stressful life experience (23). Recent data suggest that during the COVID-19 pandemic, highly resilient, risk-tolerant individuals reported having lower anxiety (13).

There are concerns that COVID-19 pandemic could lead to increased suicide rates. However, the data concerning suicidality during the COVID-19 pandemic are not conclusive. The risk of suicide may have increased due to the stigmatization of COVID-19-infected patients and their families. Moreover, people with psychiatric illnesses may experience worsening symptoms or develop altered mental states (e.g., anxiety), which is related to increased suicide risk. High levels of suicidality have been reported previously (24), while the data on suicides from 21 countries have shown no evidence of a significant increase in suicide risk since the pandemic began (25). Conversely, other studies (14) have suggested that that the COVID-19 pandemic may trigger suicidality and behavior. For example, Fountoulakis et al. (17) assume that stress and anxiety develop first, followed by depression and suicidality.

Following the World Health Organization's (WHO) declaration of a global pandemic, the Latvian authorities declared the first state of emergency in March 2020 with a number of epidemiological security measures and restrictions, primarily the restriction of meetings, travel, most public places and educational institutions, which lasted until June 2020. Noteworthy, at that time restrictions due to the pandemic in Latvia were much milder than in other Baltic and European countries. According to the Latvian National Health Service data, as of 1 July 2020, there were 1118 confirmed COVID-19 cases in Latvia with 32 deaths and 198,508 tests having been performed. A strict lockdown due to large increase in COVID-19 cases was first introduced in October 2021 (26, 27).

Given that the COVID-19 pandemic is a global problem that has affected countries to varying degrees, there is a need for a transnational understanding of the potential sociodemographic and sociopsychological predictors of anxiety. This need is reinforced by the fact that Latvia before the pandemic had one of the highest suicide rates in Europe (28). Moreover, anxiety in the general Latvian population has not yet been estimated. In addition to determine the anxiety status of the general population during the COVID-19 pandemic, key risk and protective factors

need to be identified to determine an at-risk group and measures that can be taken to protect those who are at risk from anxiety symptoms and improve their mental health.

This study aims to investigate the association between sociodemographic, health-related, and sociopsychological determinants and anxiety and identify the predicting factors for anxiety in the general population of Latvia during the state of emergency from March to June 2020.

METHODS

The Survey

We conducted a quantitative cross-sectional online survey that included a randomized stratified sample of the Latvian general population aged 18–74 years. The survey was within the framework of the National Research Program, and a sample of the Latvian general population was a part of the COVID-19 Mental Health International for the General Population project (COMET-G) (17). COMET-G is large international study with sample of 55,589 participants from 40 countries who filled the structured questionnaire (17). The survey was translated from English into Latvian and Russian. Both translations were then studied by a Latvian- and Russian-speaking focus group for verification. The COMET-G study protocol was supplemented with sections of the questions on the socio-psychological impact of the COVID-19 pandemic and the attitude on the measures implemented by the government. The full survey consisted of 27 thematic sections, including questions on sociodemographic information, overall mental functioning, general health status, fear of COVID-19, thoughts on the preventative measures taken against COVID-19, family relationships, lifestyle changes, spiritual inquiries, Internet use, psychological resilience, emotion regulation, positive and negative orientation toward social problems, and loneliness. The detailed protocol of the COMET-G (which included questions on general data, family relationships, health status, thoughts on COVID-19 and its preventative measures, anxiety, suicidality, and lifestyle changes) is available in the web appendix at Fountoulakis et al. (17).

Data Collection

The data collection was conducted from July 6 to 27, 2020 (29, 30). The fieldwork team that was provided by the research company KANTAR followed the ESOMAR International Code on Market and Social Research (31). The data collection was stratified by gender, age, region, urbanization, and nationality, and was based on statistics published by the Office of Citizenship and Migration Affairs of Latvia (32). A precisely selected and segmented database was used to correspond to the general population of Latvia thus ensuring the representativeness of the sample of respondents (33). An SSL (Secure Sockets Layer) data transmission protocol was used to ensure the security of the online data transmission (34). Respondents received individual invitations by e-mail, with a password and a link to an online questionnaire, which could be completed by respondents at their preferred time until the specified survey closing time July 27. A reminder about completing the questionnaire was sent to participants by email. During the fieldwork, the database was regularly cleaned. Inactive participants were deleted, and the database was continuously updated with new participants. When the respondent filled out the questionnaire, it was saved on KANTAR's server and was not available for later editing.

Each survey item was assigned an ID code, and the data were collected anonymously online. The study was approved by the Ethics Committee of Riga Stradins University, Riga, Latvia. The first page of the online questionnaire included the declaration of voluntarily consent for participation.

Measures

Anxiety

Anxiety symptoms were measured using the State-Trait Anxiety Inventory (STAI-S) (35), which was part of the online questionnaire. The internal consistency of the STAI in our study was good (Cronbach's $\alpha = 0.94$). The cut-off point for the STAI-S scores used in our study was based on the normative data information (mean and standard deviation scores of the non-clinical and clinical groups) (36). The cut-off score was computed as follows:

$$c = \frac{s_0 M_1 + s_1 M_0}{s_0 + s_1}, \quad (1)$$

where M1 = mean of the clinical group, S1 = standard deviation of the clinical group, M0 = mean of the non-clinical group, and S0 = standard deviation of the non-clinical group (37). According to the equation, a cut-off score of 36 was determined.

The participants' changes in anxiety were assessed using self-rated responses to the question: "How much has your emotional state changed in relation to the appearance of anxiety and insecurity compared to before the COVID-19 pandemic?" The responses were scored on a five-point scale.

Sociodemographic Determinants

To verify the association between anxiety and the sociodemographic characteristics, the participants' gender, age, ethnicity, urbanization, family status, education, and employment were recorded. Being a close relative or caretaker of a person who is at high risk of becoming infected with COVID-19 was assessed by "yes" or "no" responses.

Health-Related Determinants

The participants' general health was assessed by the question: "In general, how do you rate your health over the last month?" The responses were answered on a five-point scale. There was also an additional question: "Do you suffer from any chronic medical somatic conditions (e.g., diabetes, mellitus, hypertension, asthma, etc.)?" Self-reported mental disorders in the past were acquired by the question: "In the past, have you had any mental health problem that were serious enough to make you seek professional help, psychotherapy, or medication treatment?" The responses were in the form of "yes" or "no".

Suicidality and Behaviors

We used the Risk Assessment of Suicidality Scale (RASS) to assess participants' suicidality and behaviors. The RASS was previously validated in a study using a general Greek population sample and was found to be a reliable tool (38). The internal consistency of

the RASS in our general Latvian population sample was found to be good (Cronbach's $\alpha = 0.93$) (29).

Sociopsychological Determinants

We assessed fear of COVID-19, relationship quality, religious/spiritual inquiries, Internet use, and daily routine using the questions that are available on the COMET-G's web appendix (17).

Psychological Determinants

We evaluated loneliness using the statement: "I felt lonely more often during the state of emergency situation than in the situation before." The responses were scored on a four-point scale. We used the Emotion Regulation Skills Questionnaire (ERSQ-27), which was previously adapted for use in Latvia (39–41), to evaluate participants' emotional regulation ability. The ERSQ consists of 27 statements divided into 9 scales, with responses scored on a five-point scale. However, this study only used the total score (Cronbach's $\alpha = 0.96$). We used the Psychological Resilience Scale, which is a seven-item measure (Cronbach's $\alpha = 0.87$), to assess participants' psychological resilience. The responses were scored on a five-point scale (42).

Finally, we used the Social Problem-Solving Inventory-Revised Version (SPSI-R) (43), which was previously adapted for use in Latvia (44, 45), and is a multidimensional measure containing 52 statements. This study used two short-form scales: the Negative Problem Orientation (NPO) (Cronbach's $\alpha = 0.87$) and the Positive Problem Orientation (PPO) (Cronbach's $\alpha = 0.85$). The responses were scored on a five-point scale.

Statistical Analysis

Descriptive statistics were computed for all variables used in the analyses. A cut-off point of the STAI-S score ($\geq$ 36) was used to determine anxiety. We conducted between-group comparisons of frequencies using Pearson's chi-square test for categorical variables, and the *post hoc* analysis involved pairwise comparisons using the multiple z-test of two proportions with a Bonferroni correction. An independent samples *t*-test was used to analyze the mean differences for the continuous variables between anxiety and non-anxiety group. Variables that achieved a screening level of significance ($p < 0.05$) were simultaneously entered into a binomial logistic regression. Data were analyzed with SPSS version 27.0.

RESULTS

Sociodemographic Determinants and Their Association With Anxiety

Of the 3,110 questionnaires received, after data cleaning and weighing 2,608 questionnaires were obtained. The mean STAI-S score of the total sample is 22.88 ± 12.25. In the total sample, 15.2% ($n = 398$) are classified as having anxiety. **Table 1** presents the sample's sociodemographic characteristics and a chi-square test results. All expected cell frequencies were greater than five. The prevalence of anxiety among females is much higher than among males (77.1 vs. 22.9%, respectively). The comparison by age group reveals that the proportion of 18–29-year-olds is significantly higher in the anxiety group compared to the non-anxiety group (21.9 vs. 12.6%, respectively) and lower in the age group containing 40–49-year-olds (17.8 vs. 22.6%, respectively). The anxiety group has a difference in the proportion of Latvians and Russians (60.8 vs. 32.2%, respectively) when compared to the non-anxiety group (67.1 vs. 26.7%, respectively). The proportion of people living in the rural area is lower in the anxiety group compared to the non-anxiety group (22.1 vs. 27.6%, respectively). Meanwhile, those who are caretakers or close relatives of a person in a vulnerable group are more likely to meet the criteria of having anxiety compared to participants who are not (46.7 vs. 34.4%, respectively). The results are statistically significant (*p*-values are displayed in **Table 1**). There was not a statistically significant association between anxiety and such sociodemographic variables as family status [$\chi^2(3) = 2.84$, $p = 0.416$], education [$\chi^2(2) = 2.89$, $p = 0.235$], and employment [$\chi^2(3) = 3.68$, $p = 0.298$].

Health-Related Determinants of Anxiety

All health-related variables analyzed in this study were statistically significantly associated with anxiety (**Table 2**). Results of chi-square test show that of those who had anxiety, 61.3% show that their emotional state has worsened a little compared to 23.0% of those without anxiety, and 17.3% show that "It got a lot worse" compared to 0.9% of the group without anxiety. A total of 13.1% of respondents with anxiety state that their anxiety is "Neither better nor worse" compared to 71.4% of participants without symptoms of anxiety. A total of 35.9% of respondents with anxiety report a moderate or bad general health status compared to 11.2% of respondents without any health conditions. A total of 34.7% of those with anxiety suffer from chronic somatic conditions compared to 27.1% of respondents without anxiety. The participants with anxiety also have had significantly more mental health disorders in the past.

Table 3 shows that 20.9% of the participants who have anxiety confirm that they have a fear of dying, 2.6% have frequent thoughts of harming themselves, and 3.6% have suicide ideation. Participants with anxiety show an increased tendency to think about suicide compared to those without anxiety (15.3 vs. 4.1%, respectively). A total of 11% of participants with anxiety indicated at least one attempted suicide in the past compared to 4.8% of participants without anxiety.

Sociopsychological Determinants of Anxiety

Table 4 shows that moderate and severe fears of contracting COVID-19 are statistically significantly more prevalent in participants with anxiety than those without anxiety (63.8 vs. 27.3%, respectively) as well as the fear that a family member could contract COVID-19 and die (50.6 vs. 15.4%, respectively). Meanwhile, fear of possible stigmatization (i.e., in the case of contracting COVID-19, people would distance themselves from the infected person and behave differently to them) are statistically significantly associated with those with anxiety than those without anxiety (64.3 vs. 36.6%, respectively). The belief that the COVID-19 precautions are effective is not associated with symptoms of anxiety.

TABLE 1 | Sociodemographic determinants and their association with anxiety (n = 2,608).

Characteristics	All respondents (N = 2,608)	Anxiety below cut-off point (n = 2,210)	Anxiety above cut-off point (n = 398)
Gender		$\chi^2 = 55.95$, $p < 0.0001$	
Male	1,036 (39.7%)	945 (42.8%)$_a$	91 (22.9%)$_b$
Female	1,570 (60.2%)	1,263 (57.2%)$_a$	307 (77.1%)$_b$
Other/ did not want to define	2 (0.1%)	–	–
Age		$\chi^2 = 31.75$, $p < 0.0001$	
18–29	365 (14.0%)	278 (12.6%)$_a$	87 (21.9%)$_b$
30–39	538 (20.6%)	446 (20.2%)$_a$	92 (23.1%)$_a$
40–49	570 (21.9%)	499 (22.6%)$_a$	71 (17.8%)$_b$
50–59	598 (22.9%)	513 (23,2%)$_a$	85 (21.4%)$_a$
60–69	433 (16.6%)	380 (17.2%)$_a$	53 (13.3%)$_a$
70 and older	104 (4.0%)	94 (4.3%)$_a$	10 (2.5%)$_a$
Ethnicity		$\chi^2 = 5.96$, $p = 0.051$	
Latvian	1,724 (66.1%)	1,482 (67.1%)$_a$	242 (60.8%)$_b$
Russian	719 (27.6 %)	591 (26.7%)$_a$	128 (32.2%)$_b$
Other	165 (6.3%)	137 (6.2%)$_a$	28 (7.0%)$_a$
Urbanization		$\chi^2 = 5.53$, $p = 0.063$	
Capital city	1,013 (38.8%)	844 (38.2%)$_a$	169 (42.5%)$_a$
Other city or town	897 (34.4%)	756 (34.2%)$_a$	141 (35.4%)$_a$
Rural area	698 (26.8%)	610 (27.6%)$_a$	88 (22.1%)$_b$
Family status		$\chi^2 = 2.84$, $p = 0.416$	
Single	469 (18.0%)	386 (17.5%)$_a$	83 (20.9%)$_a$
Married or in relationship	1,733 (66.4%)	1,480 (67.0%)$_a$	253 (63.6%)$_a$
Divorced/widowed	371 (14.2%)	315 (14.3%)$_a$	56 (14.1%)$_a$
Other	35 (1.3%)	29 (1.3%)$_a$	6 (1.5%)$_a$
Education		$\chi^2 = 2.89$, $p = 0.235$	
Less than high school degree	62 (2.4%)	57 (2.6%)$_a$	5 (1.3%)$_a$
High school degree	964 (37.0%)	810 (36.7%)$_a$	154 (38.7%)$_a$
More than high school degree	1,544 (59.2%)	1,311 (59.4%)$_a$	233 (58.5%)$_a$
Missing data/ unknown	38 (1.5%)	32 (1.4%)$_a$	6 (1.5%)$_a$
Employment		$\chi^2 = 3.68$, $p = 0.298$	
Employed	1,873 (71.8%)	1,598 (72.3%)$_a$	275 (69.1%)$_a$
Unemployed	197 (7.6%)	158 (7.2%)$_a$	39 (9.8%)$_a$
Economically inactive (retired, student, housewife, etc.)	498 (19.1%)	420 (19.0%)$_a$	78 (19.6%)$_a$
Other	40 (1.5%)	34 (1.5%)$_a$	6 (1.5%)$_a$
B4 Caretaker or close relative of a person that belongs to a vulnerable group		$\chi^2 = 22.06$, $p < 0.0001$	
Yes	947 (36.3%)	761 (34.4%)$_a$	186 (46.7%)$_b$
No	1,661 (63.7%)	1,449 (65.6%)$_a$	212 (53.3%)$_b$

Each subscript letter denotes a subset of Anxiety score (below/above cut-off point) categories whose column proportions do not differ significantly from each other at the 0.05 level.

Table 5 shows that moderate to severe worries about COVID-19 information on the Internet are statistically significantly more prevalent in respondents with anxiety than those without anxiety (50.0 vs. 27.4%, respectively). Participants with anxiety are more prone to using the Internet moderately to more than usual than the participants without anxiety (59.3 vs. 34.1%, respectively). Increased use of social media is also associated with the tendency to meet the criteria of anxiety (46.5 vs. 21.4%, respectively). The results show statistical significance.

Table 6 shows that increased conflicts with family members (17.6% of those with anxiety vs. 4.2% of those without anxiety), worsening of the overall quality of relationships with the family members (16.3% of those with anxiety vs. 3.6% of those without anxiety), difficulties in maintaining a basic daily routine (49.7% of those with anxiety vs. 20.8% of those without anxiety), financial difficulties due to the pandemic (50% of those with anxiety vs. 28.9% of those without anxiety), and feelings of loneliness (64% of those with anxiety vs. 24.8% of those without anxiety) show statistically significant association with anxiety.

Psychological Determinants of Anxiety

Table 7 shows that psychological factors such as resilience, emotional regulation skills, and social problem-solving skills (such as positive and negative problem orientation) show a

TABLE 2 | Health-Related determinants of anxiety ($n = 2,608$).

Characteristics	All respondents ($N = 2,608$)	Anxiety below cut-off point ($n = 2,210$)	Anxiety above cut-off point ($n = 398$)
F21. How much has your emotional state changed in relation to the appearance of anxiety and insecurity compared to before the COVID-19 epidemic? ($M = 2.71$, $SD = 0.66$)		$\chi^2 = 636.42$, $p < 0.0001$	
It got a lot worse	88 (3.4%)	19 (0.9%)$_a$	69 (17.3%)$_b$
It got a little worse	751 (28.8%)	507 (23.0%)$_a$	244 (61.3%)$_b$
Neither better nor worse	1,631 (62.5%)	1,577 (71.4%)$_a$	52 (13.1%)$_b$
It's a little improved	106 (4.1%)	79 (3.6%)$_a$	27 (6.8%)$_b$
It has improved a lot	32 (1.2%)	26 (1.2%)$_a$	6 (1.5%)$_a$
B1. In general, your health over the last month can be described as ($M = 2.59$, $SD = 0.98$)		$\chi^2 = 179.28$, $p < 0.0001$	
Excellent	425 (16.3%)	399 (18.1%)$_a$	26 (6.5%)$_b$
Very good	665 (25.5%)	596 (27.0%)$_a$	69 (17.3%)$_b$
Good	1,127 (43.2%)	967 (43.8%)$_a$	160 (40.2%)$_a$
Moderate	333 (12.8%)	214 (9.7%)$_a$	119 (29.9%)$_b$
Bad	58 (2.2%)	34 (1.5%)$_a$	24 (6.0%)$_b$
B2. Do you suffer from any chronic medical somatic condition (for example: diabetes, mellitus, hypertension, asthma, etc.)?		$\chi^2 = 9.65$, $p < 0.002$	
Yes	736 (28.2%)	598 (27.1%)$_a$	138 (34.7%)$_b$
No	1,872 (71.8%)	1,612 (72.9%)$_a$	260 (65.3%)$_b$
B5. In the past, have you had any mental health problem serious enough to make you seek professional health, psychotherapy or medication treatment?		$\chi^2 = 123.98$, $p < 0.0001$	
Yes	410 (15.7%)	273 (12.4%)$_a$	137 (34.4%)$_b$
No	2,198 (84.3%)	1,935 (87.6%)$_a$	261 (65.6%)$_b$
Anxiety in the past		$\chi^2 = 108.71$, $p < 0.0001$	
Yes	217 (8.3%)	131 (5.9%)$_a$	86 (21.6%)$_b$
No	2,391 (91.7%)	2,077 (94.1%)$_a$	312 (78.4%)$_b$
Depression in the past		$\chi^2 = 82.74$, $p < 0.0001$	
Yes	220 (8.4%)	140 (6.3%)$_a$	80 (20.1%)$_b$
No	2,388 (91.6%)	2,068 (93.7%)$_a$	318 (79.9%)$_b$
Psychosis in the past		$\chi^2 = 13.79$, $p < 0.0001$	
Yes	27 (1.0%)	16 (0.7%)$_a$	11 (2.8%)$_b$
No	2,581 (99.0%)	2,192 (99.3%)$_a$	387 (97.2%)$_b$
Bipolar Disorder		$\chi^2 = 11.25$, $p < 0.001$	
Yes	12 (0.5%)	6 (0.3%)$_a$	6 (1.5%)$_b$
No	1,596 (99.5%)	2,204 (99.7%)$_a$	392 (98.5%)$_b$
Other		$\chi^2 = 13.84$, $p < 0.0001$	
Yes	50 (1.9%)	33 (1.5%)$_a$	17 (4.3%)$_b$
No	2,558 (98.1%)	2,177 (98.7%)$_a$	381 (95.7%)$_b$

Each subscript letter denotes a subset of Anxiety score (below/above cut-off point) categories whose column proportions do not differ significantly from each other at the 0.05 level.

weak to moderate association with the STAI-S score. Participants with anxiety show significantly lower results for psychological resilience (large effect size), emotional regulation skills, and positive problem orientation (small effect size for both variables), but higher mean scores for negative problem orientation (large effect size).

Factors That Predict Anxiety

A binomial logistic regression was performed to ascertain the effects of socio-demographic, health-related, life-style and psychological variables on the likelihood that participants have anxiety. Twenty-eight factors which were found to be associated with anxiety at a p-value of < 0.05 were further analyzed using the multiple logistic regression model to determine the predictors of anxiety. Linearity of the continuous variables (gender, B1, O1, O5, O6, O11, O12, O13, C1, C3, C4, P1, E3, E4, E5, E7, K1, K3, K4, Loneliness, Emotion Regulation, Psychological Resilience, NPO and PPO) with respect to the logit of the dependent variable was assessed *via* the Box-Tidwell procedure (46). A Bonferroni correction was applied using all 50 terms in the model resulting in statistical significance being accepted when $p < 0.001$ (47). Based on this assessment, all continuous independent variables were found to be linearly related to the logit of the dependent variable. There was 66 standardized residuals with a value of 10.82 to −7.11 (M = 3.66, SD = 2.89) standard deviations, which all were kept in the analysis, because they form only 2.53% of

TABLE 3 | The association of anxiety and suicidality and self-harm history in the general population of Latvia during the COVID-19 state of emergency ($n = 2,608$).

Characteristics	All respondents ($N = 2,608$)	Anxiety below cut-off point ($n = 2,210$)	Anxiety above cut-off point ($n = 398$)
O1. Are you afraid that you are going to die? ($M = 1.37$, $SD = 0.62$)		$\chi^2 = 360.70$, $p < 0.0001$	
Not at all	1,804 (69.2%)	1,662 (75.2%)$_a$	142 (35.7%)$_b$
A little bit	666 (25.5%)	493 (22.3%)$_a$	173 (43.5%)$_b$
Much	106 (4.1%)	48 (2.2%)$_a$	58 (14.6%)$_b$
Very much	32 (1.2%)	7 (0.3%)$_a$	25 (6.3%)$_b$
O5. Do you think of harming yourself psychically? ($M = 1.07$, $SD = 0.32$)		$\chi^2 = 45.40$, $p < 0.0001$	
Not at all	2,472 (94.8%)	2,118 (95.8%)$_a$	354 (88.9%)$_b$
A little bit	105 (4.0%)	71 (3.2%)$_a$	34 (8.5%)$_b$
Much	20 (0.8%)	17 (0.8%)$_a$	3 (0.8%)$_a$
Very much	11 (0.4%)	4 (0.2%)$_a$	7 (1.8%)$_b$
O6. Do you often think of committing suicide if you have the chance? ($M = 1.07$, $SD = 0.32$)		$\chi^2 = 43.17$, $p < 0.0001$	
Not at all	2,479 (95.1%)	2,123 (96.1%)$_a$	356 (89.4%)$_b$
A little bit	96 (3.7%)	68 (3.1%)$_a$	28 (7.0%)$_b$
Much	23 (0.9%)	16 (0.7%)$_a$	7 (1.8%)$_b$
Very much	10 (0.4%)	3 (0.1%)$_a$	7 (1.8%)$_b$
O11. How much has your tendency to thing about death and/or suicide changed, compared to before outbreak of COVID-19? ($M = 3.07$, $SD = 0.59$)		$\chi^2 = 80.51$, $p < 0.0001$	
Very much increased	32 (1.2%)	20 (0.9%)$_a$	12 (3.0%)$_b$
Increased a bit	119 (4.6%)	70 (3.2%)$_a$	49 (12.3%)$_b$
Neither increased, nor decreased	2,260 (86.7%)	1,956 (88.5%)$_a$	304 (76.4%)$_b$
Decreased a bit	40 (1.5%)	32 (1.4%)$_a$	8 (2.0%)$_a$
Very much decreased	157 (6.0%)	132 (6.0%)$_a$	25 (6.3%)$_a$
O12. Have you ever hurt yourself in any way deliberately, during your whole life so far? ($M = 1.14$, $SD = 0.51$)		$\chi^2 = 13.81$, $p < 0.003$	
Never	2,375 (91.1%)	2,030 (91.9%)$_a$	345 (86.7%)$_b$
Once	129 (4.9%)	103 (4.7%)$_a$	26 (6.5%)$_a$
2–3 times	69 (2.6%)	53 (2.4%)$_a$	16 (4.0%)$_a$
Many times	35 (1.3%)	24 (1.1%)$_a$	11 (2.8%)$_b$
O13. Have you ever attempted suicide, during your whole life so far? ($M = 1.08$, $SD = 0.33$)		$\chi^2 = 28.74$, $p < 0.0001$	
Never	2,457 (94.2%)	2,103 (95.2%)$_a$	354 (88.9%)$_b$
Once	111 (4.3%)	79 (3.6%)$_a$	32 (8.0%)$_b$
2–3 times	33 (1.3%)	25 (1.1%)$_a$	8 (2.0%)$_a$
Many times	7 (0.3%)	3 (0.1%)$_a$	4 (1.0%)$_b$

Each subscript letter denotes a subset of Anxiety score (below/above cut-off point) categories whose column proportions do not differ significantly from each other at the 0.05 level.

the total sample, and 61 of them (92.42%) are participants of the anxiety group, which is of our interest and represent real cases. The logistic regression model was statistically significant [χ^2 (28) = 882.87, $p < 0.001$], explained 50.0% (R^2) of the variance in clinically-significant anxiety, and correctly classified 89.8% of cases. Of the 28 predictor variables for anxiety, the following 15 were statistically significant and are presented in **Table 8**: gender (female: OR = 2.44, 95 % CI 1.75–3.33, $p < 0.001$), having mental health problems in the past (OR = 1.45, 95 % CI 1.03–2.04, $p = 0.035$), fear of dying during the state of emergency (OR = 1.67, 95 % CI 1.33–2.10, $p < 0.001$), suicidality in the past (OR = 1.68, 95 % CI 1.08–2.59, $p = 0.020$), fear about one's health status due to COVID-19 (OR = 1.64, 95 % CI 1.36–1.97, $p < 0.001$), fear about a family member's health due to COVID-19 (OR = 1.36, 95 % CI 1.16–1.58, $p < 0.001$), fear of stigmatization if infected with COVID-19 (OR = 1.18, 95 % CI 1.03–1.35, $p = 0.016$), worried about information regarding COVID-19 from the Internet (OR = 1.24, 95 % CI: 1.08–1.43, $p = 0.003$), loneliness (OR = 1.90, 95 % CI: 1.54–2.34, $p < 0.001$), and negative problem orientation (OR = 1.26, 95 % CI 1.06–1.51, $p = 0.011$).

Protective factors found to be improvements in general health status (OR = 0.68, 95 % CI 0.58–0.81, $p < 0.001$), maintaining one's daily routine (OR = 0.74, 95 % CI 0.61–0.90, $p = 0.003$), having a stable economic situation (OR = 0.66, 95 % CI 0.55–0.79, $p < 0.001$), and having good psychological resilience (OR = 0.90, 95 % CI 0.87–0.94, $p < 0.001$).

TABLE 4 | The association of anxiety and fears, thoughts about COVID-19, and religious/spiritual inquiries in the general population of Latvia during the COVID-19 state of emergency ($n = 2,608$).

Characteristics	All respondents ($N = 2,608$)	Anxiety below cut-off point ($n = 2,210$)	Anxiety above cut-off point ($n = 398$)
C1. Are you afraid that you will contract the coronavirus? ($M = 2.19$, $SD = 0.96$)		$\chi^2 = 455.57$, $p < 0.0001$	
Never	649 (24.9%)	621 (28.1%)$_a$	28 (7.0%)$_b$
A little	1,102 (42.3%)	986 (44.6%)$_a$	116 (29.1%)$_b$
Moderately	624 (23.9%)	508 (23.0%)$_a$	116 (29.1%)$_b$
Much	176 (6.7%)	83 (3.8%)$_a$	93 (23.4%)$_b$
Very much	57 (2.2%)	12 (0.5%)$_a$	45 (11.3%)$_b$
C2. Do you believe that the precautions work effectively or that if you are about to contract the disease, you will contract it anyway? ($M = 1.18$, $SD = 0.39$)		$\chi^2 = 1.34$, $p = 0.248$	
Precautions work effectively	2,131 (81.7%)	1,814 (82.1%)$_a$	317 (79.6%)$_a$
Precautions cannot protect you	477 (18.3%)	396 (17.9%)$_a$	81 (20.4%)$_a$
C3. Does the possibility that a member of your family could contract the coronavirus and die because of it makes you frightened? ($M = 2.52$, $SD = 1.15$)		$\chi^2 = 312.00$, $p < 0.0001$	
Never	512 (19.6%)	494 (22.4%)$_a$	18 (4.5%) $_b$
A little	930 (35.7%)	836 (37.8%)$_a$	94 (23.6%)$_b$
Moderately	626 (24.0%)	541 (24.5%)$_a$	85 (21.4%)$_a$
Much	371 (14.2%)	256 (11.6%)$_a$	115 (28.9%)$_b$
Very much	169 (6.5%)	83 (3.8%)$_a$	86 (21.6%)$_b$
C4. Are you afraid that in case you contract the coronavirus, some people will step away from your life and behave to you in a different way later? ($M = 1.70$, $SD = 1.00$)		$\chi^2 = 224.54$, $p < 0.0001$	
Never	1,544 (59.2%)	1,402 (63.4%)$_a$	142 (35.7%)$_b$
A little	550 (21.1%)	457 (20.7%)$_a$	93 (23.4%)$_a$
Moderately	333 (12.8%)	259 (11.7%)$_a$	74 (18.6%)$_b$
Much	127 (4.9%)	70 (3.2%)$_a$	57 (14.3%)$_b$
Very much	54 (2.1%)	22 (1.0%)$_a$	32 (8.0%)$_b$
P1. Over the last 2–3 weeks, my religious/ spiritual inquiries have been increased ($M = 1.27$, $SD = 0.56$)		$\chi^2 = 44.36$, $p < 0.0001$	
Not at all	2,023 (77.6%)	1,761 (79.7%)$_a$	262 (65.8%)$_b$
A little bit	475 (18.2%)	373 (16.9%)$_a$	102 (25.6%)$_b$
Much	89 (3.4%)	60 (2.7%)a	29 (7.3%)$_b$
Very much	21 (0.8%)	16 (0.7%)a	5 (1.3%)$_a$

Each subscript letter denotes a subset of Anxiety score (below/above cut-off point) categories whose column proportions do not differ significantly from each other at the 0.05 level.

DISCUSSION

This study investigates the association between anxiety and sociodemographic and health-related characteristics (e.g., such as suicidality, fear of COVID-19, relationship quality, daily routine, and Internet use) as well as psychological determinants to predict the factors for anxiety, using a representative sample of general Latvian population during the COVID-19 state of emergency. The study sample included 2,608 participants. It is noteworthy, that the prevalence of anxiety in the general Latvian population has not yet been estimated, although there is currently an ongoing population study on the prevalence of mental disorders and suicidality in Latvia (29). The current study found that the prevalence of anxiety was estimated at 15.2%, which is in line with the average prevalence of anxiety disorders in Europe (48). Many studies have suggested that COVID-19 has triggered higher levels of anxiety and distress (8, 9, 18) than the estimated anxiety prevalence rate found in our study. However, it is important to mention that different methodologies and tools have been used across these studies, and high level of anxiety might also depend on the temporal situation and specific events (49, 50). Another important aspect is that individuals who have been isolated and quarantined due to COVID-19 have experienced significant levels of anxiety, anger, confusion, and fear (51). Moreover, at the time of our study, restrictions related to the pandemic in Latvia were much milder than in other Baltic and European countries.

The data analysis revealed that anxiety was 2.44 times more prevalent in females than males. This finding is in accordance with most of the data received from different countries, and indicates that females are at a higher risk of anxiety disorders (7, 52). Although anxiety was more prevalent in the youngest age group, age was not significant in the logistic regression model.

Unsurprisingly, the data indicate that people with pre-existing mental health disorders show higher levels of COVID-19-related anxiety than those with no history of mental health disorders (17, 18). Our study confirmed this finding, as those who had mental health issues in the past were 1.45 times more likely to have anxiety. While some studies have also indicated that individuals

TABLE 5 | The association of anxiety and Internet use characteristics in the general population of Latvia during the COVID-19 state of emergency ($n = 2,608$).

Characteristics	All respondents ($N = 2,608$)	Anxiety below cut-off point ($n = 2,210$)	Anxiety above cut-off point ($n = 398$)
K1. The information and use of the internet worry me about the issue regarding the COVID-19 ($M = 1.94$, $SD = 0.99$)		$\chi^2 = 130.98$, $p < 0.0001$	
Not at all	1,059 (44.4%)	1,063 (48.1%)$_a$	96 (24.1%)$_b$
A little	640 (24.5%)	537 (24.3%)$_a$	103 (25.9%)$_a$
Moderately	657 (25.2%)	518 (23.4%)$_a$	139 (34.9%)$_b$
Much	122 (4.7%)	75 (3.4%)$_a$	47 (11.8%)$_b$
Very much	30 (1.2%)	17 (0.6%)$_a$	13 (3.3%)$_a$
K2. Generally, most of the internet sources regarding information about COVID-19 are misinforming/ misleading ($M = 2.68$, $SD = 1.09$)		$\chi^2 = 5.22$, $p = 0.266$	
Not at all	378 (14.5%)	320 (14.5%)$_a$	58 (14.6%)$_a$
A little	822 (31.5%)	703 (31.8%)$_a$	119 (29.9%)$_a$
Moderately	828 (31.7%)	705 (31.9%)$_a$	123 (30.9%)$_a$
Much	425 (16.3%)	346 (15.7%)$_a$	79 (19.8%)$_b$
Very much	155 (5.9%)	136 (6.2%)$_a$	19 (4.8%)$_a$
K3. Due to the conditions, the internet takes up more of my time than usual ($M = 2.21$, $SD = 1.26$)		$\chi^2 = 142.72$, $p < 0.0001$	
Not at all	1,084 (41.6%)	992 (44.9%)$_a$	92 (23.1%)$_b$
A little	536 (20.6%)	466 (21.1%)$_a$	70 (17.6%)$_a$
Moderately	468 (17.9%)	384 (17.4%)$_a$	84 (21.1%)$_a$
Much	391 (15.0%)	293 (13.3%)$_a$	98 (24.6%)$_b$
Very much	129 (4.9%)	75 (3.4%)$_a$	54 (13.6%)$_b$
K4. How much do you use the social media while in insolation at home? ($M = 1.80$, $SD = 0.51$)		$\chi^2 = 112.83$, $p < 0.0001$	
More than before	658 (25.2%)	473 (21.4%)$_a$	185 (46.5%)$_b$
The same as before	1,817 (69.7%)	1,621 (73.3%)$_a$	196 (49.2%)$_b$
Less than before	133 (5.1%)	116 (5.2%)$_a$	17 (4.3%)$_a$

Each subscript letter denotes a subset of Anxiety score (below/above cut-off point) categories whose column proportions do not differ significantly from each other at the 0.05 level.

with chronic medical conditions are more likely to have anxiety (53), our study found that the presence of a chronic somatic disorder was not a significant predictor. It is noteworthy that we found that the presence of chronic somatic disorders in the general Latvian population was not a risk factor for depression during the state of emergency from March to June 2020 (29). Moreover, in the study on the 12-month prevalence of major depression in Latvia was found that presence of three or more self-reported somatic conditions is related to increased odds of major depression, while presence of one or two somatic disorders is not (54). Moreover, in our study, self-rated better general health was related to decreased odds of having anxiety and served as a protective factor.

The previous literature has addressed that before the pandemic, acute stress was related to suicide ideation in older adults who had severe medical conditions. Moreover, the high risk of suicide during the pandemic has been associated with high levels of perceived stress, depression, and insomnia (24). Our study found that during the state of emergency, the fear of dying, thoughts of harming one's self, and suicide ideation were more prevalent in those who had anxiety. The logistic regression analysis revealed that fear of dying during the state of emergency and suicidality in the past increased the odds of having anxiety and, therefore, were significant predictors of anxiety, but self-harm behavior in the past was not a significant predictor. Fountoulakis et al. (17) developed a model to explain the effect of the pandemic on mental health that is based on the assumption that anxiety develops first and then progresses into depression and then suicidality.

Fears about the COVID-19 pandemic, one's health status, family members, and stigmatization were significantly more prevalent in those who had anxiety and served as predictors to anxiety. The data from previous studies have suggested that the COVID-19 pandemic has contributed to existential fears of infection and death (18). Moreover, the existing research has highlighted the important role of the complex relationship between fear, stress, and anxiety in the development of depression (55).

In our study, a decline in the overall quality of family relationships and increased family conflicts were more prevalent in the participants who had higher anxiety scores. Anxiety was also more prevalent among those who had difficulty in maintaining a basic daily routine. Maintaining a healthy lifestyle to help foster self-efficacy can, therefore, be presented as a protective factor for anxiety (56). The logistic regression model revealed two important factors that played a protective role

TABLE 6 | The association of anxiety and quality of relationships, daily routine and financial difficulties during COVID-19 epidemic ($n = 2,608$).

Characteristics	All respondents ($N = 2,608$)	Anxiety below cut-off point ($n = 2,210$)	Anxiety above cut-off point ($n = 398$)
E3. Are there any conflicts with the rest of your family members during this period? ($M = 2.71$, $SD = 0.77$)		$\chi^2 = 109.36$, $p < 0.0001$	
Much less	299 (11.5%)	252 (11.4%)$_a$	47 (11.8%)$_a$
Less	351 (13.5%)	304 (13.8%)$_a$	47 (11.8%)$_a$
Same	1,796 (68.9%)	1,562 (70.7%)$_a$	234 (58.8%)$_b$
More	143 (5.5%)	84 (3.8%)$_a$	59 (14.8%)$_b$
Much more	19 (0.7%)	8 (0.4%)$_a$	11 (2.8%)$_b$
E4. Has the overall quality of relationships with the other members of your family changed compared to the one before the quarantine, due to COVID-19? ($M = 3.07$, $SD = 0.48$)		$\chi^2 = 110.63$, $p < 0.0001$	
Much worse	11 (0.4%)	7 (0.3%)$_a$	4 (1.0%)$_a$
Worse	133 (5.1%)	72 (3.3%)$_a$	61 (15.3%)$_b$
It has not changed	2,165 (83.0%)	1,885 (85.3%)$_a$	280 (70.4%)$_b$
A little bit better	257 (9.9%)	211 (9.5%)$_a$	46 (11.6%)$_a$
Much better	42 (1.6%)	35 (1.6%)$_a$	7 (1.8%)$_a$
E5. Do you manage to maintain a basic daily routine (waking up in the morning, regular meals and sleeping hours, activities) both yourself (if you live alone) or as a family? ($M = 2.76$, $SD = 0.72$)		$\chi^2 = 153.31$, $p < 0.0001$	
Not at all	203 (7.8%)	136 (6.2%)$_a$	67 (16.8%)$_b$
Somehow, but not always	453 (17.4%)	322 (14.6%)$_a$	131 (32.9%)$_b$
Generally, yes	1,708 (65.5%)	1,537 (69.5%)$_a$	171 (43.0%)$_b$
Clearly follow (or adhere to) a routine	244 (9.4%)	215 (9.7%)$_a$	29 (7.3%)$_a$
E7. How are your finances as a result of the outbreak? ($M = 2.67$, $SD = 0.76$)		$\chi^2 = 99.44$, $p < 0.0001$	
Much more difficult than before	229 (8.8%)	149 (6.7%)$_a$	80 (20.1%)$_b$
Somehow more difficult	610 (23.4%)	491 (22.2%)$_a$	119 (29.9%)$_b$
Same as always	1,584 (60.7%)	1,404 (63.5%)$_a$	180 (45.2%)$_b$
Somehow easier	163 (6.3%)	147 (6.7%)$_a$	16 (4.0%)$_b$
Much easier than before	22 (0.8%)	19 (0.9%)$_a$	3 (0.8%)$_a$
Loneliness ($M = 1.40$, $SD = 0.68$)		$\chi^2 = 358.18$, $p < 0.0001$	
Not at all	1,804 (69.2%)	1,661 (75.2%)$_a$	143 (35.9%)$_b$
Somewhat	614 (23.5%)	459 (20.8%)$_a$	155 (38.9%)$_b$
Moderately so	139 (5.3%)	78 (3.5%)$_a$	61 (15.3%)$_b$
Very much so	51 (2.0%)	12 (0.5%)$_a$	39 (9.8%)$_b$

Each subscript letter denotes a subset of Anxiety score (below/above cut-off point) categories whose column proportions do not differ significantly from each other at the 0.05 level.

TABLE 7 | Descriptive statistics of psychological characteristics and *t*-test results in the general population of Latvia during the COVID-19 state of emergency ($n = 2,608$).

Variable	All respondents ($N = 2,608$)		Anxiety below cut-off point ($n = 2,210$)		Anxiety above cut-off point ($n = 398$)		*t*	*Cohen's d*
	M	*SD*	*M*	*SD*	*M*	*SD*		
Psychological Resilience	25.56	4.91	26.18	4.55	22.11	5.40	14.19***	0.81
Successful emotion regulation	2.48	0.73	2.50	0.74	2.38	0.67	3.23**	0.17
Negative problem orientation	1.30	0.86	1.20	0.81	1.85	0.91	−13.29***	0.75
Positive problem orientation	2.19	2.18	2.21	0.86	2.07	0.81	2.93**	0.17

***$p < 0.01$. ***$p < 0.001$. The results of t-test (assuming unequal variances) comparing the parameter estimates between the two groups (no-clinically significant anxiety, Anxiety below cut-off point; and clinically significant anxiety, Anxiety above cut-off point).*

against anxiety: maintaining a daily routine and having financial stability. These findings are in line with the existing research (57).

The previous studies have indicated a rise in problematic Internet use and overuse by the general population during the pandemic (58). Disordered Internet use generates marked distress, worry, and significant impairment in personal, family, social, educational, and occupational functioning (59). Moreover, Internet browsing about COVID-19, distress related to this

TABLE 8 | Logistic regression predicting likelihood of anxiety based on sociodemographic, health-related, relationship quality, daily routine, internet use and psychological characteristics in the general population of Latvia during the COVID-19 state of emergency.

	B	S.E.	Wald	*df*	*p*	Odds Ratio	95% CI for Odds Ratio	
							Lower	Upper
Age	−0.01	0.01	1.75	1	0.185	0.99	0.98	1.00
Gender (female *vs.* male)	0.89	0.17	27.73	1	0.000	2.44	1.75	3.33
B1. General health status	−0.38	0.08	20.27	1	0.000	0.68	0.58	0.81
B2. Chronic medical somatic condition (yes *vs.* no)	0.01	0.17	0.001	1	0.977	1.01	0.72	1.40
B4. Caretaker of person from vulnerable group (yes *vs.* no)	0.25	0.15	2.93	1	0.087	1.29	0.96	1.72
B5. Mental health problems in the past (yes *vs.* no)	0.37	0.18	4.46	1	0.035	1.45	1.03	2.04
O1. Fear to die during the emergency state	0.51	0.12	19.74	1	0.000	1.67	1.33	2.10
O5. Thoughts of harming oneself during the emergency state	−0.55	0.28	3.98	1	0.050	0.58	0.34	0.99
O6. Thoughts about death/suicide during the emergency state	0.16	0.29	0.31	1	0.576	1.18	0.67	2.08
O11. Changes in the frequency of thoughts about death/suicide during the emergency state	0.08	0.12	0.41	1	0.524	0.93	0.74	1.17
O12. Self-harm in the past	−0.30	0.16	3.62	1	0.057	0.74	0.547	1.01
O13. Suicide attempt in the past	0.52	0.22	5.39	1	0.020	1.68	1.08	2.59
C1. Fear about one's health due to coronavirus	0.49	0.10	27.05	1	0.000	1.64	1.36	1.97
C3. Fear about family member's health due to coronavirus	0.30	0.08	15.22	1	0.000	1.36	1.16	1.58
C4. Fear about stigmatization after illness (coronavirus)	0.16	0.07	5.79	1	0.016	1.18	1.03	1,35
P1. Religious / spiritual inquiries	−0.08	0.12	0.49	1	0.485	0.92	0.729	1.16
E3. Conflicts with family members	0.16	0.10	2.73	1	0.099	1.18	0.97	1.42
E4. Changes in the quality of relationships with family members	−0.19	0.14	1.66	1	0.197	0.83	0.63	1.10
E5. Managing to maintain a basic daily routine	−0.30	0.10	9.10	1	0.003	0.74	0.61	0.90
E7. Financial strain	−0.42	0.09	21.06	1	0.000	0.66	0.553	0.79
K1. The information and use of the internet worry me about the issue regarding the COVID-19	0.22	0.07	8.83	1	0.003	1.24	1.08	1.43
K3. Increase in internet usage time	0.05	0.07	0.51	1	0.477	1.05	0.92	1.19
K4. Changes in the use of social media	0.21	0.15	1.98	1	0.160	0.81	0.60	1.09
Loneliness	0.64	0.11	36.59	1	0.000	1.90	1.54	2.34
Emotion Regulation	0.23	0.14	2.87	1	0.090	1.26	0.96	1.64
Psychological Resilience	−0.10	0.02	28.03	1	0.000	0.903	0.87	0.94
Negative Problem Orientation	0.23	0.09	6.52	1	0.011	1.26	1.06	1.51
Positive Problem Orientation	0.14	0.11	1.78	1	0.182	1.15	0.94	1.42
Constant	−2.60	1.12	5.42	1	0.020	0.07		

Gender is for, females compared to males; B2. Chronic medical somatic condition is for "yes" response compared to "no"; B4. Caretaker of person from vulnerable group is for "yes" response compared to "no"; B5. Mental health problems in the past are for "yes" response compared to "no". Odds Ratio = Exp(B).

information, excessive time spent on the Internet, and increased use of social media have been associated with increased anxiety in the general population during the pandemic (60). Although we found that excessive time spent online and more frequent social media use during the state of emergency was more prevalent among those who had anxiety, the logistic regression analysis revealed that these factors were not significant predictors of anxiety. In our study, excessive worrying about COVID-19 was a significant risk factor for having anxiety (OR = 1.24), yet a change in social media use was not a risk factor, which is in line with a study on interactions between anxiety levels and life habits changes in the general population of Russia (3). We also found that an increase in Internet usage was not a significant predictor.

Loneliness has been identified as a major adverse consequence of the COVID-19 pandemic. The previous studies have reported that when people are isolated or lonely, they become significantly more vulnerable to anxiety (61, 62). In our study, those who had experienced loneliness were 1.90 times more likely to risk having anxiety. This result indicates that anxiety can be predicted when people have low psychological resilience. Our results support the recent studies during the COVID-19 pandemic that show that having a lower psychological resilience score indicates a higher level of anxiety (13). Our data also show that anxiety can be predicted by having a negative orientation in problem-solving during the pandemic.

A major strength of our study is that it includes a large representative sample of the general Latvian population, which allows for both estimations and determinants of anxiety at the national level. Our results also highlight the importance of supporting those who are at risk to alleviate suffering in the

instance of future possible lockdowns, and emphasize that groups that already had poor mental health before the pandemic are at risk both during and after the pandemic. These findings show the importance of providing the community with the necessary psychological support to reduce anxiety. In addition to focusing on the negative effects, it is very important to develop prevention and intervention measures that aim at thriving, so as to reduce harm and achieve positive results (18).

This study has several practical implications. Our findings can help develop future strategies for managing psychological support for segments of the population who are at risk. Our results indicate that the following measures could be implemented: (1) improve the recognition of anxiety and other mental disorders at the primary-care level and provide general practitioners with advice and consultations from mental health specialists; (2) use a variety of communication channels (e.g., infographics, social media, school websites, etc.) to inform the target group about simple, realistic, effective, and evidence-based self-help strategies for mental health prevention, and promote and strengthen psychological resilience techniques; and (3) enable collaboration between psychiatrists, psychologists, and policymakers to develop effective interventions and implementation strategies to strengthen the psychological resilience of the Latvian population.

CONCLUSION

This study examines the association between various factors and anxiety, and identifies the predicting factors for anxiety using a representative sample of the general Latvian population during the COVID-19 pandemic. We identified the following predictors for anxiety: being female, having mental health problems in the past, suicidality, having fears about one's health status due to COVID-19, fear of stigmatization if infected with COVID-19, worrying about information on the Internet, loneliness, and having negative problem orientation. Protective factors were also identified (improvements in general health status, maintaining one's daily routine, having a stable economic situation, and having good psychological resilience). These findings confirm previous recommendations by other authors on the need for proactive intervention to protect the mental health of the population, but especially of vulnerable groups (17).

Limitations

The results of current paper must be considered in the context of some limitations. Our cross-sectional study did not allow us to make any causal interferences. Therefore, further longitudinal studies could provide more information on causal relationships. An important limitation is that invitations were sent to potential respondents *via* e-mail. For that reason certain groups of the Latvian populations probably were less likely to fill in the questionnaire. Another important limitation that may have influenced the results is the use of self-report measures and scales. For example, anxiety symptoms were measured using a self-reported questionnaire which may have brought bias to an overestimation or underestimation of the prevalence of observed pathology. Moreover, there is no clinical verification of anxiety disorders. Finally, recall bias may have influenced some measures, such as report of existing chronic somatic disorders. It should be noted that Latvian population speak Latvian or Russian and the preparation phase of the study was limited in time, therefore it was not possible to validate the measures used in the COMET-G study. Voluntary recruitment can also lead to so-called non-response bias, where non-respondents may have different characteristics than survey respondents. In the present study it was impossible to identify whether the non-participants were significantly different from the sample of the survey respondents, and this is one major limitation of our study. It is noteworthy to mention that as a part of the study was international, the use of a single protocol was critical. It is also important to state that the data were collected in July 2020, in the period, when number of COVID-19 cases in Latvia was low. Moreover, during the state of emergency from March to June 2020, the COVID-19 restrictions were noticeably milder than in other Baltic and European countries. Finally, use of highly related variables in logistic models may affect significance. It would be worthwhile to conduct a similar study in the future to investigate the long-term outcome and the long-term impact of the pandemics on mental-health of the Latvian population because of more strict COVID-19 restrictions, and significantly increased rates of the cases of infected people and the death rate. Finally, the lack of baseline data concerning anxiety and related factors before the pandemic did not allow us to make any comparisons.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of Research in Riga Stradins University. The first page of the online questionnaire included the declaration of voluntarily consent for participation. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JV contributed with development of the conception and design of the study and he is a national coordinator of COMET-G project, participated in the translation of the protocol to Latvian and Russian languages, and wrote the first draft of the manuscript. VP contributed with the development of the conception and design of the study, development of the questions for the questionnaire, was responsible for the translation of the developed questionnaire into Russian, was responsible for the statistical data analysis and the result part of the manuscript, interpreted the data, and participated in writing the manuscript. KM contributed with development of the conception and design of the study, development of the questions for the questionnaire, and participated in writing the manuscript. JK contributed with development of the conception and design of the study, was

responsible for the translation of the developed questionnaire into Russian, and participated in writing the manuscript. IK participated in writing the manuscript. DS coordinator of the COMET-G project. KF principal investigator of the COMET-G project and development of the study protocol. ER contributed with development of the conception and design of the study, is a national coordinator of the COMET-G project, and participated in writing the manuscript. All authors participated in interpreting the data and developing further stages and the final version of the paper.

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Concerns and Challenges Related to Sputnik V Vaccination Against the Novel COVID-19 Infection in the Russian Federation: The Role of Mental Health, and Personal and Social Issues as Targets for Future Psychosocial Interventions

Anna V. Vasileva[1,2], Tatiana A. Karavaeva[1,3,4,5], Dmitriy S. Radionov[1], Alexander V. Yakovlev[6,7], Igor N. Mitin[8], Emanuele Caroppo[9], Sergey I. Barshak[8] and Kirill S. Nazarov[8]*

[1] Federal State Budgetary Institution «V. M. Bekhterev National Research Medical Center for Psychiatry and Neurology» of the Russian Federation Ministry of Health, Saint-Petersburg, Russia, [2] I. I. Mechnikov North-Western Medical State University, Saint Petersburg, Russia, [3] Federal State Budgetary Institution of Higher Education «Saint-Petersburg State University», Saint-Petersburg, Russia, [4] Federal State Budgetary Institution of Higher Education «Saint-Petersburg State Pediatric Medical University» of the Ministry Healthcare of Russian Federation, Saint-Petersburg, Russia, [5] Federal State Budget Institution «National Medical Research Center of Oncology Named After N. N. Petrov» of the Russian Federation Ministry of Health, Saint-Petersburg, Russia, [6] Federal State Budgetary Military Educational Institution of Higher Education «Military Medical Academy Named After S. M. Kirov» of the Ministry of Defense of the Russian Federation, Saint Petersburg, Russia, [7] Saint-Petersburg State University of Aerospace Instrumentation, Saint Petersburg, Russia, [8] Federal State Budgetary Institution "Federal Research and Clinical Center of Sport Medicine and Rehabilitation of Federal Medical Biological Agency", Moscow, Russia, [9] Local Health Unit ASL Roma 2, Rome, Italy

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***Correspondence:**
Anna V. Vasileva
annavdoc@yahoo.com

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Background: Vaccine hesitancy causes serious difficulties in vaccination campaigns in many countries. The study of the population's attitude toward vaccination and detection of the predictive important individual psychological and social factors defining the vaccination necessity perception will allow elaborating promoting vaccination adherence measures.

Objectives: The aim of this research was to study COVID-19 threat appraisal, fear of COVID-19, trust in COVID-19 information sources, COVID-19 conspiracy beliefs, and the relationship of sociodemographic variables to COVID-19 preventive behavior.

Methods: We carried out a cohort cross-sectional study of the population's attitude toward vaccination against the novel COVID-19 coronavirus infection, using a specially designed questionnaire for an online survey. Totally, there were 4,977 respondents, ranging in age from 18 to 81 years. Statistical assessment was carried out using the SPSS-11 program.

Results: There were different attitudes toward vaccination. Among respondents, 34.2% considered vaccination to be useful, 31.1% doubted its effectiveness, and 9.9% considered vaccination unnecessary. The survey indicated that 7.4% of respondents were indifferent to the vaccine, while 12.2% deemed it to be dangerous. Nearly one-third

(32.3%) of respondents indicated that they did not plan to be vaccinated, while another third (34.0%) would postpone their decision until more comprehensive data on the results and effectiveness of vaccination were available. Only 11.6% of the respondents were vaccinated at the time of the study. Young people were less focused on vaccination compared to middle-aged and elderly people. Receiving information concerning COVID-19 vaccination from healthcare workers and scientific experts was associated with greater vaccination acceptance.

Conclusion: The study results showed that vaccination attitudes interacted with individuals' mental health and various sociodemographic factors. Insofar as reports of physicians and experts are essential for shaping attitudes to vaccination, the study results inform the selection of target groups in need of particular psychosocial interventions to overcome their vaccine hesitancy.

Keywords: attitudes toward vaccination, COVID-19, coronavirus infection, pandemic, psychosocial interventions targets

INTRODUCTION

The COVID-19 pandemic outbreak, which began in early 2020, has become the hitherto most critical event of the century, with a toll of millions of lives. Furthermore, the pandemic has had a serious impact on the mental health and wellbeing of populations around the world (1, 2). State-of-the-art technologies, including mathematical model-based analysis, big-data techniques, and algorithms based on artificial intelligence (AI) have been implemented to cope with this health, economic, and social emergency. In particular, the recent use of AI has significantly accelerated the development of vaccines and treatments. In some circles, this technology has been a source of fear, mistrust, and conspirological beliefs (3). The mathematical model-based analysis enables a better understanding of the factors promoting COVID-19 transmission, supporting a more reliable prediction of the pandemic development: even at its earlier phase, such methods showed that even a moderately effective vaccine would significantly reduce the rate of COVID-19 transmission. The model-based analysis predicted that even a vaccine, such as VES, with greater than 70% efficacy against infection could stop the spread of COVID-19. Conversely, the achievement of herd immunity in the worldwide population would likely have resulted in up to 30 million deaths, while exhausting healthcare resources worldwide (4).

Given the present circumstances of restrictions and risks, rational actors would reasonably be expected to be vaccinated based on their informed appraisal of risk and benefit (5). Nevertheless, we have observed massive disapproval and hostility to vaccination and restriction measures aimed to stop the spread of COVID-19 transmission, culminating in protests in many countries against obligatory vaccination. One of the main expressed concerns is about the safety and possible side effects of the new speedily developed COVID-19 vaccines. Psychological defense mechanisms along with partial reality distortion make mental health issues a serious obstacle in the campaign against the pandemic (6, 7). The spread of COVID-19 infection is accompanied by a massive infodemic, with misinformation spreading much faster than the virus itself and having a great effect on public acceptance of vaccination another other public health measures (8–10).

In particular, the involvement of the new technologies aimed to stop the pandemic is dramatically augmenting public mistrust, conspirological theories, and vaccine hesitancy as detected by digital media portals (9, 11–14). Vaccine hesitancy is a matter of great concern to the World Health Organization (WHO). Even in 2015, the WHO, 2015 Strategic Advisory Group of Experts on Immunization identified vaccine hesitancy as a delay in acceptance or refusal of vaccination, despite the availability of vaccination services. Vaccine hesitancy can differ in intensity and involves various conspirological beliefs, such as the contention that it serves as a tool of mass chipping and pervasive social control. The spread of misinformation only increases vaccine hesitancy, and WHO announced this in 2019 (thus, prior to the pandemic) to be one of ten main global health threats and a massive obstacle to achieving population immunity against disease (15, 16). In the Russian Federation, the Moscow-based Gamaleya Research Institute of Epidemiology and Microbiology applied its experience in platform research for Ebola and Middle East respiratory syndrome vaccines toward the development of Gam-COVID-Vac (Sputnik V), a heterologous rAd26 and rAd5 vector-based COVID-19 vaccine. This initially demonstrated a good safety profile and induced strong humoral and cellular immune responses in participants in phase 1/2 clinical trials. The interim analysis of the phase 3 trial of Gam-COVID-Vac showed 91.6% efficacy against COVID-19 and good tolerance (17, 18). Experience has shown that because of vaccine hesitancy and mythological thinking, vaccine availability does not ensure mass population vaccination.

