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Psychosocial, behavioral, and clinical implications for public mental health during the COVID-19 pandemic

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Psychosocial, behavioral, and clinical implications for public mental health during the COVID-19 pandemic

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Editorial: Psychosocial, behavioral, and clinical implications for public mental health during the COVID-19 pandemic

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COVID-19, mental health, psychosocial changes, public health, behavioral changes

Editorial on the Research Topic
Psychosocial, behavioral, and clinical implications for public mental health during the COVID-19 pandemic

The emergence of COVID-19 has caused widespread confusion, anxiety, and fear among the general public, which affected everyone worldwide. Exploring behavioral and psychosocial changes during the pandemic may shed light on the social determinants of mental disorders. It may prepare societies for novel mental health promotion and prevention interventions during future emerging disease outbreaks.

This Research Topic gathers diverse contributions highlighting the following topics: (1) the behavioral and psychosocial changes during the COVID-19 pandemic in various populations, (2) the preventive measures and governance enacted during COVID-19. This Research Topic consists of ten original articles, two systematic reviews, and three brief research reports.

The COVID-19 pandemic has profoundly impacted people's mental health worldwide. The research in this Research Topic sheds light on the various aspects of this impact, including the mental health of working women, healthcare professionals, university students, and the general public.

The infection may lead to psychiatric symptoms. Individuals infected with SARS-CoV-2 might experience persistent long-COVID symptoms more than 4 weeks post-recovery. Marchi et al. conducted a systematic review with 32 reports on patients with long COVID syndrome and found that the most common psychiatric symptoms are sleep disturbances, depression, post-traumatic symptoms, anxiety, and cognitive impairment.

Society has undergone significant transformations during COVID-19. Du et al. conducted a longitudinal study to assess the extent of stress, anxiety, and depression in Chinese residents at four different time points, from the initial outbreak to 26 months later. The study found that the respondents experienced high levels of stress, anxiety, and depression. Over time, stress symptoms decreased in the short term, while anxiety and depression symptoms remained unchanged.

Moreover, Aguayo et al. took advantage of the Predi-COVID study to explore the association between pre-existing psychological disorders during the COVID pandemic and the severity of COVID-19 infection, using the regular psychotropic medication use as an indicator for the severity of mood disorders. Their study concluded that pre-existing use of psychotropic medication is associated with more severe symptoms and prolonged recovery.

Han et al. developed a moderated mediation model based on the survey conducted on 536 employees in a Chinese company. They found that COVID-related work changes would negatively impact their mental health and boost their interpersonal conflict and aggression in working populations by increasing their ego depletion. Moreover, Akbar and Ghazal conducted quantitative, cross-sectional survey-based research involving over 300 female employees and students. They reported that in Pakistan, women faced increased occurrences of sexual harassment post-COVID-19, in addition to employment instability, both of which negatively affected their mental health.

Various public health strategies and mitigation measures have been implemented within society to control the pandemic. However, these measures have unavoidably led to mental health issues. Hui et al. conducted an online cross-sectional study on the family members of nursing home residents in China and reported that around one-quarter of family members had symptoms of anxiety owing to the restrictions to nursing home visiting, the extent of which is inversely associated with their satisfaction with the care quality.

Additionally, this Research Topic highlights the impact of COVID-19 on healthcare workers and their coping strategies. It emphasizes the need for appropriate support and resources to help healthcare workers deal with the emotional stress and burnout associated with pandemic control.

Zhao et al. conducted a cross-sectional study of Shanghai residents in China and utilized latent class analysis to identify the subgroups based on depressive symptoms, and they reported that medical staff, especially those with longer internet usage time and occurrence of daytime dysfunction, tended to have higher rates of depressive symptoms. Nurses are at the frontline when fighting COVID-19. Mao et al. recruited 740 female nurses using random cluster sampling to conduct an online cross-sectional study and found that 7.9 and 17.8% of the respondents exhibited symptoms of anxiety and depression, respectively. Moreover, they found that insomnia and post-traumatic experiences contribute to worsening symptoms while being married is a protective factor for depressive symptoms.