The WHO recommends that each country study its climate of vaccine hesitancy and develop targeted strategies, including brief psychosocial interventions or campaigns, to increase vaccination acceptance (19). Our first study, conducted during the early months of Sputnik V vaccination, preceding the public

Abbreviations: COVID-19, coronavirus disease 2019; WHO, World Health Organization.

educational campaigns, showed that only 12.2% of respondents had been vaccinated and more than 60% had some degree of hesitancy. Recent studies have shown the importance of receiving information about COVID-19 vaccination from healthcare workers for vaccination acceptance as well as the perceived severity of COVID-19 (20). The other research emphasized the impact of COVID-19 threat appraisal on the COVID-19 preventive behavior adherence (5). As mentioned above, the COVID-19 experience is an important factor in the study of attitudes toward vaccination. Understanding the factors that determine vaccine hesitancy is essential for the planning of brief, targeted psychosocial interventions (21). Understanding the sources of unwillingness to be vaccinated is crucial for elaboration of appropriate measures to improve vaccination adherence.

Objectives

The objectives of this study are identification of the predictive significant individual psychological and social combination of variables, determination of vaccination attitude at the beginning of the vaccination campaign in the Russian Federation, and elaboration of the model that can predict vaccination attitude.

Hypothesis

Different vaccination attitudes are connected with specific respondents' characteristics such as sociodemographic factors, gender, social and educational status, personal COVID-19 experience, presence of anxiety and worries, wellbeing status, personal beliefs about vaccination usefulness or harm, and attitude to one's health. The identification of these variables' patterns allows the prediction of vaccination attitudes in different population groups for the further development of the targeted public health programs aimed to increase vaccination acceptance.

MATERIALS AND METHODS

A cohort cross-sectional study of the population's attitude toward vaccination against the COVID-19 coronavirus was carried out using a specially designed questionnaire for a mass online survey. The sample was collected through study promotion *via* the most popular social media (VK, WhatsApp, Viber, Facebook, and Telegram). Considering the importance of opinions of healthcare professionals, we targeted our recruitment toward medical professional portals and mailing lists. In addition, to obtain a group of respondents with preexisting mental health conditions, we promoted the study through mailing list databases and *via* a partnership with the Russian Society of Psychiatrists and patient organizations. The total sample of 4,172 respondents included 42.2% with higher medical education and 20.5% with a previous history of mental disorders, attested by their presence on mailing lists. The study was attended by respondents from 64 of the 85 districts of the Russian Federation. Most cities with a population of 1 million or more were represented, namely, St. Petersburg, Moscow, Novosibirsk, Chelyabinsk, Kazan, Ufa, Rostov-on-Don, Voronezh, and Krasnodar (refer to **Table 1**). Approximately 40% of respondents lived in smaller settlements (less than 500,000 people) but were nonetheless able to participate given the broad Internet penetration. The survey was extended from 5 March to 5 June 2021.

The questionnaire allowed us to obtain sociodemographic, anamnesis, clinical data, and psychological characteristics of respondents while assuring anonymity. The complete questionnaire was divided into the following sections:

Section 1 included sociodemographic parameters such as age, sex, education, social status, the population of the place of residence, type of activity, family, and a financial statement.

Section 2 included attitude toward vaccination against the novel coronavirus infection, the incidence of previous novel coronavirus infection among respondents and their immediate family/social circle, the general attitude toward vaccination and specifical vaccination against the novel coronavirus infection, if the respondent was vaccinated, and whether he/she plans to be vaccinated, willingness to recommend that relatives and friends be vaccinated (which greatly affects the broader formation of attitudes to vaccination), the presence of anxiety associated with the risk of getting sick and with the risk of possible complications from vaccination, and the presence of somatic and mental disorders that might affect the attitude to vaccination.

Section 3 was comprised as follows:

1. A questionnaire containing beliefs about vaccines and vaccination. The Vaccination Attitudes Examination (VAX) Scale, the double translation of the questionnaire, has been made before its implementation in the study (22).
2. The General Health Questionnaire, GHQ12, evaluating an individual's psychological wellbeing and distress D. P. Goldberg (1972). The adaptation of the Russian version was made by Burlachuk L. F. in 2005 (23, 24).
3. Health Attitude Questionnaire (R. A. Berezovskaya, 2005).

Participation in the study was anonymous and voluntary. The Independent Ethical Committee at the V. M. Bekhterev National Medical Research Center approved the study for Psychiatry and Neurology (EK-I-31/21 from 25 February 2021). Before filling out the questionnaire, the respondent had the opportunity to get acquainted with the goals and conditions of the study and to give informed consent to participate by marking in the appropriate paragraph. After filling out the questionnaire, the respondent could send the completed data, or withdraw from the survey without the inclusion of their responses in the survey. Only surveys with 100% completion were analyzed. Analysis and assessment of the survey's results were carried out within 2 months after the launch of Russia's mass vaccination campaign.

TABLE 1 | Sociodemographic characteristics of the study group.

Settlement	Sample (n)	Percentage (%)
In the countryside	324	7.8
In a city with a population of less than 100,000 people	478	11.5
In a city with a population of 100,000 – 500,000 people	931	22.3
In a city with a population of 500,000 -1,000,000 people	844	20.2
In a city with a population of more than 1,000,000 people	1,595	38.2
Total sample	4,172	100

The inclusion criteria were as follows:

1. Over the age of 18
2. Informed consent to participate in the study
3. Ability to read Russian and fill out an online questionnaire

The ex/non-inclusion criteria were as follows:

1. Age less than 18 years
2. Inability to understand the text and content of the questionnaire

The exclusion criteria were as follows:

1. Participants declining at any stage to participate in the survey

Statistical assessment was carried out using the SPSS-11 program. Descriptive data analysis and two-dimensional (cross-tabulation) statistical analysis were used. Statistical confidence was judged according to the F-test (Fisher's criterion; φ). The procedure for data collection excluded the possibility of duplication. The significance level was defined as l φ = 0.05. Results from 4,977 people aged 18–81 years were included, with a mean (SD) age of 37.58 (13.56) years. Of the population, 1,393 (28.0%) were men and 3,584 (72.0%) were women. The study included all age groups of the adult population, according to the WHO classification: young aged (18–44 years)—3,445 (69.2%); middle-aged (45–59 years)—1,178 (23.7%); elderly aged (60–74 years)—343 (6.9%); and extremely old aged—11 (0.2%). The elderly and extremely elderly groups were combined to yield 354 respondents (7.1%). The educational attainment of respondents was 23 (0.5%) with secondary education, 987 (19.8%) with further education, 387 (7.8%) with incomplete higher education, 2,603 (52.3%) with higher education, and 977 (19.6%) with two higher educations or academic degrees.

Social Status of Respondents

Among the 4,977 respondents, 921 (18.5%) were students, 3,426 (68.8%) were working, 249 (5.0%) were business owners, and 153 (3.1%) were homemakers. There were 160 (3.2%) pensioners, 57 (1.1%) unemployed, and 11 (0.2%) living on benefits. Since the presence of technical knowledge is important for the formation of attitudes toward vaccination, medical education and medical specialty were separately considered. The total sample included 2,153 (X%) health workers, among which 908 people (42.2%) were physicians, 291 (13.5%) nurses, 59 (2.7%) paramedics, 28 (1.3%) medical attendants, 498 (23.1%) medical students, 122 (5.7%) administrative staff, and 247 (11.5%) other health workers. Among the respondents, 859 (20.5%) suffered from anxiety disorders, of which 411 (9.9%) had suffered from depression and 126 (3.0%) mainly had psychotic mental disorders.

RESULTS

COVID-19 Personal Experience

About half (n = 2,909; 58.4%) of the respondents did not suffer from a novel coronavirus infection since COVID-19 outbreak, asymptomatic infection (n = 390; 7.8%), mild illness (n = 910; 18.3%), moderate illness (n = 670; 13.5%), and severe illness (n = 98; 2.0%). Restrictive measures introduced for the older population and the very old proved to be effective; among these age groups, a significantly higher proportion of patients did not experience infection with the virus (67.8%), compared to rates in the young (58.7%) and middle-aged (54.8%) subgroups. Reliable differences are observed both between the young and the elderly ($p < 0.01$; φ = 2.798) and between the middle aged and the elderly ($p < 0.01$; φ = 3.572).

It was also assessed whether close contacts of individuals had suffered from a novel coronavirus infection as well as the severity and course of the disease. Respondents were allowed to answer the question in a multiple-choice format. One-third of respondents' relatives (n = 1,654; 33.2%) suffered asymptomatic infection; 3,584 (72.0%) experienced mild illness. Almost half of respondents' relatives (n = 2,123; 42.7%) suffered from severe illness (hospitalization was required) and a large number of relatives (n = 1,015; 20.4%) died as a result of coronavirus infection. Only 647 (13.0%) of relatives did not have this infection.

COVID-19 Vaccination Attitude

Among the population, there were different views and ideas about the benefits and need for vaccinations in general and vaccination against various infections. Responses were distributed approximately evenly across four types of vaccination attitudes. No significant differences by age group were found for this variable.

Among respondents, 1,309 (26.3%) people tried to avoid any vaccination, 1,370 (27.5%) were vaccinated sometimes, 855 (17.2%) were always observed, and 1,443 (29.0%) were vaccinated at the recommendation of specialists. The main objective was to assess the attitude of the population to vaccination against the novel coronavirus infection. A third of those respondents (n = 1,703; 34.2%) considered vaccination useful, while a third (n = 1,550; 31.1%) doubted its effectiveness, 9.9% (n = 492) of respondents considered vaccination unnecessary, and 12.2% (n = 609) considered it to be dangerous. Indifferent attitude toward vaccination was formed in 7.4% (n = 367) of respondents. Some other opinions were held by 5.1% (n = 256). There is a relationship between the attitude to vaccination and the age of the respondents (refer to **Table 2**). Old and very old respondents considered vaccination to be unnecessary, dangerous, or doubtful in its effectiveness less often than young or middle-aged respondents ($p < 0.01$).

There are also sex differences in vaccination attitude; more men than women consider vaccination to be useful ($p < 0.01$; φ = 6.461), and there are fewer respondents among men who doubt the effectiveness ($p < 0.01$; φ = 5.923). Among women, there is a greater percentage of those who consider vaccination to be dangerous ($p < 0.01$; φ = 3.389). Most of the respondents do not have fears related to possible vaccine shortages (n = 3,579; 85.8%). Such concern was noted by 500 people (12.0%), with 93 (2.2%) respondents having very significant concerns about vaccine shortages. When the questionnaire asked regarding specific actions of respondents

TABLE 2 | COVID-19 vaccination attitudes among different age groups.

The attitude of the population to vaccination against COVID-19	Age groups (WHO)			Total sample n (%)
	Age group I (ages from 18 to 44)	Age group II (ages from 46 to 54)	Age group III (ages from 60 to 89)	
Vaccination is unnecessary	411	71	10	492 (9.9%)
	11.9%	6.0%	2.8%	
	I and II. $p < 0.01$. $\varphi = 6.192$ I and III $p < 0.01$. $\varphi = 6.593$			
Vaccination is useful	957	542	204	1703(34.2%)
	27.8%	46.0%	7.6%	
	I and II. $p < 0.01$. $\varphi = 11.259$ I and III. $p < 0.01$. $\varphi = 10.965$ II and III. $p < 0.01$. $\varphi = 3.828$			
Vaccination is dangerous	474	116	19	609 (12.2%)
	13.8%	9.8%	5.4%	
	I and II. $p < 0.01$. $\varphi = 3.674$ I and III. $p < 0.01$. $\varphi = 5.232$II and III. $p < 0.01$. $\varphi = 2.772$			
Doubts about the effectiveness	1113	343	94	1550 (31.1%)
	32.3%	29.1%	26.6%	
	I and II. $p < 0.05$. $\varphi = 2.044$			
	I and III. $p < 0.05$. $\varphi = 2.224$			
Indifferent attitude	325	32	10	367 (7.4%)
	9.4%	2.7%	2.8%	
	I and II. $p < 0.01$. $\varphi = 8.681$ I and III. $p < 0.01$. $\varphi = 5.142$			
Others	165	74	17	256 (5.1%)
	4.8%	6.3%	4.8%	
Total sample n (%)	3445	1178	354	4977 (100%)
	100.0%	100.0%	100.0%	

in attitude to their own vaccination, 577 (11.6%) respondents noted they have already been vaccinated, 661 (13.3%) planned to vaccinate shortly, 1,693 (34.0%) are going to make decisions based on data on long-term outcomes and vaccination results, 1,610 (32.3%) indicated they do not plan to vaccinate, and 436 (8.8%) have medical contraindications (refer to **Figure 1**).

There are significant differences in the age group. Among young people, there are more respondents who do not plan to be vaccinated than among middle-aged people ($p < 0.01$; $\varphi = 11.288$) and the elderly ($p < 0.01$; $\varphi = 10.499$), less who plan to be vaccinated in the near future ($p < 0.01$; $\varphi = 4.978$; $\varphi = 5.679$), and less already vaccinated ($p < 0.01$; $\varphi = 7.526$; $\varphi = 4.264$). The proportion of respondents who would recommend vaccinations to friends and relatives and their relation to attitude to this preventive measure is important for assessing respondents' attitudes to vaccination against the novel coronavirus infection. Less than a third of respondents (1,340; 26.9%) noted that they would recommend a vaccine; 1,986 (39.9%) respondents are not ready to recommend it, and 293 (5.9%) intend to actively dissuade others, and 1,358 (27.3%) have not yet decided. Respondents who are ready to recommend vaccinations to friends and relatives consider it useful for the most part (88.1%). Respondents who replied that they will try to dissuade relatives or did not plan to recommend it consider it dangerous (54.3% and 19.4%, respectively), unnecessary (25.3% and 16.1%), or ineffective (16.0% and 43.2%) (refer to **Supplementary Table 1**).

The impact of sociopsychological factors on the attitude toward vaccination.

The attitude toward vaccination is manifested and largely formed depending on the results shown by vaccination in different countries, i.e., on data provided by the media, official state, and medical sources. It was noted assessing the respondents number who were interested in the course of vaccination, monitor the results and effectiveness of vaccinations, 723 (14.5%) people closely follow, they report that they monitor to some extent, a third of respondents ($n = 1,478$; 29.7%); 1,255 (25.2%) are somewhat less interested. A third of respondents ($n = 1,521$; 30.6%) do not monitor the results of vaccination. Those respondents who consider vaccination unnecessary (63.0%) and are indifferent (56.4%) are more interested in vaccination results. A significant number of respondents who consider the vaccine dangerous or doubt its effectiveness continue to be interested in the results (58.5% and 67.0%, respectively).

The likely cautious population's attitude toward vaccination may be due to fear of perceived complications. Only 946 (19.0%) people are not afraid of possible complications, 1,342 (27.0%) are slightly feared, 1,163 (23.4%) are moderately feared, 801 (16.1%) are greatly feared, and 725 (14.6%) are very much feared. In the group of respondents who are very afraid of complications from vaccination, the greater proportion of those generally consider it dangerous (40.6%) or doubt its effectiveness (30.3%) (refer to **Supplementary Table 2**). Notably, doctors are reliably less afraid of complications from vaccination than all other categories of medical workers and respondents who do not work in the medical field ($p < 0.01$).

Of the total sample, 1,485 (29.8%) people suffer from any chronic disease (e.g., hypertension, diabetes mellitus, bronchial

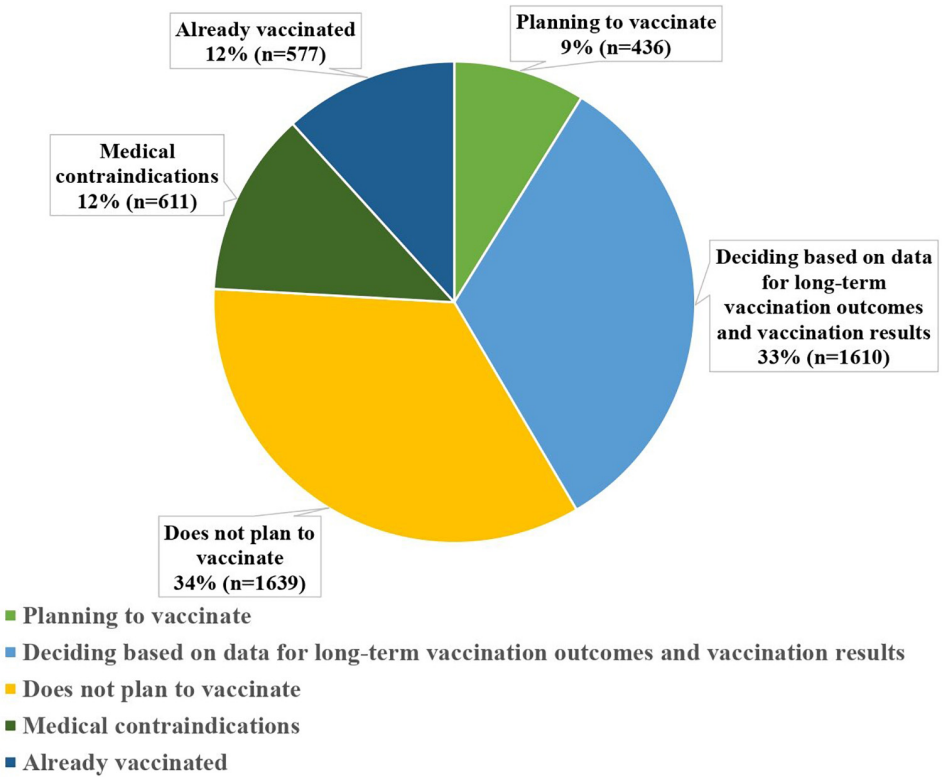

FIGURE 1 | Vaccination behavior types as presented in the study group.

asthma, obesity, or being overweight). Among them, some people are very afraid of complications ($p < 0.01$; $\varphi = 25.621$). In addition, significantly less than those who consider vaccination unnecessary-87 – 5.9%) ($p < 0.01$; F = 6.585) than necessary.

The study demonstrated that vaccination attitude is influenced by individuals' mental health. By filling out the questionnaire, respondents were able to indicate the presence of a known mental health disorder based on a previously given diagnosis. Individuals with anxiety ($p < 0{,}01$; $\varphi = 6.584$) and depressive disorders ($p < 0.01$; $\varphi = 4.671$) had significantly more concerns about possible vaccination complications than healthy respondents. In contrast, people with anxiety disorders more than others evaluated immunization as a useful measure against COVID-19 ($p < 0.01$; $\varphi = 6.352$); among the depressive patients, more respondents had doubts about vaccination efficacy than in the other groups ($p < 0.01$; $\varphi = 5.149$). Patients with other mostly psychotic mental disorders to some degree were more indifferent to vaccination ($p < 0.01$; $\varphi = 7.437$). In addition, there are significantly fewer people who consider vaccination unnecessary – 87 (5.9%) ($p < 0.01$; $\varphi = 6.585$). In all groups of people who fear for the health of relatives, the proportion of those who consider vaccination useful is significantly higher compared to those who do not have such fears ($p < 0.01$; $\varphi = 7.263$; $\varphi = 11.451$; $\varphi = 10.76$; $\varphi = 8.56$). There is a relationship between the vaccination attitudes and the fear of the severity of contracting coronavirus infection (refer to **Supplementary Table 3**).

Among those who are not afraid of contracting coronavirus, the percentage of those who consider vaccination unnecessary is **higher** compared to those who are afraid of getting sick ($p < 0.01$ compared to all groups). Almost half of those who fear getting sick moderately (45.0%; $p < 0.01$; $\varphi = 12.328$), strongly (52.6%; $p < 0.01$; $\varphi = 6.15$), and very strongly (47.7%; $p < 0.01$; $\varphi = 5.338$) are confident in the utility of vaccination, reliably more than those who are not afraid to get sick. These groups of respondents have less doubt about the effectiveness of the vaccine. A slightly more than a third of respondents ($n = 2{,}000$; 40.2%) noted that they do not experience anxiety at all due to the current situation with coronavirus, rarely experience anxiety ($n = 1{,}247$; 25.1%), sometimes ($n = 1{,}326$; 26.6%), often ($n = 302$; 6.1%), and very often ($n = 102$; 2.0%). Among those who often and very often experience anxiety due to the situation with coronavirus, a large number of those who consider the vaccine useful (44.7% and 52.9%; respectively) are significantly more than those who do not experience anxiety (25.4%) ($p < 0.01$; $\varphi = 6.625$; $\varphi = 5.645$). Individuals who very often experience anxiety are less doubtful of vaccine efficacy, at only 22.5%, which is lower than in other groups where anxiety was less common ($p < 0.05$; $\varphi = 2.476$). The fear of dying due to coronavirus is not experienced by 2,552 (51.3%) respondents, is experienced less by 1,871 (37.6%) respondents, is experienced strongly by 345 (6.9%) respondents, and is experienced very strongly by 209 (4.2%) respondents. The preferred information sources defining the vaccination

attitudes and behavior in the population were studied (refer to **Table 3**). The respondents were provided with a list of the main information sources with multiple-choice options. The majority of the respondents preferred reports from scientists, physicians, and other experts (81.2%). Opinions of family members and friends (22.9%), the media (20.9%), and social networks (16.3%) have a significantly lower influence. Statements and opinions of public figures have the lowest level of public confidence (10.6%), significantly lower compared to scientists and physicians ($p < 0.01$; $\varphi = 78.918$).

There is a relationship between the education of respondents and the proportion of people who noted the significant influence of a particular information sources. Among people with higher education, a significantly larger number noted the significant influence of scientists, doctors, and experts on their relationship to vaccination compared to those who had further education (85.0% and 64.7%, respectively, $p < 0.01$, $\varphi = 12.76$). Among those with further education, respondents noted the influence of the media (31.4%) and social networks (24.0%) are more than among those with higher education (18.4%: $p < 0.01$; $\varphi = 8.106$ and 14.2%: $p < 0.01$; $\varphi = 6.715$, respectively).

Vaccination Beliefs

A questionnaire on attitudes to vaccination was included as a separate block of the questionnaire, with 12 questions and four scales, namely, "Distrust of the benefits of the vaccine," "Distrust of unforeseen consequences in the future related to the vaccine," "Concerns about commercial speculation," and "Preference for natural immunity." Respondents noted their attitude to the statements in the questionnaire on a six-point scale ranging from 1 (absolutely disagree) to 6 (absolutely agree). The average value was calculated. Indicators ranging from 1 to 3 indicate disagreement with the statements, indicators ranging from 3 to 4 indicate neutrality, and indicators ranging from 4 to 6 indicate consent with the statements. Responses from respondents in different age groups were also studied. Those surveyed by all age groups believe the vaccine has not been sufficiently studied and can negatively affect health. Among respondents, there is no support for the idea of commercial speculation on vaccination that vaccines are more beneficial to pharmaceutical companies than the population, and the vaccination program itself is profane (2.96). Young people do not believe that vaccination gives them a sense of safety (2.95), unlike middle-aged and elderly people who agree that vaccines can stop serious infectious diseases (4.03 and 4.29).

TABLE 3 | Information sources influencing the formation of attitudes toward vaccination.

	Opinion about coronavirus infection and vaccination is determined by:	Sample (n)	Sample (%)
1	Reports by scientists, physicians and other experts	4,042	81.2
2	Opinion of famous people and public figures	527	10.6
	1 and 2 $p < 0.01$; $\varphi = 78.918$		
3	Media	1,041	20.9
4	Opinions of my family members and friends	1,140	22.9
5	Information in social networks	809	16.3

Discriminant Analysis Results

To build a model, the respondents' answer about their attitude toward vaccination (variable Q2_015) has been chosen as a group variable. According to the values of this variable, the observations were divided into 6 groups of respondents (refer to **Table 4**).

The analysis of the questionnaire results, based on the descriptive statistic methods and contingency tables revealed that the respondents' attitudes toward vaccination, can be influenced by a number of variables. These variables, conditionally combined into 6 semantic groups, are shown in **Supplementary Table 4**.

Notably, a number of variables presented in **Supplementary Table 4** were calculated based on the respondents' answers. These are the variables Q1_009a from the first group of variables and Q2_014a from the second group of variables. The variables included in the 4th to 6th groups of variables are the values of the scales of the previously mentioned questionnaires VAX, GHQ-12, and attitude to one's health questionnaire (R. A. Berezovskaya) and also were calculated based on the respondents' answers.

The task was to develop a mathematical-statistical model that could classify the respondent into one of the 6 groups presented in **Table 4** based on the values of the variables presented in **Table 4**.

To build the model, the initial data set of 4,977 observations was analyzed, and 83 observations containing incomplete data were excluded. The remaining 4,894 observations were divided into two parts, namely, the training sample ($N = 2447$) and control sample ($N = 2447$).

To develop the model, the observations from the training sample were used. To check the quality of the developed model, observations from the control sample were used.

Discriminant analysis was used to build this model. The first five canonical discriminant functions were used in the calculated model. Thus, the first discriminant function provides 88.7% of the prognosis and the second for 7.5%. The sum of the first two discriminant functions provides a 96.2% prognosis (refer to **Table 5**).

Supplementary Table 5 shows the unstandardized coefficients of the canonical discriminant functions for each of the variables used in the model. Group means of non-standardized canonical discriminant functions (group centroids) for the groups of respondents described in **Table 4** are presented in **Supplementary Table 6**.

TABLE 4 | Respondents' groups as divided by the factor of their attitudes toward vaccination.

Q2_015 = 1	Respondents who consider vaccination unnecessary (group 1)
Q2_015 = 2	Respondents who consider vaccination useful (group 2)
Q2_015 = 3	Respondents who consider vaccination dangerous (group 3)
Q2_015 = 4	Respondents who doubt vaccination effectiveness (group 4)
Q2_015 = 5	Respondents who are indifferent toward vaccination (group 5)
Q2_015 = 6	Respondents who have others attitude toward vaccination (group 6)

TABLE 5 | Classification model confusion matrix (% of true and false classification results in the control sample data).

Discriminant function	Eigen value	% of variance	Cumulative%	Canonical correlation
1	1,010a	88,7	88,7	,709
2	,086a	7,5	96,2	,281
3	,024a	2,1	98,3	,154
4	,014a	1,2	99,5	,117
5	,005a	,5	100,0	,072

Supplementary Table 5 allows you to calculate the values of discriminant functions 1–5 based on the variables presented in **Supplementary Table 4**. The obtained values of discriminant functions 1–5 are compared with group centroids (in **Supplementary Table 6**). Thus, the respondents are classified, i.e., assigning it to one of the six groups under consideration.

Figures 2, **3** present the groups and groups' centroid location on the discriminant functions axis. Consequently, group 1 (respondents consider vaccination to be unnecessary), group 5 (respondents who are indifferent toward COVID-19 vaccination), and group 2 (respondents who think vaccination to be useful) were located on the first discriminant function axis. At the same time, group 1 follows group 3 (respondents who consider vaccination to be dangerous) on the second discriminant function axis.

Thus, a set of discriminant functions was developed that allows the recognition (classification) of the respondent's attitude toward vaccination based on the analysis of his/her answers to a number of questions from the proposed questionnaire.

To evaluate the effectiveness of the developed model, the data in the control sample were classified using the developed discriminant functions. **Supplementary Table 7** presents the results of the quality assessment of the developed classification model. These results are presented in the form of a matrix containing the percentage of correct and incorrect classifications of control sample data. Computations showed that 45.7% of the primary groups were classified correctly.

It is worth mentioning that the model has a high percentage of correct classification (69.9%) for group 2 (respondents who thought vaccination to be useful), and a relatively high percentage of the correct classification (50.5%) for group 3 (those who consider vaccination dangerous). At the same time, the model hardly differentiates groups 1 and 3. However, if we classify this group as a vaccination non-compliant population, the percentage of correct allocation can be acceptable.

DISCUSSION

During the start-up phase of prevention programs against the novel coronavirus infection, participants were surveyed about their views on vaccination. A third of respondents consider vaccination useful, while the same portion doubts its effectiveness. About a quarter of respondents perceive it as unnecessary, dangerous, or indifferent. These perceptions influence behavior and decision-making regarding one's own vaccination. A third of the entire sample notes that they do not plan to vaccinate, another third doubts the decision and focuses on the more distant results of the vaccination program conducted in the country, 11.6% are already vaccinated, and 13.3% plan to vaccinate shortly. The percentage of Russian citizens who were unwilling to get a COVID-19 vaccine was similar to the results from a European survey published in 2020 of adults across seven European countries (19). Our results suggest more positive vaccination attitudes among older adults (65 years and older) and middle-aged adults compared to young people. The COVID-19 vaccine-related attitudes research in Canada has shown similar results of some degree of vaccine hesitancy in 60% of the respondents, with a significant association with younger age (18–39 years). In a similar United Kingdom study, the uncertain group made up nearly a quarter, with a large proportion of younger age respondents constituting the 14% who were unwilling to get vaccinated (6.21). The study results showed that men considered the vaccine useful more often and had a lower proportion of those with vaccine hesitancy compared to women. Women had negative attitudes toward COVID-19 vaccination in a large number of studies conducted worldwide, which can most likely be attributed to beliefs that the vaccine can have a negative impact on reproductive function (23–27). Lack of trust in the vaccine's benefits and efficacy as well as concerns about the novelty, safety, and unknown side effects comprise the key obstacles to vaccine willingness.

Overall, respondents' concerns are mostly related to fear of possible negative complications from the vaccine, which are currently unobvious or unknown (4.17). This echoes results obtained in numerous other studies; newness, safety, and potential side effects can be considered universal concerns, making an impact on achieving COVID-19 public immunity (14, 28, 29). The absence of COVID-19 contamination concerns, poor compliance with epidemiological guidelines, and low knowledge about COVID-19 and possible complications is associated with lower vaccination adherence. The same tendencies were found in a number of other studies (30, 31). The attitude toward vaccination determines the population's activity and intention to recommend vaccination to their loved ones and friends. Only less than a third of those interviewed are willing to do the latter. Most respondents will experience, to varying degrees, fear of getting a coronavirus infection, concern for the health of their relatives, and anxiety due to the current situation with coronavirus in general. The presence of these experiences contributes to a more positive attitude toward vaccination. Considering the higher mortality rate and the difficulties in compliance with protective behavior due to cognitive defects, there is an urgent need to develop personalized psychosocial interventions to improve vaccination adherence in mentally ill patients (32–34). Among the factors influencing vaccination attitudes, the reports of scientists, physicians, and experts in the field are of greater importance, which generally reflects the public's confidence in the information obtained from these sources. In general, among the population, the level of confidence in the vaccine can currently be estimated as average. Among young people, the idea of the benefits of the vaccine is viewed with more

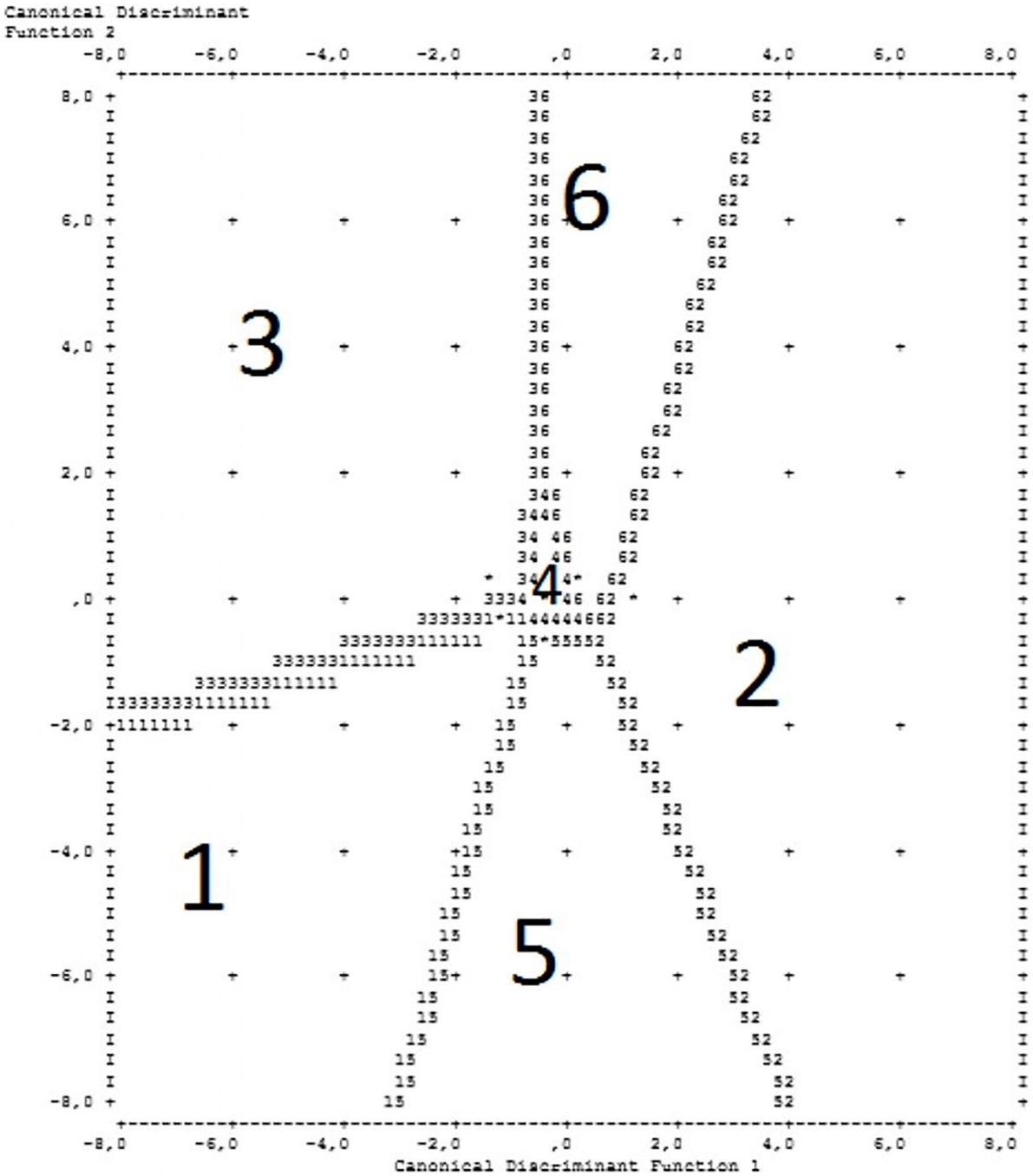

FIGURE 2 | Groups and groups' centroid location on the discriminant functions axis.

skepticism than among middle-aged and elderly people. Most of the concerns relate to possible negative unforeseen consequences of vaccination that may result in the future. The analysis showed an association of certain sociodemographic characteristics and individual experiences of the COVID-19 pandemic with attitudes toward vaccination.

The implementation of discriminant analysis in the large sample analysis allowed us to make a mathematical model. It can be used to predict an individual's attitude toward vaccination against the novel coronavirus infection based on the connected variables group. The use of predictive models can determine specific population groups and implement public health programs aimed to increase vaccination adherence at the early stages of vaccination campaigns. Considering the factors that separate the groups provides the opportunity to elaborate on targeted public health strategies and correct their content. As an

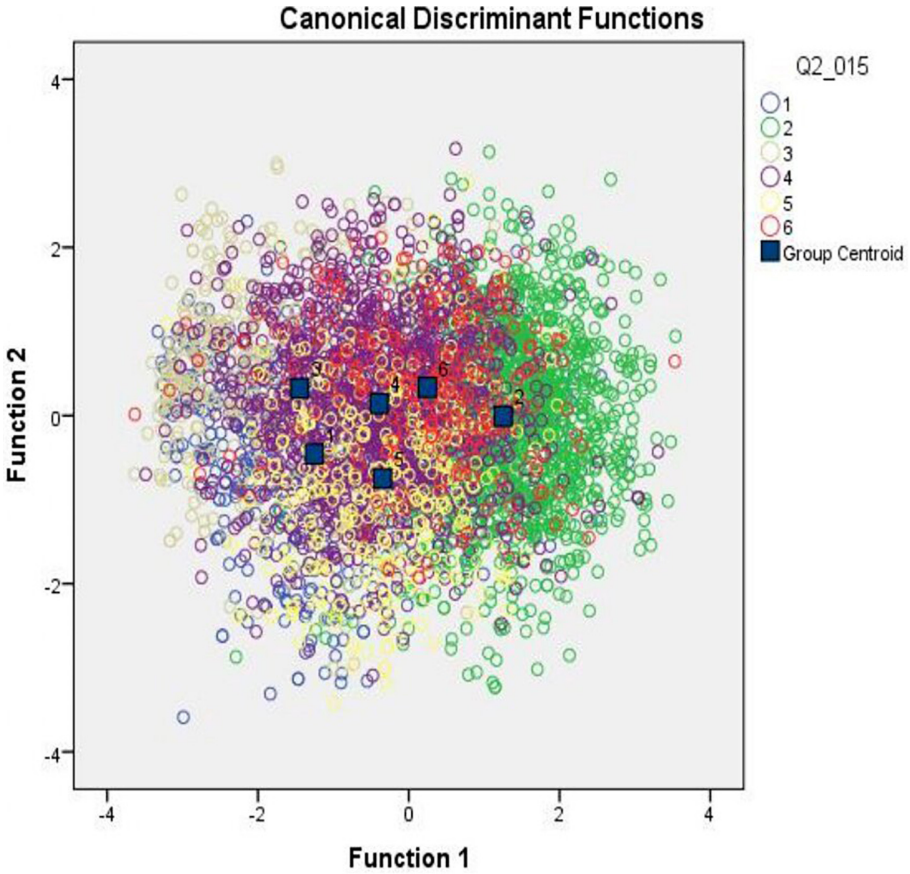

FIGURE 3 | Groups and groups' centroid location on the discriminant functions axis.

example, people having concerns about possible vaccination side effects should be provided with information about vaccination consequences, and people with indifferent vaccination attitudes should be addressed with motivation enhancing interventions.

CONCLUSION

The study results show the population's vaccination attitude in the first 2 months after its start. The data analysis revealed the impact of specific social demographic characteristics, personal COVID-19 pandemic experience, and mental health status on the vaccination attitude rate.

1) At the beginning of the vaccination campaign, 32.4% of the respondents considered it useful; 31.1% doubted its effectiveness; 9.9% considered vaccination unnecessary; 12.2% deemed it dangerous; and 7.4% are indifferent toward vaccination.

2) Higher vaccination adherence is associated with elderly and senile age, negative COVID-19 personal experience (respondents themselves or their close ones had severe COVID-19 cases, or died), somatic diseases, anxiety disorders, and healthcare worker professions.

3) Vaccine hesitancy is mainly determined by fear of possible adverse side effects and distrust of the benefits of vaccination.

4) The mathematical model can statistically accurately classify patients in one of the defined groups, using analysis of the following variables: gender and social characteristics, COVID-19-associated personal experience, presence of somatic diseases and mental health problems, COVID-19-associated anxiety, presence/absence of the specific general vaccination beliefs, psychological wellbeing and distress level, and attitude to one's health.

Given the importance of creating accurate perceptions among the population concerning the fight against the new coronavirus infection, psychosocial interventions aimed at increasing adherence to vaccination should address targets that are associated with a wary attitude of the population toward preventive measures. Considering the relatively large proportion of uncertain individuals in the sample, future research should investigate the factors defining the uncertainty about vaccination to build the most promising target for psychosocial interventions aimed to improve immunization. Concerns about vaccine safety and novelty, identified in the study as important factors in vaccine hesitancy, should be included as the main targets in the tailored public health vaccination campaign. Simple, clear explanations of how the new technologies can speed up vaccine creation and a balanced discussion of immunization risks and benefits should be emphasized. Given that healthcare professionals and scientists

are more trusted sources, these key opinion leaders should be more involved in the vaccination campaign. The additional refreshment professional training for healthcare workers focused on infectious diseases and immunology can significantly improve their own vaccine hesitancy and make them knowledgeable and encouraging in their dialog for vaccine uncertain and unwilling populations. For specific social groups that are associated with vaccine hesitancy, including younger people and women, the public health messaging should be tailored accordingly to provide transparent and clear-cut information about vaccination safety and address the female fears about possible infertility and vaccination teratogenic effects. For the young population, relevant celebrities should be involved in the vaccine campaign, and the negative social consequences of the prolonged pandemic should be emphasized to empower the youth that their decisions and behavior matter in the fight against the COVID-19 pandemic.

Taking into account the higher mortality rate and difficulties in compliance with protective behavior due to cognitive deficits, there is an urgent need to develop motivating psychosocial interventions to improve vaccination adherence in mentally ill patients (12). It could be recommended to organize the COVID-19 vaccination centers in the framework of mental health services to provide timely immunization to patients suffering from psychotic disorders. When researching vaccination attitudes, it is vital to involve population groups with more nuanced decision-making processes and vaccination unwillingness and uncertainty understanding in order to design psychosocial interventions accordingly.

Study Limitations

The major limitation of this cross-sectional study is that it represents one snapshot in time. The responses were collected at the beginning of the mass vaccination campaign and before any announcements about the success and safety of mass COVID-19 vaccination could be made.

The survey recruited participants from social media platforms and through mailing lists. There could be a component of selection bias as participants volunteered to participate in the research surveys through an electronic platform, which may lead to an increased selection of individuals with higher involvement in the COVID-19 pandemic, resulting in an underestimation of vaccine hesitancy. The availability of "Sputnik V" in all regions of the Russian Federation should inspire the government to encourage the population to get vaccinated, which can differ from other countries.

Our research also has some limitations regarding instruments. Since data collection took place over the Internet, the population study design does not permit the usage of psychometric instruments to evaluate anxiety symptoms' intensity and their interrelationship with attitudes toward vaccination. Further research in smaller groups that include patients with anxiety and other mental disorders should be designed with the use of appropriate psychometric scales to obtain more specific information about psychopathological disturbances. The "attitude to one's health" questionnaire used in this study is an original Russian instrument that cannot be compared to the results of similar international studies. It can be useful to include international instruments in further study designs.

Despite the diversity of the sample and the rich geographic representations and demographic measures, we cannot exclude that more extreme views on vaccines were not adequately captured or that certain specific subgroups, including rural areas, within the population, were not fully represented. We can infer that certain population groups were more likely to participate in the study than others, such as active Internet users.

Future research tracking changing attitudes toward vaccination will be important as the COVID-19 pandemic and its vaccination campaign continue.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The participants provided their written informed consent to participate in this study. The Independent Ethical Committee at the V. M. Bekhterev National Medical Research Center approves the study for Psychiatry and Neurology (EK-I-31/21 from 25.02.2021).

AUTHOR CONTRIBUTIONS

AV and TK designed the study and wrote the first draft of the manuscript. AV, TK, DR, IM, SB, KN, and EC performed the study. AY undertook the imaging data analysis. EC, AV, and DR revised the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.835323/full#supplementary-material

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Validity and Reliability of the Persian Version of COVID-19 Anxiety Syndrome Scale Among the Iranian General Population

Esmaeil Hoseinzadeh[1], *Abbas Ebadi*[2,3], *Hamid Sharif Nia*[4,5], *Erika Sivarajan Froelicher*[6,7] *and Pardis Rahmatpour*[8]*

[1] Department of Nursing, School of Nursing and Midwifery, Tehran Islamic Azad University of Medical Sciences, Tehran, Iran, [2] Behavioral Sciences Research Center, Life Style Institute, Baqiyatallah University of Medical Sciences, Tehran, Iran, [3] Nursing Faculty, Baqiyatallah University of Medical Sciences, Tehran, Iran, [4] Department of Nursing, School of Nursing and Midwifery, Mazandaran University of Medical Sciences, Sari, Iran, [5] Department of Nursing, School of Nursing and Midwifery Amol, Mazandaran University of Medical Sciences, Sari, Iran, [6] Department of Physiological Nursing, School of Nursing, University of California, San Francisco, San Francisco, CA, United States, [7] Department of Epidemiology & Biostatistics, School of Medicine, University of California, San Francisco, San Francisco, CA, United States, [8] Department of Nursing, Alborz University of Medical Sciences, Karaj, Iran

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Xenia Gonda, Semmelweis University, Hungary

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***Correspondence:**
Pardis Rahmatpour
par.rahmatpour@gmail.com

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The crisis of the COVID-19 prevalence in Iran, as well as the world, caused mental disorders and anxiety syndrome. The COVID-19 anxiety syndrome scale (C-19ASS) assesses conceptually and psychometrically the nature of the COVID-19 threat experience instead of a response to the threat, fear, and COVID-19 anxiety. Therefore, the aim of this study is to evaluate the psychometric properties of the Persian version of the anxiety syndrome scale of COVID-19 in the population of Iran. The Persian version of C-19ASS was sent to Iranian adults *via* online social networking applications and finally, 932 adults responded to the questionnaire. The results of exploratory factor analysis revealed two-factor structures for C-19ASS, which explained 48.70% of the total variance. Given the confirmatory factor analysis findings, all goodness of fit indices confirmed the model fit. All coefficients of internal consistency were estimated as acceptable reliability. The results showed that the C-19ASS has good psychometric properties, and can be used by researchers, psychologists, and healthcare providers to assess the anxiety syndrome of the Iranian population during the COVID-19 pandemic.

Keywords: COVID-19, anxiety syndrome, Iran, validity, reliability

INTRODUCTION

In Iran, from 3 January 2020 to 15 March 2022, there have been 7,126,906 confirmed cases of COVID-19 with 139,063 deaths, according to WHO (1). It is well known that stressful life events can cause psychological symptoms (2). The public physical health, anxieties, and human safety are affected by this infectious disease that has caused numerous psychological health problems and psychological symptoms (3, 4). The COVID-19 outbreak is exacerbating the anxiety that many people feel. Anxiety is defined as distress or fear caused by the prediction of an event or a real or understandable threatening situation (3, 5). Anxiety syndrome may appear in a combination of avoidance, worrying, and monitoring of threat, such a set of incompatible contrasting forms may have an essential role in the stability of psychological depression (6).

The COVID-19 pandemic has exerted high pressures on health systems of countries where the virus is most prevalent (7). It has destructive and variable effects on all aspects of human life (8). It led to lockdowns that lasted over multiple months affecting educational and non-essential business activities in many countries. These lockdowns were implemented for the rapid reduction of COVID-19 transmission (9). All affected countries have a complete or partial cessation of social activities and a wide range of interventions. Examples include social isolation, individual isolation, social distancing, and quarantine to prevent the gathering of large numbers of people, beyond the immediate members of the household.

Many people who have been quarantined may feel lonely, bored, inactive, and insecure about food and economic issues as well as feel fear and anxiety about the infection caused by the disease (10). National polls show a severe increase of fear and anxiety about the virus (11). For example, a study of 44,000 participants in Belgium, conducted at the beginning of April 2020, reported that 20% of people had anxiety and 16% of them had a depressive disorder (11). Based on the model provided in Iranian study anxiety syndrome and fear of COVID-19 with mediation effects of perceived stress explained 70% of the total variance of psychological behavioral responses (4). According to the clinical manifestations of this disease such as respiratory failure, sepsis, shock, and various organ failures, it is understandable that medical professionals and public health specialists focus on caring for the sick people. While it is recognized that corona virus spreads to the general population, there is less attention given to the mental health consequences of the COVID-19 crisis (12). About 54%of the Chinese general population (n = 1,210) reported moderate or severe psychological effects of the disease outbreak, 16.5% reported moderate or severe depressive symptoms, and 28.8% reported moderate or severe anxiety symptoms (13). In the systematic review study of Salari et al. (14) the prevalence of stress, anxiety, and depression among the general population during the COVID-19 pandemic were 29.6% (sample size of 9,074), 31.9% (sample size of 63,439), and 33.7% (sample size of 44,531), respectively. Previous research has shown that people who suffer from pandemic anxiety tend to also show an increase in stress, anxiety, and suicide (15).

There are different scales such as the scale of the fear of COVID-19 (16), Coronavirus anxiety scale (17), scale of threat of Coronavirus (18), and COVID stress scale (19). These scales are intended to identify people who have been affected by anxiety, fear, and uncertainty over this growing epidemic crisis. However, the COVID-19 anxiety syndrome scale (C-19ASS) assesses conceptually and psychometrically the nature of the COVID-19 threat experience instead of a response to threat, fear, and COVID-19 anxiety. This scale has been developed and psychometrically tested by Nikcevic and Spada in the U.K. This scale identifies features of anxiety syndrome related to COVID-19 and assessed its validity and reliability (6).

Considering the prevalence of COVID-19 anxiety syndrome in Iran, and the lack of an accurate scale to measure it among the Iranian population, the aim of this study is to evaluate the psychometric properties of the Persian version of the anxiety syndrome scale of COVID-19 in the population of Iran.

METHODS

This methodological study design was used to achieve the research objective. Data collection took place between October and November 2021.

Measurement

The measurements consist of two parts: demographic information, and the Persian version of C-19ASS. The original version of C-19ASS consists of nine items and two factors including perseveration (six items) and avoidance (three items). The C-19ASS is a short easily administered scale that can be used with both healthy and frail individuals exposed to any specific traumatic event. The response options for the C-19ASS are scored on a 5-point Likert-type scale from 0 (not at all) to 4 (Nearly every day) (6).

Translation

At first, the written permission was obtained from the authors of the scale, Professor Marcantonio M. Spada *via* email. Then, two English-Persian translators translated the C-19ASS independently. The research team, as well as two professional translators, evaluated the two translations and created a Persian translation of C-19ASS. In the next step, two Persian to English translators who had no knowledge of the English version of the C-19ASS were asked to back-translate the Persian version of the C-19ASS scale into English. Then the panel of experts compiled and compared the results of the back-translation with the original instrument to detect any differences and similarities between the original instrument and the back-translated version.

All items translate into Persian and back-translated into English without any required modifications and Dr. Marcantonio M. Spada (The main developer scale) confirmed The Backward Scale. It is noteworthy that all the steps of this process were performed based on the World Health Organization protocol of forward-backward translation technique (20).

Participants

The Persian version of C-19ASS was sent to Iranian adults *via* an online data gathering and 932 adults responded to the questionnaire. The online scale was created *via* Google Forms and its URL link was sent by email or social networking applications such as a Telegram channel or WhatsApp to a group of adults. To prevent duplicate data, the Google Form was restricted to get the data from each individual once. The inclusion criteria for participants were adults (age $>$ 18) who were willing to participate in this study. The sample size should be at least 200 cases for factor analysis (21). Of these, 466 subjects were used for the exploratory factor analysis (EFA) and a second group with 466 subjects serves as the confirmatory factor analysis (CFA).

Data Analysis

The construct validity of the Persian version of C-19ASS was evaluated by exploratory and confirmatory factor analysis. Maximum likelihood EFA with Promax rotation was conducted. The Kaiser–Meyer–Olkin test (KMO > 0.7: acceptable) and Bartlett's test of sphericity were calculated. The number of factors was determined based on parallel analysis, scree plot. Items with absolute loading values of 0.3 or greater and communalities more than 0.2 were considered appropriate (21). For assessment of the extracted factors, CFA was conducted using the maximum-likelihood method and the most common goodness of fit indices.

According to Fornell and Larcker's criteria (22), the Average Variance Extracted (AVE), Maximum Shared Squared Variance (MSV), and Composite Reliability (CR) were estimated to assess the convergent and discriminant validity. In addition, discriminant validity was evaluated by heterotrait-monotrait ratio of correlations (HTMT) approach. All values in the HTMT matrix table should be <0.85 (23). The reliability of the scale was evaluated using internal consistency and construct reliability (CR). The average inter-item correlation (AIC) was in the range of 0.2 to 0.4, Cronbach's alpha and McDonald's omega was >0.7 and are considered acceptable internal consistency (24). The CR was calculated using the structural equation model analysis as an alternative to Cronbach's alpha coefficient – it was acceptable if it was >0.7 (25). The relationship between demographic information and level of C-19ASS were evaluated by independent *t*-test, one-way ANOVA, and Pearson correlation coefficient.

TABLE 1 | Demographic characteristics of participants ($n = 932$).

Variables	EFA (466): *n* (%)	CFA (466): *n* (%)
Gender	388 (83.26)	404(87.12)
Female	380 (81.54)	414 (88.84)
Male	78 (16.73)	60 (12.87)
Marital status		
Single	164 (35.19)	134 (28.75)
Married	302 (64.80)	332 (71.24)
Education level		
Under diploma	3 (0.64)	10 (2.14)
Diploma	19 (4.07)	34 (7.29)
Upper Diploma	26 (5.57)	59 (12.66)
Bachelor	233 (50)	207 (44.42)
Master	155 (33.26)	125 (26.82)
PhD	30 (6.43)	31 (6.65)

Multivariate Normality and Outliers

Both univariate and multivariate normality of the data was evaluated in this study. The univariate distributions were tested for outliers, skewness, and kurtosis. The normality of the multivariate distribution was assessed using Mardia's coefficient of multivariate kurtosis, and the Mardia's coefficient. Mardia's coefficient > 7.98 can be considered as indicative of departure from multivariate normality. Moreover, the outliers of the multivariate distribution were detected using Mahalanobis distance ($P < 0.001$) (21).

The $SPSS_{26}$, SPSS-R $menu_2$, $AMOS_{26}$, and $JASP_{0.15.0.0}$ software were used to perform all of the statistical calculations.

Ethical Consideration

The Tehran Islamic Azad University of Medical Sciences Research Ethics Committee approved the protocol of this study (IR.IAU.TMU.REC.1400.315). While sending the online scale through social networking programs, the objectives of the study

TABLE 2 | Exploratory factors extracted of COVID-19 anxiety syndrome scale (C-19ASS; $n = 466$).

Factors	Q_n. Item	Factor loading	h^2	λ	%Variance
COVID-19 Anxiety	**7.** I have checked my family members and loved one for the signs of coronavirus (COVID-19).	0.932	0.772	2.748	30.535
	8. I have been paying close attention to others displaying possible symptoms of coronavirus (COVID-19).	0.817	0.640		
	2. I have checked myself for symptoms of coronavirus (COVID-19).	0.706	0.519		
	9. I have imagined what could happen to my family members if they contracted coronavirus (COVID-19).	0.650	0.461		
	6. I have read about news relating to coronavirus (COVID-19) at the cost of engaging in work (such as writing emails, working on word documents or spreadsheets).	0.494	0.320		
Self-care behaviors	**3.** I have avoided going out to public places (shops, parks) because of the fear of contracting coronavirus (COVID-19).	0.707	0.498	1.636	18.173
	1. I have avoided using public transport because of the fear of contracting coronavirus (COVID-19).	0.641	0.341		
	5. I have avoided touching things in public spaces because of the fear of contracting coronavirus (COVID-19).	0.571	0.389		
	4. I have been concerned about not having adhered strictly to social distancing guidelines for coronavirus (COVID-19).	0.530	0.444		

λ, *Eigenvalue;* h^2, *Communalities.*

were fully explained to the participants. Subjects were informed that participation was voluntary and that their decision would not affect their care. Participants were reassured about the confidentiality of the data.

RESULTS

The mean and standard deviation for the age of 932 adults was 31.14 (SD = 7.81) years. Other demographic characteristics of participants are shown in **Table 1**. Also, the level of C-19ASS was estimated 31.68 (SD = 8.23, CI 95%: 31.14–32.21).

In maximum likelihood EFA, the KMO test value was 0.852, and Bartlett's test value was 30,036.137 ($P < 0.001$). The EFA results revealed two factors with 48.70% explained variance for the C-19ASS (see **Table 2**, **Figure 1**).

The acceptable fit indices showed that the model was confirmed (see **Table 3** and **Figure 2**). The convergent and discriminant validity for both factors were acceptable for the current study. The value in the HTMT matrix was <0.66, indicating discriminant validity was established in this study. All coefficients of internal consistency were estimated as acceptable reliability (see **Table 4**). There was no significant relationship between demographic variables and C-19ASS.

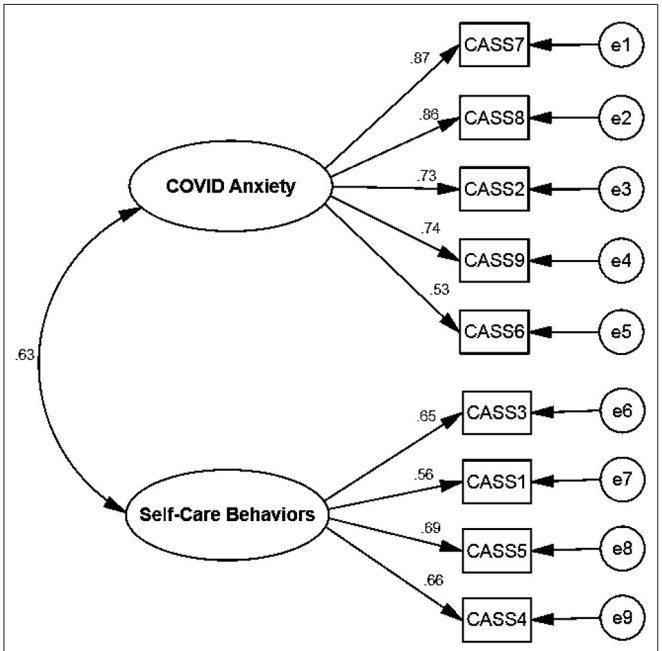

FIGURE 1 | The CFA model of the C-19ASS.

DISCUSSION

The results of this study demonstrated that the Persian version of C-19ASS has nine items in two subscales namely *COVID-19 Anxiety* and *self-care behaviors*, these two factors explained about the half of total variance of anxiety syndrome among the Iranian general population. Although one of the advantages of convenience sampling is that participants are readily available but at a disadvantage, a particular sample may be given more attention or, conversely, a group of the target population may not be included in the sample. Due to the fact that in this study, samples were collected through Google Form and social networks, people who were not members of social networks could not access the data collection form.

In the present study, the high level of Cronbach's alpha (>0.72), McDonald's omega (>0.72), and the average correlation between the items demonstrated that two factors of the scale had acceptable internal consistency. The results of internal consistency were almost similar to the original scale. The calculation of McDonald's omega is the advantage of this study because it does not depend on sample size and numbers of items. Also, based on the results of CR (>0.85) and Max-R, the Persian version of C-19ASS had good reliability. The CR is estimated by factor loading in CFA (26).

Based on the EFA results, two factors were identified, the first of which is *COVID-19 anxiety* which consists of five items. Anxiety is a mental disorder defined by excessive anxiety that leads to panic and is often accompanied by physical symptoms (27). People usually need more information about critical events to reduce anxiety caused by uncertainty in a critical event (27). For this reason, in examining COVID-19 anxiety syndrome in this study, people more than anything, are searching for the signs and symptoms of COVID-19 disease and news related to COVID-19.

The second factor is *self-care behaviors*. Behaviors that are performed with the aim of preventing disease and maintaining individual well-being is commonly defined as self-care behaviors. Self-care is a decision-making process with the aim of preventing COVID-19 and maintaining well-being in the COVID-19 pandemic (28).

The numbers of factors and items of the Persian version of C-19ASS were similar to the original. The only difference between the original version and the Persian version was an item "4) I have been concerned about not having adhered strictly to social

TABLE 3 | Fit indices of the first order confirmatory factor analysis of the C-19ASS ($n = 466$).

CFA index	CFI	IFI	PCFI	PNFI	RMSEA	CMIN/DF	*P*-Value	df	χ^2
	0.957	0.957	0.691	0.672	0.033	2.107	<0.001	26	54.798

DF, Degree of freedom; PCFI, Parsimonious Comparative Fit Index; PNFI, Parsimonious Normed Fit Index; CMIN/DF, Minimum Discrepancy Function divided by Degrees of Freedom; RMSEA, Root Mean Square Error of Approximation; TLI, Tuker-Lewis Index; and CFI, Comparative Fit Index, IFI, Incremental Fit Index, Fitness indexes, PNFI, PCFI (>0.5); TLI, IFI, CFI (>0.9), RMSEA (<0.08), CMIN/DF (<3 good, <5 acceptable).

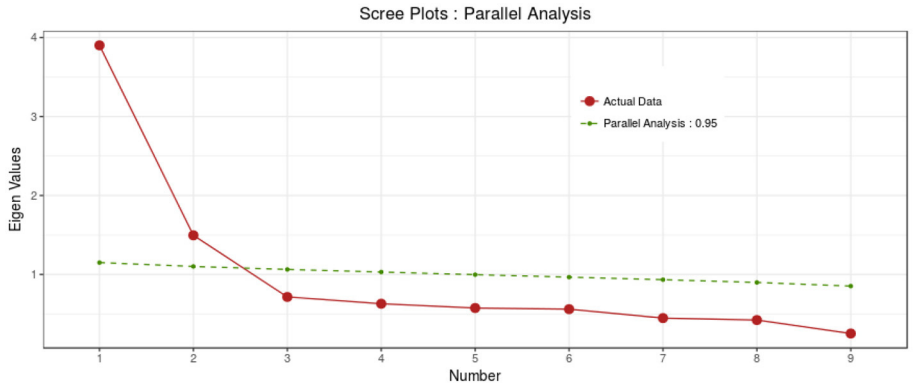

FIGURE 2 | The scree plot of the C-19ASS.

TABLE 4 | The indices of the convergent, discriminant validity, and internal consistency C-19ASS for the CFA ($n = 466$).

Index / Factors	CR	AVE	MSV	MaxR (*H*)	Alpha (CI95%)	Omega	AIC
COVID-19 anxiety	0.867	0.573	0.399	0.897	0.844(0.828 to 0.859)	0.849	0.521
Self-care behaviors	0.738	0.417	0.399	0.743	0.721(0.691to 0.749)	0.726	0.396

distancing guidelines for COVID-19". This item in the original version loaded into the first factor. But in the present study replaced in the second factor.

The findings of this study indicate that the Iranian version of the C-19ASS scale for evaluating COVID-19 anxiety syndrome is effective and useful in the general population to determine the prevalence of COVID-19. This scale helps the health-care providers, psychologists, and psychiatrists to identify and screen high-risk individuals and to offer preventive interventions to minimize the development of irreversible complications of anxiety syndrome.

The crisis of COVID-19 prevalence in the world, as well as Iran, caused mental disorders and COVID-19 anxiety syndrome, physical, psychological, and financial impacts on people and the government (29). The psychometric analysis of C-19ASS in the Iranian population in this situation showed that the concept of anxiety caused by COVID-19 was explained nearly 50% by the C-19ASS, which contained acceptable psychometric properties.

One of the limitations of this study was related to convenience sampling which is limited in its ability to reach all groups of the population (for example, the elderly population and individuals with no internet or without access to social media such as WhatsApp, Telegram, or email). Since the elderly are more affected by the COVID-19 pandemic due to their vulnerability and it was difficult to access them through social networks, it is recommended that this group be considered in evaluating the scale.

CONCLUSION

The Persian version of the C-19ASS scale had an acceptable construct validity and reliability. It has two factors with nine items that explained 48.70% of the total variance of the C-19ASS in the Iranian population during the COVID-19 pandemic. This scale could be beneficial for researchers, psychologists, and healthcare providers to assess anxiety syndrome during the COVID-19 pandemic.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The Tehran Islamic Azad University of Medical Sciences Research Ethics Committee approved the protocol of this study (IR.IAU.TMU.REC.1400.315).

CONSENT TO PARTICIPATE

Informed consent was obtained from all individual participants included in the study.

AUTHOR CONTRIBUTIONS

AE, HS, ES, and EH contributed to the study conception and design. Material preparation and data collection were performed by EH and HS performed data analysis. The first draft of the manuscript was written by EH, PR, HS, and AE. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Second Wave of COVID-19 Pandemic in Argentinian Population: Vaccination Is Associated With a Decrease in Depressive Symptoms

Pedro Benedetti[1†], *Alejo Barbuzza*[1†], *Franco Moscato*[1], *Victoria Reppucci*[1], *Celina Goyeneche*[1,2], *Cynthia Katche*[1,2], *Jorge H. Medina*[1,2], *Haydee Viola*[1,2,3], *Fabricio Ballarini*[1,2‡] *and Diego Moncada*[1,2,4*‡]

[1] *Instituto Tecnológico de Buenos Aires, Buenos Aires, Argentina,* [2] *Facultad de Medicina, Instituto de Biología Celular y Neurociencia "Prof. E. De Robertis" (IBCN), UBA-CONICET, Buenos Aires, Argentina,* [3] *Departamento de Fisiología, Facultad de Ciencias Exactas y Naturales, Biología Molecular y Celular "Dr. Héctor Maldonado" (FBMC), University of Buenos Aires (UBA), Buenos Aires, Argentina,* [4] *Centro Integrativo de Biología y Química Aplicada, Universidad Bernardo O'Higgins, Santiago, Chile*

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***Correspondence:**
Diego Moncada
dmoncada@fmed.uba.ar

[†]These authors have contributed equally to this work and share first authorship
[‡]These authors have contributed equally to this work and share last authorship

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Background: Since the irruption of the coronavirus disease 2019 (COVID-19) the planet has submerged in a time of concern and uncertainty, with a direct impact on people's mental health. Moreover, the recurrent outbreaks that periodically harry different regions of the world constantly refocus people's concerns to the pandemic. Yet, each new wave heats the diverse countries in different situations, including the advances in their vaccination campaigns. In this research, we studied the levels of the general anxiety disorder (GAD) and depression in the Argentine population across the first and second waves of infections that occurred in our country.

Methods: We conducted an on-line survey, within each peak of the pandemic. People were asked to self-report GAD and depression symptoms using the GAD-7 and PHQ-9 questioners, inform their vaccination status, the frequency they performed physical activity as well as working condition and modality. Here, we identified the more vulnerable groups and evaluated factors that could mitigate the rise of these mental disorders, focusing on vaccination.

Results: Our data shows that reported GAD and depression levels were higher during the second wave than during the first one. More importantly, vaccinated people were less depressed than non-vaccinated people, while GAD levels remained equivalent in both groups. Other factors directly associated with lower GAD and depression levels were performing frequent physical activity and being employed, regardless of the employment modality. These observations were replicated in different age ranges and genders.

Conclusion: This work evidences GAD and depression in different pandemic waves in Argentina, as well the factors that may contribute to reducing the magnitude of these disorders, including vaccination.

Keywords: COVID-19, GAD-7, PHQ-9, vaccination, physical activity

INTRODUCTION

COVID-19 is a disease caused by the coronavirus SARS-CoV-2 that has stroked mankind for more than 18 months. So far, up to the end of August 2021 it has caused 4.4 million deaths on the planet and 110.000 originated in Argentina, which unfortunately ranks 15th in the world (1). In addition to the many physical illnesses associated with the COVID-19, it also causes psychological disorders such as depression and anxiety. Several examples of this have been reported around the world (2–11). In this work, we studied the self-perceived levels of GAD and depression in adults between 18 and 50 years old, along the pandemic period, throughout two cross-sectional surveys performed in the first (November 2020) and at the second waves (May 2021) of the SARS-CoV-2, in the Buenos Aires Metropolitan Area of Argentina. Furthermore, our objective was to analyze the impact of vaccination, physical activity and work modality, under the hypothesis that they may act as possible protective factors of the population's mental health after such a prolonged period of the pandemic.

It is reported that key changes in life domains, including home confinement, reduction in face-to-face social interaction and disrupted occupation/ education roles, are associated with the impairments observed in common mental disorders such as anxiety and depression (12). The clearer tool available to end such disrupted daily routines is massive vaccination at the national and worldwide level. Fortunately, different COVID-19 vaccines were developed and proved efficient to reduce the number of hospitalizations with severe symptoms and the number of casualties. Unfortunately, there is a continuum from complete acceptance to total refusal of all vaccines, with vaccine hesitancy lying between the two poles (13). One of the reasons to refuse vaccination is the fear of vaccines side effects (14). Therefore, adequate information on this subject is critical to make people aware about the importance of weighing their decision to accept and foster the vaccination process.

The interaction between mental disorders and the effect of vaccination is intricate. It was reported that GAD and depression can increase associated with vaccine hesitancy (15, 16), but also people with higher levels of anxiety are those who agree to be vaccinated (15, 17). On the other hand, these psychological factors negatively influence vaccine efficacy (18). In Argentina the first wave of COVID-19 occurred in the absence of vaccines (November 2020), but the second wave (May 2021) surprised the country in the middle of the massive vaccination campaign which to that moment vaccinated more than a million people per week (19). Thus, we registered the self-reported levels of GAD and depression in the adult population during these two waves of COVID-19 and analyzed the impact of vaccination on their mental health.

Besides vaccination, other public policies were applied during the pandemic for the prevention of infections, which included social isolation. Elevated self-reported levels of anxiety and depression were associated with self-reported COVID-19 pandemic-related self-isolation and self-quarantine activity (20–22). One of the consequences of social isolation was the obligation or necessity of many people to carry out their work at home. In this study we have analyzed the levels of GAD and depression in adults in relation to their working status (workers or non-workers) and modality (face-to-face, work from home or hybrid). Finally, a behavioral factor that contributes to reduce the risk of suffering from these ailments is the practice of physical activity. Various studies have been carried out relating the frequency and intensity of physical activity with respect to its effectiveness in terms of mental health (23–26). Here, we determined the distribution of the adult population that exercises with low or high weekly frequency and analyzed its relation with people's self-perception of GAD and depression.

In summary, we conducted the research under the hypothesis that vaccination, physical activity and work modality, may act as possible protective factors on GAD and depression during the pandemic waves. Our results show variations of GAD and depression reported at the population level in two consecutive COVID-19 outbreaks. They describe the impact in different age groups and genders, and shed light on the positive effects of vaccination, physical activity and working status on the mental health during the pandemic.

MATERIALS AND METHODS

Study Settings and Participants

A cross-sectional design was performed to survey adult population, residents of the Metropolitan Area of Buenos Aires (AMBA), Argentina, in two different moments during the COVID-19 pandemic. The participants were recruited via social media of local scientific communicators, and responded to the survey through the platform Google Forms. In both surveys, the participants completed the GAD-7 and the PHQ-9 tests and reported their COVID-19 vaccination status, the weekly frequency they performed physical activity, their employment status, and the work modality (**Supplementary Materials**). After accessing the webpage, the participants were allowed to complete the survey without time limits. In general, this operation lasts approximately 15 min. Only full answered surveys were considered for the analysis.

Data were collected first in October/November 2020 (from 22nd October 2020 to 7th November 2020, $n = 1{,}531$, 79,29% women) and second in May 2021 (from 5th May 2021 to 10th May 2021, $n = 4{,}576$, 83,10 % women). We divided this population into two groups of study: people between 18 and 30 years old and people between 31 and 50 years. This division was performed using as guidance the one established by the national institute for statistics and census (INDEC) to differentiate between young (15–29 years) and adults (17, 26, 30–58) within the economically active population (27–30). In our case we excluded the population under 18 years old due to the impossibility of obtaining reliable on-line informed consents signed by the parents of the minors. These groups can share certain lifestyles, and characteristics: young are studying or having a low-responsibility jobs, in our country a large percentage of them live with their parents (64%) and do not have children (90%) (29). On the other hand, the majority of people between 30 and 60 years of age must have greater family care responsibilities and are the economic support of the family (28–30).

In total 2,830 people responded the first survey. We excluded from the analysis 1,285 respondents that did not belong to the AMBA region and 14 for being older than 50 years old. In the first case exclusions were performed for not being representative samples of their geographical regions. In the second for not being representative of the age range (>50) of the target region. In the second survey responded 7,735 participants. In this case, and to match samples, 3,002 were excluded for geographical reasons and 157 for being older than 50 years old. People younger than 18 years were blocked by the system. Considering the AMBA population and the proportion of people between 18 and 50 years old, at least of 379 persons are required to have a confidence level of 95% with a 5% of margin error. Since we surveyed people using an online convenience method, we decided to maximize the sample size to all the participants that responded within the data collection period.

The AMBA is the biggest urban conglomerate in Argentina. It is a geographical region composed of the Autonomous City of Buenos Aires and multiple political units of the Buenos Aires province with a population of approximately 15 million people.

Dynamic of COVID-19 Pandemic and Vaccination in Argentina

In Argentina, the first case of COVID-19 was detected on the 3rd March 2020. On the 18th March 2020 the government decreed a nationwide lockdown (31) that lasted until the 7th November. During this period, only the essential activities were permitted. Restrictions were revised and updated every 2 weeks by a phase system that moved depending on the epidemiological indicators.

The surveys were conducted within the first and the second waves of contagions, in the context of particular epidemiological situations. The first one, performed in October/November 2020, matched with the end of the first wave of SARS-CoV-2 when the total confirmed cases in Argentina were 1.236.851, with 33.348 confirmed deaths, a 59,6% of occupied Intensive Therapy Unit (ITU) beds in the AMBA (32), and without vaccines available. At the end of the second data recollection (10th May 2021) Argentina counted 3.165.121 total confirmed cases, 67.821 confirmed deaths, and an ITU occupancy of 77% in the AMBA. However, at this moment 7,718,272 people were vaccinated with one dose (17.2%) and 1,404,487 with two doses (3.1%), in the middle of a nationwide vaccination campaign (33). The first vaccinated group was the risk population (Sanitary personnel, people aged over 60 years, and those with certain preexistent medical problems).

Survey Structure Measures

Socio-Demographics

in both surveys, all participants (October/November 2020 and May 2021) informed their gender ("men," "women," and "other"), age ("18" up to "50"), area of residence ("AMBA" or "Not AMBA"), employment status ("worker" or "non-worker"), work modality ("Face to face," "Work from home" or "Hybrid"), and number of days they performed physical activity per week ("0" up to "7"). In the second survey, we also asked about the vaccination status (vaccinated, not vaccinates or I'd rather not answer); 3 participants decided not to answer and were excluded from this part of the analysis. Only people of the AMBA region were considered for this study.

Mental Health Measures

Generalized Anxiety

Generalized anxiety was measured through the 7-item Generalized Anxiety Disorder Scale (GAD-7, 34) which is validated and widely used in various populations (35, 36). This mental health instrument gathers information about generalized anxiety symptoms of the 2 weeks previous to the questionnaire. Respondents report their symptoms using a 4-point Likert rating scale ranging from 0 (not at all) to 3 (almost every day) along 7 questions, therefore the total score ranges from 0 to 21. Scores of 0–4 are thought to represent minimal anxiety, 5–9 mild anxiety, 10–14 moderate anxiety, and 15–21 severe anxiety (34). We assessed the reliability in both periods of data collection by calculating the Cronbach indexes, which were contained within the 95% of confidence interval (CI). They were $\alpha = 0.88$ (CI 0.87–0.89) for the first wave and $\alpha = 0.89$ (CI 0.885–0.895) for the second one, reflecting a high reliability.

Depression

Depression was measured using the Patient Health Questionnaire (PHQ-9; 37). The PHQ-9 resulted in a reliable and widely validated measure of depressive symptoms (37–39). Each respondent must answer nine questions that describe depression symptoms, considering the last 2 weeks. Each question can be answered with a 4-point Likert rating scale ranging from 0 (not at all) to 3 (almost every day) along nine questions, thus the total score ranges from 0 to 27. Scores of 0–4 suggest minimal depression, 5–9 mild depression, 10–14 moderate depression, 15–19 moderately severe depression, and 20–27 severe depression (37). The Cronbach indexes were $\alpha = 0.86$ (CI 0.849–0.87) for the first wave and $\alpha = 0.86$ (CI 0.854–0.866) for the second one, reflecting high reliability on the data collected in both periods.

Ethical Considerations

This study was approved by ethics council of the Life Sciences Department of the Instituto Tecnológico de Buenos Aires. Before answering the survey, each participant was provided with an informed consent that had to be approved to participate in the study. Data was analyzed to maintain anonymity of the participants. All the procedures conducted in this study followed the ethical standards of the institutional and/or national research committee as well as with the Helsinki Declaration of 1975, as revised in 2008.

Statistical Analysis

Depending on the type of variable we calculated descriptive statistics for the sample. For each continuous variable (GAD-score from GAD-7, Depression score from PHQ-9 and mean day of weekly days of physical activity) descriptive statistics were expressed as means with standard error of the mean (SEM) and for non-continuous variables as counts and percentages (%). The specific statistical tests used in each case are informed in the corresponding figure legends. Descriptive statistic for

each figure is supplied as **Supplementary Tables 1–6**. Normality and homocedacy were analyzed using the Kolmogorov-Smirnov, Bartlett's and F tests (**Supplementary Tables 7–12**). Non-parametrical tests were used to analyze samples that did not follow a normal distribution or the homocedacy requirements of parametric tests. Outliers were searched using the ROUT method with a Q value of 1%. All the non-parametric statistics were re-analyzed using the equivalent parametric test by assuming a normal distribution of the means due to the large sample size. No differences between tests were found. The differences were considered significant when $p < 0.05$ ($\alpha = 0.05$). We report exact *p*-values, no adjustments were adopted. The statistical analysis was performed using GraphPad Prism® 8.0.1 software. Effect sizes are reported for all the significant differences, in the correspondent figure legends. For this purpose, Cohen's d was calculated for *t*-tests; Cohen's f^2 and η^2 for one-way ANOVAs and Cohen's f^2 and partial η^2 (η_p^2) for two-way ANOVAs. Cohen's d and f^2 were calculated using the WebPower On-line software; η^2 and η_p^2 were calculated manually. In both cases, we assumed a normal distribution of the sample mean, due to its large size, to perform the calculations. Effect sizes for X^2 independency tests are expressed as phi (φ) coefficient. The relation between GAD and depression scores were calculated using the Spearman's rank correlation coefficient (r_s).

RESULTS

We started by analyzing the GAD in people from 18 to 30 years old (from now young adults) and observed increased scores during the second wave compared to the first wave (**Figure 1A**). In fact, mean GAD scores during this second wave went over 10, usually considered the cut-off between mild and moderate GAD conditions (34). Hence, we analyzed whether the increased anxiety was reflected by change in the percentage of people expressing moderate to severe GAD (score>10) and we observed that, during the second wave of the pandemic, the population with these conditions increased by almost 10% (**Figure 1B**). A posterior gender analysis revealed a differential effect of the wave on young men and women. The latter group reported higher GAD scores during the second outbreak, and in addition women presented higher GAD than men in both waves (**Figure 1C**). Actually, while the man population with moderate to severe GAD increased less than 2% during the second wave, that of the woman population raised almost 11% (**Figure 1D**).

Then, we evaluated the same variables for people between 31 and 50 years old (from now adults). In this case, we also observed a higher mean GAD scores in the second wave of contagion than in the first one, which overpassed the value of 10 (**Figure 1E**). This increase also reflected a rise of more than 15 % of the population that reported moderate to severe GAD scores during this period (**Figure 1F**). The posterior gender analysis revealed that women were more anxious than men since the first wave; in addition, this gender difference remained during the rise of anxiety observed in both genders at the second wave (**Figure 1G**). In particular, population with moderate to severe GAD increased around 15% in adult men and women, showing that both genders contributed evenly to the rise of GAD observed in adult people during the second wave (**Figure 1H**). It is worth noting that during the second wave, for both age ranges, circa 60% of women reported moderate to severe GAD while only 40 % of men were in these conditions.

In young adults, the depression scores reported during the second wave were significantly higher than in the first one (**Figure 2A**). This was also reflected in a higher percentage of people reporting moderate to severe depression symptoms during the second wave with respect to the first one, representing approximately 5% more of the surveyed population (**Figure 2B**). The posterior gender analysis revealed that young women reported higher depression levels than men in both outbreaks (**Figure 2C**). Analyzing the percentage population that reported moderate to severe symptoms, we observed a significative increase of almost 5% in women during the second outbreak (**Figure 2D**). A similar profile was observed in adults, with higher depression levels reported during the second wave (**Figure 2E**); reflecting an increase of 6 % in the population with moderate to severe depression (**Figure 2F**). As with the young adults, women reported higher depression scores than men in both waves. Women, also reported higher depression scores during the second outbreak (**Figure 2G**), a moment when the percentage of female population with moderate to severe symptoms increased by 9% (**Figure 2H**). On the contrary, the adult male population reported similar levels of depression during these pandemic waves, which was reflected in similar percentages of the adult male population with depression scores over 10 in both waves (**Figures 2C,D,G,H**).

Given the well-known comorbidity between GAD and depression, we evaluated their relation in both outbreaks and observed that their scores correlated positively for both age ranges and almost indistinguishable in both waves (Young adults $r_s = 0.73$ (95% CI: 0.6895–0.7623) and $r_s = 0.69$ (95% CI: 0.6665–0.7156) for 1st and 2nd wave, respectively. Adults: $r_s = 0.68$ (95% CI: 0.6410–0.7158) and $r_s = 0.72$ (95% CI: 0.6998–0.7371) for 1st and 2nd wave, respectively). Neither the slope of the linear regressions adjusting to the correlations nor the basal values changed between outbreaks ($p > 0.05$), pointing to an equivalent relation between GAD and depression of the populations surveyed in the first and the second outbreak.

It is worth notice that, while vaccines were unavailable in Argentina during the first wave, the second wave started during the vaccination campaign. Thus, we also studied whether the vaccination status was related to GAD and depression scores. We observed that regardless of the vaccination status, GAD scores during the second wave were higher than during the first wave, both, for young adult (**Figure 3A**) and adult (**Figure 3D**) populations, with the exception of young adult men (**Figures 3B,C,E,F**). In the same direction, the unvaccinated people from the second wave reported higher depression scores than the group of the first wave (**Figure 4**, except for young men **Figure 4C**). However, those persons of the adult population that received at least one dose of any COVID-19 vaccine reported fewer depression symptoms than those unvaccinated in the second wave (**Figures 4D,E,F**). This same effect repeated in the group of young adult women (**Figure 4B**). Thus, excepting the

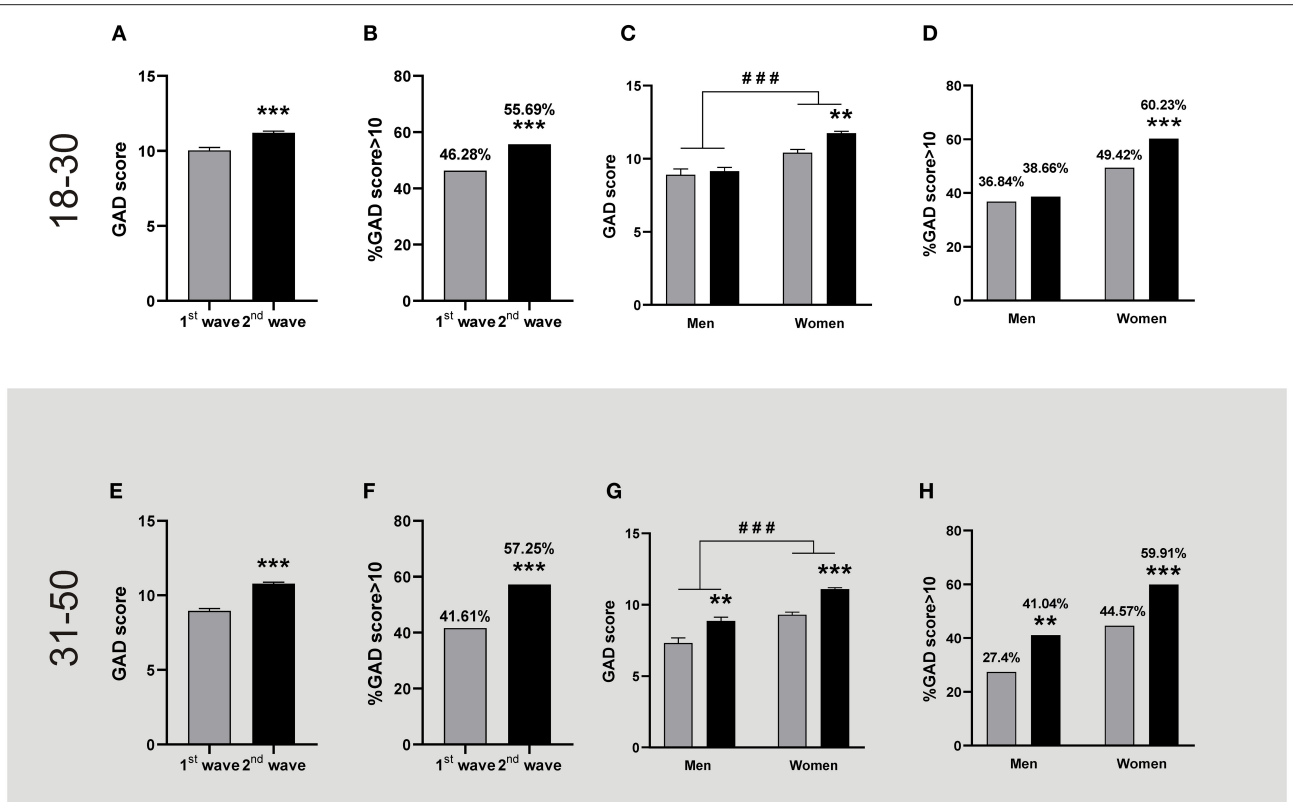

FIGURE 1 | GAD levels registered during the first and the second wave of COVID-19. The figures show the mean + SEM GAD scores or the percentage of people with GAD scores >10 during the first (grey bars) and the second (black bars) wave. The descriptive statistics are reported in **Supplementary Table 1**. **Top panel:** People aged between 18 and 30. **(A)** People reported higher GAD scores in the 2nd wave ($n = 1,844$) than in the 1st wave ($n = 685$). Mann-Whitney U-test, $^{***}p < 0.001$; Cohen's $d = 0.23$. **(B)** The percentage of people with a GAD score >10 was higher during the second wave; $^{***}p < 0.001$, X^2, $\varphi = 0.096$. **(C)** Women but not men reported higher GAD scores in the 2nd wave. $^{###}p < 0.001$ women vs. men, and $^{**}p < 0.01$ vs. 1st wave after two-way ANOVA; Cohen's $f^2 = 0.23$; $\eta_p^2 = 0.023$ for the gender factor and $\eta_p^2 = 0.003$ for wave factor (women: 1st wave $n = 514$, 2nd wave $n = 1,456$. Men: 1st wave $n = 171$, 2nd wave $n = 388$). **(D)** A higher percentage of women reported a GAD score >10 during the 2nd wave; $^{***}p < 0.001$ vs. 1st wave, X^2, $\varphi = 0.10$. **Bottom panel:** People aged between 31 and 50. **(E)** People reported higher GAD scores in the 2nd wave ($n = 2,732$) than in the 1st wave ($n = 846$). Mann-Whitney U-test, $^{***}p < 0.001$, Cohen's $d = 0.37$. **(F)** The percentage of people with a GAD score >10 was higher during the second wave; $^{***}p < 0.001$, X^2, $\varphi = 0.13$. **(G)** Both genders reported higher GAD scores in the 2nd wave. $^{###}p < 0.001$ women vs. men, and $^{**}p < 0.01$ and $^{***}p < 0.001$ vs. 1st wave after two-way ANOVA; Cohen's $f^2 = 0.49$ and 0.31 for men and women respectively; $\eta_p^2 = 0.016$ for the gender factor and $\eta_p^2 = 0.010$ for wave factor (Women: 1st wave $n = 700$, 2nd wave $n = 2,347$. Men: 1st wave $n = 146$, 2nd wave $n = 385$). **(H)** A higher percentage of women and men reported GAD scores >10 during the 2nd wave; $^{**}p < 0.01$ and $^{***}p < 0.001$ vs. 1st wave, X^2., $\varphi = 0.13$ for both men and women.

young adult men group, vaccination was associated with lower depression symptoms.

Since performing physical activity has been associated with lower levels of GAD and depression (26) the survey also inquired the participants about the frequency they performed exercise. Then we clustered them into two groups, those who exercised up to 2 days per week (low frequency) and those who did it 3 days or more (high frequency). We observed that, despite the registered levels of GAD and depression increased both in young adults and in adults regardless of the frequency of physical activity, in all cases the high frequency of physical activity was associated with a lower anxiety (**Figures 5A,B**) and depression (**Figures 5C,D**). In fact, the percentage of participants exercising with low frequency almost doubled to those who did it with high frequency, regardless of the age range and the analyzed wave (**Figure 5**). Thus, while the changes in GAD and depression levels reported in the two waves were unrelated to the percentage of people performing more or less exercise, the group of persons performing frequent exercise were also the one with less anxiety and depression symptoms.

Finally, considering that different working modalities were adopted since the beginning of the pandemic, we evaluated the effect of this variable on the anxiety and depression levels during the second wave, a moment when the change in the working modality was consolidated for most people in Argentina. In particular, we focused on the working status, that is, people who work or who do not work (non-working), and the work modality, that is, from home, face to face, or hybrid. As shown in **Figure 6A** the GAD of the young adult population was equivalent among non-workers and workers of the different modalities. On the contrary, adult working people were less anxious that non-working adult people, irrespective of their

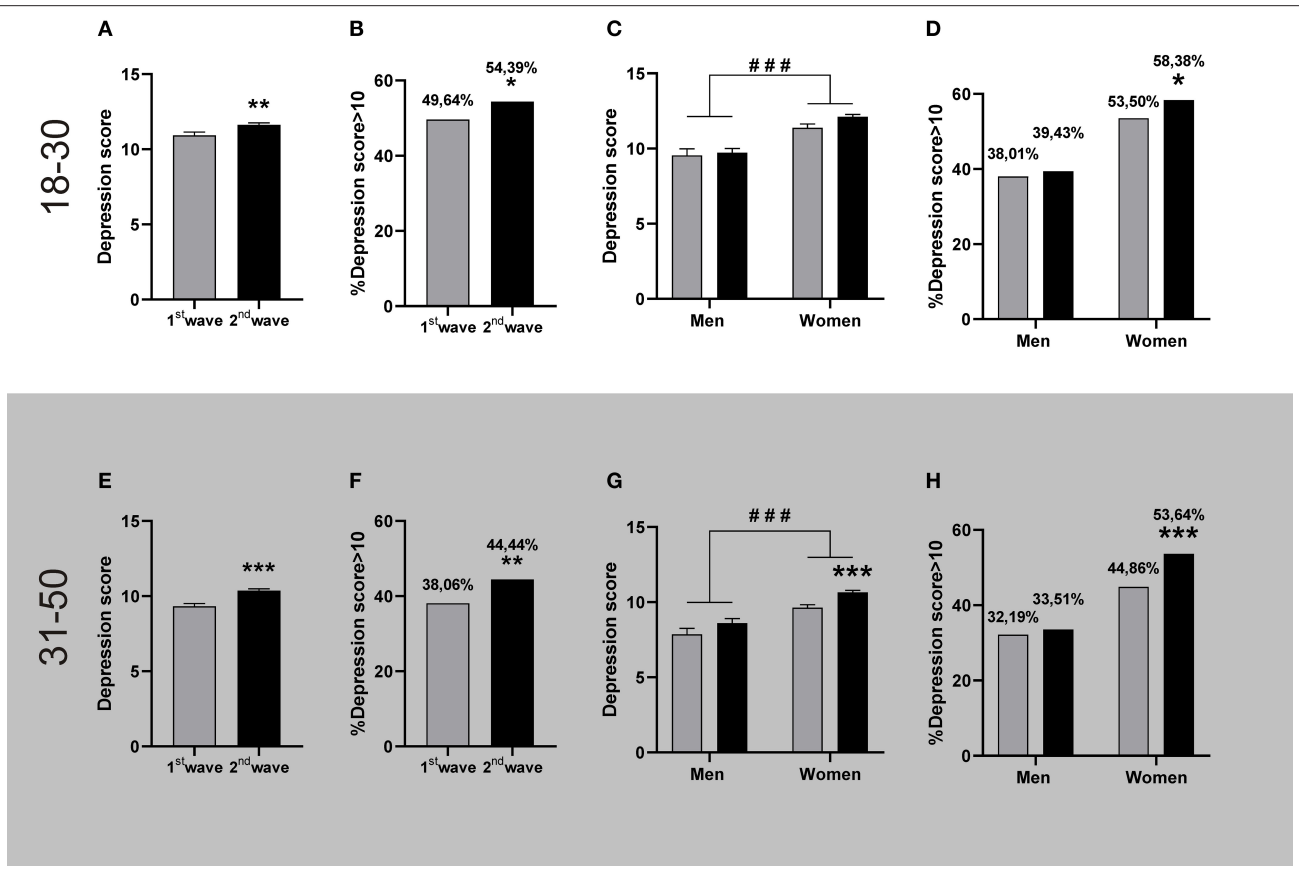

FIGURE 2 | Depression levels registered during the first and the second wave of COVID-19. The figures show the mean + SEM depression score or the percentage of people with depression scores >10 during the first (grey bars) and the second (black bars) wave. The descriptive statistics are reported in **Supplementary Table 2**. **Top panel:** People aged between 18 and 30. **(A)** People reported higher depression scores during the 2nd wave ($n = 1{,}844$) than in the 1st wave ($n = 685$). Mann-Whitney U-test, $^{**}p < 0.01$; Cohen's $d = 0.11$. **(B)** More people presented depression scores >10 during the 2nd wave; $^{*}p < 0.05$, X^2, $\varphi = 0.042$. **(C)** Both genders reported equivalent GAD levels in both waves, and women reported higher GAD than men within each wave, $^{\#\#\#}p < 0.001$ women vs. men, after two-way ANOVA; $\eta^2_p = 0.018$ for the gender (Women: 1st wave $n = 514$, 2nd wave $n = 1{,}456$. Men: 1st wave $n = 171$, 2nd wave $n = 388$). **(D)** A higher percentage of women reported depression scores >10 during the 2nd wave; $^{*}p < 0.05$ 1st wave, X^2, $\varphi = 0.043$ for women. **Bottom panel:** People aged between 31 and 50. **(E)** People reported higher depression scores during the 2nd wave ($n = 2{,}732$) than in the 1st wave ($n = 846$). Mann-Whitney U-test, $^{***}p < 0.001$; Cohen's $d = 0.19$. **(F)** More people presented depression scores >10 during the 2nd wave; $^{**}p < 0.01$, X^2, $\varphi = 0.054$. **(G)** Women reported more depression in the second wave. $^{\#\#\#}p < 0.001$ women vs. men, and $^{***}p < 0.001$ vs. 1st wave, after two-way ANOVA; Cohen's $f^2 = 0.17$ for women; $\eta^2_p = 0.016$ for the gender factor and $\eta^2_p = 0.010$ for wave factor. (Women: 1st wave $n = 700$, 2nd wave $n = 2{,}347$. Men: 1st wave $n = 146$, 2nd wave $n = 385$). **(H)** A higher percentage of women presented depression scores >10 during the 2nd wave; $^{***}p < 0.001$ vs. 1st wave, X^2, $\varphi = 0.073$ for women.

working modality (**Figure 6C**). This effect was more pronounced on the depression scores, where working adults, independently of the work modality, were less depressed than non-working ones (**Figure 6D**). A similar pattern, but less conspicuous and without evident effect of face-to-face work ($p = 0.842$), was observed in young adults (**Figure 6B**).

DISCUSSION

The most relevant results of this work indicate that subjects between 18 and 50 years old reported higher GAD and depression scores during the second wave of COVID-19 than those who did it after the first wave. In accordance with these results, the percentage of the population with a GAD and depression scores higher than moderate (equal to or higher than 10) increased during the second wave compared to the first one. Moreover, our results show a series of factors that help to mitigate the effect of GAD and depression in mental health. The most notorious factor was the effect of vaccination. Being vaccinated against COVID-19, was associated with lower levels of depression within the second wave. In contrast, being vaccinated did not alter GAD levels. Also, practicing physical activity more than twice a week was associated with reduced anxiety and depression in both the first and the second wave. Finally, lower GAD and depression levels were specifically identified during the second wave in adults of 31–50 years old who worked, either face-to-face or online, in contrast to those who did not work.

We start analyzing these results concerning others obtained in Argentina by different research groups. Reports from March 2020, at the start of the lockdown, informed in young people

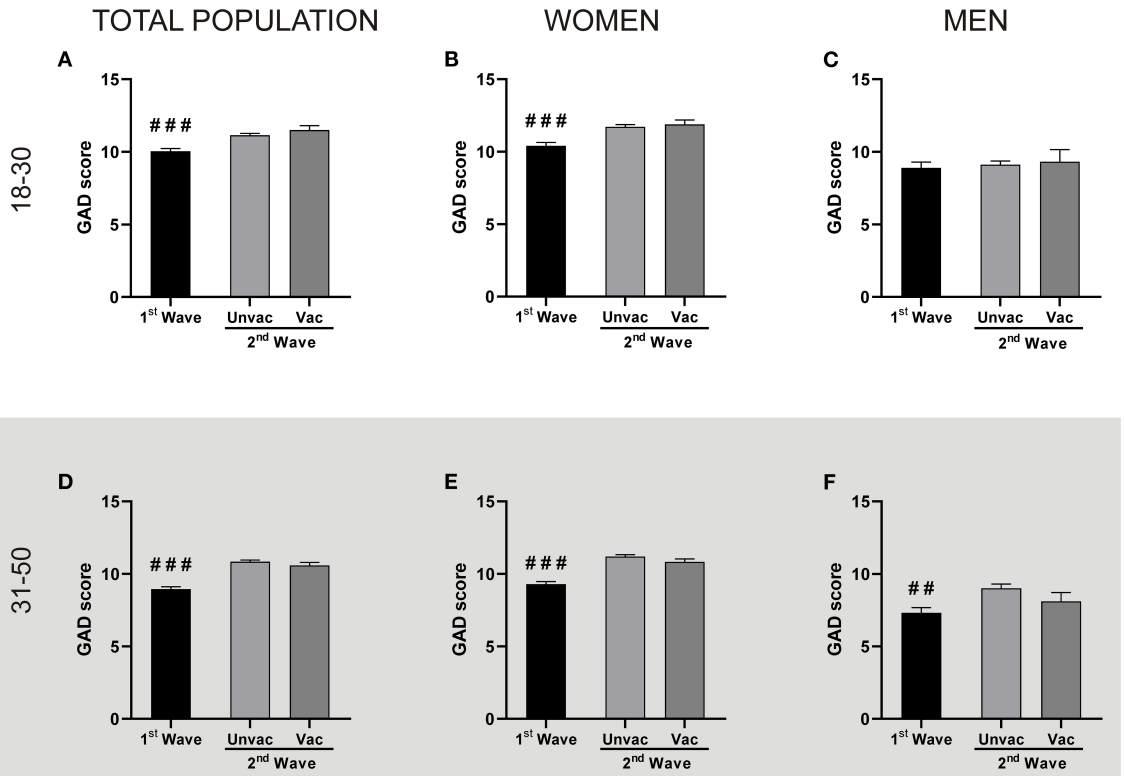

FIGURE 3 | The vaccination status did not correlate with GAD levels changes. Each panel compares the GAD scores reported by the unvaccinated people during the 1st and the 2nd wave, and the GAD scores between unvaccinated (Unvac) and vaccinated (Vac) people within the 2nd wave, by two independent Mann-Whitney *U*-test. Data shown as mean + SEM. The descriptive statistics are reported in **Supplementary Table 3**. **Top panel:** People aged between 18 and 30. **(A)** Total population: $^{###}p < 0.001$ vs. unvaccinated; Cohen's $d = 0.21$; (Unvac 1st wave $n = 685$; unvaccinated $n = 1{,}538$; vaccinated $n = 303$). **(B)** Women: $^{###}p < 0.001$ vs. unvaccinated; Cohen's $d = 0.26$ (1st wave $n = 514$; unvaccinated $n = 1{,}195$; vaccinated $n = 259$). **(C)** Men: (1st wave $n = 171$; unvaccinated $n = 343$; vaccinated $n = 44$). **Bottom panel:** People aged between 31 and 50. **(D)** Total population: $^{###}p < 0.001$ vs. unvaccinated; Cohen's $d = 0.38$ (Unvac 1st wave $n = 846$; unvaccinated $n = 2{,}035$; vaccinated $n = 692$). **(E)** Women: $^{###}p < 0.001$ vs. unvaccinated; Cohen's $d = 0.39$ (1st wave $n = 700$; unvaccinated $n = 1{,}709$; vaccinated $n = 633$). **(F)** Men: $^{##}p < 0.01$ vs. unvaccinated; Cohen's $d = 0.40$ (1st wave $n = 146$; unvaccinated $n = 326$; vaccinated $n = 59$).

from 18 to 25 years old a prevalence of moderate to severe GAD of 35% (40). In April of the same year, reports from the general population evidenced a 31.8% incidence (4). Our data collected in November 2020 showed a prevalence of 46%, and in May 2021, at the second wave of infections, it was 56%. When analyzing the group aged between 25 and 44 years, the prevalence was 25% in March 2020 (40); in our group of adults (30–50 years old) in November of 2020, it was 42%, and in May of 2021, it was 57%. This information suggests that the percentage of adults between 18 and 50 years old who reported moderate to severe GAD symptoms increased steadily in the 15 months since the beginning of the lockdown in Argentina. The reports of moderate to severe depression of Argentinean young people show that its prevalence ranged between 40 and 60% from the beginning of the lockdown until May 2021 (40, 41). In March of the 2020th, its incidence in the population aged between 25 and 44 was around 30% (40). This value was similar to that obtained in the general population for April 2020 (4). Then, our results in the adult population for November 2020 showed 38% of incidence, and in May 2021, 44%. Together, the information of this age group evidences a slight but sustained increment of moderate to severe depression symptoms during the curse of the pandemic.

In the regional context, other countries that suffer from limited economies and resources for their health services also experienced the first COVID-19 outbreak at a comparable time course. A study compared GAD and depression symptoms carried out in seven of those Latin American countries (Argentina, Ecuador, Mexico, Paraguay, Uruguay, Colombia, and El Salvador) between June and September 2020, when they experienced their first wave of contagions. That research informed a prevalence of moderate to severe GAD and depression symptoms of 25–30%. The exception was Uruguay, with an incidence close to 10%. In the particular case of Argentina, at that time, these parameters were at 30% (42). On the other hand, Brazil, the most affected country by the pandemic of the region, reported between May and July 2020 an 81.90% prevalence of anxiety and 68% of depression, with moderate to severe symptoms (43). In Argentina, when the cases of contagion showed a sustained increase toward November 2020, we found a 40–50% prevalence for both parameters, and in May 2021, these values were between 45 and 57%. In Peru, another country in the

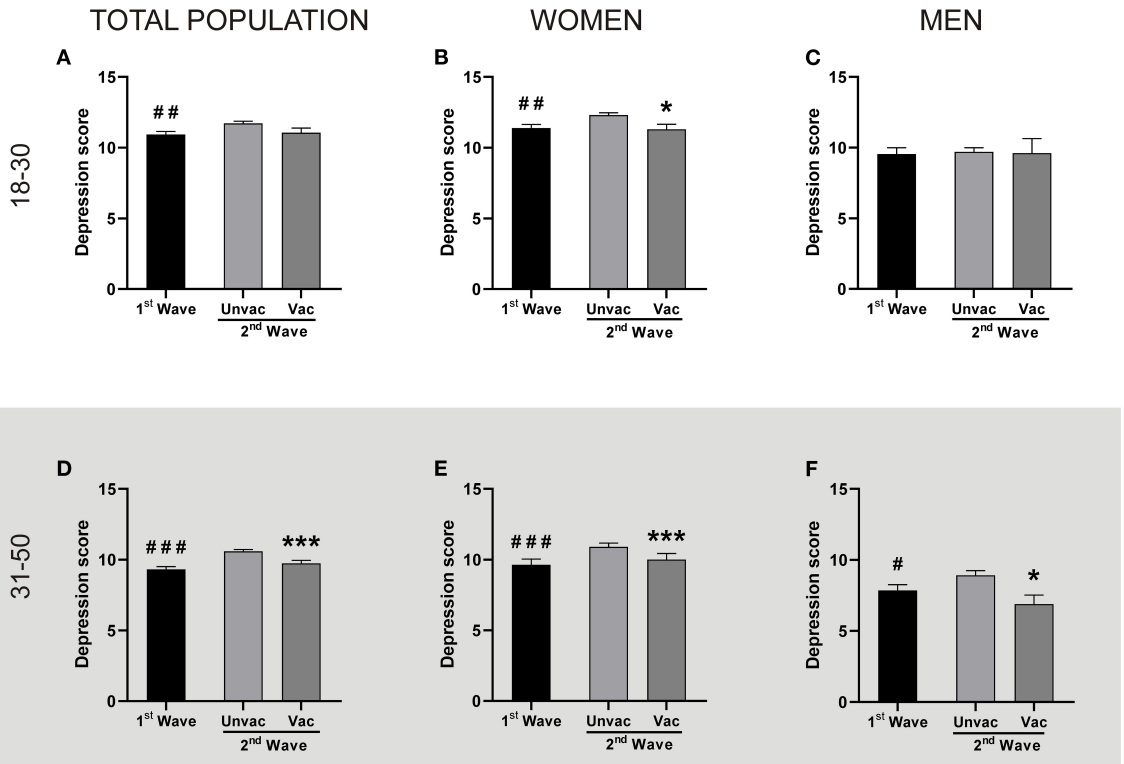

FIGURE 4 | Vaccination was associated with lower depression levels in adult people and young adult women. Each panel compares the Depression levels reported by the unvaccinated people during the 1st and the 2nd wave, and also the same parameter between unvaccinated and vaccinated people within the 2nd wave, by two independent Mann-Whitney *U*-test. The descriptive statistics are reported in **Supplementary Table 4**. **Top panel:** People aged between 18 and 30. **(A)** Total population: $^{\#\#}p < 0.01$ 1st Wave ($n = 685$) vs. Unvaccinated ($n = 1{,}538$); Cohen's $d = 0.13$. Vaccinated ($n = 303$). **(B)** Women: $^{\#\#}p < 0.01$ and $^{*}p < 0.05$ vs. Unvaccinated; Cohen's $d = 0.16$ and 0.17 respectively (1st wave $n = 514$; unvaccinated $n = 1{,}195$; vaccinated $n = 259$). **(C)** Men: ($n = 171$; 343; 44, for 1st wave, unvaccinated and vaccinated, respectively). **Bottom panel:** People aged between 31 and 50. **(D)** Total population: $^{\#\#\#}p < 0.001$ and $^{***}p < 0{,}001$ vs. unvaccinated; Cohen's $d = 0.22$ and 0.15 respectively (1st wave $n = 846$; unvaccinated $n = 2{,}035$; vaccinated $n = 692$). **(E)** Women: $^{\#\#\#}p < 0.001$ and $^{***}p < 0.001$ vs. unvaccinated; Cohen's $d = 0.23$ and 0.16 respectively (1st wave n=700; unvaccinated $n = 1{,}709$; vaccinated $n = 633$). **(F)** Men: $^{\#}p < 0.05$ and $^{*}p < 0.05$ vs. unvaccinated; Cohen's $d = 0.20$ and 0.38 respectively (1st wave $n = 146$; unvaccinated $n = 326$; vaccinated $n = 59$).

region, the prevalence of depression was 44% in young adults, although in adults was 26% by May 2021 (44). Thus, according to these works, within the Latin American region, GAD and depression of the Argentine population increased through the pandemic, showing prevalence levels similar to some of its sister countries, except for Uruguay and Brazil, which respectively had lower and higher levels than our country.

As we mentioned before, the level of GAD was higher in the second wave of infections by COVID-19 in 2021 compared to the first one. It is known that GAD values correlate positively to depression values (45, 46). A study conducted in Australia in 2012 reports that 39% of individuals with GAD also meet criteria for depression and the authors found that comorbid depression and anxiety disorders occur in up to 25% of general practice patients (47). We obtained positive correlations between GAD and depression, regardless of the age range, in both outbreaks registered in the Metropolitan area of Buenos Aires. The correlation slopes during the second wave were equivalent to those of the first one. This indicates that the populations surveyed in both waves had equivalent relations and suggest that those factors associated with the higher GAD of the second wave are most likely those associated with the higher depression scores.

Our data reflects that being vaccinated is a key factor associated with a lower self-perception of depression. This may be due to a feeling of sanitary well-being, since people who accept to receive the vaccine for COVID-19 seek to protect their health, reduce the duration and severity of the disease and look for the outbreak to end (48). On the other hand, the most common reasons for vaccination refusal are related to fear of the vaccines' side effects, the lack of knowledge about their effectiveness, and distrust to vaccines developed abroad (48). Moreover, our data showed that people were more anxious in May 2021 (during Argentina second wave of contagious), when the vaccination campaign was accelerating, than 6 months before when vaccines were not yet available. This fact could be a predictor of higher tendency to receive COVID-19 vaccines, since greater anxiety, confidence in vaccines, and collective responsibility were associated with the request of vaccination (17). In particular, COVID-19-related anxiety, and fears of infection correlated positively with vaccine acceptance (15). Alternatively, the high

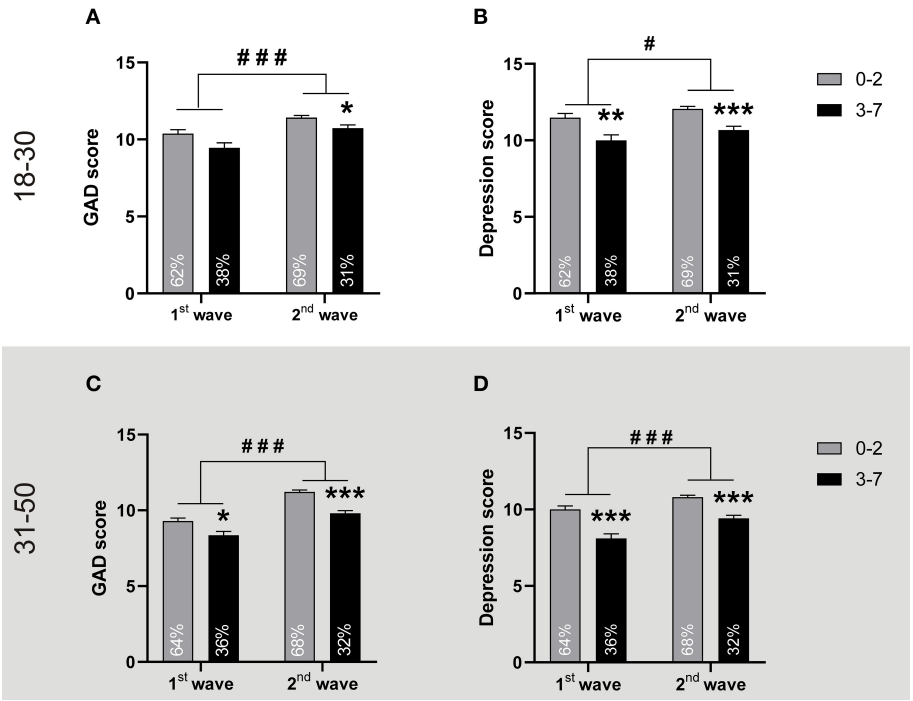

FIGURE 5 | Practicing physical activity more than 2 days per week is associated with lower GAD and depression. **Top panel:** People aged between 18 and 30. The figures show the mean + SEM of **(A)** GAD scores and **(B)** Depression scores of young adults who practiced physical up to 2 days per week (0–2), or more (3–7), in the 1st wave and in the 2nd wave ($n = 428$; 257; 1,266 and 578, respectively). $^{*}p < 0.05$, $^{**}p < 0.01$, and $^{***}p < 0.001$ vs. 0–2 group and $^{\#}p < 0.05$, $^{\#\#\#}p < 0.001$ vs. 1st wave, after two-way ANOVA. Each bar also informs the percentage of the population studied in the wave that exercised with low or high frequency. For GAD scores: Cohen's $f^2 = 0.12$ vs. 0–2 group in the 2nd wave, $\eta_p^2 = 0.004$ for the physical activity frequency factor and $\eta_p^2 = 0.009$ for the wave factor. For depression scores Cohen's $f^2 = 0.15$ and 0.23 vs. 0–2 group for the 1st and 2nd wave respectively; $\eta_p^2 = 0.010$ for the physical activity frequency factor and $\eta_p^2 = 0.002$ for the wave factor. The descriptive statistics are reported in **Supplementary Table 5**. **Bottom panel:** People aged between 31 and 50. The figures show the mean+SEM of **(C)** GAD scores and **(D)** Depression scores of adults who practiced physical activity up to 2 days per week (0–2), or more (3–7), in the 1st wave and in the 2nd wave ($n = 542$; 304; 1,870; and 862, respectively). $^{*}p < 0.05$, $^{***}p < 0.001$ vs. 0–2 group and $^{\#\#\#}p < 0.001$ vs. 1st wave, after two-way ANOVA. Each bar also informs the percentage of the population studied in the wave that exercised with low or high frequency. For GAD scores: Cohen's $f^2 = 0.09$ and 0.26 vs. 0–2 group in the 1st and 2nd wave respectively, $\eta_p^2 = 0.008$ for the frequency of physical activity factor and $\eta_p^2 = 0.017$ for the wave factor. For depression scores Cohen's $f^2 = 0.19$ and 0.24 in the 1st and 2nd wave respectively; $\eta_p^2 = 0.0134$ for the frequency of physical activity factor and $\eta_p^2 = 0.0056$ for the wave factor. The descriptive statistics are reported in **Supplementary Table 5**.

degree of GAD reported in 2021 could also be due to vaccination hesitance. In this sense, it has been reported that having ambivalent attitudes toward vaccination are related to mental health morbidity such as depression, peritraumatic stress, but fundamentally triples the risk for anxiety (16). Thus, the rise in anxiety levels observed in May 2021 could be associated either to the acceptance or the hesitance to vaccination. It worth noticing the role of mass and social media toward vaccination hesitance by the distribution of sensationalistic and/or conspiracy theories (49, 50). Thus, beyond the negative effect of this infodemic on the public health by its effect on the vaccination campaigns, it may be also responsible of direct harm to people's mental health.

A study carried out at the end of February 2021 showed that in Latin American countries 8 out of 10 adults have vaccination intention and fear of its side effects. In Argentina, the people showed a 70–75% intention of vaccination with a lower frequency of fear of side effects than in other countries of the region (84.5%) (51). The constant recommendations from peers and healthcare providers, explaining the possible side effects against the benefits of being inoculated, and its frequency, may bring peace of mind to the population and increase the willingness to get vaccinated. In this way, more population shall accept the vaccines, bringing multiple benefits for the personal and public health. From one side, the direct personal and public benefit of protection toward physical by the use of vaccine, which demonstrated positive effects against the COVID-19 (52–56). And from the other side, contributing to the concomitant decrease in the levels of depression, as shown in this study. In fact, these psychological factors shape the antibody responses to vaccines. In this sense, fear of COVID-19 itself, stress, depression, loneliness, and social isolation can impair the vaccine's ability to confer immunity against the virus (18). In any case, as it has been observed that vaccinated people can contract and spread SARS-CoV-2, it is important to keep social distancing measures for preventing the progression of the viral infection during the mass vaccination campaign (57); even when social isolation can reduce direct and indirect effects of the vaccination on mental health of the people (21, 22).

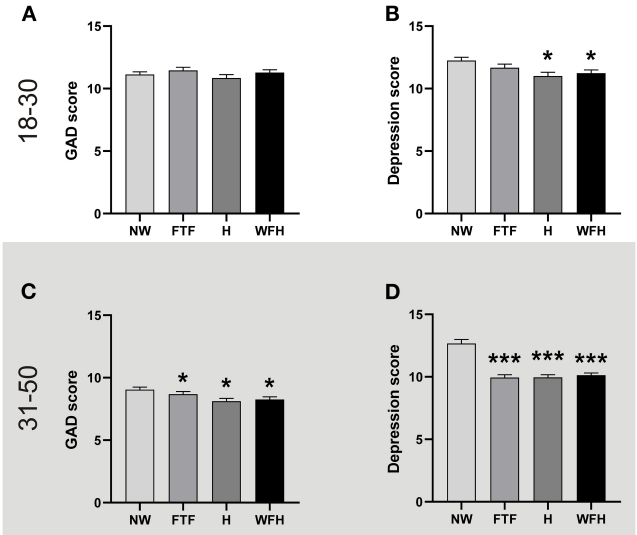

FIGURE 6 | Working was associated with less depression during the second wave. The figures show the mean + SEM of GAD or Depression scores of non-working people (NW), and those who work face to face workers, hybrid modality (H), or from home (WFH). The descriptive statistics are reported in **Supplementary Table 6**. **Top panel:** People aged between 18 and 30. **(A)** GAD scores were equivalent regardless of the working status or modality. One-way ANOVA, $p > 0.05$. **(B)** Working was associated with lower depression levels except for FTF modality. *$p < 0.05$, vs. NW, Kruskal-Wallis analysis after a one-way ANOVA (non-parametric); Cohen's $f^2 = 0.17$ and 0.16, and vs. NW for H and WFH respectively; $\eta^2 = 0.0065$. NW ($n = 568$), FTF ($n = 451$), H ($n = 311$), and WFH ($n = 514$). **Bottom panel:** People aged between 31 and 50. **(C)** Working was associated with lower GAD scores regardless of the modality. *$p < 0.05$ vs. NW, Kruskal-Wallis analysis after ANOVA (non-parametric); Cohen's $f^2 = 0.06$; 0.15 and 0.14 vs. NW for FTF, H and WFH respectively; $\eta^2 = 0.0064$. **(D)** Working was associated with lower depression levels regardless of the modality. ***$p < 0.001$ vs. NW, Kruskal-Wallis analysis after ANOVA (non-parametric); Cohen's $f^2 = 0.32$, 0.33 and 0.33 vs. NW for FTF, H and WFH respectively; $\eta^2 = 0.023$. NW ($n = 346$), FTF ($n = 630$), H ($n = 643$), and WFH ($n = 1,112$).