Furthermore, during the COVID-19 pandemic, Yang et al. conducted a cross-sectional study on 173 healthcare workers in the frontline district headquarters of COVID-19 pandemic control in Shenzhen, one of the largest metropolitans in China. They reported that 47.40% of frontline health workers manifest with burnout, a state of high emotional exhaustion or depersonalization, and their ways of coping with emotional negatives matter. Notably, a systematic review by García-Iglesias et al. reported that during the COVID-19 pandemic, suicidal thoughts were reported by 2.4–21.7% of healthcare workers, with 0.5–12.6% having attempted at least one-lifetime suicide and 0.5–3.5% having a recent suicide attempt.

The research papers in the Research Topics also call for appropriate mental healthcare preventive measures, policies, and governance during pandemics. Li et al. recruited around 3,000 university students in Shangdong Province, China, and conducted a longitudinal study to evaluate the impact of preventive behaviors on mental health. Their findings suggested that students are more tended to have depression and less likely to develop anxiety and stress in the ongoing COVID-19 pandemic, and importantly, those who actively practiced preventive behaviors such as mask-wearing, social distancing, and frequent hand washing were less likely to have mental health disorders. In this sense, compliance to practice preventive measures are important for not only the mitigation of the pandemic but also the maintenance of the mental health of the residents. Hong et al. examined the psychometric properties of a questionnaire regarding adherence to protective measures such as social distancing and health beliefs among Korean populations. Structural equation models were used to indicate the constructed relationships between health beliefs, viral anxiety, depression, and personal injunctive norms.

Moreover, this Research Topic also highlights the impact of COVID-19 on social factors. On the one hand, the COVID-19 may aggravate the pre-existing social discrepancies. For example, Turpin et al. utilized a longitudinal national study on mental health and assessed the associations between pandemic distress and racial issues. They used the segregation index and COVID racial bias scale to indicate the social segregation and extent of racial bias, and they found that the pandemic stress is positively associated with higher social segregation and racial bias. In contrast, higher social status and social support were associated with lower pandemic distress. Moreover, Chung et al. surveyed 1,018 middle-school students in Hong Kong SAR, China, using a maximum variation sampling of 12 secondary schools. They found that socioeconomic status is linked with worsening psychosocial wellbeing during the pandemic, and those with lower resilience have a more robust effect size. On the other hand, during the pandemic, the delay or absence of tackling of the social issues by governmental entities may also be to blame. Diaz-Castro et al. conducted an analytical qualitative study to analyze the governance processes in formulating healthcare policies specifically for those with mental disorders during the COVID-19 pandemic in Mexico using the governance analytical framework. This study found that the needs of people with mental health disorders were neglected in Mexico and measures should be taken to call for actions in the entire society.

Overall, the research in this topic addresses the mental health and psychosocial wellbeing in the context of pandemic, underscoring the importance of promoting appropriate policies, resources, and support to mitigate their negative impact on individuals and society as a whole.

Author contributions

ZH: Conceptualization, Writing—original draft, Writing—review and editing. BA: Writing—original draft, Writing—review

and editing. W-kM: Writing—original draft, Writing—review and editing.

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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Suicidal ideation and suicide attempts in healthcare professionals during the COVID-19 pandemic: A systematic review

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Background: COVID-19 has caused a series of economic, social, personal, and occupational consequences that may affect the mental health of healthcare workers (HCWs), with the consequent risk of developing suicidal ideation and behaviors.

Objectives: The aim of this study was to identify the main risk factors that may predispose HCWs to suicidal ideation and suicide attempts during the COVID-19 pandemic.

Methods: A systematic review of studies published between January 2020 and August 2022 was conducted following the PRISMA guidelines in the following electronic databases: Pubmed, Scopus, Web of Science, CINAHL, and PsycINFO. Methodological quality was assessed using the critical appraisal tools for non-randomized studies of the Joanna Briggs Institute (JBI). The followed protocol is listed in the International Prospective Register of Systematic Reviews (PROSPERO) with code CRD42022340732.

Results: A total of 34 studies were included in this review. There are a number of underlying factors such as higher rates of depression, anxiety, pre-pandemic lifetime mental disorders or previous lifetime suicide attempt, living alone, having problems with alcohol and/or other drugs, etc. that favor the emergence of suicidal tendencies and ideation in times of COVID-19. Similarly, the pandemic may have precipitated a series of factors such as economic concerns, assessing one's working conditions as poor, having family members or friends infected, changes in services or functions, and feeling discriminated against or stigmatized by society. Other factors such as age, sex, or type of healthcare worker show differences between studies.

Conclusion: Organizations should ensure the adoption of strategies and programmes for early detection of suicides as well as increased attention to the mental health of professions with a high workload.