Another parameter registered in the surveys was the frequency of physical activity performed by the population. We observed that those who exercised more than twice a week reported lower levels of GAD and depression than those who exercised less frequently. Our study revealed that GAD and depression levels of the studied population were higher in the second wave, regardless of the frequency that people exercised. However, within each wave, both surveys (November 2020 and May 2021) showed that the group that performed frequent physical activity also reported less anxiety and depression. Thus, while general changes between waves were independent of how much people exercised, our results show, in a consistent way and on a high number of participants, that frequent exercise benefits mental health, independently of its basal state in the population. So, recommendations to increase public awareness about the impact on mental health of interrupted daily routines should include regularizing existing positive routines, in particular, the practice of physical exercises that has been diminished in this pandemic (58, 59). In our study, the percentage of people who reported exercising more than twice a week decreased from 37 to 31% from the first wave of contagious to the second one. A research performed in Australia reported that half of responders declared a reduction in physical activity since the onset of the COVID-19 pandemic, which was likely a consequence of social distancing, the closure of usual exercise venues, or unwillingness to change previous exercise habits (25). As the result, during the lockdown the group of more sedentary people presented more anxiety and depression symptoms (60). This work did not delve into the neurobiological mechanisms by which physical activity affects the levels of anxiety and depression. However, it is worth noticing that they include the regulation of the hypothalamic-pituitary-adrenal axis, effects on the endogenous opioid system, and the increase of the brain-derived neurotrophic factor level, which also affect the reactivity to stress and mood (61, 62).

Finally, the consolidation of multiple working modalities during the pandemic let us wonder of their relation with the anxiety and the depression levels during the second wave. We observed that the group of adult working people had lower GAD and depression than people who did not work. Nevertheless, this was a work effect rather than a modality effect, as GAD and depression levels were equivalently low with independence of the working-modality (at home, face-to-face or hybrid). In the case of the young adults' group, a similar but less conspicuous association was observed only in the depression levels. Our data is in agreement with previous one, showing that active workers showed fewer depression symptoms than unemployed people did (63). The COVID-19 pandemic and lockdown seems particularly stressful for individuals without work who reported more mental health disorders (8).

In sum, our results show that the second wave of contagion in the Metropolitan area of Argentina surprised with higher GAD and depression levels than the first outbreak that occurred 6 months earlier. Being vaccinated was selectively associated with decreased levels of depression in adults between 18 and 50 years old. In addition, the regular practice of physical activity as well as working coupled to a reduced self-perception of anxiety and depression symptoms. Determining the factors that contribute to reduce the risk of GAD and depression is important at scientific, clinical and even political level. Particularly, in pandemic times when they over pass the normal population values this knowledge could be used to develop strategies, such as fostering physical activity practices, guarding the employment and accelerating the vaccination campaigns, in order to prevent further injuries to people's mental health.

STRENGTHS AND LIMITATIONS

To our knowledge, this is the first study to analyze general anxiety and depressive symptoms in two consecutive COVID-19 outbreaks and relate them to the presence and administration of COVID19 vaccines in Argentina's largest urban conglomerate. Among other strengths, it is worth noticing the large sample size and its relative representability, for recruiting the participants of the general population. Another valuable aspect is the timing of the sampling during the two waves, in moments when none of

them were vaccinated (first wave) and when only some of them were (second wave), which allowed to analyze non-vaccinated people between waves and vaccinated against non-vaccinated people within the same wave. Yet, this study has some limitations that require acknowledging. The online sampling, which allowed data recollection in lockdown periods, might be the major one. Most respondents were young to middle age people, highly educated, and actively involved in accessing to COVID19 and other scientific information. Therefore, self-selection bias could exist and affect the representativeness of the sample. Also, we decided to exclude social structure characteristics from our analysis, opening the possibility to a sociodemographic mismatch between the 1st and 2nd outbreak population of respondents. Yet, it is worth noticing that the same recruiting method (same social media from the same scientific communicators) was used in both outbreaks, thus reducing the possibility of this mismatch. Therefore, we tried to reach as many people as possible and be cautious in our conclusion. Regarding the sample size, more people responded to the second survey than the first one, probably indicating the rise of people's interest in this kind of studies during the development of the pandemics. Second, the number of women that responded to the survey was 3–4 times higher than the number proportion of men. Thus, the possibility exists that the mean in GAD and depression symptoms of the total population over represent the symptomology of women. As a positive aspect, it worth noticing than the behavior of GAD and depression symptomology, as well as their levels associated with vaccination, physical activity and working status were equivalent for women and men, with the notorious exception of young men population. Therefore, the behavior of the symptomology of the total population may well represent that of men and women. Third, we assessed the psychological impact on general anxiety disorder and depression through self-reported answers of the participants rather than clinical diagnosis by a physician. To minimize this limitation, we surveyed using the GAD-7 and PHQ-9 questionnaires. These are well-established tools for valid and efficient screening and assessing the severity of GAD and depression in clinical practice and research (2, 3, 5–10, 12, 17, 20, 21, 34–39). In addition, we think that increased or decreased symptomology in large samples may well represent the direct impact in general anxiety and depression disorders of the population. Fourth, the cross-sectional design adopted in this study implies that the association between GAD and depression symptomology with the different waves and vaccine inoculations is not necessarily causal. Also, other confounding factors associated with the vaccinated group of people may explain the decrease in depressive symptoms. Finally, this is a correlational study at group level. Therefore, the conclusions do not necessarily apply to a particular individual but reflect the possible risks and benefits for different groups in the population. Future longitudinal studies, at the individual level in other countries or regions, may help support our findings and rule out the possibility of ecological fallacy.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Council of the Life Sciences Department of the Instituto Tecnológico de Buenos Aires. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

DM, FB, HV, and JM contributed to the conception and the design of the study. FB, PB, and AB obtained the data. PB, AB, FM, VR, and CG organized the database, performed the statistical analyses, and sketched the figures. DM, HV, CK, FB, and JM oversight the statistical analyses and figures. DM and HV wrote the first draft of the manuscript. PB and AB wrote the first draft of the methods section. DM, HV, FB, CK, JM, PB, and AB contributed to the manuscript revision. All authors read and approved the final version of this manuscript.

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COVID-19 Pandemic: The Impact of COVID-19 on Mental Health and Life Habits in the Canadian Population

Felicia Iftene[1], Roumen Milev[1], Adriana Farcas[2], Scott Squires[2], Daria Smirnova[3] and Konstantinos N. Fountoulakis[4]*

[1] Providence Care Hospital, Department of Psychiatry, Queen's University, Kingston, ON, Canada, [2] Center for Neuroscience Studies, Queen's University, Kingston, ON, Canada, [3] International Centre for Education and Research in Neuropsychiatry (ICERN), Samara State Medical University, Samara, Russia, [4] 3rd Department of Psychiatry, School of Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece

Objectives: The study aims to investigate the rate of clinical depression in the adult population during the COVID-19 pandemic, as well as the changes in anxiety, distress, suicidal ideation, and their relations with several personal and interpersonal/social variables.

Methods: This is an epidemiological, non-interventional study. It is part of an international multi-center study, with the main site at the Aristotle University of Thessaloniki, in Greece (COMET-G Study). We are presenting aspects of the research involving the Canadian site, based on 508 Canadian responders to the online survey (QAIRE).

Results: Of the 508 responders, 72.2% were females aged 42.57 ± 14.00 years; 27.2% were males aged 42.24 ± 15.49 years; and 0.6% were others aged 46.33 ± 17.79 years. Increased anxiety during the lockdown was reported by 69.3% of those surveyed. The rate of suicidal thoughts increased in 19.5% of participants during the lockdown. Depression was reported by 22% of responders, while distress was present in 18.4%. We found a greater prevalence of depression, but not distress, in individuals with a history of any mental disorder. Based on the multiple regression analysis, we found four CORE factors equally influencing the changes in mental health during the lockdown (gender, quality of sleep, family conflicts, and changes in daily routine). In the Canadian population, two major changes acted as protective factors, significantly expressed when compared with the worldwide tendencies: fewer financial difficulties; and an increase in religious beliefs.

Conclusion: The rate of major depression, distress, and suicidal ideation was higher in Canadians than in the worldwide population (per COMET-G), but the relative risk to develop depression in the presence of a history of mental disorders was lower. Almost 90% of Canadians believed in the real story of COVID source of provenience.

Keywords: depression, suicidality, mental health, conspiracy theories, COVID-19, Canada, lockdown

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National and Kapodistrian University of Athens, Greece

****Correspondence:***
Felicia Iftene
iftenef@yahoo.com

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INTRODUCTION

It has been more than 2 years since March 11, 2020, when the COVID-19 pandemic was declared. We started our journey through a very difficult time of uncertainty, facing an extreme threat. We have been dealing with major changes in our daily routines and expectations, facing isolation, unemployment, economic crisis, and increased human losses. We tried to better understand "the enemy," to get organized, develop, and follow rules and protocols. According to Statistics Canada, 90% of Canadians adopted public health precautions in less than 1 month.

In December 2020, during the second lockdown in Ontario and Alberta, the COVID vaccination started. In January 2022, during the Omicron wave, 84.3% of the Canadian population aged 5 years or older had received their first dose of vaccine (83.48% of Ontarians), while 78.0% were fully vaccinated. In Ontario, where we had one of the most successful vaccination campaigns in the world, 91.2% of vaccine doses have been administered (1).

Regarding the coping aspect of this pandemic, in June 2021, only 55% of Canadians reported "excellent" or "very good" mental health, compared with 68% in 2019. As expected, different nuances of anxiety and depression were experienced, going from extremis to panic and desperation.

There is a large body of literature analyzing different aspects of mental health changes during the COVID-19 pandemic, in general, as well as during lockdowns, in particular (2–5). A recent study, which included 1,006 subjects from Italy, evaluated the psychological repercussions of isolation during the first lockdown in the spring of 2020, concluding that the longer the isolation and the less adequate the physical space where people were isolated, the worse the mental health was (e.g., depression); during this critical time, online contact was found to be crucial in protecting mental health (6). A longitudinal observational study from Germany (7) focusing on anxiety disorders suggests that those with a personal history of mental disorders, particularly anxiety disorders and generalized anxiety disorder, are vulnerable to experience psychological strain in the context of the pandemic; they might likely overestimate the potential threat and should be targeted by preventive and therapeutic interventions. Using qualitative methods (8), it was identified that a history of anxiety or depression affects multiple levels of the social-ecological model during the pandemic, defining the most important mental health stressors. At the individual level, we see isolation/loneliness, fear of contracting COVID-19, and uncertainty about the future; at the interpersonal level, we have fears of family members contracting COVID-19, separation from family members, and domestic relationships; while at the community and societal level, these stressors are represented by employment, community and societal systems, and media. At the beginning of the pandemic, an Italian study (9), aimed at identifying psychological changes during the lockdown period as well as factors associated with these changes, was conducted (original sample = 2,766, with an online follow-up survey for 439 participants). The authors found an increase in stress and depression over the lockdown, but not anxiety. Higher levels of depression at the start of the lockdown, as well as fewer coping strategies and childlessness, were associated with increased depression at follow-up, whereas higher levels of stress at the start of the lockdown and younger age were associated with higher stress at follow-up. In China [Le (10)], a large sample, cross-sectional, population-based, online survey study was conducted to investigate the prevalence of and risk factors associated with mental health symptoms in the general population (56,679 participants), during the COVID-19 pandemic. The results of this survey indicate that mental health symptoms may have been common during the COVID-19 outbreak, especially among infected individuals, people with suspected infection, and people who might have contact with patients with COVID-19. Some measures, such as quarantine and delays in returning to work, were also associated with a decline in mental health among the public.

The COVID-19 pandemic stormed our lives and changed our perspectives. Unfortunately, studies on COVID-19 have significant data heterogeneity, largely due to differing cultural/economic specifics between countries, as well as differences in timing (data collected in different phases of the pandemic), sample size, and instruments. There was a need for a holistic, longitudinal, and comparable, real-time assessment of emotional, behavioral, and societal impacts of the COVID-19 pandemic across nations (11, 12). Konstantinos Fountoulakis and his international research team worked on the COMET-G study, which gives a larger picture of the phenomena by using both a standard time frame and identical instruments in 40 counties across the world. Our current paper is a part of Fountoulakis' international study, specifically looking at the mental health changes and their possible determinants in Canadians.

As researchers and mental health providers within the scope of precision and personalized psychiatry, we consider it important to identify the exact contribution of specific variables to observed pathology. This research aims to assess how the COVID-19 pandemic, either in itself or as a result of the measures adopted to control the outbreaks, has affected various aspects of the mental functioning, needs, and behaviors of the general population.

We are referring here only to the Canadian part of the research, based on 508 Canadian responders to the online survey. This portion of the international study aims to investigate the rate of clinical depression in the adult population over the age of 18 years in Canada during the COVID-19 pandemic. Secondary aims are to investigate the changes in anxiety, distress, suicidal ideation, and their relations with several personal and interpersonal/social variables.

We hypothesized that there will be an increase in depression and distress across the general Canadian population, with a higher rate in those with a history of any mental condition.

MATERIALS AND METHODS

This is an epidemiological, non-interventional study – part of an international multi-center study, with the main site at the Aristotle University of Thessaloniki, Greece, Europe.

The questionnaire used for this project was developed as part of an initiative by the Mental Health Sector of the Scientific Researches Institute of the Pan-Hellenic Medical Association.

This study was started in Europe, and the initial approval for this research project was given by the Ethics Committee of the Faculty of Medicine, Aristotle University of Thessaloniki, Greece. For our part of this research, we received approval from the Health Science Research Ethics Board at Queen's University, Kingston, Canada. Participation in this study was voluntary and the respondents had to be at least 18 years old to participate. The first QAIRE page included a declaration of consent, which all participants accepted before filling out the survey. Due to the format of the questionnaire, respondents were required to have access to technology and be able to read and answer questions in English or French.

We used two types of Google Documents links: one with the questionnaire for the respondents and one for monitoring purposes for the research team.

For data collection, the Google Documents (one in English and another in French) disseminated the QAIRE anonymous questionnaire across the general population of Canada. QAIRE was designed as an anonymous research tool (each respondent provided only their year of birth, with no other personal data being required or registered). Using a separate link, the research team was able to use Google Documents to check the number of responses and to facilitate the data collection, when necessary. This link was only for use in Canada, as the questionnaire related to Canada's lockdown conditions (and not any other country). All responses were automatically saved and summarized in the associated Excel file on Google Disc. Only Prof. Konstantinos Fountoulakis, two general coordinators, and our research team had access to this dataset online.

The expected sample was 8,000 to 10,000 responders across Canada – Canada's population is 38.01 million (2020). Inclusion criteria: any person of age 18 years and older, with access to technology, and who were able to read/answer the questions in English or French. The enrolment period lasted from August 2020 through March 2021.

The study population was self-selected. Initially, for the first 4 months, we (research team members, neighbors, colleagues, and people from different volunteering associations) distributed the questionnaire to people from Eastern Ontario, using emails to personal connections within the region (aiming to first obtain a description of the phenomena in this part of the country). We obtained 405 answers, from the South East Ontario Region's population of 1.76 million (which includes the cities of Ottawa, Brockville, Cornwall, Kingston and Pembroke, and towns of Gananoque, Prescott and Smith Falls, and counties of Prescott and Russell, Stormont, Dundas and Glengarry, Lanark, Leeds and Grenville, Frontenac and Lennox, and Addington). Subsequently, for the last four distribution months, we circulated the questionnaire using the most common media tools (Facebook, LinkedIn, Research Gate, and Twitter). Unfortunately, the rate of response fell below expectations. This was likely due in part to the important burden imposed by the pandemic, with people using media channels to comfort themselves rather than further focusing on worries and uncertainty. The increased availability of people contacted directly could be explained by a sense of responsibility and reciprocity, compared to the wide media approach which allows for anonymity and the freedom to postpone the engagement. Some responders provided us with feedback; from this, we learned that the 107 answers from the Canada-wide distribution came mainly from Nova Scotia, British Columbia, Québec, and Alberta.

Of the 512 total responders, we excluded 4 (who were under the age of 18 years), making the working sample of 508 persons. Distress and clinical depression were identified with the use of a cut-off and a previously developed algorithm, respectively. According to a previously developed method by the Greek site (13, 14), both a cut-off score of 23/24 for the CES-D as well as a derived algorithm were used, with cases of major depression being those identified by both methods. Those identified by only one of these tools are considered cases of distress (false positive cases in terms of depression). The two bibliographical studies show that 10% of the population are falsely diagnosed with depression by CES-D; these respondents were not depressed but had high-stress levels. A combined approach with the algorithm plus the cut-off method was able to clarify if the person is depressed or stressed.

Measures

The online questionnaire (QAIRE) registered demographic, health data, previous psychiatric history, current symptoms of anxiety [STAI-Y1 state, (15)], depression (CES-D), and suicidality (RASS), as well as changes in sleep, sexual activity, family relationships, finance, eating, exercising, and religion/spirituality. Each question of the QAIRE questionnaire protocol was given an ID code, reflecting the part of the protocol it belongs to, with a capital letter (defining 12 sections, coded from A to P) and a number (total 121 questions, with Likert scale response options) to denote its position within that protocol part. Throughout the results, these ID codes are used for increased accuracy (**Supplementary Appendix 4**).

Statistical Analysis

A method of simplified post-stratification was used to create a standardized study sample with characteristics as close as possible to those of the general population. Considering the small sample size, we measured the Cronbach's alpha for the scales we used: alpha CES-D - 0.92; alpha STAI-Y1-0.93; alpha RASS-0.42.

Descriptive statistics were calculated and descriptive tables were created for the variables under investigation. Chi-square tests were used for the comparison of frequencies when categorical variables were present, and for the *post hoc* analysis of the results, a Bonferroni-corrected method of pair-wise comparisons was used. We performed multiple forward stepwise linear regressions. Multifactorial Analysis of Variance (MANOVA) was used to test for the main effect as well as the interaction among categorical variables, with Tukey's *post hoc* test being employed to investigate which variables could contribute to the development of others.

RESULTS

Study Sample

Of the 508 responders, 72.2% were females aged 42.57 ± 14.00 years; 27.2% were males aged 42.24 ± 15.49 years; and 0.6% were others aged 46.33 ± 17.79 years (**Table 1**: Descriptive Data).

Living Situation, Family Status, and Relationships

Only 18.3% of the study sample was living in the country's capital (Ottawa), 15.2% in a city of more than one million inhabitants, and 42.9% in a city with 100,000 to 1 million inhabitants. More than half (65%) of responders were married or common-law partners (marital status); only 14.6% were living alone (with nobody else under the same roof); and 45.9% had three or more people living in the house during the lockdown. In our sample, 243 responders (47.8%) had no children at all, while 28.1% have two children. For families with children, 22.7% stated that it was more difficult to manage their daily life and behavior than before. The responders stated that they were a close relative or caretaker of a person that belongs to a vulnerable group in 45.5% of cases. During the lockdown, the family relationships became more conflictual in 23.8% of cases, less conflictual in 20.3% of cases, and 55.9% of responders reported no changes. The overall quality of relationships with other family members was reported to have improved for 27.9% of responders, worsened for 18.8% of responders, and remained unchanged for 58.5%. The basic daily routine (waking up in the morning, regular meals and sleeping hours, and activities) was affected in 91.3% of cases, with 64.4% of responders noting this to be the case either "most of the time" or "always."

Education, Work, and Finances

A 88.8% of responders had a bachelor's degree or higher. In terms of employment, 45.3% were civil servants, approximately 17% were working in the private sector, 11% were college or university students, and 10.7% were retired or were not working for a variety of reasons. From our sample, 29.9% were working in the healthcare sector (6.5% were doctors, 5.1% were nurses, 3.1% were administrative staff in hospitals, and 15.2% other healthcare professions/hospital staff). The percentage of people that did not work during the lockdown was 15.2%. Changes in finances due to the outbreak were reported as worse in 28.4% of cases, better in 21.6%, and unchanged in 50%.

TABLE 1 | Descriptive statistics of the original (raw) and the standardized study samples in comparison to the general population.

	General population aged 18–87 years old		Raw study sample		Standardized study sample
	N[1]	%	*N*	%	%
Sex					
Males	9.98 mil	48.49	138	27.2	48.5
Females	10.6 mil	48.94	367	72.2	51.5
Other	0.75 mil	0.34	3	0.6	0.3
Age					
Males mean age	40.1		43.01		43.01
Females mean age	42.2		42.57		42.57
Other mean age			46.33		
Work status					
Total population	20.58 mil		508	100	100
Unemployed	1.89 mil		17	3.4	4.3
Students	1.78 mil		56	11	12.3
Self-employed	2.9 mil		134	26.3	27.7
Civil servant	3.6 mil		230	45.3	42
Disability pension	6.2 mil		4	0.8	1.2
Other			28	5.5	5.0
Family and household					
Married	14,547,623		305	60	59.5
Lives alone	3,969,790		75	14.8	14.7
2-people household	4,834,605		202	39.8	37.2
3-people household	2,140,640		85	16.7	17.6
4-people household	1,946,275		106	20.9	22.0
>5 people household	1,180,770		40	7.9	8.5
Mental health history					
History of deliberate harm			81	15.9	
History of suicide attempt			30	5.9	

[1] *Source: www.statista.com.*

General Somatic Health and Lifestyle Changes

A history of chronic somatic diseases, such as asthma, diabetes mellitus, and hypertension was reported by 28.5% of responders. A worsening sleep pattern was reported by 47% of responders; 55.1% tended to stay up late at night and slept for many hours during the day; 37.4% reported experiencing dreams in which they felt trapped; 8% were taking sleeping pills for insomnia.

And 84.4% of responders acquired an internet-related habit they didn't have before (e.g., a new FB account, engaging in cybersex, or gambling); a majority of respondents (80.7%) observed that the internet took up more of their time than usual.

Changes in their sexual life were reported by 37.8% of responders, with a decrease in desire for sexual intercourse reported in 20.9% of cases, and 20.7% of responders characterizing the frequency of their sexual intercourse as clearly inadequate. However, 30.5% believed that sex helps in dealing with stress and anxiety either "much" or "very much," while 25% did not believe it does so at all.

Physical activity was not affected by lookdown for 20.9% of responders, while it decreased by 44.3% and increased by 34.9%. A great number of subjects (90%) stated that exercise helps with anxiety prevention, with 49.5% saying it does so either "much" or "very much."

Eating habits were unchanged for 39.0% of responders, 41.7% were eating larger amounts of food or more meals per day than usual, and 30.5% reported eating healthier than usual. An increase in body weight was reported by 43% of responders.

During the lockdown, there were reported positive changes (using less) in smoking (11.6%), drinking patterns (15.2%), and illegal substance use (11.2%). A worsening use pattern was reported by 9.3% of responders for smoking, 29.3% for drinking (more than one drink or its equivalent every day), and 4.1% for illegal drugs.

Changes in religious/spiritual beliefs were present in 34% of those surveyed.

Conspiracy Theories

Supplementary Appendix 3 summarizes the responses to all conspiracy theories, by current clinical depression and history of any mental disorder. We did not find a significant correlation between any theory and current depression and/or history of mental illness.

Mental Health Data

Emotional Status

Increased anxiety during the lockdown was reported by 69.3% of those surveyed, and more than 18% reported that it increased "much" (24.8% reported unchanged and 5.7% reported decreased anxiety during the lookdown). The rate of suicidal thoughts increased for 19.5% of responders during the lockdown.

Depression at the time of completing the survey was reported by 22% (112 individuals), while distress was present in 18.4% of responders.

The subjective (by answers to specific questions) and objective (CES-D) emotional state is represented in **Table 2**.

The rate of clinical major depression and distress was higher in females (**Table 3**).

The health care workers, working on the front line during the pandemic, were the category of people most exposed to contracting the virus. The rate of distress versus major depression among health care professionals was not as high as expected (**Table 4**).

TABLE 2 | Emotional state by answers to specific questions (subjective) and clinical depression considering both CES-D methods (objective).

Question	Scoring	%
F21. How much has your emotional state changed in relation to the appearance of anxiety and insecurity compared to before the COVID-19 epidemic?	It got a lot worse	18.3
	It got a little worse	51.0
	Neither better nor worse	24.8
	It's a little improved	4.1
	It has improved a lot	1.8
G21. How much has your emotional state related to the experience of joy or melancholy changed in comparison to before the COVID-19 epidemic?	It got a lot worse	13
	It got a little worse	46.3
	Neither better nor worse	35.0
	It's a little improved	4.3
	It has improved a lot	1.4
O11. How much has your tendency to think about death and/or suicide changed, compared to before the outbreak of COVID-19 epidemic?	Very much increased	3.5
	Increased a bit	15.9
	Neither increased nor decreased	75.8
	Decreased a bit	3.7
	Very much decreased	1.0
Clinical depression according to both CES-D methods	No depression	59.6
	Depression according only to CES-D cut off[1]	40.2
	Depression according only to CES-D algorithm[1]	22.2
	Depression according to both methods[2]	22.0

[1]*Distress.* [2]*Clinical depression.*

TABLE 3 | Rate of distress and depression by gender.

	No symptoms (*n* = 303)	Distressed (*n* = 93)	Depressed (*n* = 112)
Sex (% of group)			
Males	100 (33.0)	16 (17.2)	22 (19.6)
Females	201 (66.3)	77 (82.8)	89 (79.5)
Other	2 (0.7)	0	1 (0.9)
Mean Age (SD)	44.4 (14.3)	38.5 (14.6)	41.6 (13.2)

TABLE 4 | Rate of distress and depression by employment in health care sector.

Employment in health sector (% of group)	No symptoms (*n* = 303)	Distressed	Depressed (*n* = 112)
Doctor	20 (6.6)	9 (9.7)	4 (3.6)
Nurse	18 (5.9)	2 (2.2)	6 (5.4)
Other clinicians	41 (13.5)	11 (11.8)	18 (16.1)
Administrative staff	9 (3.0)	5 (5.4)	2 (1.8)
Other hospital staff	5 (1.7)	1 (1.1)	1 (0.9)
Does not work in health sector	210 (69.3)	65 (69.9)	81 (72.3)

TABLE 5 | The relationship between depression and previous history of psychiatric and/or chronic somatic disorders (Chi-square tests).

History	Control	Distressed	Depressed	% Depressed	Chi-square (*df* = 2)
Any mental disorder	**107a (143.1)**	52a (43.9)	**81a (52.9)**	33.8%	48.37, $p < 0.001$
No mental disorder	**196b (159.9)**	41a (49.1)	**31b (59.1)**	11.6%	
Anxiety disorder	48a (48.9)	18a (15.0)	16a (18.1)	19.5%	1.02, $p = 0.602$
No anxiety disorder	255a (254.1)	75a (78.0)	96a (93.9)	22.5%	
Depressive disorder	**49a (80.5)**	29a (24.7)	**57a (29.8)**	42.2%	51.76, $p < 0.001$
No depressive disorder	**254b (222.5)**	64a (68.3)	**55b (82.2)**	14.7%	
Other disorder	10a (13.7)	5a (4.2)	8a (5.1)	34.8%	2.98, $p = 0.225$
No other disorder	293a (289.3)	88a (88.8)	104a (106.9)	21.4%	
Self-harm	**31a (48.3)**	16a (14.8)	**34a (17.9)**	42.0%	24.85, $p < 0.001$
No self-harm	**272b (254.7)**	77a (78.2)	**78b (94.1)**	18.3%	
Suicide attempt	**12a (17.9)**	5a (5.5)	**13a (6.6)**	43.3%	8.66, $p = 0.013$
No suicide attempt	**291b (285.1)**	88a (87.5)	**99b (105.4)**	20.7%	
Chronic somatic condition	83a (86.5)	24a (26.5)	38a (33.9)	26.2%	2.13, $p = 0.345$
No chronic somatic condition	220a (216.5)	69a (66.5)	74a (80.0)	20.4%	

The bold values are statistically significant.

Relationship Between Depression and Previous History of Psychiatric and/or Chronic Somatic Disorders (Chi-Square Tests)

More than half of the responders (52.1%) reported having no history of mental disorders. A history of anxiety was present in 16% of responders, bipolar disorders in 1.2%, and psychosis in 0.4%, while a history of depression was present in 26.4%.

The relationship between depression and previous history of psychiatric and/or chronic somatic disorders (Chi-square tests) is represented in **Table 5**.

The highest Relative Risk (RR) to develop depression concerned the coexistence of history of depression and self-harm/attempts (RR = 4.71) (**Table 6**).

Prediction of Changes in the Mental State During the Pandemic (Forward Stepwise Multiple Linear Regression)

Dependent variables: Change in anxiety, change in depressive affect, presence of distress or depression, change in suicidal thoughts; 54 Independent variables (**Supplementary Appendix 1**). In **Supplementary Appendix 2**, we illustrated the protective factors (in green) and the risk factors (in red) for each of the four dependent variables (change in anxiety, change in depressive affect, presence of distress or depression, and change in suicidal thoughts). In our analysis, we included an entity named CORE factors, that were consistent across all four of the psychopathology variables; two of them acted as protective factors (keeping a basic routine during the lockdown and the improved sleep) and two as risk factors (gender-female and conflicts with family). The other factors included specifics in the equation of each of the four changes in mental status discussed (**Supplementary Appendix 3**).

DISCUSSION

This study aimed to investigate the rate of clinical depression in the adult population during the COVID-19 pandemic, as well as changes in anxiety, distress, suicidal ideation, and their relations with several personal and interpersonal/social variables. We found that the rate of suicidal thoughts increased for 19.5% of responders during the lockdown. Depression was reported in 22% of participants, while distress was present in 18.4%.

Our Sample

Comprised 508 subjects, with a better representation for individuals living in Eastern Ontario, than Canada wide. However, the standardized study sample, from **Table 1**, provided close values. We used these values (**Table 1**) only to ensure that the demographic composition of our sample is comparable to the general population (16) – in our case, the Canadian population. Our results reflect the raw data and not the standardized sample. Through our analysis, we followed the same steps and strategies used in the parent study COMET –G. Through our analysis, we

TABLE 6 | The relative risk to develop depression in people with history of various mental disorders versus participants with no mental health history.

	Without history of self-harm or suicide attempt		With history of self-harm or suicide attempt	
History	**%**	**RR**	**%**	**RR**
No history of mental disorder	10.2	1.00	41.7	4.09
Any mental disorder	30.5	2.99	41.1	4.03
Anxiety disorder	17.9	1.75	26.7	2.62
Depressive disorder	38.8	3.80	48.0	4.71
Other disorders (e.g., psychosis, bipolar)	40.0	3.92	25.0	2.45

followed the same steps and strategies used in the parent study COMET –G. Gender/age distribution showed 72.2% females aged 42.57 ± 14.00 years; 27.2% males aged 42.24 ± 15.49 years; and 0.6% others aged 46.33 ± 17.79 years.

Living Situation, Family Status, and Relationships

A significant percentage of responders reported deterioration in family dynamics during the lockdown (conflicts, change for worse in the quality of relationships). As expected, changes in basic routine affected 91.3% of subjects, with routine being changed "most of the time" or "always" for 64.4% of responders. Fountoulakis found that a higher number of individuals in Greece were able to maintain their daily routine (18.13%) during the lockdown.

The families with children (52.8% in our sample) indicated struggling to manage their behaviors more than before the pandemic in 22.7% of responses, similar to Greek families (27.43%). In Italy (17), research conducted on 1226 parents found that 17% of their sample experienced significant parenting-related exhaustion, with mothers more severely affected. Greater parenting-related exhaustion was predicted by psychological distress, lower parental resilience, motherhood, fewer perceived social connections, and being single, as well as having a child with special needs, having a large number of children, and having younger children.

The rate of people being either relatives or caretakers of vulnerable persons was slightly higher in our sample (45.5%) than the one communicated by the COMET-G Study (44.41%).

Under 15% of responders from our sample were living alone (still higher than the responses communicated by the COMET-G Study, of around 10% worldwide), becoming even more isolated during the pandemic. In addition, fewer than 20% of our subjects reported a decrease in communication with the extended family.

Education, Work, and Finances

Our sample was comprised of a high number of highly educated people with more than bachelor's degree as their educational status (88.8%), higher than the general Canadian population where only 64% have higher education. This is probably due to the self-selection of responders. The worldwide percentage of people with higher education is 75%, according to the COMET-G Study [COMET-G, (18)]. In terms of employment, 11% were college or university students, 10.7% were retired or were not working for a variety of reasons, and almost 30% were working in the health sector. A higher number of people were working during the pandemic in our sample than worldwide (78.4% compared with 66.14%). It would be interesting to know the percentage of people working remotely, from home (QAIRE had no question targeting this aspect). There are differences in changes in mental health during the lockdown, modulated by the type of work [see section "Relationship Between Depression and Previous History of Psychiatric and/or Chronic Somatic Disorders (Chi-Square Tests)"]. Despite the increased number of people not working during the lockdown, 21.6% of responders from our sample stated that their finances have improved, while 50% stated that their financial status was unchanged. This is one of the protective factors for anxiety and depression and could be explained by the generous compensatory financial support through Canada's COVID-19 Economic Response Plan; for example, CERB (Canada Emergency Response Benefit), provided as financial support to employed and self-employed Canadians who were directly affected by COVID-19, as well as Canada Emergency Student Benefit (CESB), and Support for vulnerable people (homeless, indigenous communities, senior). Another explanation for this preservation in financial status is the abrupt changes in lifestyle which may have reduced spending (beauty services, restaurants, and shopping malls closed; inability to travel or pursue other hobbies such as golfing, skiing; theatres and arenas closed, etc.). And finally, we suspect that the financial status was preserved by a lower percentage of people without work (21.6%) compared with the global general population of 33.86% [COMET-G, (18)]; in Greece, this percentage was 47.37% (19).

An interesting survey conducted in Korea in December 2020 found that among the 322 participants, the prevalence of probable depression and GAD were 19.3 and 14.9%, respectively, with high rates of probable depression (23.3%) and GAD (19.4%) among persons currently having job-related and financial issues. Decreased access to nature/greenspaces during the lockdown were significantly associated with depression; an alternative explanation was that those experiencing poor mental health may be less likely to visit green spaces during the pandemic (20).

General Somatic Health and Lifestyle Changes

Are extremely important in anxiety determinism (worsening of sleeping pattern, eating more, drinking more, increase in body

weight, increased time spent on the internet). A worsening sleep pattern was reported by almost half of our sample, with more than half (55.1%) tending to stay up late at night, which could be partially explained by the increased interest in internet use. An important percentage of people (84.4%) acquired a new internet-related habit during the pandemic (e.g., a new FB account, engaging in cybersex, or gambling), while the majority (80.7%) observed that the internet took up more of their time than usual. A study of the interactions between anxiety levels and life habit changes in the Russian general population during the pandemic lockdown (21) concluded that factors of decreased physical activity and sleep disturbances related to the lockdown, as well as excessive internet browsing for information about COVID-19, emerged as risk factors for increased anxiety, more notably in women than in men. The decreased physical activity in our sample was reported by 44.3% of responders and close to the 45.05% reported worldwide [COMET-G, (18)]. The decrease in smoking and use of illegal drugs was seen equally in Canadians as in the COMET-G Study, and both studies found comparable changes related to sexual life, eating, and sleep patterns. However, 34% of interviewed people in Canada increased their religious beliefs, compared to the 19.18% communicated in the COMET-G Study. This could be considered a protective factor for suicidal attempts, if not also for distress.

Conspiracy Theories

In the COMET-G Study, Fountoulakis (19) observed that some conspiracy theories are exerting a protecting effect at certain phases. We did not find a significant correlation between any theory and current depression and/or history of mental illness.

For Canadians, out of the seven theories inquired about, only the belief that "COVID-19 appeared accidentally from human contact with animals" was embraced by almost 90%, with 53.5% believing "much" and "very much" in this.

Changes in Mental Health

Emotional Status During the Pandemic

Increased anxiety during the lockdown was reported by 69.3% in our sample. Major depression was detected in 22%, while distress was present in 18.4%. When compared with the worldwide rate of 17.80% with major depression and 16.71% with distress, calculated under the same circumstances and time [COMET-G, (18)], there was a higher rate of both in Canada. A low rate of increased anxiety during the pandemic was reported in Pakistan, and the authors concluded that it "demonstrates either the resilience of Pakistanis or the lack of understanding of the seriousness of the situation" (22). Higher distress levels were reported by Yael (23), who imagined the profile of individuals with elevated distress as: "being younger, female, not in a relationship, having a below-average income, being diagnosed with the disease, living alone during the outbreak, having a close other in a high-risk group, and negatively self-rating one's health status." Chang et al. (24) found that fear of COVID-19 among people with mental illness was associated with psychological distress (including depression, anxiety, and stress), while the present study found that mental disorder is associated with depression only.

The rate of suicidal thoughts increased for 19.5% of responders during the lockdown, while the COMET-G study found an increase of only 17.16%. There is a large heterogeneity among countries in the description of suicidal behavior during the pandemic, again, possibly due to the different times of rating and different instruments used (18, 25, 26).

The History of Any Mental Disorder

A history of self-harm and suicidality represented a risk factor for developing depression. People with a history of any mental disorder had higher rates of developing depression than people with no such history; these rates are higher for Canadians when compared with the global population as reported in Fountoulakis' paper (32% vs. 13.07%). In Fountoulakis' paper, the highest risk was associated with a history of self-harm/suicidality/bipolar disorder (RR 5.88), while in the Canadian population, the higher risk was represented by a history of self-harm/suicidality/depression (RR 4.80). People with no history of mental illness had a lower risk of developing depression (RR 1.00), the same risk for Canadians as Fountoulakis' general population. The presence of a chronic somatic condition was not a significant risk factor for the development of depression in Canadians, compared with Fountoulakis 'general population where the RR was 1.22.

A history of self-harm or suicidality emerged as a risk factor even for persons without a reported mental health history, of which 41.67% develop depression in the presence of this risk factor. The combination of both self-harm and a history of suicidal attempts with specific mental health history revealed that subjects without any such history had the lowest rate of current depression (10.00%), while the presence of previous self-harm/attempts increased the risk in subjects with past anxiety (26.67%), depression (48.00%), and other mental disorder (25.00%).

Prediction of Changes in the Mental State During the Pandemic (Forward Stepwise Multiple Linear Regression)

Of the protective and risk factors modulating the change in anxiety, the change in depressive affect, the presence of distress or depression, and the change in suicidal thoughts, we found four factors (CORE) that were consistent across all four of the psychopathology variables. Two of them acted as protective factors (keeping a basic routine during the lockdown and the improved sleep) and two as risk factors (gender-female and conflicts with family). A systematic review conducted on PubMed, Embase, Medline, Web of Science, and Scopus in 2020 [Jiaqi (27)] showed relatively high rates of symptoms of anxiety (6.33 to 50.9%), depression (14.6 to 48.3%), and psychological distress (34.43 to 38%) in the general population during the COVID-19 pandemic in China, Spain, Italy, Iran, the United States, Turkey, Nepal, and Denmark. Risk factors associated with distress measures included female gender, younger age group ($\leq$40 years), presence of chronic/psychiatric illnesses, unemployment, student status, and frequent exposure to social media/news concerning COVID-19.

CONCLUSION

In our sample, we found a greater prevalence of depression but not distress in individuals with a history of any mental disorder. Based on the multiple regression analysis, we found four CORE factors equally influencing all considered changes in mental health during the lockdown: gender, quality of sleep, daily routine, and conflicts with family.

In the Canadian population, two major changes acted as protective factors, significantly expressed when compared with the worldwide tendencies: the lesser financial difficulties (support offered by the Government, higher number of subjects working, even if from home) and an increase in religious beliefs. The impact was not on the general rate of major depression, distress, and suicidal ideation (these were higher in Canadians than worldwide), but on the lower relative risk to develop depression in the presence of a history of mental disorders.

Almost 90% of Canadians believed in the most probable real story of COVID source of provenience.

Our research findings will help better understand the factors involved in the determinism of depression, suicidality, and distress in the Canadian population during critical situations. These could be taken into consideration when organizing future mental health programs and interventions, aiming to protect at-risk populations.

Strengths and Limitations

The strength of the current paper derives from the large bulk of information obtained, which allowed us to have an idea of how the pandemic affected Canadians' life.

The limitations derive from the small sample size and the method in which data were collected (anonymously online through responder self-selection). The changes during the lockdown discussed here are only perceived changes as we do not have a pre-lockdown measure. The low internal consistency of the RASS (0.42) in the present study is another limitation.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Health Science Research Ethics Board at Queen's University, Kingston, ON, Canada. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements. Written informed consent was obtained from the individual(s), and minor(s)' legal guardian/next of kin, for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2022.871119/full#supplementary-material

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BRIEF RESEARCH REPORT
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Determinants of Stress Levels and Behavioral Reactions in Individuals With Affective or Anxiety Disorders During the COVID-19 Pandemic in Russia

Mikhail Yu Sorokin[1], Evgeny D. Kasyanov[2], Grigory V. Rukavishnikov[2], Maria A. Khobeysh[1], Olga V. Makarevich[1], Nikolay G. Neznanov[3,4], Tatyana G. Maximova[5], Dmitry N. Verzilin[6,7], Natalia B. Lutova[1] and Galina E. Mazo[2]*

[1] Department of Integrative Pharmaco-Psychotherapy of Patients With Mental Disorders, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia, [2] Department of Translational Psychiatry, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia, [3] Department of Geriatric Psychiatry, V.M. Bekhterev National Medical Research Center for Psychiatry and Neurology, Saint Petersburg, Russia, [4] Department of Psychiatry and Addictions, I.P. Pavlov First Saint Petersburg State Medical University, Saint Petersburg, Russia, [5] Faculty of Infocommunication Technologies, ITMO University, Saint Petersburg, Russia, [6] St. Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences, St. Petersburg Federal Research Center of the Russian Academy of Sciences, Saint Petersburg, Russia, [7] Department of Management and Economy of Sports, Lesgaft National State University of Physical Education, Sport and Health, Saint Petersburg, Russia

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Pedro Morgado, University of Minho, Portugal

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Arghya Pal, All India Institute of Medical Sciences, India
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***Correspondence:**
Mikhail Yu Sorokin
m.sorokin@list.ru

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Introduction: Individuals with affective and anxiety disorders are among those most vulnerable to the negative effects of the COVID-19 pandemic.

Aim: This study aims to analyze the determinants of stress levels and protective behavioral strategies associated with the COVID-19 pandemic in Russian-speaking people with affective or anxiety disorders (AADs).

Materials and Methods: In this cross-sectional online survey, the psychological distress and behavioral patterns of respondents with self-reported AAD (n = 1,375) and without disorders (n = 4,278) were evaluated during three periods of restrictive measures in Russia (March–May 2020). Distress levels were verified using the Psychological Stress Measure (PSM-25).

Results: Stress levels among respondents with AAD were higher at all study periods than for those with no mental disorder (Cohen's d 0.8–1.6). The stress level increased (Cohen's d = 0.4) in adolescents (16–18 years) with AAD and remained the same in those without disorders; in youths (19–24 years) with and without disorders, an increase (Cohen's d = 0.3) and a decrease (Cohen's d = 0.3) in the stress were observed, correspondingly; the stress in adults (25–44 years) with disorders did not change and decreased in those without disorders (Cohen's d = 0.4). Individuals with bipolar disorders demonstrated lower stress than individuals with depressive (Cohen's d = 0.15) and anxiety disorders (Cohen's d = 0.27). Respondents with depressive and bipolar disorders employed fewer protective measures simultaneously and were less likely to search for information about COVID-19.

Conclusion: The presence of affective or anxiety disorders is associated with a more acute response to the COVID-19 pandemic. Apparently, the type of mental disorder influenced stress levels and protective behavior patterns.

Keywords: SARS-CoV-2, anxiety disorders, depressive disorder, bipolar disorder, psychological distress, health risk behavior

INTRODUCTION

Stress associated with the COVID-19 pandemic has a complex multifactorial nature and an ambiguous profile of the behavioral reactions of the population (Fountoulakis et al., 2022). The danger of coronavirus infection has caused a wide range of psychological problems among the population of countries with high viral infection rates (Qiu et al., 2020). The greatest negative impact on mental health has been caused by such factors as: an unprecedented, potentially life-threatening situation of uncertain duration and economic consequences; increased family conflicts during large-scale quarantine measures in all major cities; an inconsistent information background with an oversupply of contradictory data (Sorokin et al., 2021; Vrublevska et al., 2021). The mental health consequences of such a crisis, including an increase in suicide rates, are predicted to continue for a long period of time and to peak after the actual pandemic (Pirkis et al., 2021).

Initial results confirmed that individuals with affective disorders are exposed to higher levels of stress, which in turn are associated with maladaptive situational and lifestyle changes occurring in response to the COVID-19 pandemic (Van Rheenen et al., 2020). In such individuals, the maladaptation and levels of preexisting anxiety and depressive symptoms are likely to increase with each subsequent wave of COVID-19 infection because they are more vulnerable to biological, social, and economic disruptions (Dabrowska et al., 2021). Moreover, individuals with affective or anxiety disorders are in high need of many variable factors associated with proper mental health care. Regular access to mental health-care services, medications, stable daily routines, and social interactions are necessary for those with mood illnesses. The psycho-social stress and limited access to the abovementioned elements could significantly affect the anxiety and mood symptoms in individuals with mental disorders (Asmundson et al., 2022). Subsequently, it was found that individuals with affective disorders have an increased risk of COVID-19 infection, as well as an increased risk of hospitalization and death (Diez-Quevedo et al., 2021). Thus, the impact of the COVID-19 pandemic on mental health is not equal for all groups of the population, especially for persons with major psychiatric disorders. Therefore, these imbalances in response to stress associated with the COVID-19 pandemic require more detailed study, taking behavioral reactions and socio-demographic indicators into account.

The study hypothesis is that the presence of affective or anxiety disorders is associated with a more acute response to the COVID-19 pandemic and epidemiological restrictions.

The study aims to analyze the determinants of stress levels and protective behavioral strategies associated with the COVID-19 pandemic in Russian-speaking people with affective and anxiety disorders.

METHODS

The study data were obtained through an extensive online survey conducted among Russian-speaking respondents during the restrictive period introduced as a measure to prevent the spreading of coronavirus infection. The most significant parts of the sample were obtained for 3 periods:

- 30 March to 8 April 2020 (1st period)–introduction of the first restrictive measures in Russia due to the worsening of the epidemiological situation;
- 29 April to 8 May 2020 (2nd period)–final stage of restrictive measures;
- 9 May to 18 May 2020 (3rd period)–cancellation of federal restrictive measures, early days of the post-restriction period.

Participants in the research were invited to complete an anonymous questionnaire *via* Google Forms, which took about 15 min. The questionnaire was distributed *via* social networks and on the websites of public organizations and thematic communities (refer to Acknowledgments).

The inclusion criteria were the ability to read Russian and consent to the processing of personal data. The non-inclusion criteria were the absence of values for individual points of the survey when filling in the questionnaire.

The questionnaire was based on self-reports on the socio-demographic characteristics of respondents and their place of residence, as well as on self-reports of their health status. The questionnaire, which was distributed in communities of patients with mental disorders, included a question on the presence/absence of a diagnosed affective or anxiety disorder with the option of choosing one of the proposed diagnoses in the questionnaire: depressive disorder, bipolar affective disorder, generalized anxiety disorder, cyclothymia, or dysthymia.

All participants in the study were invited to select any of the proposed concerns about the COVID-19 pandemic and any of the preventative measures they had implemented. Original questionnaire items which were already used earlier (Sorokin et al., 2020) described 10 types of concerns associated with COVID-19 (contagiousness of the virus; risk of isolation; the absence of specific treatment for COVID-19; fear for self-life; risk to the lives and health of relatives; possible financial difficulties; severe social consequences; lack of safety equipment for sale; possible lack of medication for daily intake; and impossibility of

traditional way of life) and six behavioral patterns of infection prevention (wearing a mask or respirator; use of antiseptics; hand washing; social distance; and self-isolation). The reliability of these two subsets of dichotomous questions was calculated with the Kuder–Richardson-20 test: for concerns—0.41, for preventative measures—0.6. The results reflected the diversity of emotional and behavioral reactions of respondents, so these levels were considered satisfactory. Individual respondents could also indicate how often they requested information about the pandemic during the last week ranked by eight degrees, ranging from "never" to "hourly".

Psychological stress scale (PSM-25) is 8-point Likert scale ("not at all" to "greatly") used Lemyre in 1990 to assess current stress levels. Translated and adapted version for the Russian-speaking population was used (Vodop'yanova, 2009). The integral indicator of psychological stress in it is the total score, varying between 25 and 200. It reflects the expression of emotional, cognitive, and somatic reactions through the indicators of three subscales identifying three levels of stress. A total of 6 of the 25 questions (nos. 2, 7, 9, 15, 16, and 22) on the psychological stress scale describing somatic stress reactions were evaluated separately. A high score–a sum higher than 155 points–indicates a state of maladaptation and the need for correction; a score of 154–100 points indicates an average level of stress; low–under 100 points–indicates a state of psychological adaptation to workloads. In this study, PSM-25 demonstrated excellent internal consistency with Cronbach's alpha 0.949.

The study design was controlled by the independent ethical committee (IRB registration number: Э К-И-132/20). It was in conformity with the Declaration of Helsinki. It included a collection of anamnestic, socio-demographic data, and clinical parameters after the respondents signed a voluntary informed consent.

Data Cleansing

We analyzed the values of the PSM-25 items to identify irrelevant answers and outliers. We used the scales of the PSM-25 items to calculate for all observations the Mahalanobis distances from the pattern consisting of average values. Then, we filtered out 11 outliers from the original 5,728 records. All outliers produced high Mahalanobis distances and revealed contradictory answers to interrelated questions. We also filtered out seven records with identical values in all PSM-25 items.

As there was no registration for the respondents, we checked the answers to the question: "Are you filling up this form for the first time?" For the repeated applications, we tried to find pairs with similar personal data as age, gender, educational level, marital status, occupation, and city. We identified 48 pairs (96 records) of repeat interviews of the same respondents. Among 48 pairs, we identified 26 where there was not $<$20 days between interviews. Those 26 pairs were analyzed separately as dependent samples. All 48 records of second interviews were removed from the main sample.

A total of three main grouping factors, including age, length of interview, and type of disorder (with no affective/anxiety disorder as a zero type), were used for extracting groups of records to be compared. We divided respondents into eight age groups and six periods. When comparing groups of records, we mostly used 1–5 age groups and 1–5 periods containing the majority of records.

Exploratory Analysis

We used the ANOVA test, IBM SPSS Statistics (RRID:SCR_019096), to compare the amount and dynamic of distress in groups of respondents with/without affective or anxiety disorders. All groups corresponding to different time periods were separated. We obtained higher levels of distress for respondents with a disorder and different dynamics of distress levels for groups of respondents with/without a disorder (increase/reduction in the distress level).

We used regression analysis to examine whether the total distress level depended on age. For all groups of records, we observed negative dependency between these two variables. As the age of respondents was distributed rather differently in the groups under observation, we had to use more detailed analysis to distinguish the effects of disorder type and age on the distress level.

Hypothesis Testing

When the gender composition of respondents was similar in all groups of observations (16% males and 84% females), the age distribution was essentially different. For example, the average age of respondents with a disorder was about 24, compared with 34 for those without a disorder.

For matching different groups of observations, we excluded random records, so that relative frequencies of ages became equal–not attempting to fit samples to an ideal, but filtering all the samples, so that the total number of records removed was minimal. We solved two optimization tasks: in the first task, we removed as few records as possible; in the second task, we used weights equal to inverse values of the sample sizes. The second task was used when the sample sizes were essentially different.

To compare different groups, we used factorial or one-way ANOVA and estimated standard errors and 95% confidential intervals for average values of dependent variables. We also performed *post hoc* analysis. When the variable did not match Gaussian distribution, we always used nonparametric tests, specifically repeated Mann–Whitney tests for two independent samples. However, we confirmed the fact that ANOVA tests are robust to the violation of normality for large sample sizes, as in our comparisons, ANOVA and nonparametric tests gave similar results. When testing hypothesis for all the PSM-25 items, we took into account multiple comparisons. However, there was no need to lower the level of significance, as p-values were usually low and there were many positive results among the PSM-25 items.

Sampling Characteristics

Based on the self-report data on the presence of mental disorders, the final sample of 5,662 records was divided into two groups. The research group included 1,375 records (24.1%) containing information on the presence of affective pathology: 590 (10.3%) depressive disorders (including dysthymia), 530 (9.3%) bipolar disorders (including cyclothymia), and 255 (4.5%) anxiety disorders (general anxiety disorder, and panic disorder).

The control group included 4,278 respondents (75.9%) who reported no affective or anxiety disorders.

To assess the age differences, the following subgroups of respondents within the research and control groups were included in the analysis: adolescents from 16 to 18 (1.6 and 1.8%, respectively), young adults from 19 to 24 (2.5 and 4.1%, respectively), and adults from 25 to 44 (19.9 and 42.7%, respectively). In all the subgroups analyzed (age, history of diseases, and specificity of reactions to the pandemic), the male to female ratio in the sample remained stable: 16 and 84%, respectively.

The survey covered respondents living in all federal districts of Russia. Residents of major cities made up 19.2 and 35% of the sample (Moscow and St. Petersburg, with populations of over 10 million and 5 million, respectively). Residents of other cities with populations of over one million accounted for 16.2%. Respondents from cities with a population of less than one million people constituted 29.6% of the sample.

RESULTS

Stress in Comparison Groups

In the exploratory analysis, data were obtained on significantly higher rates of psychological stress (Cohen's d 0.8–1.6) in respondents with affective or anxiety disorders than for those with no mental disorder (**Figure 1**). At this point, we examined full groups of respondents with no adjustments to the age structures. In factorial ANOVA, we obtained significant differences with $p < 2e\text{-}8$ between groups for the factor of disorder (yes/no) and for the join factor disorder*period. We obtained p=0,051 for the factor of period. *Post hoc* analysis (least significant difference (LSD) test) confirmed the differences with $p < 0{,}03$ for all $2*3 = 6$ groups except the pair period=2 and period=3 in the control group. For the factor of period, the tests of homogeneity of variances (Hartley F-max, Cohran C, Bartlett'sh chi-square) passed. The test failed for the factor of disorder. However, we can assume that the difference between the groups of respondents with/without affective disorder is too high ($p < 1e\text{-}15$) to be overturned with homogeneity tests.

In all age subgroups and time periods, respondents self-reporting affective or anxiety disorders (research groups) continued to show significantly higher rates of psychological stress than those with no affective/anxiety disorders (control group). It is noteworthy that the differences in stress levels between the control and research groups in the overall sample increased from the introduction of epidemiological restrictions to the period after their cancellation. However, these dynamics were not uniform in individual age groups.

Dynamics of Stress Levels Between Periods of Epidemiological Restrictions

Among the three age subgroups, an increase in stress levels in the research group and a reduction in the control group between the 1st and 3rd periods were observed only among

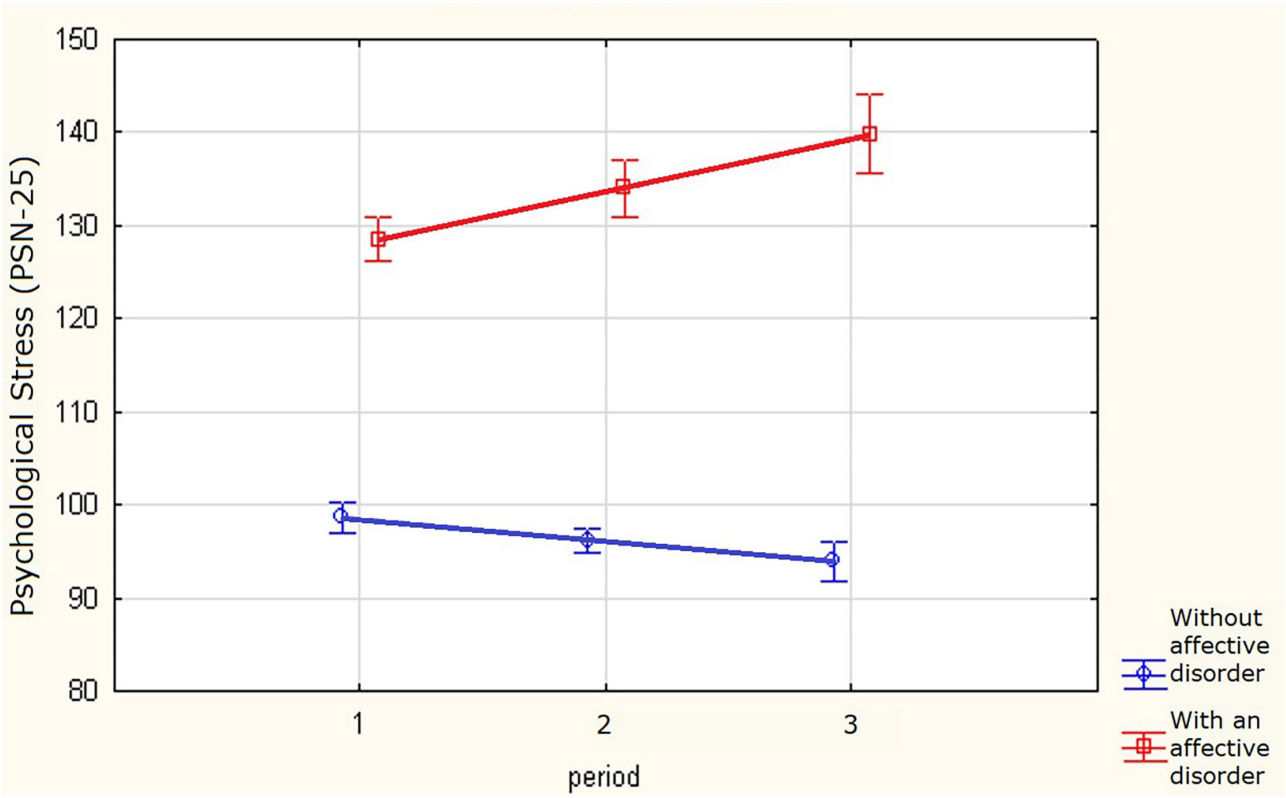

FIGURE 1 | Levels and dynamics of stress for respondents with/without affective or anxiety disorders.

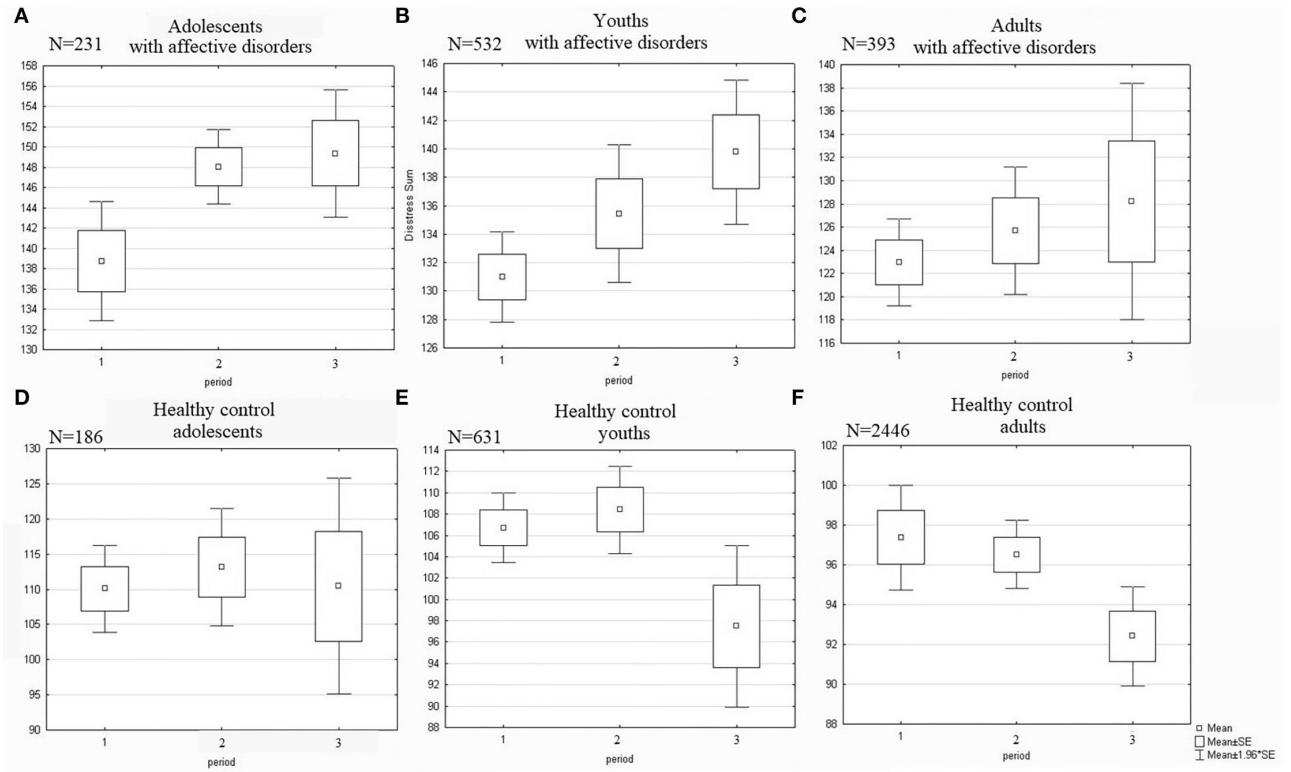

FIGURE 2 | Dynamics of stress levels in adolescents and youths in contrast to adults. Significant differences **(A)** between "1" and "2" with $p = 0.036$. **(B)** between "1" and "3" with $p = 0.02$. **(E)** between "1" and "3" with $p = 0.039$ and between "2" and "3" with $p = 0.012$. **(F)** between "1" and "3" with $p = 0.008$ and between "2" and "3" with $p = 0.017$. No significant differences between periods in adults with affective disorders **(C)** and in healthy control adolescents **(D)**.

young adults aged 19–24 (Cohen's d=0.32 and Cohen's d=0.30; **Figures 2B,E**). In all the remaining figures, we performed the Mann–Whiney U test to confirm inter-group differences as all samples were rather far from normal distribution. Adolescents aged 16–18 from the research group showed higher rates of psychological stress in the 3rd period than those interviewed during the introduction of restrictive measures in the 1st period (Cohen's d =0.39, **Figure 2A**), but no reliable control dynamics were revealed (**Figure 2D**). Among adults in the control group, a reduction in stress levels between the 1st and 3rd periods was observed (Cohen's $d = 0.40$, **Figure 2F**), but there were no reliable dynamics in the research group (**Figure 2C**).

High levels of stress among young adults in the research group were associated with higher somatic rates on the PSM-25 scale in the 3rd period compared with the 1st period (Cohen's d=0.26, **Figure 3A**). In contrast, individuals aged from 19 to 24 in the control group who were examined after the removal of the anti-epidemic restrictions showed a lower level of somatization than those examined at the beginning of quarantine in the 1st period (Cohen's d=0.40, **Figure 3B**).

Nosological Characteristics of Stress and Behavior Associated With the Pandemic

The level of stress on the PSM-25 scale was specifically associated with affective/anxiety disorders. Among subgroups of respondents with depressive, bipolar, and anxiety disorders, individuals with bipolar disorders demonstrated significantly lower levels of stress compared with individuals with depressive (Cohen's d=0.15) and anxiety disorders (Cohen's d=0.27) (**Figure 4A**).

It is also important to note that stress response characteristics were combined with the modification of protective behavior (**Figure 4B**) and the search for information about the pandemic (**Figure 4C**) both in the nosological subgroups of the research group and in the control group.

Respondents self-reporting depression and bipolar disorder used fewer protective measures simultaneously compared with the control group. However, there was a significant reduction in the concurrently practiced means of preventing infection only among those who reported depressive disorders (Cohen's $d = 0.15$), whereas among respondents with bipolar disorders the narrowing of protective measures were negligible (Cohen's $d = 0.1$). No reliable differences were found between the control group and the subgroup with anxiety disorders.

In the subgroup with depressive or bipolar disorders, respondents were less likely to search for news about the pandemic than those in the subgroup of anxiety disorders (Cohen's $d = 0.28$ and 0.28, respectively), and in comparison with the control group (Cohen's d=0.17 and 0.16, respectively). Participants self-reporting an anxiety disorder were the most

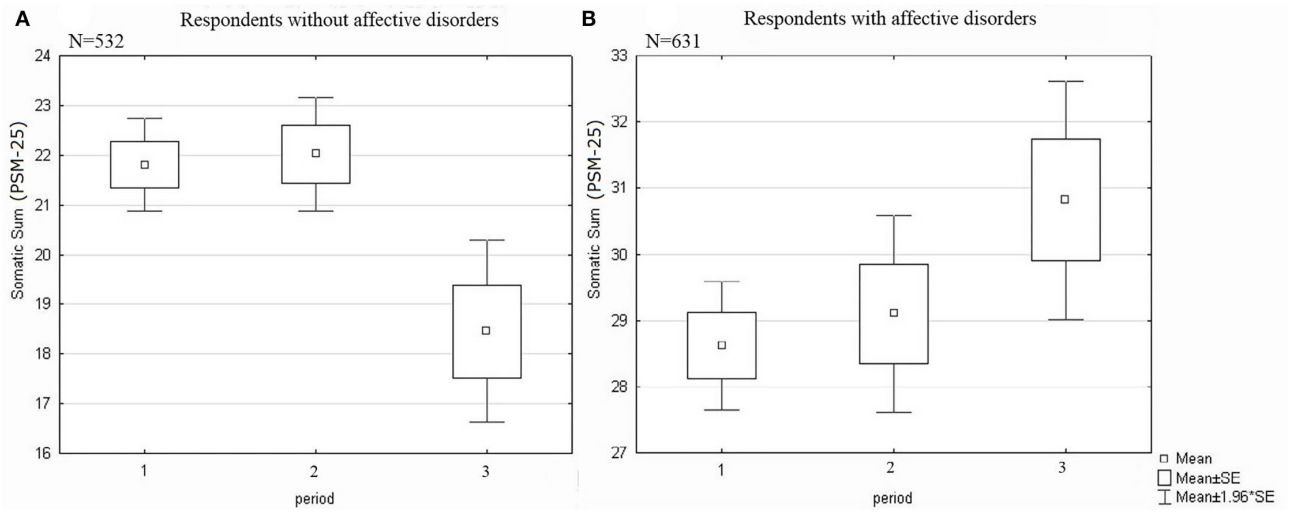

FIGURE 3 | Dynamics of somatization in presence of an affective/anxiety disorder among young adults. Significant differences **(A)** between "1" and "3" with $p = 0.01$ and between "2" and "3" with $p = 0.005$. **(B)** between "1" and "3" with $p = 0.046$.

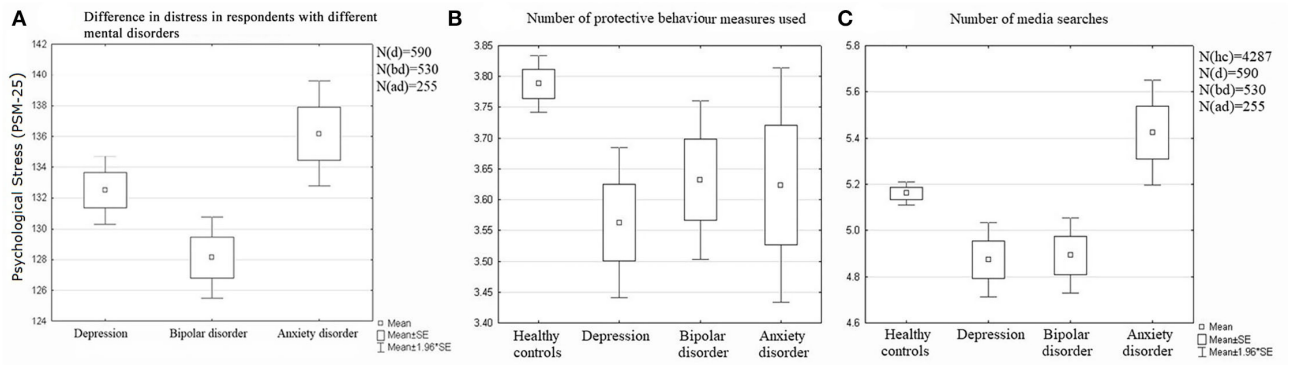

FIGURE 4 | Stress levels, anxiety, and behavioral reactions in respondents depending on the presence of an effective anxiety disorder. Significant differences **(A)** between "bd" and "ad" with $p = 0.002$. **(B)** between "hc" and "d" with $p = 0.0001$ and between "hc" and "bd" with $p = 0.043$. **(C)** between "hc" and "d" with $p = 0.017$, between "hc" and "bd" with $p = 0.012$, between "hc" and "ad" with $p = 0.001$, between "d" and "ad" with $p = 0.0002$, and between "bd" and "ad" with $p = 0.0001$.

likely to turn to the news (compared with depressive or bipolar disorders, Cohen's $d = 0.28$ and 0.28, respectively; with Cohen's $d = 0.16$). Respondents in the control group demonstrated an average frequency of searching for information about the pandemic.

DISCUSSION

Our research has demonstrated that the presence of affective or anxiety disorders is associated with a more severe response to the COVID-19 pandemic in different periods. Based on the socio-demographic characteristics, data on the behavioral reactions of the population and place of residence, as well as on the results of psychometric research on stress levels, we made four main observations.

First, stress levels among respondents self-reporting an affective or anxiety disorder were higher at all periods of the study than among those with no mental disorders. Second, the dynamics of stress levels in the research and control groups were heterogeneous and varied across the age subgroups. Third, the type of affective disorder influenced protective behavioral patterns and intensity of searching for information about the pandemic. Fourth, individuals with bipolar disorders had significantly lower stress levels than respondents with depressive or anxiety disorders.

As far as we can ascertain from available literature, this is the first study to provide evidence that multidirectional dynamics of stress during the COVID-19 pandemic are determined not only by the affective status of respondents but also by their age groups. In a sample of adolescents (16–18) and young adults (19–24) reporting a history of affective/anxiety disorders, average stress levels at the time of the cancellation of restrictive measures (period 3) were higher than at the time of the introduction of epidemiological restrictions (period 1). Among young and adult

respondents who denied having mental disorders, stress levels at the final stage of the restrictive measures (period 2) were lower than those initially identified.

The differences in stress levels and their dynamics in respondents who confirmed or denied the presence of affective/anxiety disorders (taking nosology into account) were linked to their behavioral patterns. An increase in time spent searching for information about the pandemic is known to be directly associated with increased anxiety (Nekliudov et al., 2020). At the same time, the usage of hand hygiene can be associated with the reduction of anxiety and stress associated with COVID-19 (Wang et al., 2020). In our sample, the history of anxiety disorders was associated with frequent searching for news about the pandemic. At the same time, the history of bipolar or depressive disorders was associated with less searching for news about COVID-19 in the media. Most notable is that respondents who reported a history of depressive disorders practiced the fewest protective behavioral strategies. Thus, the relatively favorable course of stress reactions in respondents with a history of bipolar disorders, on the contrary, was linked to a slight reduction in their protective behavioral patterns in relation to coronavirus.

The differences identified in behavior associated with the search for information about COVID-19 and protective measures in respondents from different nosological groups may be seen as a predisposition for a more effective response to stress among respondents self-reporting a bipolar disorder and respondents without mental disorders and less effective response among respondents self-reporting depressive or anxiety disorders. The wider spread of pandemic anxiety known from bipolar disorder literature is unlikely to be associated with the development of severe distress in our sample (Van Rheenen et al., 2020). It is possible that a stressful response to the COVID-19 pandemic may be related not to the intensity of anxiety stress but to a disturbance of an individual's adaptive-compensatory reactions (Sorokin et al., 2021). The different results regarding bipolar disorders in our study and the COLLATE project can also be explained by the use of different psychometric tools (Van Rheenen et al., 2020).

According to our data, this is one of the largest studies of the determinants of stress levels in the Russian population, which took into account the presence of mental disorders. The results of this study formed the basis for the development of algorithms for the diagnosis and therapy of mental disorders registered during the COVID-19 pandemic in Russia (Neznanov et al., 2021). The findings are important for public health to take preventive screening measures among the population to reduce the burden of the COVID-19 pandemic.

Limitations

The study had several limitations. First, it had a cross-sectional rather than longitudinal design, so the information on stress dynamics should be interpreted as a population change in response to the pandemic rather than as an increase or reduction in stress among the respondents over time. Second, data on the psychiatric condition of the subjects were based on their self-reports. According to the literature, this is strongly related to the results of medical history collection but does not enable us to speak about the verified diseases of respondents. Third, the need to comply with quarantine restrictions determined that the only possible format for conducting a study in the initial stages of the pandemic was in the form of an online questionnaire, which also had a number of features: the predominant participation of women in such studies and selection errors for persons who are not active users of the Internet. Fourth, the internal consistency of two subsets of questions about COVID-19 concerns and protective behavior was low. Meanwhile, according to Lee J. Cronbach, the reliability measure could reflect not only the consistency among items in a test but also the agreement among scorers of a performance test and the stability of performance of scores on multiple trials of the same procedure (Cronbach and Shavelson, 2004). In this sense, our results were taken into account as satisfactory and reflecting inter-subjects' diversity of COVID-19 reactions, as well as the differences revealed within periods of the pandemic and served an addition to main psychometric instrument (PSM-25) which demonstrated excellent reliability. Fifth, a number of data obtained in the course of the study, in particular about the specifics of somatic diseases of respondents, their education, family status, and the current level of the epidemic process in the region of their residence, were not taken into account in the analysis in this article, as they require further dynamic study taking into account the protracted nature of the pandemic.

CONCLUSION

Assessment of the population's psychological reactions to the COVID-19 pandemic is a complex task that requires not only consideration of socio-geographical (age, residence) and clinical characteristics (history of affective or anxiety disorders), but also an analysis of the time periods. Individuals self-reporting affective or anxiety disorders tend to respond more emotionally to the pandemic by forming a wide range of anxiety concerns and make less effective use of protective behavioral strategies. As a result, this may determine different trends in stress response: an increase in distress during a pandemic among those who report affective/anxiety disorders and a reduction among those who report no mental disorders. Given the dynamics observed, psychiatric services should be prepared for a greater burden of affective and anxiety disorders after the actual end of the pandemic, especially among young people. Future studies should pay more attention to the secondary mental health effects of the COVID-19 pandemic on the most vulnerable groups.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Independent Ethics Committee in V. M. Bekhterev

National Medical Research Center for Psychiatry and Neurology. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

Conceptualization of the study, goals, and aims: GM, NL, and EK. Investigation: EK, MS, OM, GR, and MK. Methodology and project administration: GM, NL, EK, and MS. Resources, writing, reviewing, and editing: NN, GM, and NL. Statistics: TM, DV, and MS. Writing (original draft): MS, EK, TM, and DV. All authors read and approved the final version of the manuscript.

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ORIGINAL RESEARCH
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Relatives Experience More Psychological Distress Due to COVID-19 Pandemic-Related Visitation Restrictions Than In-Patients

Sabine Felser[1], Corinna Sewtz[1], Ursula Kriesen[1], Brigitte Kragl[1], Till Hamann[2], Felix Bock[3], Daniel Fabian Strüder[4], Clemens Schafmayer[5], Désirée-Louise Dräger[6] and Christian Junghanss[1]*

[1] Hematology, Oncology, Palliative Medicine, Department of Internal Medicine, Clinic III, University Hospital Rostock, Rostock, Germany, [2] Department of Neurology, University Hospital Rostock, Rostock, Germany, [3] Department of Radiation Oncology, University Hospital Rostock, Rostock, Germany, [4] Head and Neck Surgery "Otto Koerner", Department of Otorhinolaryngology, University Hospital Rostock, Rostock, Germany, [5] Department of General Surgery, University Hospital Rostock, Rostock, Germany, [6] Department of Urology, University Hospital Rostock, Rostock, Germany

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Edited by:
Xenia Gonda,
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UOEH, Japan

***Correspondence:**
Sabine Felser
sabine.felser@med.uni-rostock.de

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Background: The COVID-19 pandemic led to visiting restrictions (VRs) of patients in hospitals. Social contacts between patients' relatives play an important role in convalescence. Isolation may cause new psychological comorbidity. The present study investigated the psychological distress of VR in in-patients and their relatives.

Methods: From April 1, 2020 to May 20, 2020, 313 in-patients (≥14 years) of the University Medical Center Rostock were interviewed by questionnaires and 51 relatives by phone. Subjective psychological distress was assessed by a distress thermometer [0 (not at all)−100 (extreme)]. The study also investigated stressors due to VR, psychological distress in dependence on demographic or disease-related data, currently used communication channels and desired alternatives and support.

Results: Relatives were more psychologically distressed by VR than in-patients (59 ± 34 vs. 38 ± 30, $p = 0.002$). Loss of direct physical contact and facial expressions/gestures resulted in the most distress. Psychological distress due to VR was independent of demographics and indicates small positive correlations with the severity of physical restriction and the general psychological distress of in-patients. The most frequent ways of communication were *via* phone and social media. Frequently requested alternatives for patients were other interlocutors and free phone/tablet use, for relatives visiting rooms with partitions.

Conclusion: VRs are a stressor for patients and their relatives. The establishment of visiting rooms with partitions and the free use of phones/tablets could reduce the additional distress.

Keywords: communication, COVID-19, psychological distress, stress, visit restriction

INTRODUCTION

As social beings, humans depend on interactions with others in group bonds and relationships. Especially during states of exception as hospitalization social contacts and clear targeted communication are of great relevance; however, depending on the situation often limited.

Information exchange regarding disease and therapy between physician, patient, and relatives has been shown to influence patient satisfaction, treatment outcome, the healing process, and compliance (1–4). Contact with family members and close friends has positive effects on the health, everyday experience, and wellbeing of hospital in-patients (5). Relatives are not only supporters, but also affected persons and caregiver, which leads to a multiple burden (6). As a result of the knowledge of the importance and positive effects of the patient-relative relationship, hospitals have established visiting hours. Visitation restrictions (VR) have existed since the first hospitals were founded in the early 1800's. These were to reduce the spread of diseases and protect patients and their families from stress (7). In 2020, severe restrictions on visiting hours and bans on visiting occurred as a result of the COVID-19 pandemic. WHO and the European Center for Disease Prevention and Control published strict public health measures and guidelines to reduce the spread of the Coronavirus (8). The German Bundestag declared an "epidemic situation of national significance" in March 2020 (9) and enacted legal Corona protection measures based on the WHO guidelines. In the middle of March 2020, severe VRs in hospitals were determined (10). Based on the evidence that isolation/quarantine for the prevention of infectious diseases can cause mental health problems, such as depression, anxiety, and insomnia, there has been intense debate about VR (11, 12). The psychological impact of VR resulting from the COVID-19 pandemic on hospitalized patients and their families is largely unknown. Preliminary study results on investigations in vulnerable groups (nursing home residents, patients in palliative and intensive care units including neonatology), relatives of hospitalized children, and those who tested positive for COVID-19 and their relatives showed increased lonesomeness, depressive symptoms, agitation, aggression, decreased cognitive abilities, and general dissatisfaction for patients. For relatives, concerns, fears, and insecurities occurred (13–19). The present study aimed to investigate prospectively: (I) Whether hospitalized patients and their relatives experience different levels of psychological distress as a result of COVID-19-related VR? (II) Which items are particularly distressing? (III) Whether demographic and disease-related data provide information about psychological distress? and (IV) Which communication channels alternative to personal contact are currently used and which additions in terms of communication channels are desirable?

MATERIALS AND METHODS

Study Design

The prospective study was designed as a two-arm cross-sectional study. A survey of in-patients and their relatives (relative was defined as the most important contact person) was conducted by questionnaire in person (patients) or by telephone interview (relatives).

Patient-Sample, Inclusion Criteria

From April 1st until May 20th, 2020, a self-designed questionnaire survey of in-patients (age $\geq$14 years) was conducted at 17 somatic clinics of the University Medical Center Rostock (UMR) with various areas of care. Questionnaires were only handed out to patients once during their stay with a length of stay $\geq$ 2 days. Further inclusion criteria were: ability to consent, German-speaking, and physical and cognitive ability to complete a questionnaire. For underage patients (14–17 years), these criteria applied with regard to the legal guardians. The patient questionnaire was administered during the informed consent interview to minimize the number of contacts. Questionnaires were distributed and collected by medical staff, nursing staff, and study center staff.

Survey of Relatives

Patients were asked to provide a relative with contact details. If a relative was named, the study center staff contacted that person by telephone. After consent was given, the interview was conducted according to a standardized interview template. The interviews had an approximate duration of 10 min.

Participation in the survey was voluntary, and all patient/relative data were analyzed in a pseudonymous manner. The study was reviewed and approved by the ethics committee of the University of Rostock (A2020-68).

Visiting Restrictions/Exceptions

From March 13th, 2020, strict visiting restrictions to the in-patient areas of the Rostock University Medical Center applied. In individual cases, it was possible to deviate from this procedure. This resulted in inconsistent procedures for different areas. In wards with primarily cure-oriented intentions, patients with palliative diseases were under certain circumstances allowed to receive visitors. On the palliative ward, a maximum of two visitors per day were allowed to visit dying patients, only. Minor children were allowed to be accompanied by a healthy caregiver. The procedure in each individual case was determined by the facility manager of the respective department. The senior physicians in charge of the wards ensured implementation in consultation with the nursing teams. From May 20th, 2020, the strict visitation restrictions were abolished. Patients were then allowed to receive visits from caregivers again under strict conditions. This marked the end of this survey.

Questionnaire/Interview

Demographics

Assessed were age, gender, living situation, and the patient-relative relationship (e.g., spouses).

Disease-Related Data

The following questions were asked of the patient: reason (diagnosis) for hospitalization, duration of illness to date, whether first hospitalization/in-patient stay, number of days spent as an in-patient, and expected length of stay.

Patients and relatives were asked to indicate on a distress thermometer (0 not at all and 100 extremely) how much they are currently physically restricted and under psychological pressure.

Importance of Communication

All participants were asked by means of 5-level Likert scales how important communication is in everyday life and direct communication with relatives, friends, etc. to them.

Attitude Toward Visitation Restrictions and Their Effects

Patients and relatives recorded: preferred frequency of visits, missed communication elements (e.g., facial expressions/gestures), understanding of the visitation restrictions, the general and personal perception of the VR on 5-point Likert scales, and the severity of the communication restriction. The strength of subjective psychological distress as a result of the VR was recorded using a distress thermometer (0 not at all−100 extremely). To be able to assess which proportion of the patients/relatives were distressed and to what extent, the following grouping was performed: Value "0" on the visual analog scale (VAS) = "not stressed," VAS $>$ 0 $\leq$ 30 = "slightly stressed," VAS $>$ 30 $\leq$ 70 = "moderately stressed," VAS $>$ 70 $\leq$ 90 = "highly stressed," and VAS $>$ 90 = "very highly stressed."

Current and Desired Communication Channels

Patients and relatives were asked to provide information about the technologies used and ways of communication under the given conditions. In addition to given answer options, the respondents had the opportunity to add further technologies. Furthermore, wishes and possibilities for improvement in communication were surveyed. In addition to the predefined answer options, there was also the possibility of free-text options.

Statistics

In addition to descriptive analysis, interval-scaled data were tested for normal distribution using the Shapiro–Wilk test. Depending on the scale level, correlations and mean differences were tested using the Pearson chi-square test, Spearman correlation, and Mann–Whitney U test, respectively. The level of significance was set at $p \leq 0.05$. Cramer's V (CV), effect size (ES), and correlation coefficient r, respectively, were used to interpret the strength of the relationships depending on the scale level. SPSS 22.0 (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis of the data.

RESULTS

A total of 313 patients participated in the survey. These provided eligible 85 relatives, 51 of whom agreed to the interviews.

Demographic Data

The questionnaires were completed by 120 (38%) women and 191 (61%) men (no sex $n = 2$). The mean age of the total cohort was 60 $\pm$ 16 years. Two hundred and seventeen (69%) of the patients lived with partner(s) and/or child(ren) at the time of hospitalization (**Table 2**).

Interviews were conducted with 51 relatives (40 (78%) women and 11 (22%) men) with an average age of 60 $\pm$ 13 years. Seventy-eight percent of the relatives were married to the patients (**Table 1**). The relatives-patients groups differed in gender distribution ($p < 0.001$, ES = 0.508).

Diseases-Related Data

Information on disease-related data can be found in **Table 2**. One-quarter of the patients each were assigned to neurological, surgical, or internal medicine institutions. Patients in the palliative care unit and patients hospitalized for COVID-19 infection were grouped under "palli/infect" (8%). "Other" facilities (18%) included radiation therapy, psychosomatics, dermatology, and pediatric and adolescent clinics. Approximately one-third of the patients surveyed were in-patients due to oncological disease.

Of all patients, physical impairment with a mean of 44 $\pm$ 29 was reported, and the current psychological distress with 38 $\pm$ 29.

The 51 family members reported a mean of 16 $\pm$ 23 for physical limitation and 54 $\pm$ 30 for current psychological distress. There were significant mean differences between patients and relatives for both factors ($p < 0.001$, ES = 0.466 and $p = 0.043$, ES = 0.200, respectively; **Table 1**).

Importance of Communication

Daily communication was considered important to very important by 80% of the patients and 100% of the relatives ($p < 0.001$, ES = 0.360). Direct communication with relatives, friends, etc. was considered (very) important by 76% of patients and 92% of relatives ($p < 0.001$, ES = 0.442; **Table 1**).

Attitude Toward Visitation Restrictions and Their Effects

Desired visit frequencies and missed communication elements are shown in **Table 1**. While 33% of the patients wanted daily visits, 65% of the relatives did ($p < 0.001$, ES = 0.345). Most frequently, both, patients and relatives, missed direct physical contact and nonverbal communication by means of facial expressions and gestures.

Comprehension of the VRs was 96% for each of the patients and relatives, respectively.

Figure 1 gives a graphical overview of the psychological distress and the perception of VR in patients compared to relatives. On average, patients reported psychological distress due to VR as 40 $\pm$ 32, whereas relatives reported it as 59 $\pm$ 34. The proportion of severely and very severely distressed was higher among relatives ($p = 0.002$). The sex-stratified analysis shows a higher psychological distress of the relatives in both genders compared to the patients (male: patients vs. relatives 40 $\pm$ 32 vs. 66 $\pm$29, $p = 0.012$, ES = 0.179; female: patients vs. relatives 41 $\pm$ 33 vs. 56 $\pm$ 35, $p = 0.014$, ES = 0.196).

As shown in **Table 2**, there are no associations between the severity of psychological distress due to VR and demographic characteristics. In relation to the disease-related data, there were small or medium associations between psychological distress due

TABLE 1 | Patient- and relatives-characteristics, study results.

	Variable	*n* = x (%) or mean ± SD (range)		*p*
		Patients	Relatives	
Patient- and relatives-characteristics	Total cohort	51	51	
	Sex			**<0.001***
	Female	14 (28)	40 (78)	
	Male	37 (72)	11 (22)	
	Age [years]	61±17 (15–89)	60 ±13 (33–82)	0.377
	Patient and relative living together			
	Yes	45 (88)		
	Patient and relative relationship			
	Married, cohabiting partner	40 (78)		
	Parent, child, other, N/A	11 (22)		
	First hospitalization			
	Yes	8 (16)		
	Days in hospital when interviewed			
	≤ 5	26 (51)		
	>5	23 (45)		
	N/A	2 (4)		
	Physical restriction (0 = none to 100 = extreme)	43 ± 29 (0–100)	16 ± 23 (0–80)	**<0.001***
	General psychological distress (0 = none to 100 = extreme)	41 ± 28 (0–100)	54 ±30 (0–100)	**0.043***
Study results	Psychological distress due to visitation restrictions (0 – none, 100 – extreme)	38 ±30 (0–100)	59 ± 34 (0–100)	**0.002***
	Importance of communication in everyday life			**<0.001***
	Very unimportant	0 (0)	0 (0)	
	Unimportant	2 (4)	0 (0)	
	Rather unimportant	8 (16)	0 (0)	
	Important	21 (41)	15 (29)	
	Very important	20 (39)	36 (71)	
	Importance of direct communication in everyday life			**<0.001***
	Very unimportant	1 (2)	1 (2)	
	Unimportant	3 (6)	0 (0)	
	Rather unimportant	7 (14)	3 (6)	
	Important	21 (41)	5 (10)	
	Very important	18 (35)	42 (82)	
	Desired visit frequency			**<0.001***
	<1 times per week	6 (12)	2 (4)	
	1–2 times per week	10 (20)	2 (4)	
	Every 2–3 days	16 (31)	10 (20)	
	Daily	16 (31)	33 (65)	
	Several times a day	1 (2)	0 (0)	
	Missing elements of communication			
	Direct physical contact	29 (57)	37 (73)	**0.049***
	Facial expression and gestures	23 (45)	37 (73)	**0.002***
	Voice	22 (43)	16 (31)	**0.280**
	Nothing	12 (24)	4 (8)	**0.036***
	Current contact via			
	Visit (special regulation)	8 (16)		
	Phone	45 (88)		
	Text-only messages	9 (18)		
	Video calls	11 (22)		
	Social media	32 (63)		

(Continued)

TABLE 1 | Continued

Variable	n = x (%) or mean ± SD (range)		p
	Patients	**Relatives**	
Desired support			
On mobile phone use	6 (12)	1 (2)	
For video calls	3 (6)	3 (6)	
Rooms/times for telephone calls	9 (18)	8 (16)	
Rooms/times for video calls	6 (12)	6 (12)	
Free bed phone	12 (24)	2 (4)	
Free use of tablet/pc	8 (16)	6 (12)	
Other interlocutors	19 (37)	N/A	
Others	3 (6)	20 (40)[1]	

SD, standard deviation; p, significance value; N/A, not available.
Bold/ statistically significant values ($p \leq 0.05$).*
[1]*Visit in a visiting room (with partitions) was indicated 16 times, 1 time each help with the use of the tablet, use of a ward tablet, conversation with the physician, and the possibility to meet/see outside or from the balcony.*

to VR and the degree of physical impairment ($p < 0.001$) or general psychological distress ($p < 0.001$). These associations did not become apparent to relatives. The variance resolution between the parameters "general psychological distress" and "psychological distress due to VR" was 21% (patients) and 8% (relatives).

Current and Desired Communication Channels

Of the 51 relatives, eight (16 %) had special visitation rights during the study period. The most frequently used means of communication were telephony and social media, which were used by 45 (88 %) and 32 (63 %) patient/relative pairs, respectively. Videotelephony was used to communicate by 11 (22%) patients/relatives pairs (**Table 1**).

Of all in-patients, 19 (37%) wished for other interlocutors (e.g., other in-patients and caregivers) as alternative visitors. Twelve (24%) wanted free bed phones and eight (16%) free use of tablet/PC. Relatives primarily used free text when indicating desired alternatives. Analysis of responses revealed that 16 (32%) desired patient visitations and suggested visitation rooms with partitions (e.g., glass partitions) as an option.

DISCUSSION

The study revealed that VR in hospitals to control the COVID-19 pandemic is an additional stressor for patients and their relatives. In the investigated cohort of in-patients and their relatives regardless of gender, relatives were more psychologically stressed by VR than patients. Direct physical contact and facial expressions/gestures were missed most by patients and relatives. Visitor rooms with partitions are a potential alternative to reduce psychological distress due to VR, especially for relatives. In the following, the causes and possible consequences of psychological distress due to VR and recommendations for action are discussed.

Attitude Toward Visitation Restrictions and Their Effects

Almost all patients and relatives had an understanding of the VR and generally considered them to be (very) good. This is consequently considering the aim and reason for the VR was to protect these groups of people from infection, among other things. Nevertheless, the consequences of the VR had an impact on the mental conditions of patients and relatives. The collected data show that patients and relatives felt the psychological distress due to VR comparable to the general psychological distress they were exposed to in the actual situation. Both parameters, "general psychological distress" and "psychological distress due to VR" correlate only slightly with each other. The low variance resolution indicates that the VR is an additional stressor that is largely independent of other parameters. Consequently, VR places additional stress on the mental status of patients and relatives, as described by Meesters, among others, in mothers of infants (14).

Since the study presented here is cross-sectional, no concrete statements can be made about the medium- and long-term consequences among the respondents. In addition, the psychological distress due to VR was not assessed qualitatively. But based on the fact that elective procedures were severely restricted during the study period as part of the provision of ICU capacity in the context of the COVID-19 pandemic, it can be assumed that patients were confronted with more serious medical conditions (more than one-third were hospitalized due to cancer). The impact of VR during the COVID-19 pandemic on the wellbeing of hospitalized patients and their visitors, particularly in vulnerable populations, was examined by Inees et al. (20). Overall, the VRs were associated with negative emotions and detrimental effects on most in-patients and their families, especially in the context of end-of-life care (21). In end-of-life care, limiting visits or prohibiting visits resulted in inadequate emotional and spiritual care/support for patients and anxiety and despair among family members (22, 23). Patients were afraid of dying alone (24). In patients in the postoperative period, VR affected

TABLE 2 | Patient characteristics and association with psychological distress as a result of visit restriction[a].

Variable	*n* = x (%) or mean ± SD (range)	*p*	CV or r
Total cohort	313		
Sex		0.193	CV = 0.141
Female	120 (38)		
Male	191 (61)		
Diverse, N/A	2 (1)		
Age [years]	60 ± 16 (15 – 89)	0.173	r = −0.078
Living situation		0.451	CV = 0.114
Alone	74 (24)		
With partner or child(ren)	217 (69)		
Nursing or retirement home, N/A	22 (7)		
Assignment of facilities		0.351	CV = 0.120
Neurology	71 (23)		
Surgery[1]	78 (25)		
Internal medicine[2]	81 (26)		
Palliative care / Infectology	25 (8)		
Others[3]	58 (18)		
Oncological disease		0.757	CV = 0.084
Yes	110 (35)		
No	162 (52)		
N/A	41 (13)		
Duration of illness [month]		0.637	CV = 0.102
<3	143 (46)		
3–12	78 (25)		
>12	76 (24)		
N/A	16 (5)		
First hospitalization			
Yes	71 (23)		
No	239 (76)	0.991	CV =0.031
N/A	3 (1)		
Days in hospital when interviewed		0.307	CV = 0.127
≤ 5	153 (49)		
> 5	150 (48)		
N/A	10 (3)		
Expected additional days in hospital (pts perspective)		0.363	CV = 0.119
≤7	165 (53)		
>7 or unknown	142 (45)		
Physical restriction (0 = none to 100 = extreme)	44 ± 29 (0–100)	**<0.001***	r = 0.233
General psychological distress (0 = none to 100 = extreme)	38 ± 29 (0–100)	**<0.001***	r = 0.458

[a]*On a scale from 0 (none) to 100 (extreme), the psychological distress resulting from the visit restriction is on average 40 ± 32.*

SD, standard deviation; p, significance value; CV, Cramer's V; r, correlation coefficient; N/A, not available.

[1]*General-, Visceral-, Vascular- and Transplant-Surgery, Otorhinolaryngology, Head and Neck Surgery, Urology, Neurosurgery, Trauma-, Hand- and Reconstructive-Surgery.*

[2]*Hematology, Oncology, Pneumology, Gastroenterology, Cardiology, Nephrology, Endocrinology.*

[3]*Radiation therapy, Psychosomatics, Dermatology, Children's Hospital.*

*Bold/*statistically significant values (p ≤ 0.05).*

satisfaction with the hospital experience, and patients without visitors reported social isolation due to a lack of psychosocial support (25).

We suspect that the greater psychological distress on relatives results in part from the fact that they could not form their own impression of the patient's condition. It is known that inadequate information is a stressor for negative psychological effects such as posttraumatic stress symptoms, confusion, and anger (26). Furthermore, relatives feel helpless and guilty, because they cannot support their beloved ones (24). In addition, due to the extensive Corona protection measures, the relatives were exposed to additional restrictions (e.g., quarantine, contact blocks, and distance regulations) in everyday life, which have direct negative psychological consequences (11, 12, 26, 27). Furthermore, the

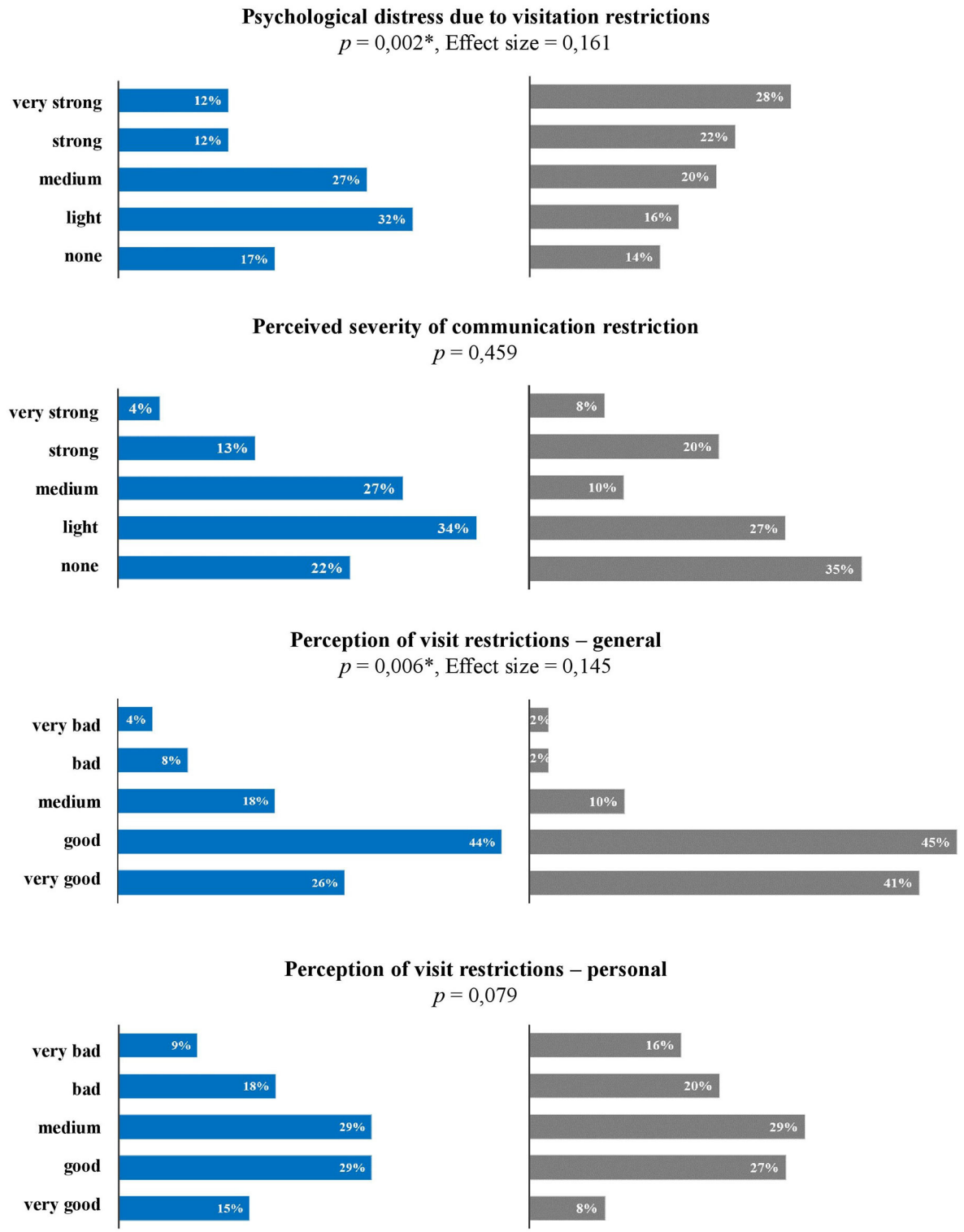

FIGURE 1 | Psychological distress and perception of visit restrictions by patients and relatives. *Statistically significant mean differences are indicated with $*p < 0.05$.

data suggest that patients, although more physically limited than their relatives, felt cared for well in the hospital. Different data show that an in-patient environment with appropriate medical presence and participatory decision-making processes can contribute to anxiety reduction and higher satisfaction (2, 3, 28).

Even if VR contribute to a reduction of surgical site infections in postoperative patients (29), this does not outweigh the sum of the mentioned serious consequences for patients and their relative. Urgent action is needed to reduce or prevent the negative psychological effects and psychiatric symptoms resulting from VR.

Impact of Demographic and Disease-Related Data

No predictors of the severity of psychological distress were identified within the demographic parameters analyzed. Also, length of hospitalization, single or repeated hospitalization, or cause of hospitalization (e.g., neurologic, surgical, and palliative) did not provide information on the severity of psychological distress due to VR. Only the severity of physical limitations and/or the general psychological distress the patients were under, showed a small positive correlation with psychological distress due to VR. For this reason, all patients should be given the necessary attention and offered help in dealing with VR.

Used Communication Channels, Missed Items, and Desired Support

Relatives, independent of the gender, claimed to have more distress than in-patient due to VR. This can partly be explained by the higher importance of communication and interpersonal relationships among the relatives. Thus, the desire to visit the in-patients was more pronounced among the relatives than the desire to get visited among the patients. During the study period, patients and relatives communicated most frequently *via* phone and social media. Consequently, direct physical contact and facial expressions/gestures were missed the most. While patients mentioned other interlocutors (e.g., other patients and caregivers) as a possible alternative, the establishment of visiting rooms with protective measures (e.g., partition walls/glasses) was most frequently desired by relatives. Video calls were used by only a few and were also mentioned as an alternative by only a few. We suspect that lack of experience, technical difficulty, and lack of access to a device are barriers. However, unsuitability for patients, e.g., due to sedation, could also be a reason (30). According to the answers, especially patients could benefit from free phone, tablet, and/or PC use. In addition, the patients' and relatives' requests for rooms/times for phone and video calls indicate a desire for more privacy.

To protect mental health, the establishment of visiting rooms with partitions and free phone/chat rooms as alternative communication channels for patients and relatives in clinics should be examined and implemented. These measures could reduce psychological distress, especially for the relatives of in-patients, due to visual contact, an improved flow of information, and more privacy. Special attention should be paid to bed-ridden patients with limited communication skills (e.g., sedation, mechanical ventilation, and tracheostomy) and their relatives (31).

Since the Corona case numbers in the federal state, where the investigation was performed (Mecklenburg-Vorpommern) during the study period were rather low compared to other federal states (from mid-March to the end of May 2020, 15 Corona patients were treated at UMR, three of them intensively; all patients were discharged), it can be assumed that the psychological distress of patients and their relatives was even higher in risk areas. Further research is needed to take targeted measures to benefit the mental health of patients and relatives during pandemic periods.

Limitations and Strengths

The survey was successfully conducted prospectively on a large cohort, despite the difficult baseline conditions, even for the study investigators. The service volumes and elective procedures were reduced at some hospitals during the survey period. The high number of oncological patients may be explained first by the fact that the study was led by the Department of Hematology, Oncology and Palliative Medicine (bias). Second, the treatments of these patients cannot be electively discharged. At the same time, this represents a strength, since specifically oncological patients were affected by VR.

Due to the involvement of a large number of clinics in the survey and the applicable contact restrictions, it was not possible to record exactly how many patients refused to participate, despite the coding of the questionnaires. A statement on the response rate is therefore not possible. As a result, a bias of the answers in the direction of socially desirable answers cannot be ruled out.

To keep the questionnaire and the interview duration short despite the complexity of the survey (aim: to increase the number of participants), only a visual analog scale and no standard psychological questionnaires were used to record psychological stress. As a consequence, no statements can be made about qualitative psychological stress. Whether and to what extent the visit restrictions had serious health consequences and which coping strategies were used should be investigated in further studies. Whether and to what extent the patients/relatives used psychotherapeutic services was not recorded and represents a further limitation of this study.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the University of Rostock. The patients consented to participate in the study by filling out the questionnaire. The relatives verbally agreed to be interviewed before the interview.

AUTHOR CONTRIBUTIONS

SF and CJ: conception of the work, data analysis and interpretation, and drafting the article. UK: conception of the work, data collection, and drafting the article. CSe: conception of the work and data collection. BK: data collection and head of study office. TH, FB, DS, CSc, and D-LD: data collection and critical revision of the article. All authors contributed to the article and approved the submitted version.

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BRIEF RESEARCH REPORT
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Sleep Quality Impairment Is Associated With Pandemic Attitudes During the Coronavirus Disease 2019 (COVID-19) Circuit Breaker Lockdown in England: A Cross-Sectional Study

Jonathan Kantor[1,2,3,4]*, *Bella Nichole Kantor*[5], *Rebecca G. Fortgang*[5] and *Edward F. Pace-Schott*[6]

[1] Center for Global Health, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, United States, [2] Center for Clinical Epidemiology and Biostatistics, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, United States, [3] Department of Dermatology, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, United States, [4] Florida Center for Dermatology, St Augustine, FL, United States, [5] Department of Psychology, Harvard University, Cambridge, MA, United States, [6] Department of Psychiatry, Harvard Medical School, Massachusetts General Hospital, Boston, MA, United States

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Pedro Morgado,
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***Correspondence:**
Jonathan Kantor
jonkantor@gmail.com

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Objectives: The COVID-19 pandemic has been associated with sleep quality impairment and psychological distress, and the general public has responded to the pandemic and quarantine requirements in a variety of ways. We aimed to investigate whether sleep quality is low during a short-term (circuit break) quarantine restriction, and whether sleep quality is associated with respondents' overall attitudes to the pandemic using a validated scale.

Design and Setting: Online cross-sectional study in England in November 2020.

Participants: The study included 502 respondents over the age of 18.

Measurements: Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), and pandemic attitudes were assessed using the Oxford Pandemic Attitudes Scale–COVID-19 (OPAS-C), a validated 20-item, 7-domain scale that assesses pandemic-related stress, fear, loneliness, sense of community, sense of exaggerated concern, non-pharmaceutical interventions, and vaccine hesitancy. Unadjusted and multivariable logistic regression odds ratios of association were assessed between the dependent variable of poor sleep quality (PSQI>5) and risk factors, including OPAS-C score, age, sex, educational status, and income.

Results: The mean (SD) PSQI score was 7.62 (3.49). Overall, 68.9% of respondents met criteria for poor sleep quality using the PSQI cutoff of >5. The mean (SD) OPAS-C score was 60.3 (9.1). There was a significantly increased odds of poor sleep quality in the highest vs. lowest OPAS-C quartiles (OR 4.94, 95% CI [2.67, 9.13], $p < 0.0001$). Age, sex, income, political leaning, employment status, and education attainment were not associated with poor sleep quality.

Conclusions: More than two-thirds of respondents met criteria for poor sleep quality. The odds of poor sleep quality increased in a dose-response relationship with pandemic attitudes (such as higher levels of pandemic-related stress, fear, or loneliness). The association between poor sleep quality and pandemic attitudes suggests opportunities for public health and sleep medicine interventions, and highlights the need for further research.

Keywords: COVID-19, sleep, OPAS-C, pandemic (COVID-19), mental health

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has been associated with significant effects on sleep quality, and numerous studies have evaluated the intersection between the pandemic, quarantine, physical activity reduction, and mental health outcomes (1–8). Several mechanisms have been proposed for the observed impaired sleep quality associated with the COVID-19 pandemic, including increased stressors and anxiety, decreased entrainment, and decreased physical activity, and several studies have now reviewed these associations (9–12).

The psychological toll of the COVID-19 pandemic is significant, and the effect of the pandemic – modulated both through its direct effects on stress and indirect effects on schedule – has been explored for both healthcare workers and the general population (6, 13, 14). Indeed, for those with baseline psychiatric comorbidities, such problems may be even more pronounced (6). Studies have explored the sleep quality of the general public, healthcare workers, those with baseline sleep disorders, and those with baseline psychiatric comorbidities during the various phases of the COVID-19 pandemic (15–25). Several studies have also reported longitudinal data, suggested a worsening of sleep quality during the pandemic (26, 27), while others have used historical controls to assess pandemic-related sleep quality changes (28).

In November 2020, in response to an increased COVID-19 caseload and concerns regarding hospital capacity, Prime Minister Boris Johnson announced a "circuit break" quarantine would go into effect across England (29). The finite nature of this circuit break, coupled with the public's recent lived experience of 8 months of preceding restrictions, presented an opportunity to investigate the effect of limited-duration lockdowns on sleep quality. Given that sleep quality impairment has been tied to loneliness and other *chronic* stressors, whether a short-term lockdown, where the emotional stressors and overall experience is anticipated to be temporary, affects sleep quality is unknown. Since individuals may be less bothered both practically and emotionally by a temporary and finite lockdown than by restrictions that have no predetermined endpoint, and because these short-term restrictions may become a more common approach as the pandemic continues to evolve, this is an area where further research is needed.

We therefore sought to explore both whether sleep quality is low during a circuit break quarantine of finite duration and whether sleep quality is associated with respondents' overall attitudes to the pandemic using validated scales. A better understanding of these questions may have implications for both public policy and public health interventions.

METHODS

Participants and Procedure

Participants consisted of an internet-based sample of adults residing in the UK. Inclusion criteria were age 18 years or older and current residence in the UK at the time of the study. This study was approved by the Ascension Health Institutional Review Board.

This was a cross-sectional, internet-based study conducted in November 2020. An online survey was developed using the Qualtrics platform (Qualtrics Corp, Provo, Utah) that included validated scales for sleep quality and COVID-19 attitudes, as well as other demographic questions. The survey was distributed using Prolific Academic (Oxford, United Kingdom), an established platform for academic survey research, to a database of survey respondents in the UK, and distributed using a survey panel approach (30). Respondents were rewarded with a small payment (<£1). Participants provided consent and were permitted to terminate the survey at any time. All surveys were anonymous and confidential, with linkages between data performed using a 24-character alphanumeric code. The investigators had no access to identifying information at any time.

Sleep Quality

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a validated 9-question scale that has been used extensively to assess sleep quality in the context of the COVID-19 pandemic (4, 22, 31–34). Scores range from 0 (no sleep quality impairment) to 21 (extreme sleep quality impairment), and a cutoff of >5 has been used since the scale's original development to define impaired sleep quality (31). Previous studies have suggested that the PSQI has a sensitivity of 89.6% and specificity of 86.5% using this cutoff for identifying impaired sleep quality (35).

COVID-19 Attitudes

Attitudes to the COVID-19 pandemic were assessed using the Oxford Pandemic Attitudes Scale – COVID-19 (OPAS-C), a validated 20-item, 7-domain scale that assesses a range of attitudes to COVID-19 (**Table 1**) (36). Domains include stress, fear, loneliness, sense of community, sense of exaggerated concern, non-pharmaceutical interventions, and

TABLE 1 | The OPAS-C.

Number	Item	Domain
1	I am having trouble relaxing because of the virus	Stress
2	I cannot control worrying about the virus.	Stress
3	I think about the virus more than I would like.	Stress
4	Thoughts of the virus pop into my head even when I do not want them to.	Stress
5	I have trouble concentrating because I think about the virus so much.	Stress
6	I check the news or online sources for updates on the virus more than I would like.	Stress
7	I am having trouble sleeping because I am thinking about the virus.	Stress
8	I am afraid of getting the virus myself.	Fear
9	I am afraid of a family member getting the virus.	Fear
10	I feel isolated from other people in the pandemic.	Loneliness
11	With the pandemic, I feel like I cannot connect to other people.	Loneliness
12	I feel close to other people.	Community
13	I feel part of a larger community of people.	Community
14	I think the pandemic is a hoax.	Exaggerated
15	I think people are getting too excited about the pandemic.	Exaggerated
16	I am wearing a face covering or mask when I am around people.	NPIs
17	I am social distancing.	NPIs
18	I am washing my hands frequently.	NPIs
19	I would take the coronavirus vaccine when it becomes available.	Vaccine
20	I would have my children or parents take the vaccine when it comes out.	Vaccine

All answer choices are rated using a 5-point Likert scale (strongly disagree though strongly agree). For questions 1–13, strongly agree is scored as 5, while for questions 14–20 strongly agree is scored as a 1 (reverse scoring). Higher values reflect a greater burden, and the total score therefore ranges from 20 to 100.

vaccine hesitancy. Scores range from 20 to 100, with higher values representing a greater burden and less adjustment to the pandemic.

Demographic Information

Age, sex, employment status, household income, and political affiliation were included based on self-report. Binary choices were provided for sex selection. Employment status was divided into full-time, part-time, or no employment. Income was included as a continuous variable based on total yearly household income. Political leaning was established through a Likert-style question regarding self-identification as conservative or liberal.

Statistics

Sample size calculations were conducted for the primary endpoint of detecting a 5% difference in the OPAS-C by sleep quality status, dichotomizing between those with and without poor sleep quality using a PSQI cutoff of 5. 442 subjects (221 per group) would be adequate to detect a 5% change in OPAS-C with 80% power and with an alpha of 0.05, assuming a baseline OPAS-C mean of 56.1 with a standard deviation of 10.5 and assuming equal group sizes (37).

Demographic data are presented as mean values with 95% confidence intervals (CI). *T*-tests and chi-squared tests were used as appropriate for continuous and categorical variables, respectively. Unadjusted and multivariable logistic regression odds ratios of association were assessed between the dependent variable of poor sleep quality (defined as PSQI>5) and putative risk factors, including OPAS-C score, age, sex, educational status, and income. Respondents were also divided into quartiles based on OPAS-C score, and both mean PSQI values and the proportion meeting poor sleep quality criteria were presented by quartiles; the significance of interquartile differences was assessed using analysis of variance.

All statistical analyses were performed using Stata 13 for Mac (Stata Corporation, College Station, Texas).

RESULTS

Characteristics

Of the 513 subjects who were recruited, 502 completed the survey, yielding a completion rate of 97.9%. All completed surveys were received during the lockdown. The mean (SD) age of respondents was 34.2 (12.8), and 341 (69.5%) of the respondents were female; respondent characteristics are outlined in **Table 2**. Demographic data did not differ significantly between those that did and did not meet criteria for poor sleep quality.

Sleep Quality

The mean (SD) PSQI score was 7.62 (3.49) with a range of 1-20. Overall, 68.9% ($n = 346$) of respondents met criteria for poor sleep quality using the established PSQI cutoff of >5.

Pandemic Attitudes

The mean (SD) OPAS-C score was 60.3 (9.1), with a range of 38 to 80; for reference, the mean (SD) OPAS-C score in the UK assessed in July 2020 during the original OPAS-C validation study was 56.1 (10.5) (36). The mean (SD) OPAS-C subscale scores were as follows: stress 19.9 (6.9); fear 7.8 (1.9); loneliness 10.5 (3.2); sense of community 5.3 (2.0); concern that the pandemic is exaggerated 8.3 (1.8); attitude to non-pharmaceutical interventions (NPIs) 4.4 (1.9); and attitude to vaccination 4.2 (2.5). The OPAS-C subscales have not been separately validated, and no cutoffs have been established for a negative or dysfunctional attitude to the COVID-19 pandemic.

Association Between Sleep Quality and Pandemic Attitudes

Stratifying overall PSQI scores and the proportion meeting poor sleep quality criteria by OPAS-C quartiles demonstrated a progressive worsening of sleep quality as pandemic attitudes worsened, as seen in **Table 3** ($p < 0.0001$). Unadjusted logistic regression analysis demonstrated that OPAS-C scores were significantly associated with poor sleep quality (OR 1.07, 95% CI [1.05, 1.10], $p < 0.0001$ for each unit increase in OPAS-C score).

TABLE 2 | Demographic and characteristics of respondents, overall and by sleep quality status.

Characteristic	No. (%)		
		Poor Sleep Quality*	
	Total	Yes	No
Overall	502 (100)	346 (68.9)	156 (31.1)
Sex			
Men	150 (30.6)	97 (46.1)	53 (54.3)
Women	341 (69.5)	241 (53.9)	100 (45.7)
Age, y			
18–30	244 (48.6)	171 (70.1)	73 (29.9)
31–40	121 (24.1)	80 (66.1)	41 (33.9)
41–50	69 (13.8)	52 (75.4)	17 (24.6)
51–60	44 (8.8)	28 (63.6)	16 (36.40
>60	24 (4.8)	15 (62.5)	9 (37.5)
Education level			
< High school	1 (0.2)	0 (0)	1 (100)
High school	131 (26.2)	96 (73.3)	35 (26.7)
Some college	101 (20.2)	71 (70.3)	30 (29.7)
Bachelor's	184 (36.7)	119 (64.7)	65 (35.3)
Graduate	84 (16.8)	59 (70.2)	25 (29.8)
Employment status			
Full time	201 (46.6)	141 (70.2)	60 (29.9)
Part time	102 (23.7)	70 (68.6)	32 (31.4)
Not employed	128 (29.7)	87 (68.0)	41 (32.0)
Income			
<£10,000	57 (11.4)	41 (71.9)	16 (28.1)
£10,000–£30,000	171 (34.1)	119 (69.6)	52 (30.4)
£30,001–£50,000	147 (29.3)	105 (71.4)	42 (28.6)
£50,001–£80,000	80 (15.9)	50 (62.5)	30 (37.5)
£80,001–£100,000	20 (4.0)	12 (60.0)	8 (40.0)
£>100,000	27 (5.4)	19 (70.4)	8 (29.6)
Political leaning			
Conservative	81 (16.1)	55 (67.9)	26 (32.1)
Liberal	261 (52.0)	183 (70.1)	78 (29.9)
Ambivalent	160 (31.9)	108 (67.5)	52 (32.5)

*Defined as PSQI>5.

TABLE 3 | Sleep quality stratified by OPAS-C quartile.

OPAS-C Quartile	Mean (95% confidence intervals)	
	PSQI raw score	Proportion of respondents meeting cutoff criteria for poor sleep quality*
Quartile 1	6.45 (5.93, 6.96)	0.54 (0.46, 0.63)
Quartile 2	7.08 (6.43, 7.73)	0.59 (0.50, 0.68)
Quartile 3	7.80 (7.28, 8.33)	0.78 (0.71, 0.86)
Quartile 4	9.35 (8.66, 10.04)	0.85 (0.79, 0.92)

*Defined as PSQI>5.

TABLE 4 | Association of individual OPAS-C subscale scores with the likelihood of being a poor sleeper (defined as PSQI>5).

OPAS-C Subscale	Odds of being a poor sleeper (per 1-point increase in each subscale)	*P*-value
Stress	1.11 (1.07, 1.14)	<0.0001
Fear	1.16 (1.05, 1.28)	0.003
Loneliness	1.16 (1.09, 1.23)	<0.0001
Community	0.82 (0.75, 0.91)	<0.0001
Exaggerated	1.01 (0.91, 1.13)	0.787
NPIs	0.86 (0.78, 0.95)	0.002
Vaccine	1.02 (0.95, 1.11)	0.560

There was a significantly increased odds of poor sleep quality in the highest versus lowest OPAS-C quartiles (OR 4.94, 95% CI [2.67, 9.13], $p < 0.0001$), suggesting that poor sleep quality is associated with less positive or healthy pandemic attitudes. These associations persisted in fully adjusted models (OR 1.07, 95% CI [1.05, 1.10], $p < 0.0001$ for each unit increase in OPAS-C score and OR 4.88, 95% CI [2.51, 9.48], $p < 0.0001$ for the highest versus lowest OPAS-C quartiles). In a secondary analysis, association of poor sleep quality with the individual OPAS-C subscales varied by subscale (**Table 4**).

Age (OR 0.99, 95% CI [0.98, 1.01], $p = 0.421$), sex (OR 0.76, 95% CI [0.51, 1.14], $p = 0.186$ for male sex), income (OR 0.93, 95% CI [0.80, 1.08], $p = 0.352$), political leaning (OR 0.98, 95% CI [0.55, 1.74], $p = 0.950$), employment status (OR 0.90, 95% CI [0.56, 1.46], $p = 0.676$ for unemployed vs. full time), and educational attainment (OR 1.08, 95% CI [0.65, 1.80], $p = 0.765$ for those with a graduate degree vs. all others) were not significantly associated with sleep quality on logistic regression analyses with categorical variables. A fully adjusted logistic regression model similarly did not demonstrate any significant associations.

DISCUSSION

We found that the November 2020 circuit break was associated with impaired sleep quality in the UK, and that the degree of sleep quality impairment was associated with pandemic attitudes as assessed with the OPAS-C. Every 1-point increase in the OPAS-C score – with higher scores representing worsening attitudes to the pandemic –was associated with a 7.4% increase in odds of being a poor sleeper. Thus for each 1-SD increase in OPAS-C score, the odds of being a poor sleeper increased by 66.7%. An important strength of this study was our use of validated scales for assessing both sleep quality and pandemic attitudes.

Both the raw PSQI scores and the proportion of respondents meeting criteria for poor sleepers appeared high when compared with historical controls, though without a longitudinal design it is impossible to determine this definitively. The mean PSQI score in an Italian general population prior to the COVID-19 pandemic was 4.0 and approximately 35% of the population met criteria for poor sleep, though one study of young adults in Spain suggested

a pre-pandemic mean PSQI of 5.8 with 47% meeting criteria for poor sleep pre-pandemic (38–40).

We did not detect an association between poor sleep quality and several demographic variables, such as age, sex, employment status, political leaning, and income. While the study may have been underpowered to detect these associations, this also bolsters the effect size of our finding that pandemic attitudes are associated with poor sleep quality. A prior study evaluated the relationship between sleep quality and pandemic attitudes, and also found an association between impaired sleep quality and dysfunctional pandemic attitudes, though it did not use a validated scale for pandemic attitudes and focused exclusively on worry, stress, and adverse life impact related to COVID-19 (41).

Several studies have demonstrated that with a shift to lockdown, where the majority of the population is restricted from working and leaving their homes on a regular basis, the absence of an early morning awakening drive may lead to both a reduction in social jetlag, as weekdays and weekends functionally merge, and a more delayed chronotype (42). Thus, the decreased entrainment seen as part of the loss of zeitgebers may be responsible for some of the sleep onset delay seen in the pandemic context (43, 44). In addition to delayed onset, a modest increase in sleep quantity has been observed in several studies (45).

Several other mechanisms may be responsible for the effect of the COVID-19 pandemic on sleep, and these were not directly evaluated in this study; some have suggested that decreased physical activity brought on by quarantine leads to sleep impairment and ensuing poor mental health outcomes, and decreased physical activity itself may be associated directly with the poor mental health outcomes as well (46, 47). Sleep impairment may also be associated with an increase in electronic device usage and other sedentary behavior, further exacerbating this feedback loop (39). Moreover, decreased daylight exposure due to activity restrictions may lead to a further reduction in entrainment induced by the primary zeitgeber (48, 49). Finally, dietary changes are another possible contributor to pandemic-related sleep impairment, as this may also affect both sleep itself as well as the likelihood of engaging further in physical activity (5).

Given the association between sleep disorders and mental health outcomes, and the potential effects of both pandemic-related stress and reduced entrainment on sleep, the COVID-19 pandemic may represent a perfect storm, as unhealthy behaviors such as decreased activity couple with decreased daylight exposure, reduced work-related zeitgebers, and general stress induced by both schedule change and pandemic-related fears to produce a sleep-unfriendly environment. Thus the combination of stress and reduced entrainment may be partly responsible for a decrease in sleep quality during the pandemic (50). Given the social responsibility for sleep researchers to educate the general public and healthcare providers regarding sleep in the pandemic context, further highlighting the importance of research investigating the intersection between COVID-19 and sleep quality is of significant value (48).

Loneliness and perceived social support may represent important considerations when attempting to understand the intersection between sleep and the COVID-19 pandemic. Loneliness may be responsible for part of the sleep quality impairment seen in older adults, and this may combine with an increased baseline prevalence of sleep quality disturbance to result in an elevated risk of poor pandemic-context sleep in older adults (51). Moreover, one study demonstrated a dose-response relationship between social support and sleep quality, and a similar modulating effect between social support and mental health outcomes such as depression and anxiety (52). Furthermore, self-esteem may modulate the effects of stress on both anxiety and sleep (9), and false beliefs may also affect sleep quality (53), while habituation may lead to a gradual improvement in sleep quality (54), further complicating the psychological constructs underlying sleep impairment. Finally, impaired sleep may interact further with underlying psychological processes and result in impaired immune function, with potentially serious effects in a pandemic context (55, 56).

As seen in **Table 4**, there was a variable association of individual OPAS-C subscale scores with poor sleep quality, with the stress, fear, and loneliness subscales associated with worse sleep quality and community and NPI subscales associated with improved sleep quality. While stress, fear, and loneliness are known to be associated with impaired sleep quality, the sense of community and NPI subscales of the OPAS-C increase for those who are less concerned with the effects of the pandemic—and thus are associated with decreased stress—potentially explaining their protective association with sleep quality. Indeed, these findings echo work that has suggested that media consumption regarding the pandemic is associated with more severe symptoms of depression (57).

Despite evidence regarding the negative sleep quality effects of the COVID-19 pandemic, some evidence, particularly from early in the pandemic course, suggested that the net effect on sleep quality was salutary, so that most healthy adults were sleeping more – and better – than before the pandemic (41). Still, even in that study those most vulnerable to sleep impairment before the onset of the pandemic were most likely to experience sleep quality decline in the pandemic context (41).

Our study has several limitations. First, the generalizability of our findings may be limited by the non-representative nature of our population. This is a particularly important problem given the potential interaction between type of work, risk of COVID-19 exposure, and sleep quality (1). Second, as with any survey study, response bias and social desirability bias may affect the validity of the data, though the anonymous survey design may help mitigate these concerns. Third, our selection of independent variables was not exhaustive, and other important variables, such as family stress (58), underlying mental health diseases (59), and others may be important confounders. Fourth, the composite OPAS-C score is heterogeneous, capturing a range of attitudes on disparate pandemic responses such as fear and vaccination concerns; future studies validating the component subscale scores for use independently, and evaluating the ideal ways in which the composite scores should be used, would be beneficial. Finally, this cross-sectional study lacks a comparator group and cannot establish causation; therefore, we do not know whether the

associations we describe truly represent clinical risk factors. Future prospectively designed studies evaluating outcomes over several longitudinal timepoints with representative populations may be helpful.

Both impaired sleep quality and pandemic attitudes – including a tendency to eschew non-pharmaceutical interventions and vaccination – may be associated with an increased risk of COVID-19 infection or worsening long-term outcomes (56, 60). Therefore, the public health implications of these findings raise the specter of a synergistic interaction between poor sleep, COVID-19 attitudes, decision-making and ultimate outcomes. Sleep quality during the limited-duration circuit-break quarantine in the UK was impaired, and poor sleep was strongly associated with less desirable attitudes to the pandemic. The dose-response relationship between impaired sleep quality and pandemic attitudes has important implications for further research and suggests potential avenues for possible sleep quality and public health interventions in the future.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ascension Health IRB. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JK: study conception. JK and BK: data collection. EP-S, RF, and BK: critical editorial review. EP-S and RF: supervision. All authors contributed to the article and approved the submitted version.

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Perceived Stress, Resilience, and Wellbeing in Seasoned Isha Yoga Practitioners Compared to Matched Controls During the COVID-19 Pandemic

*Preeti Upadhyay[1], Shilpa Narayanan[1], Tanvi Khera[1], Lauren Kelly[1], Pooja A. Mathur[1], Akshay Shanker[1], Lena Novack[1], Ruth Pérez-Robles[1], Kim A. Hoffman[2], Senthil Kumar Sadhasivam[3] and Balachundhar Subramaniam[1]**

[1] Beth Israel Deaconess Medical Center, Boston, MA, United States, [2] Oregon Health and Science University-Portland State University School of Public Health, Portland, OR, United States, [3] Riley's Children's Hospital, Indiana University, Bloomington, IN, United States

Background: Yoga practices, including breathing, meditation, and posture protocols (asanas), have been shown to facilitate physical and mental wellbeing.

Methods: Seasoned yoga practitioners were recruited from the Isha Foundation. Recruitment of the comparison group was achieved using snowball sampling and were not yoga practitioners. Participants in the non-yoga group were randomized to a 3-min Isha practice or a comparator group asked to perform 15-min of daily reading. Participants completed a series of web-based surveys (REDCap) at baseline, 6, and 12 weeks. These surveys include validated scales and objective questions on COVID-19 infection and medical history. The validated questionnaires assess for: perceived stress (PSS), mood states [anxiety and depression (PHQ-4), joy (DPES-Joy subscale)], mindfulness attention and awareness (MAAS), resilience (BRS), mental wellbeing (WEMWBS) and recovery from traumatic event (PTGI). Weekly activity diaries were employed as a tool for collecting compliance information from study participants. Perceived stress scale scores were identified as primary outcome for this study.

Findings: The median Perceived Stress Scale (PSS) score for the yoga practitioners compared to the active and placebo comparators was significantly lower at all time-points: baseline: 11 [IQR 7–15] vs. 16 [IQR 12–21] in both the active and placebo comparators ($p < 0.0001$); 6 weeks: 9 [IQR 6–13] vs. 12 [IQR 8–17] in the active comparator and 14 [IQR 9–18] in the placebo comparator ($p < 0.0001$); and 12 weeks: 9 [IQR 5–13] vs. 11.5 [IQR 8–16] in the active comparators and 13 [IQR 8–17] in the placebo comparator ($p < 0.0001$). Among the randomized participants that were compliant for the full 12 weeks, the active comparators had significantly lower median PSS scores than the placebo comparators 12 weeks [10 (IQR 5–14) vs. 13 (IQR 8–17), $p = 0.017$]. Further, yoga practitioners had significantly lower anxiety at all three-time points ($p < 0.0001$), lower depression at baseline and 6 weeks ($p < 0.0003$), and significantly higher wellbeing ($p < 0.0001$) and joy ($p < 0.0001$) at all three-time points, compared to the active and placebo comparator groups.

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***Correspondence:**
Balachundhar Subramaniam
Bsubrama@bidmc.harvard.edu

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Interpretation: The lower levels of stress, anxiety, depression, and higher level of wellbeing and joy seen in the yoga practitioners compared to the active and placebo comparators illustrate the impact of regular yoga practices on mental health even during the pandemic.

Trial Registration: ClinicalTrials.gov, identifier: NCT 04498442.

Keywords: yoga, meditation, perceived stress, Isha Foundation, wellbeing

INTRODUCTION

The global toll of COVID-19 on physical and mental health has been severe, as the disease continues to disrupt lives and impact wellbeing (1, 2). Research has already documented that psychological distress (3, 4), anxiety (5), sleep disturbances (6), greater feelings of isolation (7), and problematic substance use have increased as a result of the pandemic (8). In addition, perceived stress has been shown to accompany COVID-19 infection and treatment (9). Adopting strategies to maintain or increase mental, emotional, and physical health during these difficult times will enable greater resilience in individuals as we begin to emerge from the pandemic (10, 11). In fact, the US Centers for Disease Control has emphasized the importance of managing stress during the pandemic time and avoiding maladaptive behaviors to cope with stress and anxiety (9).

Yoga practices, including breathing, meditation, and posture protocols (asanas), have been shown to facilitate enhanced physical and mental wellbeing (12, 13). Enhanced wellbeing is achieved through improvements in the modulation of the autonomic nervous system (14), improved sleep quality (15), and immunity (16), and reductions in stress (17, 18), anxiety (19), and depression (20, 21) in regular yoga practitioners. In a meta-analysis of 47 trials, researchers found evidence that meditation reduced multiple negative dimensions of psychological stress such as anxiety and depression (22). Similarly, in a study of yogic breathing practices, functional magnetic resonance imaging (fMRI) showed significantly decreased states of anxiety and negative affect and modulation of activity in brain regions involved in emotional processing, attention, and awareness (23). A significant decrease in perceived stress after a single yoga class (17) and after an 8-week course (18) suggests that yoga has both immediate and longer-term impacts on perceived stress during continued yoga practice. The Centers for Disease Control and Prevention reports that an increasing number of adults are practicing yoga and meditation to enhance wellbeing (24).

The Isha Foundation (25), an international school of yoga, teaches yogic practices designed to meet individual needs and improve wellbeing. The Isha Foundation's Inner Engineering course including seven online modules, and a 1-day in-person program were offered in the traditional modality before the pandemic and online-only during the pandemic. We enrolled 8,519 participants (6,892 regular Inner Engineering practitioners vs. 2,344 age, gender, and zip code matched controls) to test the program's effectiveness. We evaluated the stress and wellbeing of participants at three different times during this pandemic. Participants in the non-yoga group were not yoga practitioners and were randomized into either the *active comparator arm* or the *placebo comparator arm*. We randomized the non-yoga group to a simple 3-min breathing practice group and an active reading control group to assess the effect on perceived stress. We hypothesized that those undertaking the yogic practices would (a) have the least amount of perceived stress and (b) report higher levels of wellbeing than the control [specifically, the placebo comparator group (i.e., reading group)] over the study period of May 2020 to September 2020.

METHODS

We designed the study to comply with the then COVID-19 precautions imposed by federal and state governments in the U.S. Beth Israel Deaconess Medical Center Institutional Review Board approved this study.

Recruitment and Intervention

The methodology paper detailing the study has been published elsewhere (26). Briefly, seasoned Isha yoga practitioners were recruited by social media, websites, flyers, word of mouth, and email announcements from the Isha Foundation. Participants consented to study participation *via* REDCap. The second stage of recruitment used snowball sampling (27). Yoga practitioners were requested to nominate two friends or colleagues who did not practice yoga within the last month as age, gender, and zip-code matched controls (preferably from the same neighborhood). The study team reached out to those nominated and obtained REDCap consent from those who chose to enroll.

Non-meditator controls were randomized to an *active comparator arm* or the *placebo comparator arm*. Those in the *active comparator arm* were taught a 3-min yoga practice, Simha Kriya, which involved a specific breathing practice with rapid, deep breathing and breath retention designed during the pandemic to improve the pulmonary function. It was perceived as useful by 77% of healthcare workers participating in a study conducted at MD Anderson (Houston, TX) during the pandemic's peak (28). These participants were asked to perform Simha Kriya using a web-based application twice per day. Those randomized to the *placebo comparator arm* performed either reading activities or remained idle for 15-min a day throughout the study period.

Respondents in the observational arm (seasoned yoga practitioners) continued their usual yoga practices. On an average, seasoned yoga practitioners reported to have ∼5.6 years (SD: ± 7.2) of practice experience. Their average session

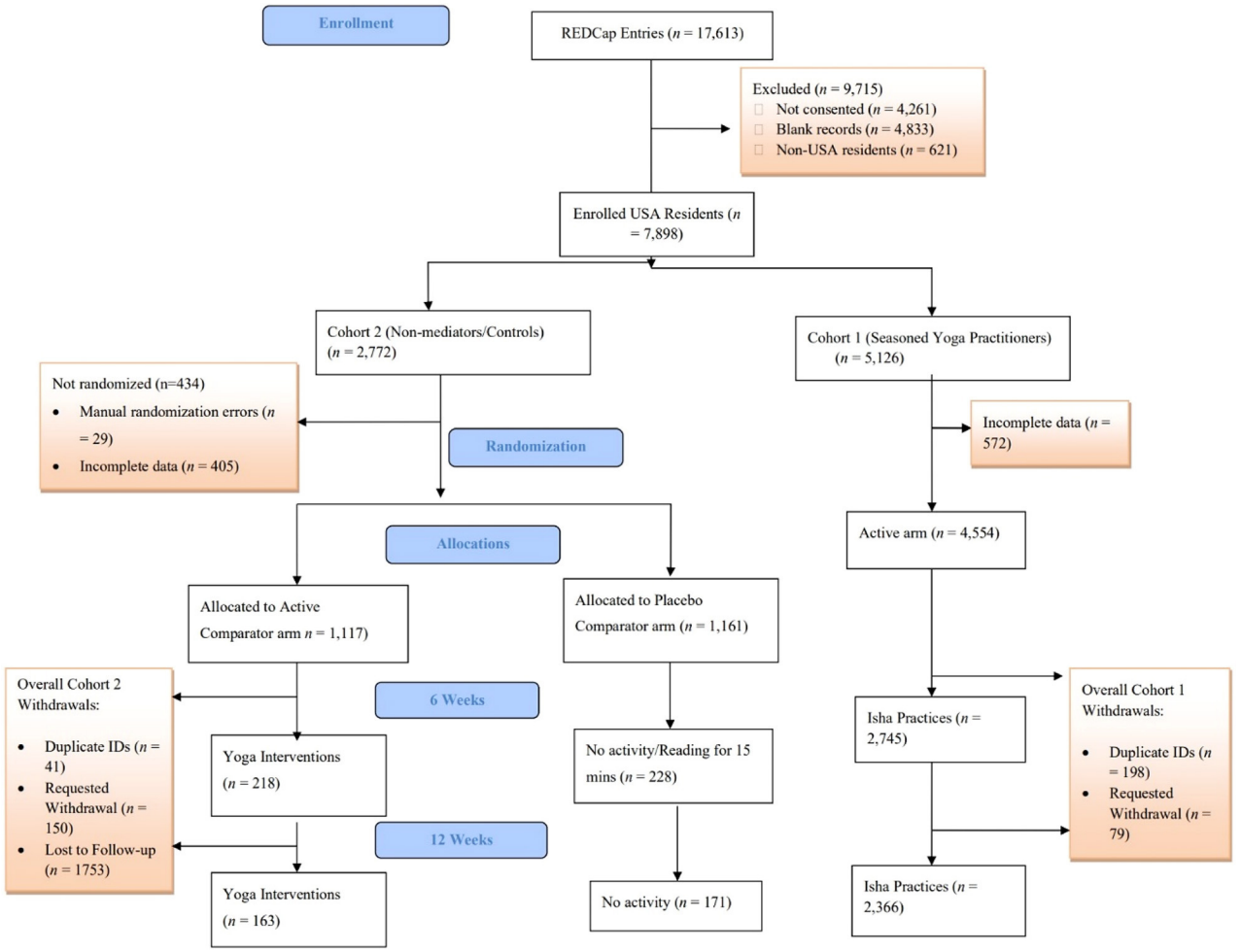


FIGURE 1 | CONSORT flow diagram.

duration was reported to be 6.6 h (SD: ± 5.7) each day. The expertise of yoga in seasoned practitioners varied greatly. Their expertise ranged from practitioners who recently completed inner engineering online course and performed simple yoga practices for 30-min each day to highly motivated practitioners with 6 h or more of dedicated meditation and yoga practices.

Data Collection and Measures

Participants completed a series of web-based surveys (REDCap) at baseline, 6, and 12 weeks. Data collection included weekly activity diaries, medical history, and eight validated neuropsychological scales assessing stress (Perceived Stress Scale, PSS), anxiety and depression (PHQ-4), joy predisposition (DPES-Joy Subscale), mindfulness awareness (MAAS), resilience (BRS), mental wellbeing (WEMWBS), and post-traumatic growth (PTGI). PSS is defined as the primary outcome, while BRS was the key secondary outcome.

Statistical Analysis

Descriptive statistics are presented to summarize the data. Continuous data were presented as median [interquartile range] after confirming with the Shapiro-Wilk test that data did not follow a normal distribution. Differences within groups between baseline and 6 weeks and 6 and 12 weeks were assessed with a Wilcoxon Signed-Rank test for paired data. Differences between two groups were assessed with a Wilcoxon Rank-Sum test and between three groups with a Kruskal–Wallis test. Categorical data were presented as frequencies and percentages and assessed with chi-square or Fisher's exact test, as appropriate.

All primary analyses were assessed using intention-to-treat principles. Further, differences between groups for the primary and key secondary outcomes (PSS and BRS) were also assessed using a Poisson Regression model with scaled deviance to adjust for potential confounding by region, employment status, and age. SAS 9.4 (SAS Institute Inc., Cary, NC) was used for all analyses with two-sided $p < 0.05$ considered statistically significant.

RESULTS

Of the 8,519 participants that agreed to participate, 6,892 participants were included in the baseline analysis because they were from the United States and had at least partially

TABLE 1 | Demographic characteristics.

	Active comparators (n = 1,177)	Placebo comparators (n = 1,161)	Yoga practitioners (n = 4,554)	*P*-Value
Gender, No. (%)				
Female	679 (57.7)	666 (57.4)	2,631 (57.8)	1.0
Male	497 (42.2)	494 (42.6)	1917 (42.1)	
Other	1 (0.1)	1 (0.1)	6 (0.1)	
Age				<0.0001
Median (IQR)	42 (33, 50)	41 (33, 50)	43 (36, 52)	
Mean (SD)	42.5 (13.0)	42.3 (12.8)	44.6 (11.7)	
Educational qualifications, No. (%)				0.20
Less than bachelor's degree	141 (12.0)	123 (10.6)	491 (10.8)	
Bachelor's degree	390 (33.1)	370 (31.9)	1,391 (30.5)	
Higher than bachelor's degree (Master's, Professional, Ph.D)	646 (54.9)	668 (57.5)	2,672 (58.7)	
Employment status, No. (%)				<0.0001
Employed full time	754 (64.0)	743 (64.0)	2,603 (57.2)	
Employed part time (self-employed, contingent worker)	163 (13.9)	160 (13.8)	928 (20.4)	
Not employed/Laid off	113 (9.6)	122 (10.5)	493 (10.8)	
Retired	53 (4.5)	64 (5.5)	252 (5.5)	
Other (disabled, student, military service)	94 (8.0)	72 (6.2)	278 (6.1)	
Region, No. (%)				<0.0001
Midwest	242 (20.6)	232 (20.0)	692 (15.2)	
North East	266 (22.6)	300 (25.9)	1,152 (25.3)	
South East	218 (18.5)	234 (20.2)	1,010 (22.2)	
South West	193 (16.4)	152 (13.1)	605 (13.3)	
West	257 (21.9)	240 (20.7)	1,092 (24.0)	
Unknown	1 (0.1)	3 (0.3)	3 (0.1)	

complete data. Of these, there were 1,177 active comparators, 1,161 placebo comparators, and 4,554 yoga practitioners. At 6 weeks, 218 (18.5%) of the active comparators, 228 (19.6%) of the placebo comparators, and 2,745 (60.3%) of the yoga practitioners remained in the study. At 12 weeks, these numbers reduced to 163 (13.8%), 171 (14.7%), and 2,366 (52%), respectively (**Figure 1**).

Baseline Characteristics

Around 57% of participants in each group were females with mean ages ranging from 42 to 45, and more than half of each group having a higher education than a Bachelor's Degree. Sixty-four percentage of active and placebo comparators were employed full-time and 14% part-time compared to 57 and 20%, respectively, among the yoga practitioners (**Table 1**). There were also significant differences in the regions that the groups reside in. Around 20% of the comparator groups were from the Midwest, but only 15% among yoga practitioners. These characteristics that were found to be significantly different were adjusted for in the primary analyses (Refer to **Figure 2** for geo-distribution at baseline, remaining charts available in **Supplementary Materials**).

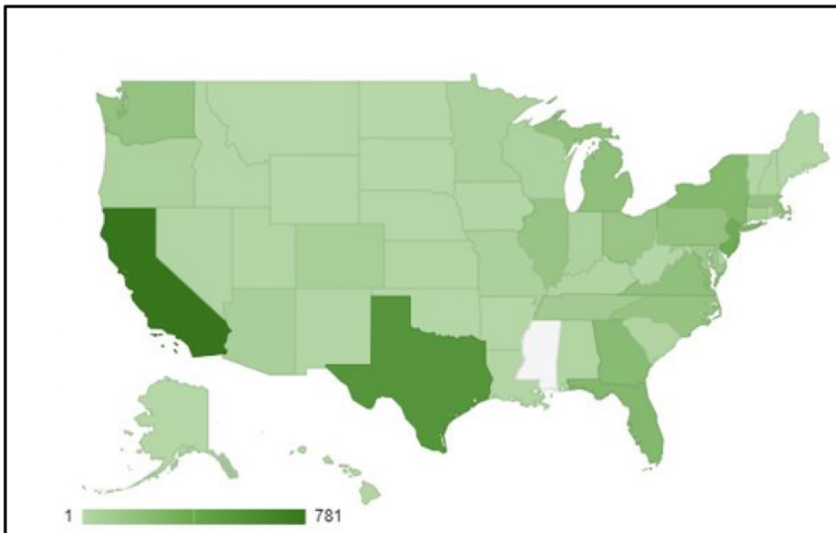
Primary Outcome—Perceived Stress During the Pandemic (PSS Scores)

At baseline, 6, and 12 weeks, yoga practitioners had significantly lower PSS scores than active and placebo comparator groups (**Figure 3**).

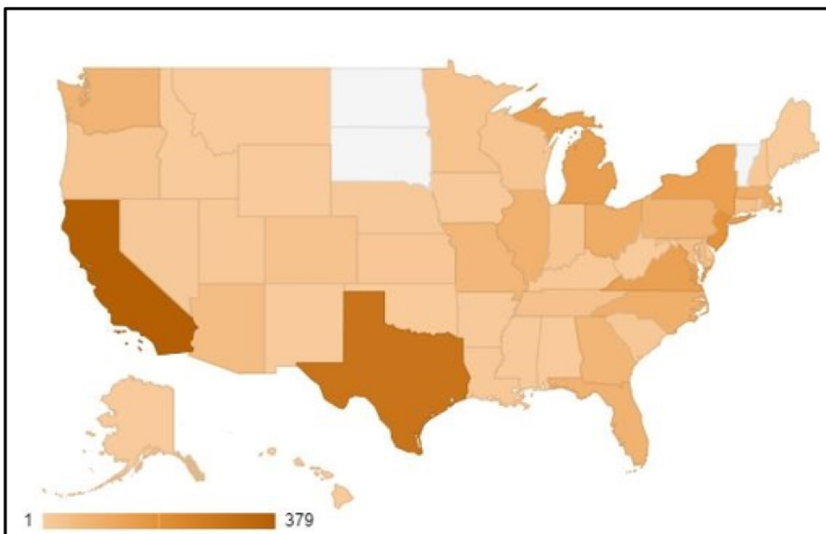
The median PSS score for the yoga practitioners compared to the active and placebo comparators was significantly lower at all time-points: baseline: 11 [IQR 7–15] vs. 16 [IQR 12–21] in both the active and placebo comparators ($p < 0.0001$); 6 weeks: 9 [IQR 6–13] vs. 12 [IQR 8–17] in the active comparator and 14 [IQR 9–18] in the placebo comparator ($p < 0{\cdot}0001$); and 12 weeks: 9 [IQR 5–13] vs. 11.5 [IQR 8–16] in the active comparators and 13 [IQR 8–17] in the placebo comparator ($p < 0.0001$) (**Table 2**). Adjusting for age, region, and employment status, the yoga practitioners, had a significantly lower PSS scores compared to the placebo comparators [31% reduction (R.R. 0.69 (95% CI 0.67–0·71)) at baseline, 30% reduction (R.R. 0.70 (95% CI 0.65–0.75)) at 6 weeks, and 29% reduction (R.R. 0.71 (95% CI 0.65–0·77)) at 12 weeks]. In the adjusted analysis, the active comparators did not have significantly different PSS scores compared to the placebo comparators at any time point (Refer to **Supplementary Table A** for further details).

Within the Group Change in PSS Score

There was a statistically significant difference in median PSS scores between baseline and 6 weeks among all groups. The active comparators had a two-unit [IQR −5–1] decrease ($p < 0.0001$), the placebo comparators had a two-unit [IQR −5–1] decrease ($p < 0.0001$), and the yoga practitioners had a zero-unit [IQR −3–2] change ($p < 0.0001$). We also found a significant difference when comparing these median changes between the three groups



Alabama	18	Nebraska	8
Alaska	3	Nevada	15
Arizona	64	New Hampshire	19
Arkansas	5	New Jersey	362
California	781	New Mexico	9
Colorado	71	New York	254
Connecticut	66	North Carolina	161
Delaware	14	North Dakota	2
Florida	256	Ohio	147
Georgia	235	Oklahoma	6
Hawaii	10	Oregon	44
Idaho	5	Pennsylvania	172
Illinois	153	Rhode Island	9
Indiana	40	South Carolina	27
Iowa	11	South Dakota	2
Kansas	17	Tennessee	101
Kentucky	29	Texas	537
Louisiana	11	Utah	13
Maine	4	Vermont	5
Maryland	106	Virginia	196
Massachusetts	165	Washington	168
Michigan	189	Washington D.C.	13
Minnesota	48	West Virginia	4
Missouri	49	Wisconsin	41
Montana	8	Wyoming	1



Alabama	4	Missouri	67
Alaska	1	Montana	1
Arizona	46	Nebraska	8
Arkansas	7	Nevada	9
California	379	New Hampshire	10
Colorado	30	New Jersey	182
Connecticut	35	New Mexico	1
Delaware	5	New York	141
Florida	80	North Carolina	93
Georgia	71	Ohio	100
Hawaii	2	Oklahoma	10
Idaho	2	Oregon	19
Illinois	84	Pennsylvania	77
Indiana	20	Rhode Island	7
Iowa	7	South Carolina	13
Kansas	15	Tennessee	32
Kentucky	12	Texas	300
Louisiana	12	Utah	11
Maine	2	Virginia	138
Maryland	41	Washington	77
Massachusetts	94	Washington D.C.	7
Michigan	144	West Virginia	4
Minnesota	25	Wisconsin	22
Mississippi	6	Wyoming	1

FIGURE 2 | Geo-charts (baseline only).

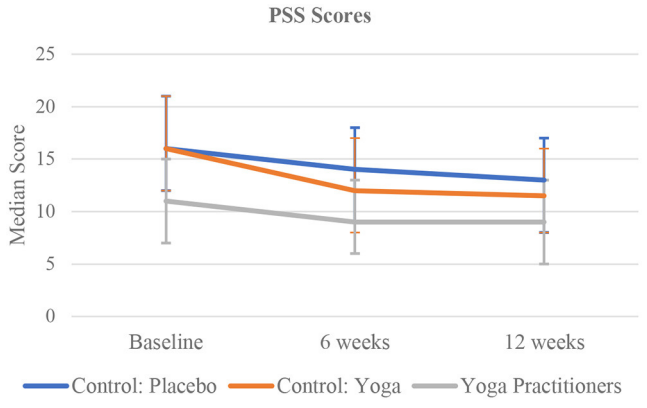


FIGURE 3 | Time trend comparison of PSS Scores in the three study group at all three time points.

($p < 0.0001$). There were no significant differences in PSS scores between 6 and 12 weeks for any of the groups.

Key Secondary Outcome—Brief Resilience Scores

The median BRS score at baseline for both the active comparators and placebo comparators was 2 [IQR 1.8–2.3] compared to 2 [IQR 1.8–2.2] for the yoga practitioners ($p < 0.0001$). There were no significant differences between median BRS scores at 6 or 12 weeks. There were also no significant differences between the BRS scores of the groups when adjusted for age, region, and employment status.

Other Secondary Outcomes

Based on the PHQ-4 scores, yoga practitioners had significantly lower anxiety at all three-time points ($p < 0.0001$), lower depression at baseline and 6 weeks ($p < 0.0003$), and significantly higher wellbeing ($p < 0.0001$) (**Figure 4**) and joy ($p < 0.0001$) at all three-time points, compared to the active and placebo comparator groups.

The results were analyzed for compliant participants only. At baseline, measures of negative affect (stress, anxiety, depression) and positive affect (wellbeing, joy, resilience) and mindfulness were comparable between these two groups (Refer to **Table 3** for further details).

Compared to the placebo comparators, the active comparators had lower median PSS scores at 6 weeks [11 (IQR 7–15) vs. 13 (IQR 8–17), $p = 0.082$] and at 12 weeks [10 (IQR 5–14) vs. 13 (IQR 8–17), $p = 0.017$] (**Figure 5**).

The active comparator group had higher median wellbeing scores at 6 weeks ($p = 0.048$), and 12 weeks ($p = 0.046$), and higher median joy at 6 weeks ($p = 0.029$), compared to the placebo comparator group (**Figure 6**). Other measures such as anxiety, depression, resilience, and mindfulness were similar between these two groups at 6 and 12 weeks (**Table 4**).

The period prevalence rates of COVID-19 between May 21 and Jun 21 among the active comparators, placebo comparators, and yoga practitioners are 0.4, 0.6, and 0.5%, respectively. The rates between July 5 and August 5 are 0.5, 0.4, and 0.3%, respectively. The rates between Aug 15 and Sep 15 were 0.6, 2.3, and 1.1%, respectively. At baseline, 19 (90.5%) of yoga practitioners with COVID-19 reported symptoms of either fever or shortness of breath compared to 2 (40%) of the active comparators and 4 (57.1%) of the placebo comparators ($p = 0.023$). There were no other significant differences in the frequency of symptoms reported between the groups at any other time point. There was no significant difference in the duration of symptoms reported nor in the Post Traumatic Growth Inventory Scores between groups at any time point.

Compliance

Compliance is defined as 3 days of activity each week for at least 3 weeks from baseline to 6 weeks, or a minimum of 6 weeks from baseline to 12 weeks. Based on the responses collected from the weekly updates, seasoned yoga practitioners completed their activity for an average of 6.1 days per week (SD:1.5), while active comparator arm only performed Simha Kriya for an average of 3.3 days per week (SD:3.0) and placebo comparator arm performed their chosen activity for an average of 3.8 days per week (SD:2.9) (Refer to **Supplementary Tables B–G** in **Supplementary Materials**).

Eighty of the 1,177 active comparators and 100 of the 1,161 placebo comparators were found to be compliant for the full 12 weeks. At baseline, there were no significant differences in the scores between the compliant active and placebo comparators. At 6 weeks, the active comparators had higher median wellbeing [55 (IQR 50–61) vs. 52 (IQR 45–58), $p = 0.048$] and median joy scores [5.5 (IQR 4.5–6) vs. 5 (IQR 4.2–5.8), $p = 0.029$]. compared to the placebo comparators. At 12 weeks, the active comparators had higher wellbeing [56 (IQR 49–61.5) vs. 53 (IQR 46–58), $p = 0.046$] and joy scores [5.5 (IQR 4.5–6) vs. 5 (IQR 4.2–5.8), $p = 0.029$]. compared to the placebo comparators. At 12 weeks, the active comparators also had lower median PSS scores compared to the placebo group with 10 [IQR 5–14] and 13 [IQR 8–17], respectively ($p = 0.017$) (**Table 4**).

Between baseline and 6 weeks, the median difference in PSS scores among both the compliant active and placebo comparators was a three-unit [IQR −5–0] decrease ($p < 0.0001$). There was a 1.5-unit [IQR −1–5] increase in wellbeing scores among the active comparators ($p = 0.0008$), and a two-unit [IQR −2–5] increase among the placebo comparators ($p = 0.0042$). For joy scores, there was a zero-unit [IQR −0.2–0.5] change among the active comparators ($p = 0.035$), but no significant change among the placebo comparators.

Between 6 and 12 weeks, the median difference in PSS scores among the compliant active comparators was a one-unit [IQR −5–2] decrease ($p = 0.025$). However, there was no significant change among the placebo comparators. Joy scores increased by 0.2 units [IQR −0.3–0.5] among the placebo comparators ($p = 0.037$), but there was no significant change among the active comparators. Mindfulness awareness (MAAS) scores increased by 0.2 units [IQR −0.2–0.6] between 6 and 12 weeks among the active comparators ($p = 0.0033$) but not the placebo comparators.

TABLE 2 | PSS scores—primary outcome (primary outcome for the 3 groups at all 3 time points).

	Baseline				Week 6				Week 12			
	Active comparators (*n* = 1,177)	Placebo comparators (*n* = 1,161)	Yoga practitioners (*n* = 4,554)	*P*-Value	Active comparators (*n* = 218)	Placebo comparators (*n* = 228)	Yoga practitioners (*n* = 2,745)	*P*-Value	Active comparators (*n* = 163)	Placebo comparators (*n* = 171)	Yoga practitioners (*n* = 2,366)	*P*-Value
PSS score, median (IQR)	(*n* = 1,176)[a]	(*n* = 1,160)	(*n* = 4,552)	<0.0001	(*n* = 207)	(*n* = 222)	(*n* = 2,658)	<0.0001	(*n* = 146)	(*n* = 157)	(*n* = 2,108)	<0.0001
	16 (12, 21)	16 (12, 21)	11 (7, 15)		12 (8, 17)	14 (9, 18)	9 (6, 13)		11.5 (8, 16)	13 (8, 17)	9 (5, 13)	

[a](*n* = X) represents the number of patients with PSS scores in the specific group at the specific time point.

DISCUSSION AND CONCLUSION

Seasoned yoga practitioners had better psychological status compared to the rest of the study population at all-time points. Lower levels of stress in seasoned yoga practitioners have also been documented in studies conducted by Tyagi et al. (29) and Peterson et al. (30). Significant lowering in levels of depression in yoga practitioners appeared in results of a randomized control trial study conducted by Prathikanti et al. (20).

Furthermore, when subjected to a short 3-min online guided breathing exercise (Simha Kriya), the control arm participants demonstrated significant changes in their perceived stress. The active comparator arm reported lower levels of stress at weeks 6 and 12. This result demonstrates the positive effect of a 3-min breathing and meditation practice on diminishing stress levels. Our findings are comparable to Doria et al. (31) where a yoga practice that includes a specific breathing technique reduced stress levels in patients suffering from generalized anxiety disorder. Vinchurkar et al. (32) found that short periods of yoga and meditation improved mental health. Other health benefits reported by Peterson et al. (30) include sleep quality improvement, higher levels of focus and attention, and physiological benefits such as stabilizing the cardiac autonomic nervous system in yoga practitioners. These studies emphasize the importance of a short period of exposure to mindfulness practices that can result in improved mental health in participants.

Next, a closer look at compliant participant scores in the cohort with brief exposure to yoga intervention (Simha Kriya) revealed a sustained improvement in PSS scores at week 6 and week 12 compared to non-compliant participants. These findings agree with those reported by Chang et al. (33) in a waitlisted RCT in college students during the pandemic. They reported that consistent practice of yoga for 3 or more times per week resulted in significant changes in stress, anxiety, depression, wellbeing, resilience, positive & negative affect scores. Sadhasivam et al. (34) found similar results in a study conducted wherein study participants of a four-day yoga retreat experienced improved focus, happiness, and positive wellbeing with reduced depression and anxiety. Scores increased immediately after the retreat compared with participants' baseline values assessed 2 weeks before the program ($p < 0.001$). All improvements were sustained 1 month after the program. Blood tests from participants ($n = 142$) also showed increased endocannabinoid levels (lipid mediators associated with enhanced mood and reduced anxiety/depression) as well as a brain-derived neurotrophic factor suggesting a role for these biomarkers in the underlying mechanism of yoga's protective effects.

With implementation of social distancing and work from home approaches to curb the spread of COVID-19 pandemic, telemedicine has become a cornerstone in healthcare delivery approaches (35, 36). Meditation and yoga are optimal choices for complementary health practices for promotion of mental and physical wellbeing (37). It is important to recognize that the current study has successfully demonstrated the scalability and accessibility of Simha Kriya as an intervention. While several

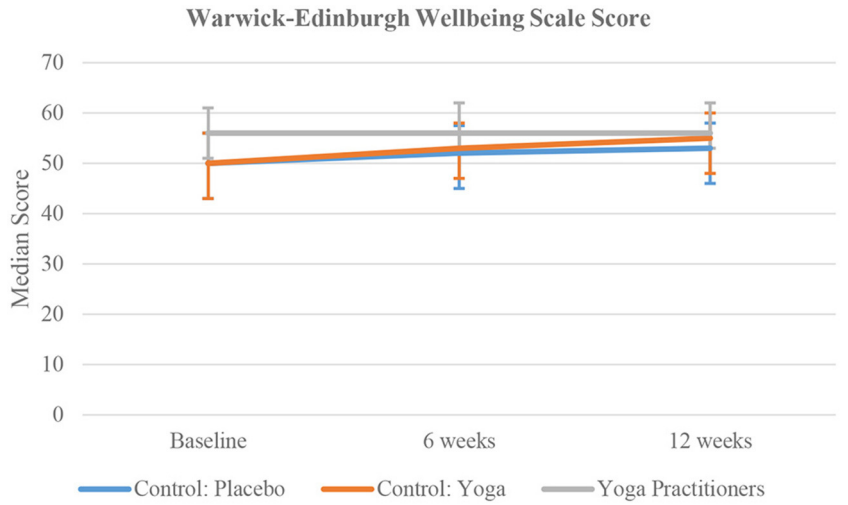


FIGURE 4 | Time trend comparison of WEMWBS Score in the three study group at all three time points.

studies are now studying the impact of remote administration of the mindfulness-based intervention, only a few have been able to successfully implement them (38, 39).

Study Strength

The study draws its strength from a large number of participants enrolled in the study. Small sample sizes and relatively self-selected population enrolling into mindfulness-based research studies often affect the scalability and generalizability of the studies' results. Furthermore, the complex study design enabled the flexibility of simply observing the seasoned yoga practitioners in their typical practice while simultaneously generating and testing a hypothesis on the effects of a short breathing practice on novice practitioners. The use of validated neuro-psychological scales lent validity to the self-reported survey responses and helped establish an association between yoga and mental health outcomes. Finally, as previously mentioned, despite being employed in a sub-group of control participants i.e., active comparator group, the study team was able to remotely deliver and provide a brief yet effective breathing practice in times of need.

Study Limitations

A limitation of our study is that we could not randomize all study participants. As the investigation was performed during peak COVID-19 infections in the U.S., it would have been unethical to advise routine yoga practitioners to forego their practices for the sake of the study's internal validity. In order to account for the various confounding variables on the data collected, the study team undertook the following measures:

1. Actively match for age, gender, and region between the two cohorts of seasoned yoga practitioners and controls,

2. Treating and analyzing the data collected from seasoned practitioners as an observational arm, and

3. Finally, collecting detailed information on intervention practiced, frequency of interventions, and duration of practice and accounted for these details in analysis phase.

The study team acknowledges that the two cohorts were not identical and that seasoned yoga practitioners had greater exposure to the mindfulness practices with an advantage of time and experience than the controls. As Davidson and Kaszniak (40) eloquently offer in their review; estimating mindfulness is complex by virtue of several confounding variables (e.g., mindfulness practice time, style of practice, home vs. retreat practice, formal vs. informal practice, age, and cultural variations etc.). These variables lead to variation in expectations from seasoned vs. novice practitioner's mindfulness quality and experience. Quantification of these variables is not possible with use of self reports alone.

Another limitation that can be identified is that only Isha School of yoga practitioners were invited to participate in this study, introducing an element of selection bias. However, since the comparator cohort composed of novice practitioners was subjected to randomization, selection bias did not truly impact the study's reported outcome measures. Seasoned yoga practitioners were treated as an observational cohort while the comparator arm participants: who are recruited by snowball sampling technique and have no prior meditation or yoga experience, were introduced to either intervention or control group activities based on the group they are allocated.

Lastly, many participants did not complete the study, and the participant attrition rates were high in all cohorts. The attrition rates amounted to ∼50% at each time point which is fairly consistent with the wide range for attrition reported in the literature, i.e., 8–60% (41, 42). The difficult time faced by the participants during the pandemic and the usual reasons could be a contributing cause.

TABLE 3 | Secondary outcomes (secondary outcomes for the 3 group at all 3 time points).

	Baseline				Week 6				Week 12			
	Active comparators (*n* = 1,177)	**Placebo comparators (*n* = 1,161)**	**Yoga practitioners (*n* = 4,554)**	***P*-Value**	**Active comparators (*n* = 218)**	**Placebo comparators (*n* = 228)**	**Yoga practitioners (*n* = 2,745)**	***P*-Value**	**Active comparators (*n* = 163)**	**Placebo comparators (*n* = 171)**	**Yoga practitioners (*n* = 2,366)**	***P*-Value**
Measures of negative affect[a]												
PHQ anxiety score, No. (%)	(*n* = 1,173)[d]	(*n* = 1,156)	(*n* = 4,547)	<0.0001	(*n* = 204)	(*n* = 218)	(*n* = 2,654)	<0.0001	(*n* = 144)	(*n* = 154)	(*n* = 2,088)	<0.0001
None	982 (83.7)	958 (82.9)	4,314 (94.9)		182 (89.2)	198 (90.8)	2,572 (96.9)		133 (92.4)	140 (90.9)	2,039 (97.7)	
Mild	154 (13.1)	162 (14.0)	192 (4.2)		17 (8.3)	16 (7.3)	76 (2.9)		10 (6.9)	13 (8.4)	44 (2.1)	
Moderate	37 (3.2)	36 (3.1)	41 (0.9)		5 (2.5)	4 (1.8)	6 (0.2)		1 (0.7)	1 (0.7)	5 (0.2)	
PHQ depression score, No. (%)	(*n* = 1,173)	(*n* = 1,156)	(*n* = 4,547)	<0.0001	(*n* = 204)	(*n* = 218)	(*n* = 2,654)	0.0003	(*n* = 144)	(*n* = 154)	(*n* = 2,088)	0.051
None	999 (85.2)	993 (85.9)	4,224 (92.9)		185 (90.7)	201 (92.2)	2,541 (95.7)		135 (93.8)	144 (93.5)	2,012 (96.4)	
Mild	159 (13.6)	145 (12.5)	294 (6.5)		17 (8.3)	16 (7.3)	106 (4.0)		9 (6.3)	10 (6.5)	74 (3.5)	
Moderate	15 (1.3)	18 (1.6)	29 (0.6)		2 (1.0)	1 (0.5)	7 (0.3)		0 (0.0)	0 (0.0)	2 (0.1)	
Measures of positive affect[b]												
Warwick-Edinburgh wellbeing	(*n* = 1,169)	(*n* = 1,146)	(*n* = 4,539)	<0.0001	(*n* = 195)	(*n* = 216)	(*n* = 2,623)	<0.0001	(*n* = 139)	(*n* = 152)	(*n* = 2,053)	<0.0001
scale score, median (IQR)	50 (43, 56)	50 (43, 56)	56 (51, 61)		53 (47, 58)	52 (45, 57.5)	56 (52, 62)		55 (48, 60)	53 (46, 58)	56 (53, 62)	
DPES score, median (IQR)	(*n* = 1,175)	(*n* = 1,154)	(*n* = 4,548)	<0.0001	(*n* = 200)	(*n* = 217)	(*n* = 2,650)	<0.0001	(*n* = 144)	(*n* = 153)	(*n* = 2,079)	<0.0001
	5 (4.2, 5.7)	5 (4.3, 5.7)	5.5 (4.8, 6.2)		5 (4.5, 5.8)	5 (4.2, 5.8)	5.7 (5, 6.2)		5.2 (4.4, 5.9)	5 (4.3, 5.7)	5.7 (5, 6.2)	
BRS score, median (IQR)	(*n* = 1,169)	(*n* = 1,151)	(*n* = 4,542)	<0.0001	(*n* = 198)	(*n* = 217)	(*n* = 2,639)	0.21	(*n* = 140)	(*n* = 153)	(*n* = 2,064)	0.20
	2 (1.8, 2.3)	2 (1.8, 2.3)	2 (1.8, 2.2)		2 (1.8, 2.2)	2 (1.8, 2.2)	2 (1.8, 2.2)		2 (1.8, 2.2)	2 (2, 2.2)	2 (1.8, 2.2)	
Mindfulness scores[c]												
MAAS score, median (IQR)	(*n* = 1,170)	(*n* = 1,153)	(*n* = 4,545)	<0.0001	(*n* = 200)	(*n* = 217)	(*n* = 2,642)	<0.0001	(*n* = 143)	(*n* = 153)	(*n* = 2,067)	<0.0001
	4.2 (3.4, 5)	4.2 (3.2, 5)	4.8 (4, 5.2)		4.6 (3.8, 5.2)	4.4 (3.6, 5.2)	4.8 (4.2, 5.4)		4.8 (4, 5.4)	4.6 (3.6, 5.2)	5 (4.2, 5.4)	
COVID positive participants only												
Post-Traumatic growth	(*n* = 5)	(*n* = 7)	(n=20)	0.28	(*n* = 1)	(*n* = 1)	(*n* = 12)	0.62	(*n* = 1)	(*n* = 3)	(*n* = 26)	0.68
inventory score, median (IQR)	65 (11, 68)	63 (45, 84)	72.5 (53.5, 86.5)		56 (56, 56)	54 (54, 54)	78.5 (52, 83.5)		48 (48, 48)	73 (28, 76)	72.5 (48, 81)	

[a]Decline in scores suggests successful impact of meditation practices, [b]Increase in scores suggests successful impact of meditation practices, [c]increase in scores suggests successful impact of meditation practices, [d](n = X) represents the number of patients with this score in the specific group at the specific time point.

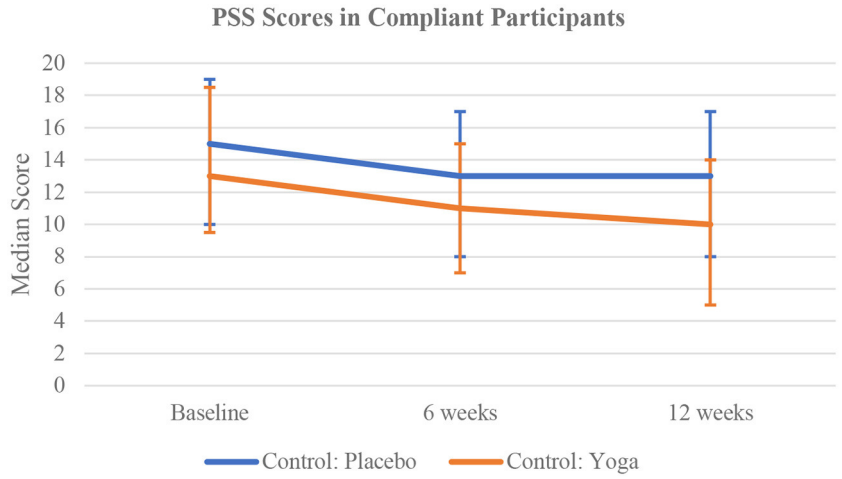


FIGURE 5 | Time trend comparison of PSS Scores in the compliant participants of non-meditator cohort at all three time points.

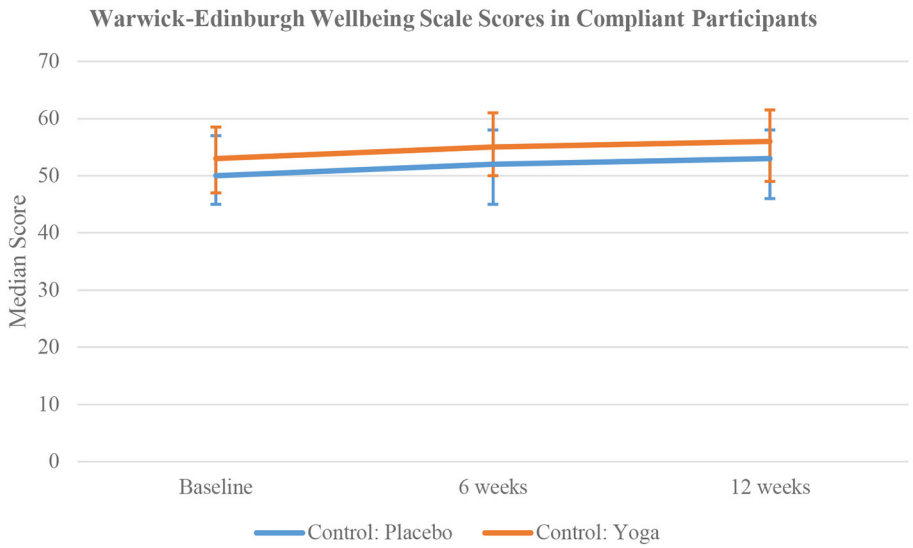


FIGURE 6 | Time trend comparison of WEMWBS Scores in the compliant participants of non-meditator cohort at all three time points.

Future Directions

The study team identifies a lack of objective physiological markers provided by wearable health-tracking devices as a limitation of the current study. The study team could not introduce data collection from these devices due to financial and time constraints when the study was introduced. Additionally, restrained physical communication and work from home added another layer of complexity in data collection from such devices. These were also the reasons why we refrained from any lab collections for the study. However, the study team aims at incorporating data points from these devices as a compliance marker in upcoming studies to make a more robust comparison.

With this study, the study team demonstrated that seasoned yoga practitioners had better psychological status compared to the rest of the study population at all-time points thereby signaling the protective effects of yoga practice, especially during the uncertain times of a pandemic. Further adherence to a brief 3-min breathing practice for as less as 3 days/week resulted in sustained improvements in stress and mental wellbeing of study participants. This offers an opportunity for providing Simha kriya as remotely delivered, accessible practice to all who suffer from COVID-19 as an adjunct therapy. Further clinical efficacy trails are warranted to establish the true impact of such breathing techniques.

TABLE 4 | Compliant participant comparison in the comparator group only (at 6 week and 12 week).

Scores	Week 6			Week 12		
	Active comparator (*n* = 80)	**Placebo comparator (*n* = 100)**	***P*-Value**	**Active comparator (*n* = 80)**	**Placebo comparator (*n* = 100)**	***P*-Value**
Measures of negative affect[a]						
PSS score, median (IQR)	(*n* = 78)[d]	(*n* = 97)	0.082	(*n* = 73)	(*n* = 95)	0.017
	11 (7, 15)	13 (8, 17)		10 (5, 14)	13 (8, 17)	
PHQ anxiety score, No. (%)	(*n* = 78)	(*n* = 97)	0.80	(*n* = 72)	(*n* = 93)	0.82
None	73 (93.6)	92 (94.9)		67 (93.1)	85 (91.4)	
Mild	4 (5.1)	4 (4.1)		4 (5.6)	7 (7.5)	
Moderate	1 (1.3)	1 (1.0)		1 (1.4)	1 (1.1)	
PHQ depression score, No. (%)	(*n* = 78)	(*n* = 97)	0.34	(*n* = 72)	(*n* = 93)	1.0
None	72 (92.3)	93 (95.9)		70 (97.2)	90 (96.8)	
Mild	6 (7.7)	4 (4.1)		2 (2.8)	3 (3.2)	
Moderate	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)	
Measures of positive affect[b]						
Warwick-Edinburgh wellbeing scale score, median (IQR)	(*n* = 78)	(*n* = 97)	0.048	(*n* = 72)	(*n* = 93)	0.046
	55 (50, 61)	52 (45, 58)		56 (49, 61.5)	53 (46, 58)	
DPES score, median (IQR)	(*n* = 78)	(*n* = 97)	0.029	(*n* = 72)	(*n* = 94)	0.32
	5.5 (4.5, 6)	5 (4.2, 5.8)		5.3 (4.5, 6)	5.2 (4.3, 6)	
BRS score, median (IQR)	(*n* = 78)	(*n* = 97)	0.56	(*n* = 72)	(*n* = 94)	0.56
	2 (1.8, 2.2)	2 (1.8, 2.2)		2 (1.8, 2.2)	2 (2, 2.2)	
Mindfulness scores[c]						
MAAS score, median (IQR)	(*n* = 78)	(*n* = 97)	0.099	(*n* = 72)	(*n* = 94)	0.087
	4.8 (4, 5.4)	4.4 (3.6, 5.2)		5 (4, 5.5)	4.8 (3.8, 5.2)	
COVID positive participants only						
Post-Traumatic growth inventory score, median (IQR)	(*n* = 1)	(*n* = 1)	N/A	(*n* = 1)	(*n* = 2)	1.0
	56 (56, 56)	54 (54, 54)		48 (48, 48)	52 (28, 76)	

[a]Decline in scores suggests successful impact of meditation practices, [b]Increase in scores suggests successful impact of meditation practices, [c]increase in scores suggests successful impact of meditation practices, [d](n = X) represents the number of patients with this score in the specific group at the specific time point.

CONCLUSION

We provide evidence that routine yoga practice during the COVID-19 pandemic did reduce stress and enhanced wellbeing in study participants who were exposed to some form of yoga activity during the 12-week study duration.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Commitee on Clinical Investigations at Beth Israel Deaconess Medical Center. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

BS, PU, and LN conceptualized the study's design. SN, TK, PM, and AS conducted data collection. PU, LN, and LK carried out the data analysis. PU did project administration/supervision. LN and LK verified the underlying data. All authors contributed to the writing, review, editing, confirm that they had full access to all the data in the study, and accept responsibility to submit for publication.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.813664/full#supplementary-material

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EDITED BY
Xenia Gonda,
Semmelweis University, Hungary

REVIEWED BY
Sebastian Contreras,
Max-Planck-Institute for Dynamics and Self-Organisation, Germany
David Alfredo Medina Ortiz,
University of Magallanes, Chile

*CORRESPONDENCE
Jonathan M. P. Wilbiks
jwilbiks@unb.ca

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Remember the past, plan for the future: How interactions between risk perception and behavior during the COVID-19 pandemic can inform future Canadian public health policy

Moira A. Law, Jonathan M. P. Wilbiks*, Sean P. Roach and Lisa A. Best

Department of Psychology, University of New Brunswick Saint John, Saint John, NB, Canada

The ongoing COVID-19 pandemic necessitated the implementation of numerous temporary public health policies, including social distancing, masking, and movement limitations. These types of measures require most citizens to follow them to be effective at a population level. This study examined population adherence to emergency public health measures using early data collected in the Spring of 2020, when all Canadian jurisdictions were under relatively strict measures. In total, 1,369 participants completed an online questionnaire package to assess adherence, perceptions of government response, and perceptions of COVID-19 risk. Results indicated that most Canadians were pleased with the government's handling of the early phases of the pandemic and immediately engaged new public health mandates. Willingness to change behaviors was unrelated to satisfaction with the government response. Similarly, behavioral adherence was also unrelated to satisfaction with government, or personal risk perceptions; however, adherence to public health guidelines was related to elevated psychological distress. As the pandemic continues, public health officials must balance the mental health of the population with the physical health concerns posed by COVID-19 when applying public health mandates.

KEYWORDS

COVID-19, public health policy, collective behavior, behavioral adherence, public mental health

Introduction

The current COVID-19 pandemic has been a novel situation with many unknowns, including how individuals would respond to the pandemic itself and how they would respond to associated public health recommendations, guidelines, and policies. Although public health measures vary in their effectiveness and can have effects on both physical and mental health (1, 2), adherence is typically high in emergency situations; for example, Tracy et al. (3) reported that when quarantine is required, the public generally supports governmental decisions. Nonetheless, because even the implementation of less restrictive measures can lead to distress among Canadian populations (4), public health authorities must strike a balance between physical and mental health risks. An understanding of how individuals perceive government responses to pandemics and, importantly, how that relates to their adherence with public health policies is vital. Although preventative regulations focus on preventing transmission of the SARS-CoV-2 virus, population-level adherence to such measures can be influenced by several factors that vary widely depending on global location; these factors include psychological wellbeing, personal risk perception, as well as impressions of government competence and health care system capacity. For instance, many countries in the Global South did not have the economic and organizational capacity to swiftly respond to the current pandemic, hence their citizenry's initial behavioral adherence reflected their vulnerable circumstances, such as poor employment conditions, as well as perceptions of government and interpersonal characteristics, including risk perception (5–7).

Although perceptions of specific health measures influence adherence to behaviors (8, 9), the factors influencing this relationship are not fully clear. Although increased risk perception, fear, and anxiety are associated with preventive actions, including frequent handwashing, social distancing, and self-isolation (2, 10, 11), higher adherence is not always associated with greater risk of disease spread. For example, during the 2009–2010 H1N1 outbreak of influenza in Hong Kong, although the risk of individuals contracting disease was low there was a widespread acceptance of avoidance behaviors (12).

During the H1N1 epidemic in Beijing, Xu and Peng (13) used a longitudinal design to examine people's perceptions of the disease and their behaviors at various stages of the pandemic. During the pre-pandemic phase, behaviors recommended by public health officials to reduce transmission were inversely related to personal risk perceptions, such that those persons with higher estimates of their own risks associated with contracting the disease, were less likely to engage in the recommended behaviors. During the rising phase, there was a positive relationship; individuals who believed they were at risk of infection were *more* likely to engage in such behaviors. Finally, at the peak of the pandemic, the association between risk perception and adherence was less clear; social distancing was positively associated with perceived risk, but hand hygiene was not. Thus, further investigation is required to clarify the factors that govern adherence to public health policies in emergency situations.

The purpose of this study was to examine the relationships between risk perception, psychological distress, perceptions of government performance, and behavioral adherence to public health directives during the COVID-19 pandemic in Canada, March 31–April 15, 2020. Research during the COVID-19 pandemic has indicated that women exhibit higher adherence to public health measures (5, 14), higher COVID-19 risk perceptions (15) and more psychological distress (16). Hence, we also surveyed sex difference among the observed associations.

Method

Participants

In total, 297 males and 1,072 females completed an online questionnaire package. The mean age of females was slightly lower than that of the males $M_{age} = 40.61$, $SD = 14.76$ vs. 43.48, $SD = 17.29$; $t_{(1,367)} = 2.85$, $p = 0.01$. In addition, 12 participants identified as neither male nor female and these participants were significantly younger, $M_{age} = 34.17$, $SD = 15.35$. Most participants reported that they were Caucasian, $n = 1,295$; 93.5%; 2.5% of participants reported that they were East Asian or Asian and ∼1% of participants reported that they were Black. Most participants were currently enrolled ($n = 257$) in or completed ($n = 551$) post-secondary education programs, with 464 participants who were enrolled in or had completed a graduate or professional program.

Materials

Behavioral adherence was measured using seven items rated on a 4-point Likert scale ranging from "always" to "never." Items assessed specific aspects of social distancing (e.g., I avoid crowded places) and hygiene behaviors (e.g., hand washing). For each item, participants also indicated (yes or no) if their behavior had changed because of COVID-19, with lower scores indicating higher adherence. The Cronbach's α was 0.76 and 0.64 for the adherence behaviors and change items, respectively.

Risk perception was evaluated using a five-item questionnaire rated on a five-point Likert scale (1 = strongly disagree) to assess perception of risk related to the virus, e.g., "I believe there is a high risk of death if someone contracted COVID-19." This measure had adequate reliability, with Cronbach's α = 0.72. COVID-19 Worry was assessed using

five questions adapted from Lau et al. (17). Participants used a 5-point Likert scale (1 = strongly disagree) to rate their panic, depression, and emotional stability as well as the degree to which they were worried about their personal and family safety. The reliability of this measure was high, Cronbach's $\alpha = 0.82$.

Public perception of government performance was assessed using a seven-item self-report questionnaire. Based on a scale from 1 to 10, with 5 considered a passing grade, participants assessed government performance reporting on how satisfied they were with the measures being taken to prevent the spread of the virus, the timeliness of measures, and the effectiveness of implemented measures.

Procedure

Data collection for this study took place between March 31 and April 15, 2020 when strict social distancing regulations were implemented in all Canadian provinces and territories. Participants were recruited from social media sites (i.e., Facebook, Twitter) and were directed to an online survey platform (Qualtrics). We recruited broadly and our questionnaire did not include questions to examine individual history of COVID-19 infection. After providing informed consent and answering basic demographic questions, participants completed the randomized questionnaire package. Questionnaire completion took ∼12 min. This study was reviewed and approved by the University of New Brunswick Research Ethics Board.

Data analysis strategy

SPSS V. 28 was used for data analysis. Prior to data analysis, data conditioning was conducted to ensure there were no out-of-range values or missing data. The assumptions underlying the statistical tests were examined. Correlational analyses were used to examine the associations between risk perception, psychological distress, perceptions of government performance, and behavioral adherence. *T*-tests were used to examine specific gender differences and a mixed model analysis of variance (ANOVA) was used to examine adherence as a function of gender and education.

Results

Canadians exhibited overall satisfaction with their government, with responses on the government performance questionnaire indicating a higher than acceptable rating ($M = 5.42$, $SD = 1.15$) (see Table 1 for descriptive statistics and correlations between study variables). A correlational analysis indicated that mean perception of Government Performance was significantly associated with lower overall Risk Perception, $r_{(901)} = -0.12$, $p < 0.001$, as well as perceived Personal, $r_{(900)} = -0.09$, $p = 0.005$, and Family, $r_{(899)} = -0.10$, $p = 0.002$, risk of contraction. Mean Risk Perception was associated with adherence to Personal Hygiene guidelines, $r_{(892)} = -0.09$, $p = 0.01$, but not with adherence to Social Distancing guidelines, $r_{(890)} = -0.03$, $p = 0.40$. Correlational analyses were also conducted to determine if negative psychological outcomes were related to adherence to government directives for social distancing and personal hygiene. The correlations between overall COVID-19 Worry and Social Distancing, $r_{(896)} = -0.12$, $p = 0.001$, and Personal Hygiene, $r_{(896)} = -0.12$, $p < 0.001$, indicated that individuals who experienced more COVID-19 Distress were more likely to follow guidelines.

Mean satisfaction with Government Performance was 5.42 ($SD = 1.15$); <20% of participants rated Government Performance negatively (Figure 1). Although there was no difference in satisfaction among males and females ($M = 5.33$ and 5.45, respectively; independent samples *t*-test: $t_{(1,110)} = 1.39$, $p = 0.17$), there was a statistically significant correlation between age and satisfaction with Government Performance, $r_{(1,382)} = 0.102$, $p < 0.001$, indicating that older participants reported higher satisfaction than did younger participants.

In addition to being satisfied with the governmental response, respondents were optimistic about the ability of the local health care system to manage the pandemic. Respondents reported that their local health system had sufficient space, $M = 3.82$, $SD = 1.12$, enough medical personnel, $M = 3.77$, $SD = 1.10$, and adequate personal protective equipment, $M = 4.01$, $SD = 1.04$. Further, participants believed that the Canadian government would be able to control the current pandemic, $M = 3.14$, $SD = 1.04$, although there was less confidence in the ability to manage a large scale COVID-19 outbreak, $M = 3.02$, $SD = 1.10$.

Virtually all participants reported that their behaviors had changed due to government directives and reflected social distancing and personal hygiene recommendations. Participants reported that their social distancing and personal hygiene behaviors changed in response to the pandemic (average reported change was 85.5%). Although there were sex differences in social distancing, the degree of behavioral change in response to COVID-19 was similar for males and females. The degree of behavior change varied across measures, with greater change for social distancing measures (e.g., respecting social distancing guidelines) and less change for food sharing, likely because participants avoided food sharing prior to the pandemic. Further, although there were differences in how satisfied participants were with specific governmental responses, dissatisfaction with the government did not affect the behavioral changes associated with preventing COVID-19.

Compared to males, females were more likely to comply with social distancing, $t_{(1,114)} = 3.08$, $p = 0.002$, and hygiene, $t_{(1,111)} = 3.10$, $p = 0.002$, guidelines. Further, correlational

TABLE 1 Mean (standard deviation) and correlations between variables of interest.

	Risk perception	COVID-19 worry	Government performance	Adherence: social avoidance	Social avoidance change	Adherence: hygiene	Hygiene change
Mean (sd)	3.08 (0.76)	3.41 (0.91)	5.42 (1.15)	3.71 (1.40)	0.76 (0.23)	1.26 (0.49)	0.81 (0.40)
Risk perception		0.444***	−0.125***	−0.014	0.054	−0.086**	0.006
COVID-19 worry			−0.067*	−0.109**	0.156***	−0.118***	0.142***
Government performance				−0.035	0.022	0.020	0.025
Social avoidance					−0.001	0.285***	−0.010
Social avoidance Change						−0.011	0.356***
Hygiene							0.100**

*p < 0.05, **p < 0.01, ***p < 0.001.
Social Avoidance and Hygiene were reverse scored, such that lower numbers indicated increased adherence.

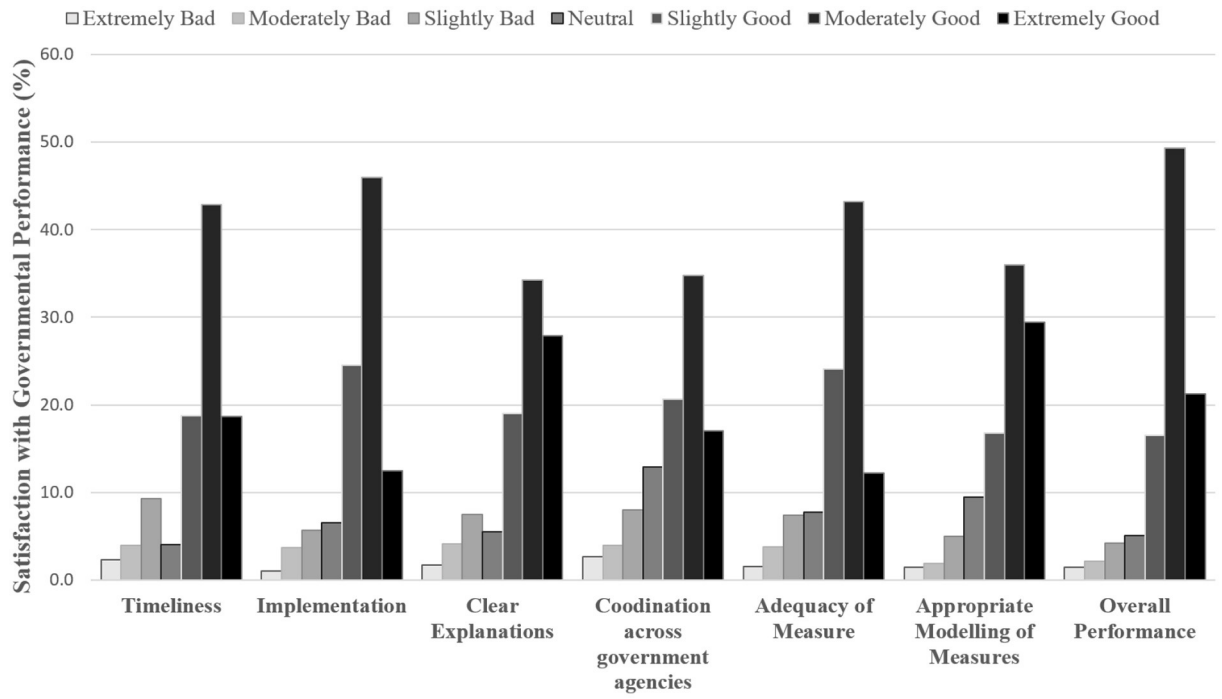

FIGURE 1
Satisfaction of participants with government measures (N = 1,386).

analyses indicated that older individuals were more likely to be satisfied with overall government performance, $r_{(1,110)} = 0.10$, $p < 0.001$, and adhere to social distancing, $r_{(1,113)} = 0.13$, $p < 0.001$, guidelines. To control for potential effects of age, a partial correlational analysis was used to examine the association perceived government performance and compliance with recommendations in the overall sample. The partial correlations between perceived satisfaction with government performance and overall compliance were not significantly associated with social distancing, $r_{(873)} = -0.036$, $p = 0.29$, or personal hygiene, $r_{(873)} = 0.04$, $p = 0.26$.

To examine specific differences in adherence to government directions as a function of demographic variables a 2 (sex) × 2 (education: university vs. no university) × 2 (measure type: social distancing, hygiene) mixed model analysis was conducted (see Table 2). There were statistically significant main effects

TABLE 2 Mean differences (and standard deviations) in adherence of government guidelines as a function of sex and education.

	No university education			University education		
I avoid...	**Males**	**Females**	**Total**	**Males**	**Females**	**Total**
...crowded places (i.e., to practice social distancing).	1.31 (0.56)	1.17 (0.42)	1.20 (0.46)	1.18 (0.46)	1.15 (0.41)	1.15 (0.42)
...going out unless necessary.	1.38 (0.63)	1.28 (0.55)	1.30 (0.57)	1.41 (0.63)	1.25 (0.54)	1.28 (0.57)
...shaking hands.	1.67 (1.00)	1.38 (0.78)	1.45 (0.84)	1.62 (0.97)	1.46 (0.83)	1.49 (0.86)
...sharing my food and drinks.	1.52 (0.76)	1.49 (0.72)	1.49 (0.73)	1.46 (0.66)	1.46 (0.67)	1.46 (0.68)
...sitting directly next to someone.	1.71 (0.88)	1.60 (0.78)	1.62 (0.81)	1.71 (0.87)	1.59 (0.82)	1.62 (0.83)
Social avoidance mean	1.52 (0.52)	1.38 (0.48)	1.41 (0.49)	1.48 (0.51)	1.38 (0.48)	1.40 (0.49)
I practice proper hygiene and regularly wash hands, minimum 20 s.	1.34 (0.54)	1.19 (0.42)	1.23 (0.45)	1.36 (0.55)	1.26 (0.51)	1.28 (0.52)

Adherence was rated on a 1 (always) to 4 (never) scale, with lower scores indicating higher adherence to guidelines.

of sex, $F_{(1,1106)} = 16.54$, $p < 0.001$, with females exhibiting greater overall compliance, and measure type, $F_{(1,1,106)} = 50.65$, $p < 0.001$, with participants reporting higher compliance with social distancing guidelines than with personal hygiene.

Discussion

During the initial stages of the COVID-19 pandemic, between March 31 and April 15, 2020, most Canadians (80%) surveyed were satisfied with the performance of their government. Notwithstanding limitations of generalizability due to this survey being launched on social media platforms this high approval rating was similar to a global sample of 25,992 adults aged 18–74 years surveyed during the week of April 23–26th that reported comparable satisfaction rates of their government response by Canadians (81%), Indians (87%), and Australians (84%); and much higher than Japanese (31%), Russians (38%) and French (43%) citizens (18). The absence of a gender difference with respect to government satisfaction was surprising given the documented disparities women have experienced during this state of emergency in terms of caregiving responsibilities (19), perceived risks to family members (4) and employment disruptions (20). Perhaps the anticipated gender differences would have emerged if data collection was longer than 2 weeks and later in the pandemic (21, 22). Another notable limitation of this study is the high number of female respondents, 78% (n = 1,072), reducing the generalizability of our findings and marking the need for replication with more representative samples. Higher female participation may have led to higher rates of reported psychological distress, behavioral adherence, and risk perceptions in this study (5, 22–26).

Most participants (85%) reported immediately changing their behaviors due to the pandemic, exhibiting widespread adherence to social distancing and personal hygiene recommendations. Interestingly, although there was no sex difference in governmental satisfaction, females adhered more closely than males to all public health policies from March 31–April 15, 2020. These findings are similar to studies conducted in March 21–26, 2020 (14) and March to December 2020 (5) and align with an earlier study that found women had higher risk perceptions for family members than for themselves during the earliest days of this outbreak; it was for the safety of loved ones rather than themselves that motivated behavioral changes (4). One year later, distressed concern for loved ones continued (23, 27) and may support public health maintaining a focus on compassionate messaging to motivate adherence behaviors as the pandemic continues (24, 25).

A notable limitation of this study is the high proportion of respondents with some or completed post-secondary education limiting the conclusions that can be drawn for the broader population. Unlike other studies that found higher adherence was related to higher levels of education (26, 28, 29), the current results did not indicate an association between levels of education and adherence to public health guidelines suggesting initial adherence may have been primarily motivated by emotional response rather than reason (30).

Global fear quickly rose as mainstream and social media's growing coverage on the spread of the SARS-CoV-2 virus abroad may have been affecting Canadian citizens well before March 2020 when the country went into lockdown (31). The current pandemic led to unprecedented connectivity to sources of information that were both reliable, e.g., public health briefings, and unreliable, e.g., social media, often to the detriment of the public's wellbeing (32, 33). Misinformation became mainstream (34) and even peer-reviewed scientific publications that generated initial overestimations of infection mortality rates contributed to the public's mounting angst (35). The interplay of social contagion via social media and disease spread may have been contributing to growing fear (36) that directed early adherence behaviors measured in this study and detected in other studies in the same time frame (4, 30, 33) neutralizing any effects of education and critical thinking early at this stage in this pandemic. Later studies provided compelling evidence that education is a moderator of employment conditions that affords

more choice in social distancing requirements (37, 38), giving rise to a significant disparity between the "laptop class" and front line workers (39) that may require government and public health coordination when considering social mitigation in the future, i.e., enhanced social assistance.

Older Canadians reported higher satisfaction and behavioral adherence with the government's early response to the pandemic, perhaps reflecting their knowledge of being at greater risks for adverse COVID outcomes (31) and their relief to see governmental responses unfolding quickly and in a unified manner (40). With most Canadian COVID-19 deaths reported among seniors (41) since this early data was collected it is expected adherence in this population will remain high. Strikingly, there was no relationship between government satisfaction and adherence with public health guidelines, which highlights the need for a better understanding of the factors and context influencing adherence behaviors that are vital to successful pandemic mitigation.

Individuals with an overall lower perception of personal and family risk assessed the government's response more positively, suggesting public health officials would be wise to deescalate the public's personal risk perceptions by continuing to provide timely and accurate information during future outbreaks (42). Surprisingly, overall risk perception was not associated with social distancing behaviors, e.g., standing 2 m apart, but significantly related to personal hygiene, e.g., hand washing directives. This was the opposite of findings from the peak of the H1N1 outbreak, in which social distancing was positively associated with perceived risk but hand hygiene was not (13). This is interesting as hygiene behaviors, such as hand washing (43, 44) and sneezing into elbow (45), have a well-established evidence base compared with social distancing behaviors (46). Future pandemic investigations should consider the extrinsic and intrinsic motivation of adherence behaviors across genders, different age groups, and those with elevated risk perceptions.

Finally, and not surprisingly, individuals who experienced elevated levels of worry and distress were more likely to adhere to public health guidelines and report that their behaviors changed in response to the current pandemic as noted in previous pandemics (2, 10, 11). Despite these results, public health officials should be reminded that excessive and prolonged stress interferes with adherence (47–50) and mental health professionals have been sounding the alarm on elevated mental health conditions as the pandemic has progressed (51–54). In addition to guidelines designed to curtail disease spread as new variants of the SARS-CoV-2 virus emerge, managing risk perceptions for various subpopulations, and incorporating broader definitions of health that supersede single factor analysis, e.g., physical health (40, 41) need to become integrated into public health management plans.

Canadian policy makers need to be cognizant of co-operating within international frameworks that will serve Canadians and other countries well and remain aware of issues regarding vaccine availability, systemic disadvantages, and daily individual struggles that are commonplace in other countries (55). Moderate policies that are not too strong or too weak optimize desired health outcomes (56). For instance, policies that reduce social contacts to a moderate level and avoid full lockdowns may achieve outcomes that protect the healthcare system and avoid economic consequences (57) while avoiding severe conditions that exacerbate psychological distress. This relationship between psychological distress and adherence to public health directives warrants continued monitoring as the effects of prolonged mitigation may evolve into serious pathology and adherence behaviors deteriorate due to psychological fatigue. In short, the secondary impacts of social mitigation, such as deterioration in mental health (4) and economic repercussions (46, 57) must be heavily factored into public health plans as the country continues to move forward.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Research Ethics Board at the University of New Brunswick Saint John. The patients/participants provided their written informed consent to participate in this study.

Author contributions

LB analyzed the data and created figures. ML wrote the initial draft of the manuscript. JW, SR, and LB revised the manuscript. All authors conceptualized the paper, designed the method, and collected data and have reviewed and approved the final submission.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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EDITED BY
Xenia Gonda,
Semmelweis University, Hungary

REVIEWED BY
Min Tan,
Affiliated Hospital of North Sichuan Medical College, China
Mahlagha Dehghan,
Kerman University of Medical Sciences, Iran

*CORRESPONDENCE
Caixia Xie
xiecaixia1999@163.com
Limei Liao
limeiliao@uestc.edu.cn

†These authors have contributed equally to this work

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Prevalence and influencing factors of psychological distress among nurses in sichuan, china during the COVID-19 outbreak: A cross-sectional study

Caixia Xie[1,6*†], Jia Zhang[2,6†], Jia Ping[2,6†], Xinyu Li[3,6], Yu Lv[4,6] and Limei Liao[5*]

[1]Department of Nursing, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [2]Department of Neurosurgery, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [3]General Practice Center, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [4]Department of Healthcare-Associated Infections Control Center, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [5]School of Medicine, University of Electronic Science and Technology of China, Chengdu, China, [6]Chinese Academy of Sciences Sichuan Translational Medicine Research Hospital, Chengdu, China

Background: The COVID-19 pandemic has spread across the world. Nurses have inevitably been influenced by it.

Purpose: To investigate the prevalence and influencing factors of psychological distress among nurses in Sichuan, China over the COVID-19 outbreak.

Methods: This study used a cross-sectional survey design. Thousand eight hundred and seventy nurses who worked in COVID-19-designated hospitals participated in the study during the pandemic. Data was collected online between February 8 and February 13, 2020. The self-designed General Information Questionnaire, the General Health Questionnaire-12, the Perception of Hospital Safety Climate Scale, and the Simplified Coping Style Questionnaire were used. The binomial logistic regression model was applied to assess the association between psychological distress and potential explanatory variables.

Findings: At the beginning of the epidemy of the COVID-19 outbreak, 12% of nurses were found to experience psychological distress. The main influencing factors were personal precautionary measures at work, discomfort caused by protective equipment, perception of the hospital safety climate, coping style, and professional title.

Conclusions: In the pandemic, wearing protective equipment correctly, a safe hospital climate, and positive coping style for nurses could be beneficial for nurses' mental health. Nurse managers should take measures to build a safe hospital climate.

KEYWORDS

mental health, nurses, COVID-19, psychological distress, prevalence and influencing factors

Introduction

The coronavirus (COVID-19) outbreak began in December 2019, resulting in significant loss of life across the world. Level 1 emergency status, the highest level, was announced, with the strictest infection control measures implemented. Sichuan, China, was affected by several cases from Wuhan and local transmission. Nurses were the primary implementers of the protective measures taken to control COVID-19 in Sichuan (1). In all three major coronavirus outbreaks of the last two decades (SARS, Ebola, and COVID-19), nurses' mental health has been affected (2). It was reported that during the COVID-19 outbreak, 34.4% of the medical and nursing staff working in Wuhan had mild psychological distress, 22.4% had moderate psychological distress, and 6.2% had severe psychological distress (3).

Psychological distress is an unpleasant emotional experience caused by several psychological (cognitive, behavioral, emotional), social, and spiritual factors. It can develop from and involve vulnerability, sadness, fear, anxiety, depression, social separation, and spiritual crisis (4). Psychological distress is reported to cause adverse effects on physical health including lowered immunity (5, 6), the inability to make the most accurate and optimal decisions for patients, which might impair their safety (7), reduced job and life satisfaction, and tension in interpersonal relationships (8, 9). Paying attention to the mental health of nurses during COVID-19 and exploring its influencing factors is essential for the formulation of mental health promotion strategies for nurses at both the individual and organizational levels. These will help nurses reduce any possible psychological distress and improve their mental health.

During the pandemic period of COVID-19, the psychological distress of nurses was affected by numerous individual and work-related factors, including their personality characteristics, age, gender, marital status, years of work experience, level of exposure to affected patients, self-efficacy, and presence of physical symptoms (2, 10, 11). However, the above studies did not explore whether characteristics of the workplace, such as the supply of protective materials, application of protective measures, and any possible discomfort caused by protective equipment, were influencing factors contributing to nurses' psychological distress.

Perception of a hospital's safety climate refers to employees' overall perception of the safety of their working environments (12). It was suggested that the perception of hospital climate may be related to nurses' psychological distress. Coping style refers to the method of dealing with stress and maintaining psychological balance. For nurses, participation in work related to COVID-19 is a significant stressor. It is suggested that nurses' different coping styles may have an impact on their psychological distress. Therefore, it is necessary to explore the influence of the supply of protective materials in the workplace, the application of personal protective measures, discomfort caused by protective equipment, perception of hospital safety climate, and coping style on nurses' psychological distress.

The main objectives of this study were to (1) describe the psychological distress of Chinese nurses in COVID-19-designated hospitals in Sichuan during the COVID-19 outbreak and (2) examine the main factors of psychological distress with a focus on work status, perception of hospital safety climate, and coping styles.

Methods

Design

This study used a cross-sectional survey design.

Participants

The sample size of logistic regression (binary outcome) generally follows the principle of 10 events per variable. There were 13 independent variables to be included in this study, so the number of positive events was at least $14 \times 10 = 130$. As per past research, when SARS broke out, the incidence of psychological distress among nurses was 27.5% (13). Therefore, we used a positive event rate of 27.5% for the sample calculation. Considering the loss of 10–20% of the sample, the minimum sample size required for this study was $N = 14 \times 10 \times (1+0.2) \div 27.5\% = 611$.

From February 8 to February 13, 2020, during the COVID-19 outbreak in China, a convenient sampling method was used. One COVID-19-designated hospital each from five regions, East, South, West, North and middle, of the Sichuan Province were selected. Nurses from these five hospitals were invited to participate in the study, and 1,870 nurses volunteered.

Data collection

Data was collected online through the Questionnaire Star platform, an online survey tool similar to Survey Monkey. Information about the investigation and the survey quick response code were sent through WeChat, a web-based social media application, to nurse managers in the five hospitals. This was then distributed to the nurses. The number of answers provided by the same IP address was limited, and each IP address could only answer the survey once. Therefore, repeat submissions and invalid data were effectively controlled. Four main questionnaires were used in this study. They are outlined as follows:

The general information questionnaire

The GIH is a self-designed instrument for demographic information and work status during the COVID-19 pandemic. The demographic characteristics included sex, age, marital status, number of children, nursing educational background, work year, and professional title. The work status information focused on direct contact with confirmed or suspected COVID-19 patients, the supply of protective materials in the workplace, application of personal protective measures, and any possible discomfort caused by protective equipment.

The general health questionnaire-12 (GHQ-12)

Psychological distress was measured using the 12-item GHQ-12, which is a widely used self-administered tool for emotional distress derived from the original 60-item version (14, 15). It consists of six positively phrased items and six negatively phrased items with four responses each, ranging from "better than usual" to "much less than usual." A cut-off score of four was selected to identify the presence of psychological distress, defined as a break from normal functioning (e.g., loss of sleep, loss of self-confidence, or the inability to make decisions) (16). The reliability of the GHQ-12 in the general population ranged from 0.71 to 0.86 (17). The internal consistency of the GHQ-12 in this study was 0.85.

The perception of hospital safety climate scale (PHSCS)

The perception of hospital safety climate was measured using the revised Chinese version of the PHSCS (18), which was initially used in the context of organizational commitment to management projects to reduce blood-borne pathogen exposure risk (12). It consists of 21 items and five dimensions: management support with six items, obstacles to safe work with three items, feedback and training with six items, cleanliness and tidiness with three items, and conflict and communication with three items. Each item has a score ranging from 1 (strongly diagree) to 5 (strongly agree) as per a 5-point Likert scale. The lower the score, the better the perception of the hospital safety climate. With an assessment of 391 nurses conducted, the internal consistency and retest reliability of the revised Chinese version of PHSCS were reported to be 0.87 and 0.84, respectively (18). The internal consistency of the revised Chinese version of the PHSCS in this study was 0.84.

The simplified coping style questionnaire (SCSQ)

This questionnaire (19) was based on the Ways of Coping questionnaire (20). It is a 20-item self-report questionnaire that includes two dimensions: an positive coping style with 12 items and a negative coping style with eight items. The items measured typical coping attitudes and methods using a four-point Likert scale (0 = never; 1 = sometimes; 2 = often; 3 = always). The SCSQ has been commonly used in China, and its test-retest coefficient is 0.89. The internal consistency coefficients (Cronbach's alpha) were reported to be 0.89 and 0.78 for the active and positive coping dimensions (19). In this study, they were 0.929 and 0.830, respectively.

Ethical considerations

This study was approved by the Human Research Ethics Committee of the Sichuan Provincial People's Hospital (Protocol No. 2020103). Completion of the online survey was considered consent to participate in the study, which was clearly stated in the instructions for the questionnaires.

Data analysis

Analyses were performed using the SPSS 22.0 statistical program (IBM Corp., Armonk, NY, USA). Categorical variables were expressed with frequency and percentages, and continuous variables were expressed using mean and standard deviation (SD). A Pearson's chi-square test and independent Students' *t*-test were performed to identify potential explanatory variables for psychological distress. The binomial logistic regression model was applied to assess the association between psychological distress and potential explanatory variables while adjusting for other identified predictors. This was carried out using a sequential modeling approach. *P*-values <0.05 were considered to be statistically significant.

Results

Participant characteristics

Totally, 1,870 nurses participated in the study. Characteristics of the subjects are presented in Table 1.

Descriptive statistics

Table 2 displays the incidence of psychological distress, scores of perception of hospital safety climate and coping style in nurses. With scores of the GHQ-12 equal to or greater than 4, 225 nurses (12%) experienced psychological distress. The mean and SD of the total score of the PHSCS was 98.1 ± 10.5 with management support dimension of 28.2 ± 3.2; obstacles to safe work of 13.5 ± 2.2; feedback and training of 28.6 ± 2.9; cleanliness and tidiness of 13.6 ± 2.1; and conflict and

TABLE 1 Characteristics of the subjects ($N = 1,870$).

Variable	Frequency (n)	Proportion (%)
Gender		
Male	69	3.7
Female	1,801	96.3
Age (years)		
<25	301	16.1
25∼30	709	37.9
31∼35	417	22.3
36∼40	204	10.9
>40	239	12.8
Marital status		
Unmarried	664	35.5
Married	1,206	64.5
Child/Children's situation		
No	767	41
Yes	1,103	59
Highest education		
College and below	641	34.4
Undergraduate and above	1,229	65.6
Work year		
<5	499	26.7
5–10	730	39.0
11–15	276	14.8
16–20	120	6.4
>20	245	13.1
Professional title		
Registered nurse	498	26.6
Primary	868	46.4
Intermediate	419	22.4
Senior	85	4.5
Protective supplies in your workplace		
Sufficient	130	7.0
Basically sufficient	1,256	67.2
Not Sufficient	484	25.9
Personal precautionary measures at work		
Adequate	713	38.1
Basically adequate	1,026	54.9
Inadequate	131	7.0
Discomfort caused by protective equipment		
No discomfort	606	32.4
Somewhat discomfort	988	52.8
Discomfort	276	14.8
Direct contact with confirmed or suspected cases		
No	169	9.0
Possible	1,371	73.4
Yes	330	17.6

communication of 14.2 ± 1.6. The mean and SD of the SCSQ with positive coping style was 24.7 ± 7.9; and the negative coping was 9.6 ± 5.3. The normality test showed that all quantitative data had normal distributions.

Univariate analysis

Pearson's chi-square tests and independent Student's t-tests were performed to identify potential variables for psychological distress. Table 3 compares the characteristics of the subjects between groups with and without psychological distress.

Logistic regression analysis

Logistic regression analysis identified six factors that were significantly associated with the presence of psychological distress (see Table 4). Nurses without any professional title had 48.8% lower odds of developing psychological distress when compared with nurses with a senior professional title (OR 0.512, 95% CI 0.207–1.267). Inadequacy in personal precautionary measures at work resulted in a significantly increased risk of psychological distress (taking "adequate" as a reference, OR 1.753 for "basically adequate," and OR 3.568 for "inadequate"). Discomfort caused by protective equipment was associated with an increased risk of psychological distress (taking taking "No discomfort" as a reference, OR 1.832 for "Somewhat discomfort," and OR 3.137 for "Discomfort"). The higher the score of perception of hospital safety climate and positive coping, the lower the incidence of psychological distress. The higher the score of negative coping, the higher the incidence of psychological distress.

Discussion

The prevalence of psychological distress

One interesting finding of the study was that 12% of the nurse respondents reported experiencing psychological distress, at the beginning of the epidemy of the COVID-19 outbreak. The study was conducted in COVID-19-designated hospitals in Sichuan, which was a region less affected by COVID-19.As of February 2020, it had recorded a total of 539 confirmed cases and three deaths. A recent study found that the prevalence of psychological distress among healthcare workers differed across regions with varying incidences of COVID-19 infections (21). This is reasonable because nurses in Sichuan may potentially feel safer than nurses in Hubei, for example, when evaluating the possibility of receiving a COVID-19 patient, since they are working in a less-affected area.

TABLE 2 Scores of the PHSCS and SCSQ, and percentages of psychological distress.

Variables	*N* (%)	Mean ± SD	Response range
Perception of hospital safety		98. 1 ± 10.5	
Climate			21–105
Management support		28.2 ± 3.2	6–30
Obstacles to safe work		13.5 ± 2.2	3–15
Feedback and training		28.6 ± 2.9	6–30
Cleanliness and tidiness		13.6 ± 2. 1	3–15
Conflict and communication		14.2 ± 1.6	3–15
Positive coping		24.7 ± 7.9	0–36
Negative coping		9.6 ± 5.3	0–24
Psychological distress		1.4 ± 1.7	0–2
No	1,646 (88.0%)		
Yes	224 (12.0%)		

Influencing factors of psychological distress

Personal precautionary measures at work

During COVID-19, taking personal precautionary measures at work was a crucial step for frontline nurses to avoid getting infected (22). The results revealed that the psychological distress of nurses with inadequate personal protective measures was 3.568 times higher than that of nurses with adequate personal protection. This suggests that the implementation of personal protective measures can predict nurses' psychological distress when dealing with such sudden infectious diseases. In this study, personal protective measures referred to the necessary preventive measures in different workplaces based on first-, second-, and third-level protection requirements, which play an important role in isolation protection and reducing the rate of nosocomial infection (23). For instance, the emergency department has to take the first level of protection, requiring nurses to wear work clothes, isolation clothes, work caps, disposable surgical masks, and latex gloves and carry out hand hygiene and standard prevention when caring for patients. In the fever and isolation clinics, nurses should wear medical protective masks, work clothes, protective clothing, work caps, and latex gloves and take droplet isolation and contact isolation based on the requirements of the second-level protection. When performing procedures that may produce aerosol in suspected or confirmed COVID-19 patients, nurses should be equipped with a face mask or comprehensive respirator on the basis of secondary protection, according to the requirements of third-level protection (24, 25). Due to the sudden nature of the outbreak, there was a lack of protection knowledge and skills (26), and thus nurses could not correctly apply protection measures at the beginning of the pandemic. For example, when wearing a protective mask, the air tightness did not meet the requirements needed (27), and when taking off protective clothing, exposure behavior often occurred (28). Therefore, it is particularly important to strengthen nurses' training in the correct implementation of protective measures (29).

Discomfort caused by protective equipment

The results of this study showed that more than half the nurses experienced some discomfort, and 14.8% of nurses felt constant discomfort, due to protective equipment. The psychological distress of nurses who felt discomfort caused by protective equipment was 3.14 times higher than that of nurses who did not feel it. Nurses must wear medical protective equipment to avoid catching COVID-19. This can cause several types of discomfort, such as (1) stuffiness and dyspnea, (2) decreased visual clarity and operation sensitivity, (3) insufficient diet and water intake at work, (4) facial pressure injury (30), and (5) a variety of skin problems such as acne, seborrheic dermatitis, and dry skin (31). In addition, the use of facial coverings also impairs direct communication and eye contact between nurses, their colleagues, and patients (32). Therefore, it is important to explore safe and effective strategies to reduce the discomfort and inconvenience caused by protective devices.It was proposed that the prophylactic use of thin hydrocolloid dressings on the bridge of the nose could effectively protect against pressure injuries when protective devices were used (33). Measures such as sweat absorption clothing and antiperspirant can be used to improve comfort and ease the burden faced by medical staff wearing protective clothing. Anti-fogging agents and indwelling films can work well to minimize goggle fogging (34). Research on the improvement of protective equipment, including protective masks and goggles, should be carried out in the future. It is also necessary to explore effective training and management strategies that will help reduce the discomfort caused by incorrect wearing of protective devices.

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TABLE 3 Univariate analysis of psychological distress in nurses.

	No. of respondents				Statistics	
	No psychological distress (*n*, %) (*n* = 1,645)	Psychological distress (*n*, %) (*n* = 225)	No psychological distress (Mean ± SD) (n = 1,645)	Psychological distress (Mean ± SD) (n = 225)	χ/t	*P*-value
Gender					2.593	0.107
Male	65 (4.0%)	4 (1.8%)				
Female	1,580 (96%)	221 (98.2%)				
Age (years)					38.454	<0.001
<25	286 (17.4%)	14 (6.2%)				
25∼30	198 (12%)	41 (18.2%)				
31∼35	642 (39%)	67 (29.8%)				
36∼40	351 (21.4%)	66 (29.3%)				
>40	168 (10.2%)	37 (16.5%)				
Marital status					15.957	<0.001
Married	1,034 (62.9%)	172 (76.4%)				
Unmarried	611 (37.1%)	53 (23.6%)				
Child/Children					24.058	<0.001
no	709 (43.1%)	58 (25.8%)				
yes	936 (56.9%)	167 (74.2%)				
Highest education					5.131	0.024
College and below	579 (35.2%)	62 (27.6%)				
Undergraduate and above	1,066 (64.8%)	163 (72.4%)				
Work year					32.221	<0.001
<5	644 (39.1%)	86 (38.2%)				
5–10	468 (28.4%)	30 (13.3%)				
11–15	232 (14.1%)	45 (20%)				
16–20	98 (6%)	22 (9.8%)				
>20	203 (12.4%)	42 (18.7%)				
Professional title					34.071	<0.001
Registered nurse	460 (28%)	38 (16.9%)				
Primary	775 (47.1%)	94 (41.8%)				
Intermediate	347 (21%)	72 (32%)				
Senior	64 (3.9%)	21 (9.3%)				
Protective supplies in your workplace					35.984	<0.001
Sufficient	120 (7.3%)	10 (4.5%)				
Basically sufficient	1,136 (69.1%)	120 (53.3%)				
Not Sufficient	389 (23.6%)	95 (42.2%)				
Personal precautionary measures at work					60.909	<0.001
Adequate	670 (40.7%)	43 (19.1%)				
Basically adequate	881 (53.6%)	145 (64.4%)				
Inadequate	94 (5.7%)	37 (16.5%)				
Discomfort caused by protective equipment					54.827	<0.001
No discomfort	572 (34.8%)	34 (15.1%)				
Somewhat discomfort	861 (52.3%)	128 (56.9%)				

(Continued)

TABLE 3 Continued

	No. of respondents				Statistics	
	No psychological distress (*n*, %) (*n* = 1,645)	Psychological distress (*n*, %) (*n* = 225)	No psychological distress (Mean ± SD) (n = 1,645)	Psychological distress (Mean ± SD) (n = 225)	χ/t	*P*-value
Discomfort	213 (12.9%)	63 (28%)				
Direct contact with confirmed or suspected cases						
No	1,241 (75.4%)	130 (57.8%)			31.566	<0.001
Possible	137 (8.3%)	32 (14.2%)				
Yes	267 (16.3%)	63 (28%)				
Perception of hospital safety climate			99.0 ± 10.0	91.6 ± 12.0	10.141	<0.001
Positive coping			25.1 ± 7.9	21.7 ± 6.6	6.252	<0.001
Negative coping			9.4 ± 5.4	11.0 ± 4.2	−4.222	<0.001

TABLE 4 Logistic regression analysis of psychological distress on nurses.

Variable	B	Standard Error	Wald	*P*-value	OR	95% CI
Professional title						
Senior					1.000	
Intermediate	−0.774	0.348	4.963	0.026	0.461	0.233–0.911
Primary	−1.131	0.394	8.215	0.004	0.323	0.149–0.699
Registered nurse	−0.67	0.462	2.097	0.148	0.512	0.207–1.267
Personal precautionary measures at work						
Adequate					1.000	
Basically adequate	0.561	0.197	8.126	0.004	1.753	1.192–2.578
Inadequate	1.272	0.285	19.881	<0.001	3.568	2.040–6.242
Discomfort caused by protective equipment						
No discomfort					1.000	
Somewhat discomfort	0.605	0.213	8.041	0.005	1.832	1.206–2.784
Discomfort	1.143	0.246	21.519	<0.001	3.137	1.935–5.086
Perception of hospital safety climate	−0.032	0.006	29.437	<0.001	0.968	0.957–0.980
Positive coping	−0.073	0.011	41.519	<0.001	0.930	0.910–0.951
Negative coping	0.095	0.017	29.381	<0.001	1.099	1.062–1.138

Perception of hospital safety climate

Perception of hospital safety climate refers to the employees' overall perception of the working environment, including safety decision making, safety practices, and safety procedures (12). In the 1990's, the "safety climate perception to nurse occupational safety management" (35) was first applied. The study reported that the perception of hospital safety climate directly affected the safety behavior of medical staff. The better the perception of hospital safety climate, the better the occupational protection behavior and the lower the occupational injury rate (36).

The regression analysis showed that the better the nurses' perception of a hospital's safety climate, the lower the incidence of psychological distress. During the pandemic period, nurses' perceptions of hospital safety climates were affected by many factors including the high risk of virus infection (37), sharp increase in the number of patients (38), prolonged working hours, lack of protective equipment, and safety promotion measures taken by hospitals (39). In the face of the pandemic, nurse managers should consider the importance of perception of hospital safety climate a priority for nurses' mental health, and they should take all recommended measures

to improve it in a timely and effective manner. This can include training for greater protection knowledge and skills (40), establishment of an inspection system for protective devices before work, and provision of adequate protective equipment (39).

Coping style

Positive coping refers to positive strategies to eliminate or avoid stressors or decrease stress (41), while negative coping refers to avoidance (e.g., ignoring problems) or deterioration rather than solving problems (42). The results of this study showed that 1,870 nurses had either positive (9.6 ± 5.3) and negative (1.4 ± 1.7) coping scores during the pandemic period, which indicated that the frontline nurses working in the hospital exhibited more positive responses.

Regression analysis of this study showed that positive coping was a protective factor for nurses' mental health, which is consistent with the results of a study by Ilić et al. (43). It may be that, in the pandemic, a sense of professional mission, professional honor (44), professional values (45), and self-esteem (46) helped nurses adopt a variety of positive coping styles (47). Of course, there were also some negative coping strategies demonstrated, such as fear or avoidance of patients with suspected or actual COVID-19 infections. Therefore, nursing managers should pay attention to the coping styles of nurses during such periods and guide them to adopt positive ones. Furthermore, negative coping styles can be reduced through training.

Professional titles

This study shows that the higher the professional title, the more severe the recorded mental health problems are. Those with higher professional titles have to demonstrate stronger critical care thinking abilities (3) and undertake more social roles, which leads to greater psychological pressure. For these reasons, they are more likely to experience psychological distress.

Limitations

Our study has several limitations. First, the study used a cross-sectional design. A causal link between main influencing factors and psychological distress over the COVID-19 outbreak was not established in this study. Second, the data was collected over 5 days at the beginning of the epidemy, without any longitudinal follow-up. With the fluctuation of the pandemic situation, nurses' psychological distress could oscillate.

Conclusions

At the beginning of the epidemy of the COVID-19 outbreak, the incidence of psychological distress was 12%. Personal precautionary measures at work, discomfort caused by protective equipment, perception of hospital safety climates, coping styles, and professional titles were the factors influencing nurses' psychological distress. When dealing with sudden infectious diseases such as COVID-19, nurse managers must ensure that the protective equipment provided is sufficient. They must also train nurses in the correct use of protective equipment while performing actual work. At the same time, medical institutions and nursing managers should take effective measures for safety decision making, safety practices, and safety procedures according to the current pandemic situation and the specific situations of medical institutions so as to improve nurses' perception of the hospital safety climate. Nurse managers should assess whether the mental state of nurses who usually use negative coping styles is suitable for COVID-19 work. The application of these measures may reduce the incidence of psychological distress among nurses during the COVID-19 outbreak. Any possible long-term psychological distress of nurses is worth further investigation.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

CX, JZ, and JP carried out the studies, participated in collecting data, drafted the manuscript and supervision whole process. LL, XL, and YL conducted data analysis and helped to draft the manuscript. All authors read and approved the final version of the manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Daria Smirnova,
Samara State Medical University, Russia

REVIEWED BY
Foong Ming Moy,
University of Malaya, Malaysia
Salmi Razali,
Universiti Teknologi MARA, Malaysia

*CORRESPONDENCE
Wendy Wan Ying Tay
drwendytay@gmail.com

†These authors have contributed equally to this work and share first authorship

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Eighteen months into the COVID-19 pandemic: The prevalence of depression, anxiety, and stress symptoms in Southeast Asia and the associated demographic factors

Wendy Wan Ying Tay[1*†], Jehanita Jesuthasan[1†], Kim Sui Wan[2], Tiffanie Ong[1] and Feisul Mustapha[2]

[1]Naluri Hidup Sdn Bhd, Kuala Lumpur, Malaysia, [2]Ministry of Health, Putrajaya, Malaysia

Mental health has become a growing concern in the wake of the COVID-19 pandemic. We sought to determine the prevalence of mental health symptoms 18 months after the pandemic's declaration. Our cross-sectional study conducted among 18- to 65-year-old adults (N = 33,454) in October 2021 using the Depression, Anxiety and Stress Scales (DASS-21) found a high prevalence of severe to extremely severe anxiety (49%), depression (47%) and stress (36%) symptoms in Malaysia, Indonesia, Thailand, and Singapore. Multiple logistic regression showed that female and non-binary genders were associated with increased odds of severe/extremely severe symptoms of anxiety (female: aOR 1.44 [95% CI 1.37–1.52]; non-binary aOR 1.46 [1.16–1.84]), depression (female: aOR 1.39 [1.32–1.47]; non-binary aOR 1.42 [1.13–1.79]), and stress (female: aOR 1.48 [CI 1.40–1.57]; non-binary aOR 1.42 [1.12–1.78]). In all three symptom domains, the odds of severe/extremely severe symptoms decreased across age groups. Middle- and high-income respondents had lower odds of reporting severe/extremely severe anxiety (middle-income: aOR 0.79 [0.75–0.84]; high-income aOR 0.77 [0.69–0.86]) and depression (middle-income: aOR 0.85 [0.80–0.90]; high-income aOR 0.84 [0.76–0.94]) symptoms compared to low-income respondents, while only middle-income respondents had lower odds of experiencing severe/extremely severe stress symptoms (aOR 0.89 [0.84–0.95]). Compared to residents of Malaysia, residents of Indonesia were more likely to experience severe/extremely severe anxiety symptoms (aOR 1.08 [1.03–1.15]) but less likely to experience depression (aOR 0.69 [0.65–0.73]) or stress symptoms (aOR 0.92 [0.87–0.97]). Respondents living in Singapore had increased odds of reporting severe/extremely severe depression symptoms (aOR 1.33 [1.16–1.52]), while respondents residing in Thailand were more

likely to experience severe/extremely severe stress symptoms (aOR 1.46 [1.37–1.55]). This study provides insights into the impacts of the COVID-19 pandemic on the point prevalence of psychological distress in Southeast Asia one and a half years after the beginning of the pandemic.

KEYWORDS

mental health, COVID-19, anxiety, depression, stress

Introduction

Mental health is a growing concern around the world. In the wake of the COVID-19 pandemic, significant concerns about its impact on mental illness have been raised. Social distancing measures, designed to limit the spread of the virus, and their accompanying impact on social support systems, can contribute to increased depression and anxiety. Moreover, psychological distress can also emerge from fears of infection and loss of employment resulting from economic instability (1).

During the pandemic, screen time increased dramatically, owing to reduced opportunities for face-to-face interaction and offline activities. These changes are likely to have also had a significant effect on mental health, given the association between internet usage and both depression and anxiety (2). Social media use in particular has been found to increase psychological distress. For example, high levels of social media usage, including addictive and compulsive use, and using large numbers of social media sites, can trigger social media fatigue, and, in turn, anxiety and depression (3–6). Moreover, high exposure to COVID-19 information online was shown to have a detrimental impact on mental health, particularly on anxiety symptoms (7–9).

In Southeast Asia during the COVID-19 pandemic, prevalence rates of anxiety and depression have been reported to be 31% and 16% for anxiety and depression, respectively, among the general population (10). Crucially, rates may be even higher among internet users specifically, for the reasons outlined above. Indeed, rates of problematic mental health symptoms in an Australian internet-based sample in March to April 2020 were especially high, at 79% (11). This highlights the importance of examining the prevalence of psychological distress among internet users.

Given the widespread impact of the pandemic on mental health, it is also crucial to identify the groups most affected. This can enable the development and delivery of support tailored to these individuals, in an effort to move toward precision public health. Studies have demonstrated that the impacts of the pandemic have not been equal across demographic groups. Wang et al.'s (12) study on the general population of seven Asian countries found that depression, anxiety, and stress scores varied between countries, age groups, genders, and education backgrounds. However, much of the research describing rates of psychological distress during the COVID-19 pandemic was conducted in the immediate months after the pandemic was announced (13, 14). The public health situation is perpetually evolving with new waves of outbreaks, changing social and movement restrictions, and increasing vaccination coverage. Consequently, the mental health status of the population should continue to be monitored to understand how the mental health impact of the pandemic is changing.

Our study therefore aims to determine the point prevalence of depression, anxiety, and stress symptoms in a Southeast Asian internet-based sample 18 months after the declaration of COVID-19 as a global pandemic and identify the factors associated with severe to extremely severe levels of these symptoms.

Method

Design and participants

This cross-sectional study was conducted in October 2021 using an online survey distributed to individuals in four countries in Southeast Asia, namely Malaysia, Indonesia, Singapore, and Thailand. Respondents were working-age adults (18- to 65-years-old) recruited through paid advertisements on social media platforms (Instagram and Facebook) and on Google Search and Google Display to complete the online survey on Naluri's website. There were no tokens or services provided for their participation in this study. Naluri is a Southeast Asian digital health company providing structured multidisciplinary health coaching to support and improve physical and mental health. Respondents who were outside of the target age range, lived outside of the four target countries, or did not answer all demographic questions were excluded.

Ethics approval was obtained from the Sunway Research Ethics Committee (ID 014/2021/IND/ER). All respondents provided digital informed consent and no personally identifiable information was collected.

Measures and instruments

The survey was composed of two parts: a demographics questionnaire and the 21-item Depression, Anxiety, and Stress Scales (DASS-21) (15). The demographics questionnaire asked

respondents to report their gender, year of birth, country of residence, and household income. Three domains of respondent's mental health (depression, anxiety, and stress) were measured using the DASS-21. The DASS-21 is a self-report questionnaire that includes three scales corresponding to the depression, anxiety, and stress domains of mental health. The depression scale assesses anhedonia, hopelessness, low energy, and dysphoria. The anxiety scale refers to autonomic arousal, including agitation and physiological symptoms. The stress scale measures chronic arousal, which entails irritability, tension, and nervousness. Each scale contains seven items, which the respondents score on a scale of 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time). The items for each subscale are summed and multiplied by a factor of two, yielding a score ranging 0 to 42 for each subscale. These scores can be categorized into five categories, namely normal, mild, moderate, severe, and extremely severe, using the cut-offs proposed by Lovibond and Lovibond (15). The primary outcome in the current study was the prevalence of severe/extremely severe depression (score $\geq$21), anxiety (score $\geq$15), and stress (score $\geq$26). We used severe/extremely severe symptoms as the cut-off for regression analyses as the identification of factors associated with this specific group of populations would allow targeted public health interventions.

The DASS-21 has been validated among Asians in previous research (16–19). To minimize reporting bias, the questions were presented in English, Malay, Chinese, Indonesian, or Thai using published translations based on the participant's preference. The Malay, Chinese, and Indonesia versions have been previously validated (19–21), while only the 42-item version of the DASS has been validated in Thai (22). The DASS-21 is in the public domain, so permission is not required to use it.

Respondent's demographic characteristics were age, gender, country of residence, and household income. The response options for gender were male, female, non-binary, and prefer not to answer. Non-binary gender refers to individuals who identify as neither male nor female. Age was used as a 4-level categorical variable using the categories 18–29, 30–39, 40–49, and 50–65. Household income was also used as a categorical variable, using the categories low, middle, and high income. Low income was defined as $\leq$ MYR 5,000, $\leq$ IDR 5,000,000, $\leq$ SGD 2,000, and $\leq$ THB 15,000 for residents of Malaysia, Indonesia, Singapore, and Thailand, respectively. High income was defined as $>$ MYR 11,000, $>$ IDR 12,000,000, $>$ SGD 18,000, and $>$ THB 50,000 for residents of Malaysia, Indonesia, Singapore, and Thailand, respectively. Respondents reporting incomes between these cut-offs were categorized as middle-income. For Singapore and Malaysia, household income level thresholds were defined based on government definitions (23, 24). For Indonesia and Thailand, middle income was defined as household income between the 20th to 80th percentile of the income distribution (25). Low income and age 18 to 29 years were chosen as the reference categories as these made up the largest portion of the sample. Malaysia was chosen as the reference category for country of residence as the study was designed and conducted by researchers based in Malaysia.

Data analyses

Data for depression, anxiety, and depression scores are presented in mean $\pm$ standard deviation (SD). Both frequency and percentages are reported for categorical variables. The 95% confidence intervals are also presented for the prevalence of depression, anxiety, and stress symptoms.

Simple logistic regressions were performed to examine the influence of each of the independent variables on the odds of experiencing severe to extremely severe symptoms of depression, anxiety, and stress. Variables with $p < 0.25$ were included in the multiple logistic regression model using forward likelihood ratio. The Omnibus test of model coefficients of determination, R^2, Hosmer & Lemeshow, classification table, and area under the Receiver Operating Characteristic (ROC) curve were reported. Data analyses were performed using statistical software (*R* version 4.02).

Results

Participant characteristics

Responses from 33,454 respondents who met the inclusion criteria were analyzed. The median age of our study population was 23 years (interquartile range 8). Sample characteristics are reported in Table 1. The majority of the sample was female (75.96%), 18- to 29-years-old (72.53%), and low-income (73.41%).

Prevalence of psychological distress

The prevalence of anxiety, depression, and stress symptoms for each level of severity in each country and across the sample is shown in Table 2. In our sample, 46.86% had severe to extremely severe symptoms of depression. Anxiety symptoms were experienced at a rate of 49.34%, while 36.19% of the sample had severe or above stress symptoms. In addition, 61.24% of the sample had severe or above symptoms in at least one of the three domains.

The prevalence of severe or above anxiety symptoms was highest in the Indonesian sample (53.09%), followed by the Malaysian (47.58%) and Thai (46.80%) samples, while the Singaporean sample had the lowest prevalence (44.78%). Similar proportions of the samples from Singapore, Thailand, and Malaysia reported depression symptoms (50.43, 49.94,

and 48.32%, respectively), while a smaller proportion of the respondents from Indonesia experienced these symptoms (43.05%). Rates of stress were higher among respondents from Thailand (42.64%) than among those from Malaysia, Indonesia, or Singapore (33.58, 33.88, and 31.32%, respectively).

Factors associated with severe/extremely severe psychological symptoms

Simple logistic regressions revealed that all four demographic variables were factors significantly associated with severe to extremely severe symptoms for depression, anxiety, and stress (Supplementary Table 1). All four variables were therefore entered into multiple logistic regression models for the three outcome variables, the results of which are shown in Tables 3–5.

For anxiety, females and non-binary respondents had odds of 1.44 and 1.46, respectively, of having severe or above symptoms of anxiety compared to males. In addition, the odds of meeting this cut-off decreased with age: compared to 18- to 29-year-olds, the odds of symptoms of this severity were 0.55, 0.38, and 0.22 among 30- to 39-year-olds, 40- to 49-year-olds, and 50- to 65-year-olds, respectively. Respondents from Indonesia were 8% more likely than those from Malaysia to experience severe or higher symptoms. Compared to respondents in the low-income category, those in the middle-income and high-income categories were 21 and 23% less likely to report severe or above anxiety symptoms, respectively.

With regards to depression symptoms, female and non-binary respondents had odds of 1.39 and 1.42 of reporting symptoms at or above the severe cut-off compared to males, respectively. Increasing age was associated with decreased odds of severe to extremely severe symptoms. Indeed, compared to 18- to 29-year-olds, 30- to 39-year-olds were 46% less likely to experience symptoms of this severity, while 40- to 49-year-olds and 50- to 65-year-olds were 66 and 80% less likely to experience these symptoms, respectively. Residents of Indonesia were 31% less likely than residents of Malaysia to experience these symptoms, but residents of Singapore were 33% more likely than residents of Malaysia to do so. Middle and high income were both associated with approximately 15% lower odds of experiencing severe or above symptoms compared to low income.

For the stress dimension, females and non-binary respondents were 48 and 42% more likely than males to have severe to extremely severe stress symptoms, respectively. In addition, 30- to 39-year-olds were less than two-thirds as likely as 18- to 29-year-olds to report symptoms meeting the severe cut-off. In addition, the odds of 40- to 49-year-olds and 50- to 65-year-olds experiencing symptoms of this severity compared to the youngest age group were 0.44 and 0.23, respectively. Residents of Indonesia were 8% less likely to experience severe or above stress symptoms compared to residents of Malaysia, while residents of Thailand were 46% more likely to experience these symptoms. Finally, the odds of being above the severe cut-off for middle-income respondents were 0.89 that of low-income respondents.

Discussion

Psychological distress 18 months post-pandemic declaration

The current study indicates that there is a high prevalence of psychological distress in a Southeast Asian internet-based sample in October 2021, 18 months after the declaration of COVID-19 as a global pandemic. In our sample, 46.86% experienced severe or above symptoms of depression, 49.34% experienced symptoms of anxiety, and 36.19% experienced symptoms of stress above the severe cut-off. These high prevalences are concerning and highlight a widespread impact of the COVID-19 pandemic on mental health in Southeast Asia, as well as an enduring high point prevalence of psychological distress. While we anticipated findings consistent with previous studies identifying elevated mental health problems since the beginning of the pandemic (26) and high rates of negative psychological symptoms among internet users (11), the magnitude of the psychological distress identified in our study is alarming.

Sociodemographic differences in mental health

Our study also showed that this impact of the pandemic on the point prevalence of mental severe symptoms of psychological distress 18 months after the pandemic's onset is seen particularly in female and non-binary respondents, as well as younger adults and those from low-income households. Female respondents' odds of experiencing severe or above symptoms of anxiety, depression, and stress compared to men ranged between 1.39 and 1.48. This finding is in line with previous findings on gender differences in psychopathology during the COVID-19 pandemic in Southeast Asia (27, 28). Several factors are likely to have contributed to higher anxiety, depression, and stress in females during the pandemic. Indeed, there are gender differences in stress response systems and females tend to have a greater arousal response to stress (29). In addition, during times of disaster, including disease outbreaks, the burden of productive, reproductive, and community work borne by women tends to increase (30), leading to a deterioration of their wellbeing as they take up greater responsibilities (31). In Singapore, for example, mothers were found to be more likely than fathers

TABLE 1 Respondent characteristics and mean depression, anxiety, and stress scores.

		N	%	Mean anxiety score (SD)	Mean depression score (SD)	Mean stress score (SD)
Gender	Male	7,726	23.09%	14.11 (9.71)	18.03 (11.94)	18.72 (10.57)
	Female	25,411	75.96%	16.42 (10.23)	20.67 (12.09)	21.31 (10.64)
	Other	317	0.95%	16.79 (9.68)	22.18 (10.62)	23.34 (9.29)
Age	18–29	24,264	72.53%	17.16 (9.97)	21.46 (11.72)	21.94 (10.28)
	30–39	6,701	20.03%	13.35 (9.85)	17.49 (12.28)	18.49 (10.95)
	40–49	2,001	5.98%	10.91 (9.73)	14.03 (12.00)	15.62 (10.98)
	50–65	488	1.46%	8.01 (8.01)	11.10 (10.99)	12.37 (9.96)
Country	Malaysia	10,319	30.85%	15.34 (10.72)	20.49 (12.85)	19.38 (11.27)
	Indonesia	12,590	37.63%	16.87 (10.03)	19.02 (12.07)	20.46 (10.45)
	Singapore	1,063	3.18%	15.01 (10.24)	21.45 (11.95)	19.96 (10.05)
	Thailand	9,482	28.34%	15.29 (9.56)	20.85 (11.16)	22.65 (10.08)
Income	Low	24,559	73.41%	16.61 (10.20)	20.60 (12.10)	20.99 (10.66)
	Middle	7,181	21.47%	14.08 (9.72)	18.80 (11.88)	20.08 (10.61)
	High	1,714	5.12%	13.17 (9.76)	17.81 (12.23)	19.86 (10.98)
Total sample		33,454	100.00%	15.89 (10.15)	20.07 (12.10)	20.73 (10.67)

to have poor to moderate work-family balance during the pandemic (32), illustrating the unequal impact of the pandemic and social distancing measures. Furthermore, evidence indicates that females are more likely than males to believe in COVID-19 conspiracy theories – including threatening ones, which can lead to anxiety and distress (33) and may have also contributed to the gender difference observed in our study.

Our findings of increased odds of severe psychological symptoms in non-binary respondents are consistent with the high rates of mental health problems in transgender and non-binary individuals documented in other studies (34, 35). The pattern of gender differences in our study, in which the prevalence of psychological distress was lowest among males and highest among non-binary individuals, is also the same as that reported in a recent international, multicenter study (33). Little is known about the prevalence of psychological distress in non-binary people in Southeast Asia, however, and our study is one of the first to identify the prevalence of depression, anxiety, and stress in this population. These findings are crucial as mental health challenges in this group are attributed to a variety of social and structural factors, including stigma, social exclusion, and a lack of social support, that are especially common in several Southeast Asian countries where the gender non-conforming community is highly stigmatized (36). Moreover, the COVID-19 pandemic is likely to have exacerbated the mental health challenges experienced by non-binary individuals as protective factors against psychological problems, including gender-affirming healthcare and social connectedness (34, 37), were less available during the pandemic. Many non-binary and transgender individuals have also reported decreased time living according to their gender during the pandemic, leading to increased symptoms of depression and anxiety (38). The high rates of severe depression, anxiety, and stress symptoms in non-binary individuals highlights the importance of ensuring that non-gender conforming individuals continue to have access to gender-affirming healthcare and social support (38).

Moreover, the current study found that younger adults have been disproportionately affected in all three dimensions of mental health, in line with previous research on emerging adults (18- to 29-year-olds) during the pandemic (28, 39). Previous work has shown that younger adults are more concerned than older adults about the threat of COVID-19 on multiple areas including physical health, mental wellbeing, and financial resources (40). Younger adults were especially vulnerable to mental health problems during the pandemic, as it exacerbated the instability and uncertainty that already characterize the transitional period of emerging adulthood (41). Indeed, a sample of Malaysian university students identified financial constraints and uncertainty about the future as some of the main stressors they faced during the pandemic and lockdown (42). Moreover, 18- to 24-year-olds were disproportionately affected by job loss during the pandemic (43, 44), which can have a significant impact on mental health outcomes including anxiety, depression, and life satisfaction (45). Importantly, young adults are also more likely to be more negatively impacted by the stressful and challenging circumstances created by the pandemic because their coping skills tend to be less developed than those of older adults (46). A study of UK adults reported that, during the pandemic, older adults were less likely to use avoidant coping strategies than younger adults (47), and demonstrated more resilience, a key protective factor against psychological distress (48). In addition, use of negative coping

TABLE 2 Prevalence of depression, anxiety, and stress symptoms at each level of symptom severity in each country and across the sample.

		Anxiety		Depression		Stress	
		N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Malaysia	**Normal**	2,889	28.00 (27.13–28.88)	2,481	24.04 (23.22–24.88)	3,939	38.17 (37.23–39.12)
	Mild	615	5.96 (5.51–6.44)	948	9.19 (8.64–9.76)	1,119	10.84 (10.25–11.46)
	Moderate	1,905	18.46 (17.72–19.23)	1,904	18.45 (17.71–19.22)	1,796	17.40 (16.68–18.15)
	Severe	1,216	11.78 (11.17–12.43)	1,402	13.59 (12.93–14.27)	2,062	19.98 (19.22–20.77)
	Extremely severe	3,694	35.80 (34.87–36.73)	3,584	34.73 (33.81–35.66)	1,403	13.60 (12.94–14.28)
Indonesia	**Normal**	2,311	18.36 (17.69–19.05)	3,219	25.57 (24.81–26.34)	4,267	33.89 (33.07–34.73)
	Mild	884	7.02 (6.58–7.49)	1,344	10.68 (10.14–11.23)	1,649	13.10 (12.52–13.70)
	Moderate	2,711	21.53 (20.82–22.26)	2,607	20.71 (20.00–21.43)	2,408	19.13 (18.44–19.83)
	Severe	1,696	13.47 (12.88–14.08)	1,850	14.69 (14.08–15.33)	2,494	19.81 (19.12–20.52)
	Extremely severe	4,988	39.62 (38.76–40.48)	3,570	28.36 (27.57–29.15)	1,772	14.07 (13.47–14.70)
Singapore	**Normal**	281	26.43 (23.83–29.22)	199	18.72 (16.45–21.23)	370	34.81 (31.96–37.77)
	Mild	77	7.24 (5.79–9.01)	89	8.37 (6.81–10.24)	144	13.55 (11.58–15.79)
	Moderate	229	21.54 (19.13–24.16)	239	22.48 (20.03–25.14)	217	20.41 (18.05–22.99)
	Severe	128	12.04 (10.18–14.19)	164	15.43 (13.34–17.77)	211	19.85 (17.52–22.40)
	Extremely severe	348	32.74 (29.94–35.66)	372	35.00 (32.14–37.96)	121	11.38 (9.57–13.48)
Thailand	**Normal**	2,094	22.08 (21.26–22.94)	1,674	17.65 (16.9.0–18.44)	2,353	24.82 (23.95–25.70)
	Mild	777	8.19 (7.65–8.77)	975	10.28 (9.68–10.92)	1,173	12.37 (11.72–13.05)
	Moderate	2,174	22.93 (22.09–23.79)	2,098	22.13 (21.3–22.98)	1,912	20.16 (19.36–20.99)
	Severe	1,293	13.64 (12.96–14.35)	1,648	17.38 (16.63–18.16)	2,370	24.99 (24.13–25.88)
	Extremely severe	3,144	33.16 (32.21–34.12)	3,087	32.56 (31.62–33.51)	1,674	17.65 (16.90–18.44)
Total	**Normal**	7,575	22.64 (22.20–23.1)	7,573	22.64 (22.19–23.09)	10,929	32.67 (32.17–33.17)
	Mild	2,353	7.03 (6.76–7.31)	3,356	10.03 (9.71–10.36)	4,085	12.21 (11.86–12.57)
	Moderate	7,019	20.98 (20.55–21.42)	6,848	20.47 (20.04–20.91)	6,333	18.93 (18.51–19.36)
	Severe	4,333	12.95 (12.6–13.32)	5,064	15.14 (14.76–15.53)	7,137	21.33 (20.90–21.78)
	Extremely severe	12,174	36.39 (35.87–36.91)	10,613	31.72 (31.23–32.23)	4,970	14.86 (14.48–15.24)

styles was shown to be associated with psychological problems among a sample of Chinese youth during the COVID-19 pandemic (49).

We also identified that high- and middle-income levels were associated with decreased odds of experiencing severe anxiety, depression, and stress symptoms compared to lower income levels. These findings are consistent with existing evidence of a relationship between low socioeconomic status and mood and anxiety disorders (50, 51). This relationship can be explained by the social causation hypothesis, which posits that low income can precipitate mental illness by causing adversity, stress, and a reduced capacity to cope (52). In addition, social support has been shown to moderate the relationship between economic hardship and mental health (53). This is important in the context of the COVID-19 pandemic during which many people lost their social support systems and may help explain the high rate of psychological distress in our sample, as the majority was low-income and may have been especially impacted by the lack of social support in this period of economic difficulty.

Regional differences in mental health

The prevalence of severe stress symptoms was highest among respondents from Thailand, who had significantly higher odds of stress symptoms than Malaysian respondents. This finding is in line with Wang et al.'s (12) recent study on depression, anxiety, and stress symptoms in seven Asian countries, including Malaysia and Thailand, which also reported the highest stress scores among Thai respondents. Interestingly, however, unlike in Wang et al.'s (12) study, this pattern did not hold for anxiety and depression: in our study, residing in Thailand was associated with non-significantly different odds of depression or anxiety symptoms compared to residing in Malaysia.

The inter-country difference in stress may be associated with differences in the status and economic impact of the COVID-19 pandemic between the countries. While Thailand has the second lowest total reported COVID-19 cases per million (30,389 cases) among the four countries included in the study, after Indonesia [15,404 cases; (54)], the country experienced one of

TABLE 3 Factors associated with severe/extremely severe anxiety symptoms.

Variable		(95% CI)	Odds ratio	95% CI Lower	95% CI Upper	*p*
Gender	Male	42.14 (41.04–43.25)	1.00			
	Female	51.49 (50.87–52.11)	1.44	1.37	1.52	<0.001
	Other	52.68 (47.03–58.27)	1.46	1.16	1.84	0.001
Age	18–29	54.54 (53.91–55.17)	1.00			
	30–39	38.73 (37.56–39.91)	0.55	0.52	0.58	<0.001
	40–49	29.39 (27.41–31.44)	0.38	0.35	0.42	<0.001
	50–65	18.44 (15.16–22.23)	0.22	0.17	0.28	<0.001
Country	Malaysia	47.58 (46.61–48.55)	1.00			
	Indonesia	53.09 (52.21–53.96)	1.08	1.03	1.15	0.003
	Singapore	44.78 (41.77–47.83)	1.11	0.97	1.28	0.113
	Thailand	46.79 (45.79–47.80)	0.96	0.91	1.02	0.226
Income	Low	52.31 (51.68–52.93)	1.00			
	Middle	41.80 (40.66–42.96)	0.79	0.75	0.84	<0.001
	High	38.45 (36.14–40.80)	0.77	0.69	0.86	<0.001

Omnibus test $X^2 = 1409.22$, $p < 0.001$; Nagelkerke R^2 =5.5%; Hosmer & Lemeshow test $X^2 = 31.36$, $p < 0.001$; Classification table 58.3% correct; Multicollinearity checks indicated no multicollinearity between the associated factors; ROC area = 0.582.

TABLE 4 Factors associated with severe/extremely severe depression symptoms.

Variable		% (95% CI)	Odds ratio	95% CI Lower	95% CI Upper	*p*
Gender	Male	39.99 (38.9–41.10)	1.00			
	Female	48.86 (48.25–49.48)	1.39	1.32	1.47	<0.001
	Other	53.63 (47.97–59.20)	1.42	1.13	1.79	0.002
Age	18–29	51.56 (50.93–52.19)	1.00			
	30–39	37.65 (36.49–38.83)	0.54	0.51	0.58	<0.001
	40–49	27.74 (25.79–29.76)	0.34	0.31	0.38	<0.001
	50–65	18.24 (14.97–22.02)	0.20	0.16	0.25	<0.001
Country	Malaysia	48.32 (47.35–49.29)	1.00			
	Indonesia	43.05 (42.18–43.92)	0.69	0.65	0.73	<0.001
	Singapore	50.42 (47.37–53.47)	1.33	1.16	1.52	<0.001
	Thailand	49.94 (48.93–50.95)	1.04	0.98	1.10	0.240
Income	Low	48.51 (47.88–49.14)	1.00			
	Middle	42.95 (41.80–44.10)	0.85	0.80	0.90	<0.001
	High	39.61 (37.30–41.98)	0.84	0.76	0.94	0.002

Omnibus test $X^2 = 1406.13$ $p < 0.001$; Nagelkerke $R^2 = 5.5\%$; Hosmer & Lemeshow test $X^2 = 23.72$, $p = 0.003$; Classification table 57.7% correct; Multicollinearity checks indicated no multicollinearity between the associated factors; ROC area = 0.609.

the worst economic downturns in Asia because of the pandemic. Thailand had the largest year-on-year GDP contraction of the four countries included in the study in 2021, at 6.1%, compared to 5.4% in Malaysia (55). Over 70% of Thai households experienced income loss and 23% of Thai respondents in a recent survey reported having lost their job (56), which is associated with increased likelihood of experiencing depressive and/or anxiety symptoms (57). As Thai respondents in our study did not have significantly different odds of anxiety or depression compared to Malaysian respondents, this suggests that the low COVID-19 case count may have had a protective effect on depression and anxiety rates amid these challenging conditions, for example by highlighting the value on human life of the measures contributing to economic uncertainty. Odds of severe/extremely severe stress were nonetheless highest among respondents living in Thailand, indicating that their mental health was not unaffected by the poor economic conditions.

Living in Indonesia was associated with significantly lower odds of experiencing severe symptoms of stress and depression, but significantly higher odds of anxiety symptoms, compared to living in Malaysia. This pattern is interesting and indicates that while the economic and health conditions in Indonesia may be

TABLE 5 Factors associated with severe/extremely severe stress symptoms.

Variable		% (95% CI)	Odds ratio	95% CI Lower	95% CI Upper	*p*
Gender	Male	29.26 (28.25–30.30)	1.00			
	Female	38.21 (37.61–38.81)	1.48	1.40	1.57	<0.001
	Other	43.22 (37.72–48.88)	1.42	1.12	1.78	0.003
Age	18–29	39.67 (39.06–40.29)	1.00			
	30–39	29.38 (28.30–30.49)	0.64	0.60	0.68	<0.001
	40–49	22.34 (20.54–24.24)	0.44	0.39	0.49	<0.001
	50–65	13.32 (10.50–16.73)	0.23	0.18	0.30	<0.001
Country	Malaysia	33.58 (32.67–34.50)	1.00			
	Indonesia	33.88 (33.06–34.72)	0.92	0.87	0.97	0.003
	Singapore	31.23 (28.47–34.13)	1.04	0.90	1.20	0.551
	Thailand	42.65 (41.65–43.65)	1.46	1.37	1.55	<0.001
Income	Low	36.90 (36.30–37.51)	1.00			
	Middle	34.23 (33.13–35.34)	0.89	0.84	0.95	<0.001
	High	34.25 (32.01–36.56)	0.99	0.89	1.11	0.909

Omnibus test $X^2 = 1035.36$, $p < 0.001$; Nagelkerke $R^2 = 4.2\%$; Hosmer & Lemeshow test $X^2 = 36.82$, $p < 0.001$; Classification table 63.8% correct; Multicollinearity checks indicated no multicollinearity between the associated factors; ROC area = 0.605.

less detrimental to residents' mental health in certain areas, there is some variability in the effect. The lower prevalence of stress and depression in Indonesia may be explained by the country being relatively less affected by the pandemic in terms of year-on-year GDP contraction in 2021 [2.1%; (55)] and reported COVID-19 case numbers, as Indonesia has reported the lowest total case count of the four countries (54). Interestingly, our findings are in spite of Indonesians experiencing a higher level of pandemic-related movement and social restrictions than Malaysians at the time of the study (i.e., October 2021), and these restrictions could explain the higher rates of anxiety among Indonesian respondents. This also suggests that longer-term trends play an important role in shaping mental health, rather than just the current situation. Moreover, at this point in the pandemic when individuals have already experienced strict movement restrictions, the impact of these may not be as stark as early after the declaration of the pandemic, in particular if these measures have been shown to mitigate the health emergency.

Compared to respondents residing in Malaysia, those residing in Singapore had higher odds of depression, but not significantly different odds of anxiety or stress. Singapore had the highest total number of COVID-19 cases per million (48,986) and was the only country with rising daily case numbers in October 2021 (54), which brought about the implementation of stricter social distancing measures at the end of September 2021. In addition, while mobility data from Google (58) indicates that in the months leading up to the period of the study, movement patterns in Malaysia, Indonesia, and Thailand were returning to pre-pandemic levels – albeit still showing differences in some areas – this trend was not reflected in Singapore (Supplementary Figure 1). The elevated odds of depression, but non-significantly different odds of stress and anxiety, in Singapore suggest that the enduring nature of restricted mobility combined with high number of reported COVID-19 cases may be especially conducive to symptoms of depression, by increasing feelings of loneliness and hopelessness, which are both associated with depression (59).

Deteriorating mental health status in 2021 compared to 2020

As we extrapolate our findings on Southeast Asian adults temporally, our study reveals a higher prevalence of psychological distress 18 months after the declaration of the pandemic compared to the first year of the pandemic (12, 60). Similar to our approach, Wong and colleagues (60) measured the mental health of the Malaysian public cross-sectionally between May and September 2020, using the DASS-21 administered through the internet. Their study revealed a progressive increase in the proportion of respondents experiencing problematic psychological symptoms over the 5-month study period. The highest prevalence of respondents reporting moderate of above symptoms of depression (59.2%), anxiety (55.1%), and stress (30.6%) was in the last month of the study period. One year on from Wong et al.'s study, this upward trend seems to have continued, with our study reporting an even higher prevalence of moderate to extremely severe depression (66.77%), anxiety (66.04%), and stress (50.98%) among Malaysian respondents.

This temporal increase in psychological distress is also apparent when comparing the DASS scores from our study with those reported by Wang et al. (12) in Thailand and Malaysia in the period after COVID-19 became an epidemic in each country. Indeed, for both countries, mean scores for depression, anxiety, and stress were 0.7 to 11.6 points higher in our study. The smallest difference was for the stress score

in Thailand and the largest difference was for the depression score in Malaysia. This increase in scores over time is consistent with evidence of a deterioration in mental health in Italian and Spanish samples throughout the pandemic (61, 62) and suggests that individuals in Southeast Asia are experiencing pandemic burnout as a result of the stress associated with the health crisis compounding over time (63). It should be noted, however, that the differences in the prevalence of psychological distress between our study and those conducted earlier in the pandemic could reflect differences in the samples' socio-demographic characteristics, rather than temporal changes. Indeed, our sample included a higher proportion of younger adults and low-income individuals than Wang et al.'s (12) or Wong et al.'s (60), both socio-demographic characteristics associated with symptoms of depression, anxiety, and stress.

Together with previous literature, our findings demonstrate the persistence of the mental health impact of the pandemic on Southeast Asians more than one year after its onset (12, 60). This lingering impact seems to be consistent with what has been observed in previous viral outbreaks, including the 1918–1919 influenza pandemic, the Severe Acute Respiratory Syndrome (SARS) outbreak in 2002, and the Middle East Respiratory Syndrome (MERS) outbreak starting in 2012 (64–66). Indeed, Mamelund (67) described an increase in the number of first-time hospitalizations for influenza-related mental disorders by an annual factor of 7.2 in the 6 years after the 1918 influenza pandemic. While many have attributed the psychological impact of viral outbreaks to stressors during and after quarantine such as fear of infection, frustration and boredom, inadequate supplies or information, finances, and stigma (1), others have emphasized the role of biological factors associated with viral infections, such as inflammation, in contributing to psychological morbidity, including anxiety disorder, insomnia, and dementia (66, 68, 69). These factors may better explain the temporal deterioration in psychological symptoms and longitudinal cohort studies including these biological factors are therefore needed to further examine the progression of the mental health impact of the COVID-19 pandemic over time.

Strengths and limitations

This study utilized the internet as the medium of dissemination of survey questions. As a result, a large sample was recruited within a month, over a large geographical area, otherwise not feasible with face-to-face recruitment. In addition, by including the residents of four Southeast Asian countries experiencing different socioeconomic conditions and COVID-19-related social restrictions, this study provides insights into how different dimensions of psychological distress are related to these variables.

However, several limitations of this study should be acknowledged when considering its findings. First, this study utilized a wholly internet-based approach and people with no access to the internet were excluded. However, the countries in which this study was conducted have a high proportion of population using the internet: 89.6% in Malaysia, 75.9% in Singapore, 77.8% in Thailand, and 53.7% in Indonesia (70). Second, the self-selected nature of the sample is a possible source of bias. Recruitment materials for the survey highlighted the value of gaining insights into one's own mental health status through participation, and consequently, individuals opting to participate in the study may be more likely than the target population to suspect that they are experiencing psychological distress. This may have led to an over-representation of the prevalence of the psychological symptoms measured in the study. Third, the cross-sectional nature of the study prevents us from ascertaining a cause-effect relationship between the pandemic and respondents' mental health status. Moreover, in measuring mental health status at only one point in time, this study is unable to determine whether or not the elevated point prevalence reflects long-lasting symptoms among the individuals whose mental health was negatively impacted early in the pandemic. Fourth, while there are many factors contributing to mental wellbeing, including ethnicity, education level, the physical environment, and social support networks (71), this study only included four demographic factors (age, gender, country of residence, and income level). The small number of independent variables included in the regression is likely to account for the model's low R^2. Despite the model's low explanatory power, however, the independent variables included in it are significant, which helps identify high-risk populations. Finally, our sample consists of a higher proportion of females (76%) and adults aged 18 to 29 years (74%) than the general population, limiting the representability of our findings.

Conclusions

Overall, this study provides evidence of the differing impact of the COVID-19 pandemic across demographic groups in Southeast Asia, consistent with global trends. The prevalence of depression, anxiety, and stress symptoms in an Southeast Asian internet-based sample is high 18 months after the declaration of COVID-19 as a global pandemic. Females, non-binary respondents, younger adults, and those from low-income households are more likely to experience severe to extremely severe symptoms in all three dimensions of mental health. Moreover, our findings on the differences in the mental health status of respondents between countries suggest that a complete picture comprising economic conditions, the public health situation, and social and movement restrictions should be considered in order to understand the effects of a disaster such as a pandemic on the mental health of the population. Crucially, comparison of our findings with those of other Southeast Asian studies in the year following the declaration of the pandemic further indicates that the mental health status of this population has deteriorated over time.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Sunway Medical Centre Independent Research Ethics Committee. The participants provided their informed consent digitally to participate in this study.

Author contributions

WT and FM conceptualized the study. WT and JJ acquired the data. JJ performed the statistical analysis with help from KW. JJ, WT, KW, and FM contributed to the interpretation of the results. JJ wrote the original draft of the manuscript with contributions from WT. KW, FM, and TO reviewed and edited the manuscript. All authors approved the final version of the manuscript.

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Conflict of interest

Authors WT, JJ, and TO are employed by Naluri Hidup Sdn Bhd. The authors declare that this study received funding from Naluri Hidup Sdn Bhd. The funder had the following involvement in the study: study design, collection, analysis, interpretation of data, the writing of this article and the decision to submit it for publication.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.863323/full#supplementary-material

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EDITED BY
Xenia Gonda,
Semmelweis University, Hungary

REVIEWED BY
Mohammad Farris Iman Leong Bin Abdullah,
Universiti Sains Malaysia (USM), Malaysia
Uma Suryadevara,
University of Florida, United States

*CORRESPONDENCE
Jinguo Zhai
zhaijinguo@163.com

†These authors have contributed equally to this work

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A mental health survey among young front-line clinicians in high-risk areas during the COVID-19 sporadic epidemic in China

Xingbo Suo[1†], Yang Zhang[1†], Qingxia Liu[2†], Gaofeng Zhao[3], Yanan Zhu[4], Yan Liu[1] and Jinguo Zhai[1*]

[1]Department of Psychiatry, Jining Medical University, Jining, China, [2]Department of Psychiatry, Harbin Medical University, Harbin, China, [3]Shandong Daizhuang Hospital, Jining, China, [4]Harbin First Hospital, Harbin, China

Background: The sporadic coronavirus disease (COVID-19) epidemic has placed enormous psychological stress on people, especially clinicians. The objective of this study was to examine depression, anxiety, quality of life (QOL), and related social psychological factors among young front-line clinicians in high-risk areas during the COVID-19 sporadic epidemic in China and to provide a reference for formulating reasonable countermeasures.

Methods: In this cross-sectional study, demographic information, COVID-19-related questions, anxiety (Generalized Anxiety Disorder-7, GAD-7), depression (Patient Health Questionnaire-9, PHQ-9), insomnia (Insomnia Severity Index, ISI), stress (Perceived Stress Scale-10, PSS-10), and QOL (World Health Organization Quality of Life-brief version, WHOQOL-BREF) were collected. Binary logistic regression analysis was used to test the relationships between anxiety and/or depression and other related problems. Multiple linear regression analysis was used to test the relationships among factors influencing QOL.

Results: A total of 146 young front-line clinicians were included. The prevalence rates of depression, anxiety, and anxiety-depression comorbidity were 37.7% (95% CI = 29.7–45.6%), 26.0% (95% CI = 18.8–33.2%), and 24.0% (95% CI = 17.0–31.0%), respectively. Severe stress (OR = 1.258, 95% CI = 1.098–1.442, $P < 0.01$) and insomnia (OR = 1.282, 95% CI = 1.135–1.447, $P < 0.01$) were positively correlated with depression. Severe stress (OR = 1.487, 95% CI = 1.213–1.823, $P < 0.01$) and insomnia (OR = 1.131, 95% CI = 1.003–1.274, $P < 0.05$) were positively correlated with anxiety. Severe stress (OR = 1.532, 95% CI = 1.228–1.912, $P < 0.01$) was positively correlated with anxiety-depression comorbidity. However, insomnia (OR = 1.081, 95% CI = 0.963–1.214, $P > 0.05$) was not correlated with anxiety-depression comorbidity. The belief that the vaccine will stop the COVID-19 pandemic (OR = 0.099, 95% CI = 0.014–0.715, $P < 0.05$) was negatively correlated with anxiety and anxiety-depression comorbidity (OR = 0.101, 95% CI = 0.014–0.744, $P < 0.05$). Severe stress (B = −0.068, 95% CI = −0.129 to −0.007, $P < 0.05$) and insomnia (B = −0.127, 95% CI = −0.188 to −0.067, $P < 0.01$) were negatively correlated with QOL. The belief that the vaccine could provide protection (B = 1.442, 95% CI = 0.253–2.631, $P < 0.05$) was positively correlated with QOL.

Conclusions: The prevalence of depression, anxiety, and even anxiety-depression comorbidity was high among young front-line clinicians in high-risk areas during the COVID-19 sporadic epidemic in China. Various biological and psychological factors as well as COVID-19-related factors were associated with mental health issues and QOL. Psychological intervention should evaluate these related factors and formulate measures for these high-risk groups.

KEYWORDS

COVID-19, young front-line clinicians, mental health, sporadic, high-risk areas

Introduction

In March 2020, the World Health Organization (WHO) announced coronavirus disease (COVID-19) to be a pandemic (1). Globally, to date (January 4, 2022), this destructive pandemic has spread rapidly across 226 countries/regions, and 296,496,809 confirmed cases of COVID-19 have been reported to the WHO (2). To contain this global outbreak, the Chinese government adopted a series of strict and effective public health measures, such as encouraging people to wear protective masks, self-isolation, and the cancellation of mass gatherings (3). At present, the epidemic situation in China has now largely been brought under control, and epidemic prevention and control have become the norm (4). However, there are still sporadic cases that occur in some places in China, and a higher risk of infection and stricter isolation measures were borne by the people in these areas. Due to the spread of the COVID-19 sporadic epidemic, parts of Harbin Municipality have been defined as high-risk areas of the epidemic since September 25, 2021. There was no doubt that it would seriously affect the local people's mental health and quality of life (3).

Clinicians are at the core of epidemic preparedness and control in high-risk areas during periods of sporadic epidemic situations. In contrast to the general population, front-line clinicians may have greater psychological stress in high-risk areas during the COVID-19 sporadic epidemic. Multiple past studies have demonstrated that during the Severe Acute Respiratory Syndrome (SARS), Influenza A (H1N1), and Middle East Respiratory Syndrome (MERS) outbreaks, front-line medical staff were at higher risk of psychological problems, including but not limited to anxiety, depression, and posttraumatic stress disorder (PTSD) (5–11). They are predisposed to high workloads, unpredictable work patterns, and a higher risk of infection (12–16). In addition, clinicians are easily ostracized by people around them after work because the general population easily misunderstands that clinicians are especially susceptible to carrying the virus when returning home (14). Clinicians may also be worried about becoming infected or infecting their families (14). Stress from these various sources will increase the risk for depression or anxiety if it cannot be effectively allayed (15, 17). Moreover, previous studies have shown that compared with older clinicians, young clinicians' lack of practical experience and confidence in clinical management may lead to insufficient resilience to deal with psychological problems and more serious emotional exhaustion (18, 19). Therefore, mental health conditions such as depression and anxiety may be worse among young front-line clinician populations than among senior clinician populations (20–22). In addition, the term "quality of life" (QOL) is the subjective perception of wellbeing and wholeness (23). Due to the lack of evidence-based practice related to sporadic epidemic management, even less is known about the factors that worsen or improve QOL. A study has shown that young people may have poorer QOL relative to older people during the COVID-19 epidemic (24). The mental health status and QOL of young front-line clinicians should receive more attention, so we chose this group as the main study population. Although many research articles on the psychological status and QOL of clinicians have been published during the epidemic (25–30), there has been no study on young front-line clinicians during the COVID-19 sporadic epidemic in high-risk areas.

Currently, there is a need for testimony of mental health problems during the sporadic epidemic situation to identify those at high risk and to investigate the related psychological factors and social resources that can alleviate this threat. Therefore, we carried out this study to examine depression, anxiety, QOL, and related social psychological factors among young front-line clinicians in high-risk areas during the COVID-19 sporadic epidemic in China.

Methods

Participants

Participants who met the following eligibility criteria were included: (1) clinicians, (2) aged between 18 and 40 years, (3) could read a Chinese questionnaire, and (4) WeChat users. Informed consent was obtained from all subjects before filling in the questionnaire, and this study was approved by the Research

Ethics Committee of the Shandong Daizhuang Hospital (Second Affiliated Hospital of Jining Medical University) in Shandong China.

The sample size was calculated with the following formula (31): $N = (Z\alpha^2 \times P \times (1–P))/d^2$. The confidence level (Z) was equal to 1.96 at the significance level of $\alpha = 0.05$, P was the estimated proportion, and d was the tolerated margin of error and was calculated to be 0.10. A previous study found depression and anxiety prevalence rates to be 27.9 and 31.6%, respectively, in the general population (32). As no study has shown the prevalence of anxiety and depression among young Chinese clinicians during the COVID-19 pandemic, to achieve sufficient statistical power, we used $P = 0.279$ to calculate the sample size and found 77 subjects to be needed in this study.

Data collection

This cross-sectional study was conducted between September 27th and 30th, 2021, in two hospitals in Harbin Municipality, Heilongjiang Province in China. Due to the risk of infection during the COVID-19 pandemic, face-to-face interviews could not be executed. In this study, we used an online-based survey *via* the WeChat-based survey program "Questionnaire Star" to collect data (33), mainly drawing on the fact that WeChat is the largest social communication media with more than 1 billion users in China (34). In the study, our research assistants forwarded the questionnaire to various WeChat groups of young clinicians to collect information. The questionnaire required each question be answered before it could be submitted. The same IP address could be used only once to complete the questionnaire.

Measurements

Sociodemographic variables

Using the questionnaire, we collected sociodemographic data, including gender, marriage, education level, inhabitation, and fertility.

Explanatory variables

Following previous studies on the influenza vaccine (35, 36), several standardized questions related to COVID-19 were used in this study, including (1) "Do you worry about family and friends being infected with COVID-19?" (No/Fair/Very much); (2) "Do you think COVID-19 vaccines could protect you from COVID-19?" (No/No idea/Yes); (3) "What do you think of the long-term side effects of the COVID-19 vaccines?" (Not safe with obvious side effects/No idea/Safe with no or minimal side effects); and (4) "What do you think the vaccine will stop the global epidemic?" (No/No idea/Yes).

Insomnia severity was assessed by the validated Chinese version of the 7-item Insomnia Severity Index (ISI), which has been widely used in clinical research, with a total score ranging from 0 to 28. Insomnia was defined with a cutoff point of 8, i.e., ISI $\geq$ 8 (37, 38). The Cronbach's alpha of the scale was 0.842.

Stress severity was assessed by the validated Chinese version of the 10-item Perceived Stress Scale (PSS-10), which has been widely used in clinical research with a total score ranging from 0 to 40. Higher scores indicate greater stress severity (39, 40). The Cronbach's alpha of the scale was 0.915.

Outcome variables

Depression severity was assessed by the validated Chinese version of the 9-item Patient Health Questionnaire (PHQ-9), which has been widely used in clinical research, with a total score ranging from 0 to 27. Depression was defined with a cutoff point of 5, i.e., PHQ-9 $\geq$ 5 (37, 41). The Cronbach's alpha of the scale was 0.896.

Anxiety severity was assessed by the validated Chinese version of the 7-item Generalized Anxiety Disorder (GAD-7), which has been widely used in clinical research, with a total score ranging from 0 to 21. Anxiety was defined with a cutoff point of 5, i.e., GAD-7 $\geq$ 5 (42, 43). Anxiety-depression comorbidity was defined with a cutoff point of 5, i.e., both PHQ-9 $\geq$ 5 and GAD-7 $\geq$ 5. The Cronbach's alpha of the scale was 0.945.

The overall QOL was assessed by the sum of the first two item scores of the Chinese version of the World Health Organization Quality of Life-brief version (WHOQOL-BREF), with a total score ranging from 2 to 10. Higher scores indicate a greater QOL (44). The Cronbach's alpha of the scale was 0.801.

Data analysis

All data were analyzed by using the Statistical Package for Social Science (SPSS) version 25.0. EXCEL was adopted to manage the data. Because the diseases of the subjects were different, we compared demographic variables and questionnaires between the anxiety-depression comorbidity and no anxiety or depression groups, between the anxiety and no anxiety groups, and between the depression and no depression groups. Categorical variables were compared by the chi-square test. Shapiro Wilk (S-W) was used to test the normality of quantitative variables. The variables that were compliant with normality were subjected to independent *t*-tests, while those that did not meet normality were subjected to Mann–Whitney U tests. Variables with statistical significance in the significance test were included in the binary logistic regression analysis, which was used to identify the factors associated with depression, anxiety, and anxiety-depression comorbidity. Spearman's rank-order analysis was used to test the relationship between depression and anxiety. Multiple linear regression

analysis was used to assess the associations of factors influencing QOL. Statistical significance tests were two-tailed, and $P < 0.05$ was considered statistically significant.

Results

Sociodemographic and clinical characteristics

A total of 154 young front-line clinicians were enrolled in the current analysis. A total of 146 participants met the inclusion criteria and were finally included in our study, with a response rate of 94.8%. The sociodemographic and clinical characteristics of the study participants are shown in Table 1. Regarding sociodemographic characteristics, 61.64% ($n = 90$) of the total sample were female clinicians.

The prevalence of depression was 37.7% (95% CI = 29.7–45.6%). The mean total score of the PHQ-9 was 4.32 (SD = 4.79). The prevalence of anxiety was 26.0% (95% CI = 18.8–33.2%). The mean total GAD-7 score was 2.84 (SD = 4.05). The prevalence of combined depression and anxiety was 24.0% (95% CI = 17.0–31.0%). The mean total ISI score was 4.79 (SD = 4.43). The mean total PSS-10 score was 14.96 (SD = 4.25). Spearman's rank-order correlation analysis revealed that depression and anxiety had a significant correlation (correlation coefficient = 0.73, $P < 0.01$).

Subgroup analysis

The depression and non-depression groups: The difference significance test revealed that young front-line clinicians with depression were more likely to suffer from severe stress ($P < 0.01$) and insomnia ($P < 0.01$) in high-risk areas during the COVID-19 sporadic epidemic. The prevalence of depression varied significantly across education levels ($P < 0.05$) and inhabitation ($P < 0.01$). In addition, responses to the questions about attitudes toward the long-term side effects of the COVID-19 vaccines were significantly different between the depression and non-depression groups ($P < 0.05$) (Table 1).

The anxiety and non-anxiety groups: The difference significance test revealed that young front-line clinicians with anxiety were more likely to have more severe stress ($P < 0.01$) and insomnia ($P < 0.01$) in high-risk areas during the COVID-19 sporadic epidemic. The prevalence of anxiety was significantly different by inhabitation ($P < 0.05$). Responses to the questions about attitudes toward COVID-19 vaccines except for the protective effects of COVID-19 vaccines were significantly different between the two groups (all $P < 0.05$) (Table 1).

The depression and anxiety comorbid and non-comorbid groups: The difference significance test revealed that young front-line clinicians with anxiety were more likely to suffer from severe stress ($P < 0.01$) and insomnia ($P < 0.01$) in high-risk areas during the COVID-19 sporadic epidemic. The prevalence of anxiety-depression comorbidity was significantly different by inhabitation ($P < 0.05$). In addition, responses to the questions about attitudes toward COVID-19 vaccines except for the protective effects of COVID-19 vaccines were significantly different between the two groups (all $P < 0.05$) (Table 1).

Factors influencing anxiety, depression, and anxiety-depression comorbidity

Table 2 presents the results of the binary logistic regression analysis. In the multivariate analysis, severe stress (OR = 1.258, 95% CI = 1.098–1.442, $P < 0.01$) and insomnia (OR = 1.282, 95% CI = 1.135–1.447, $P < 0.01$) were positively correlated with depression. Severe stress (OR = 1.487, 95% CI = 1.213–1.823, $P < 0.01$) and insomnia (OR = 1.131, 95% CI = 1.003–1.274, $P < 0.05$) were positively correlated with anxiety. The belief that the vaccine will stop the global epidemic (OR = 0.099, 95% CI = 0.014–0.715, $P < 0.05$) was negatively correlated with anxiety. Severe stress (OR = 1.532, 95% CI = 1.228–1.912, $P < 0.01$) was positively correlated with anxiety-depression comorbidity. Insomnia (OR = 1.081, 95% CI = 0.963–1.214, $P > 0.05$) was not correlated with anxiety-depression comorbidity. The belief that the vaccine will stop the global epidemic (OR = 0.101, 95% CI = 0.014–0.744, $P < 0.05$) was negatively correlated with anxiety-depression comorbidity.

Factors influencing overall quality of life

Table 3 presents the results of multiple linear regression analysis. In the analysis, severe stress (B = −0.068, 95% CI = −0.129 to −0.007, $P < 0.05$) and insomnia (B = −0.127, 95% CI = −0.188 to −0.067, $P < 0.01$) were negatively correlated with overall QOL. The belief that the vaccine could provide protection (B = 1.442, 95% CI = 0.253–2.631, $P < 0.05$) was positively correlated with overall QOL.

Discussion

To our knowledge, this is the first survey on the mental health status of young front-line clinicians in high-risk areas during the COVID-19 sporadic epidemic. In this study, we found that the prevalence rates of depression and anxiety among young clinicians were 37.7 and 26.0%, respectively. A study on the psychological status of Chinese adults during the epidemic showed that the prevalence of anxiety and depression in the general population was 7.6 and 11.3%, respectively (3). The different prevalence rates may be related to the higher

TABLE 1 The sociodemographic and clinical characteristics of the study participants.

Variable	No DEP ($N = 91$) N%	DEP ($N = 55$) N%	P	No ANX ($N = 108$) N%	ANX ($N = 38$) N%	P	No DEP or ANX ($N = 111$) N%	Comorbid DEP and ANX ($N = 35$) N%	P
Gender (female)	59 (64.8)	31 (56.4)	0.308	68 (63.0)	22 (57.9)	0.581	71 (64.0)	19 (54.3)	0.305
Education level									
Bachelor's degree	23 (25.3)	8 (14.5)	0.040*	25 (23.1)	6 (15.8)	0.352	26 (23.4)	5 (14.3)	0.132
Master's degree	57 (62.6)	45 (81.8)		72 (66.7)	30 (78.9)		73 (65.8)	29 (82.9)	
Doctoral degree	11 (12.1)	2 (3.6)		11 (10.2)	2 (5.3)		12 (10.8)	1 (2.9)	
Marriage (single)	77 (84.6)	49 (89.1)	0.446	91 (84.3)	35 (92.1)	0.226	94 (84.7)	32 (91.4)	0.312
Fertility (none)	83 (91.2)	53 (96.4)	0.232	99 (91.7)	37 (97.4)	0.231	102 (91.9)	34 (97.1)	0.284
Inhabitation									
Alone	17 (18.7)	9 (16.4)	0.001**	22 (20.4)	4 (10.5)	0.011*	22 (19.8)	4 (11.4)	0.003**
With family	33 (36.3)	6 (10.9)		34 (31.5)	5 (13.2)		36 (32.4)	3 (8.6)	
Others	41 (45.1)	40 (72.7)		52 (48.1)	29 (76.3)		53 (47.7)	28 (80.0)	
Worried about being infected with COVID-19									
No	33 (36.3)	14 (25.5)	0.149	39 (36.1)	8 (21.1)	0.019*	39 (35.1)	8 (22.9)	0.046*
Fair	49 (53.8)	30 (54.5)		59 (54.6)	20 (52.6)		61 (55.0)	18 (51.4)	
Very much	9 (9.9)	11 (20.0)		10 (9.3)	10 (26.3)		11 (9.9)	9 (25.7)	
Thought COVID-19 vaccines could provide protection									
No	20 (22.0)	14 (25.5)	0.403	26 (24.1)	8 (21.1)	0.232	26 (23.4)	8 (22.9)	0.303
No idea	65 (71.4)	40 (72.7)		75 (69.4)	30 (78.9)		78 (70.3)	27 (77.1)	
Yes	6 (6.6)	1 (1.8)		7 (6.5)	0 (0.0)		7 (6.3)	0 (0.0)	
Though vaccines are safe									
Not safe with obvious side effects	7 (7.7)	13 (23.6)	0.012*	11 (10.2)	9 (23.7)	0.018*	12 (10.8)	8 (22.9)	0.039*
No idea	69 (75.8)	38 (69.1)		79 (73.1)	28 (73.7)		81 (73.0)	26 (74.3)	
Safe with no or minimal side effects	15 (16.5)	4 (7.3)		18 (16.7)	1 (2.6)		18 (16.2)	1 (2.9)	
Though vaccines will stop the global epidemic									
No	14 (15.4)	16 (29.1)	0.101	19 (17.6)	11 (28.9)	0.040*	19 (17.1)	11 (31.4)	0.040*
No idea	58 (63.7)	32 (58.2)		65 (60.2)	25 (65.8)		68 (61.3)	22 (62.9)	
Yes	19 (20.9)	7 (12.7)		24 (22.2)	2 (5.3)		24 (21.6)	2 (5.7)	
	M (Q)	**M (Q)**	***P***	**M (Q)**	**M (Q)**	***P***	**M (Q)**	**M (Q)**	***P***
Insomnia	2.0 (5.0)	7.0 (6.0)	<0.001***	3.0 (5.0)	7.0 (8.0)	<0.001***	3.0 (5.0)	7.0 (6.0)	<0.001***
	μ (SD)	**μ (SD)**	***P***	**μ (SD)**	**μ (SD)**	***P***	**μ (SD)**	**μ (SD)**	***P***
stress	13.59(3.96)	17.22(3.75)	<0.001***	13.8(3.86)	18.26(3.55)	<0.001***	13.86(3.87)	18.43(3.53)	<0.001***

ANX, anxiety; DEP, depression; M, median; Q, quartiles; μ, mean; SD, standard deviation.
$p < 0.05$ was considered statistically significant.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

TABLE 2 The binary logistic regression analysis of depression, anxiety, and combined depression and anxiety in the study participants.

Variable	Depression			Anxiety			Combined depression and anxiety		
	P	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI
Education level (ref: bachelor's degree)									
Master's degree	0.716	1.228	0.406–3.714	–	–	–	–	–	–
Doctoral degree	0.638	0.588	0.065–5.358	–	–	–	–	–	–
Inhabitation (ref: alone)									
With family	0.133	0.320	0.073–1.413	0.941	1.074	0.162–7.114	0.527	0.516	0.067–4.008
Others	0.225	2.012	0.650–6.222	0.128	3.401	0.703–16.447	0.123	3.459	0.716–16.713
Worried about being infected with COVID-19 (ref: no)									
Fair	–	–	–	0.382	1.707	0.515–5.659	0.550	1.447	0.432–4.848
Very much	–	–	–	0.182	2.883	0.609–13.655	0.238	2.600	0.531–12.718
Though vaccines are safe (ref: not safe with obvious side effects)									
No idea	0.991	1.008	0.256–3.971	0.282	3.496	0.357–34.196	0.418	2.533	0.268–23.958
Safe with no or minimal side effects	0.183	3.272	0.571–18.736	0.334	3.584	0.269–47.676	0.507	2.387	0.183–31.162
Though vaccines will stop the global epidemic (ref: no)									
No idea	–	–	–	0.706	0.781	0.216–2.824	0.425	0.591	0.162–2.155
Yes	–	–	–	0.022*	0.099	0.014–0.715	0.024*	0.101	0.014–0.744
Insomnia	<0.001***	1.282	1.135–1.447	0.044*	1.131	1.003–1.274	0.187	1.081	0.963–1.214
Stress	0.001**	1.258	1.098–1.442	<0.001***	1.487	1.213–1.823	<0.001***	1.532	1.228–1.912

CI, confidential interval; OR, odds ratio; Ref, reference group.
$p < 0.05$ was considered statistically significant.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

risk of infection, unpredictable work patterns, and the high psychological stress of clinicians in high-risk areas during the epidemic. In addition, isolation measures lead to the absence of interpersonal communication. If anxiety and depression are more likely to occur, they worsen in the absence of interpersonal communication (45). Another meta-analysis showed that the prevalence of anxiety and depression among clinicians was 21.73 and 25.37%, respectively, during the epidemic (46). The high prevalence of anxiety and depression among young clinicians could be attributed to them having more anxiety characteristics, more difficulty relaxing, and more difficulty adapting to changes than older clinicians (20, 21). Young people show lower levels of wellbeing and optimism than older people, which may also be a risk factor for their vulnerability to anxiety and depression (22).

Our study showed a significant correlation between depression and anxiety ($P < 0.01$). The connection between depression and anxiety is duplex; anxiety can lead to depression, and vice versa (47, 48). This may be related to the decrease in the anterior regions of the default mode network and the increased connectivity in the posterior regions (49). Previous studies have shown that anxiety-depression comorbidity was highly prevalent during the SARS pandemic (50). In this study, the comorbidity rate of depression and anxiety disorder was 23.97%. Because of the similar pathogenesis underlying depression and anxiety (51), we speculate that anxiety-depression comorbidity may be the result of the COVID-19 sporadic epidemic in terms of mental illness.

Insomnia is more severe in individuals with depression or anxiety. According to relevant studies, insomnia can damage emotional regulation and increase the risk of depression or anxiety (52–54). However, the relationship between insomnia and depression or anxiety may be bidirectional (52). Many studies point out that depression or anxiety can reduce the quality of sleep, leading to insomnia (17, 55, 56). Serotonergic and dopaminergic dysfunctions may be the common underlying mechanism of insomnia and mental disorders (57). In addition, depression, anxiety, and insomnia may also have a common genetic basis (58). Interestingly, no correlation was found between anxiety-depression comorbidity and insomnia in this study. This is different from the results of previous studies (47, 58). The differences may be due to the use of different survey tools or different study populations. However, this was only a preliminary result that needs further confirmation from additional studies. Faced with the sporadic epidemic, the working hours and labor intensity of clinicians in high-risk areas have increased, leading to insufficient rest time and psychological distress. In conclusion, COVID-19 plays an important role in triggering or aggravating mental health conditions such as depression, anxiety, and insomnia.

TABLE 3 Multiple linear regression analysis of quality-of-life related factors.

Variable	B	*P*	95% CI	VIF
Gender (ref: male)	−0.206	0.383	−0.673 to 0.260	1.204
Education level (ref: bachelor's degree)				
Master's degree	−0.412	0.148	−0.971 to 0.147	1.541
Doctoral degree	−0.003	0.995	−0.944 to 0.938	1.683
Marriage (ref: single)	−0.811	0.080	−1.719 to 0.098	2.286
Fertility (ref: none)	0.027	0.964	−1.121 to 1.174	1.967
Inhabitation (ref: alone)				
With family	−0.408	0.261	−1.123 to 0.308	2.346
Others	−0.418	0.179	−1.030 to 0.195	2.169
Worried about being infected with COVID-19 (ref: no)				
Fair	0.199	0.450	−0.322 to 0.720	1.578
Very much	0.784	0.050	−0.001 to 1.570	1.707
Thought COVID-19 vaccines could provide protection (ref: no)				
No idea	0.514	0.081	−0.065 to 1.092	1.583
Yes	1.442	0.018*	0.253 to 2.631	1.510
Thought vaccines are safe (ref: not safe with obvious side effects)				
No idea	0.258	0.458	−0.429 to 0.946	2.165
Safe with no or minimal side effects	0.262	0.557	−0.618 to 1.141	2.143
Thought vaccines will stop the global epidemic (ref: no)				
No idea	0.052	0.876	−0.603 to 0.706	2.374
Yes	0.323	0.415	−0.457 to 1.103	2.085
Depression	−0.047	0.353	−0.146 to 0.052	5.216
Anxiety	−0.062	0.249	−0.168 to 0.044	4.270
Insomnia	−0.127	<0.001***	−0.188 to −0.067	1.678
Stress	−0.068	0.029*	−0.129 to −0.007	1.573

B, regression coefficient; CI, confidential interval; Ref, reference group; VIF, variance inflation factor.
$p < 0.05$ was considered statistically significant.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Our study showed that stress is a risk factor for anxiety and/or depression. This is consistent with the findings of previous studies (59). Therefore, to promote the mental health of clinicians, it is necessary to develop personalized intervention measures to reduce stress during the COVID-19 sporadic epidemic.

Our study showed that QOL was determined by the interaction between protective factors (e.g., the belief that the vaccine could provide protection) and risk factors (e.g., severe insomnia and stress conditions). Adequate sleep and reasonable stress relief are considered indispensable elements of health, general wellbeing, and proper daily functioning. Stress and insomnia might reduce clinicians' QOL by leading to cognitive dysfunction (60), physical discomfort (61), and job burnout (62). Further studies on the sleep patterns and stress management strategies of young front-line clinicians in high-risk areas are needed to develop strategies to prevent or alleviate problems and improve the QOL.

Currently, the absence of proven treatments for COVID-19 has led the world's population to pin their hopes for vaccines (63). After the outbreak of the epidemic, the Chinese government urgently developed a vaccine, and the Chinese population reflected the strong demand and high acceptance of the importance of COVID-19 vaccines (64). A global survey of potential acceptance of the COVID-19 vaccine showed that Chinese people's acceptance of the vaccine was nearly 90% (64). Our study showed that young front-line clinicians in high-risk areas who thought that the vaccine could stop the global epidemic were less prone to anxiety and anxiety-depression comorbidity. Raising confidence in and awareness of vaccines may help address the mental health problems of young front-line clinicians in high-risk areas. Although our sample comprised young front-line clinicians, not all clinicians work in infectious diseases departments, and some have relatively poor knowledge of vaccines. The dissemination of misinformation could have a significant impact on confidence in the COVID-19 vaccine, further exacerbating mental health problems among

the young front-line clinician population (65, 66). Therefore, national and local regulatory authorities need to conduct health education and outreach through authoritative sources to carefully explain the effectiveness of the vaccine, the duration of the antibody, and the importance of achieving group immunity. This increases confidence that the COVID-19 vaccine will end the global epidemic, reduce the prevalence of anxiety and/or anxiety-depression comorbidity, and effectively alleviate specific concerns or misconceptions in high-risk areas.

Limitation

Our study has several limitations. First, due to the cross-sectional study design, it was difficult to make a causal inference. Second, the sample size of this study was limited, and single-area studies may have limited applicability and generalizability to clinicians in other high-risk areas. Third, due to the sudden occurrence of the COVID-19 disaster, we were unable to assess the psychological status of the respondents before the sporadic epidemic. Fourth, depression, anxiety levels, and other related factors, such as sleep disturbance and stress levels, were measured by self-report questionnaires, without objective indicators of related factors in this study. Finally, social support plays a pivotal role in reducing the likelihood of psychological impact and QOL (67), but it was not evaluated in this study.

Conclusion

We identified the main mental health problems of young front-line clinicians in high-risk areas during the COVID-19 sporadic epidemic in China. Depression, anxiety, anxiety-depression comorbidity, and QOL were associated with many factors, including insomnia, stress, and a portion of attitudes toward the COVID-19 vaccine. Due to the reasonable epidemic prevention and control measures and popularization of vaccination taken by the Chinese government, there has been no recent large-scale outbreak of the epidemic in China. The sporadic epidemic may become the most important problem for the prevention and control of the epidemic in the future. Therefore, establishing early targeted mental health interventions for young clinicians in high-risk areas during the COVID-19 sporadic epidemic situation should be part of global preparedness efforts.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

XS and YZha contributed to the study design, analyzed the data, and wrote this manuscript. QL and YZhu did the online survey, data collection, and logical check. GZ, YL, and JZ revised the manuscript. All authors reviewed and approved the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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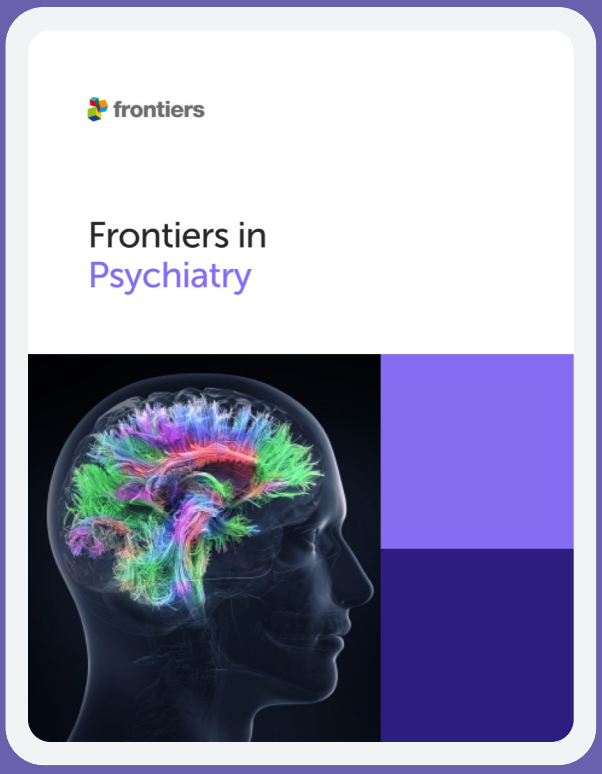

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