Systematic review registration: PROSPERO, identifier CRD42022340732.

KEYWORDS

COVID-19, health personnel, suicide, mental health, risk factors, public health

Introduction

The WHO (1) estimates that there are more than 700,000 suicide deaths per year. This phenomenon is considered a complex public health problem due to its multivariate casuistry, where psychological, sociocultural, biological, economic, and personal factors may converge.

According to the Columbia Classification Algorithm of Suicide Assessment (C-CASA) (2), there are eight categories related to suicidal behavior. Among these eight categories, we find completed suicide (self-injurious behavior that triggers the death of an individual); suicide attempt (potentially self-injurious behavior in which the individual had the intention to commit suicide); preparatory acts toward imminent suicidal behavior (where the individual takes steps to self-harm but the self or third parties prevent the act of self-harm itself); suicidal ideation (passive thoughts about wanting to be dead or active thoughts about killing oneself but not accompanied by preparatory behavior); and self-injurious behavior (self-injurious behavior where the associated intention to die is unknown and cannot be inferred).

In an attempt to explain what drives a person to commit suicide, to plan and think about it, a number of theories have been established. According to the Interpersonal Theory of Suicide (3), a person will not attempt suicide unless they have both the desire to die by suicide and the ability to do so, so there must be thwarted belongingness and perceived burdensomeness. According to the Integrated Motivational-Volitional Model of Suicidal Behavior, individuals go through three phases in which feelings of defeat and entrapment are key elements, and in which the biopsychosocial context in which suicidal behavior arises, the factors involved in suicidal ideation, and those factors linked to the transition between suicidal ideation and suicidal action are precipitating factors (4). In addition, there are other theories (5) such as the Eco-developmental Model of Suicide Attempts (6), in which individual, relational, community, and social factors converge; the Cultural Theory and Model of Suicide, where there is a cultural component of suicide that goes beyond the individual and can affect relationships, the community, and society; or the Three-Step Theory (7), in which factors such as grief and hopelessness, lack of connection or attachment to other people, the absence of a meaningful job or life project coexist with the capacity for suicide itself, among others.

All these theories refer to risk or predisposing factors for suicidal behavior. The risk factor construct is understood in terms of probability and refers to a variable or factor that predisposes an individual to develop a certain disease or pathology (8). For the general population (3, 9), there are a number of risk factors that predispose to suicidal behavior such as childhood abuse, mental disorders and previous suicide attempts, situations of social isolation, despair, lack of resources, family conflict, incarceration or unemployment, problems with authorities, alcohol and other drug abuse, family history of suicide, diagnosis of physical illness, serotonergic dysfunction, seasonal variation, and personal traits such as impulsivity, predisposition to struggle, and low self-esteem or feelings of shame or guilt. Likewise, females have a higher risk of attempted suicide than males, although males have higher rates of completed suicide (10, 11), a phenomenon known as the gender paradox (12). With all these factors, we have now added a variable such as the pandemic caused by COVID-19 [Coronavirus disease 2019, an infectious disease caused by the Severe Acute Respiratory Syndrome coronavirus 2 (SARS-CoV-2)]. The COVID-19 pandemic has led to confinement, limited mobility, changes in people's social lives, and economic problems that have negatively affected both the mental health and wellbeing of individuals (13). Compared to previous epidemics (14), suicide rates may have increased during and after health crises, as corroborated by a systematic review on suicidal ideation and behaviors during the COVID-19 pandemic (15). It is true that in recent years it has become apparent that some occupations are more prone to suicide risk, such as healthcare workers (HCWs), who are 3–5 times more likely to be at risk of suicide (16) and who, as expected, have been closely affected by the different epidemic waves of the COVID-19 pandemic (17). This suggests that suicide rates may be increased by pre-existing or emerging mental health conditions. In fact, it is estimated that the suicide rate among male clinicians is almost 1.5 times higher than that of female clinicians and 2.3 times higher than in the general population (11, 18). Among female nurses, there are also higher suicide rates than in the general population (19). Healthcare professionals appear to have occupation-specific risks for suicide as a result of their highly stressful work

environment or the impact of the situations they experience, such as being involved in a physician error, among others (11). The consequences of suicidal ideation can lead to suicide attempts and completed suicide with the resulting personal loss. More specifically, in clinical practice, such thoughts can affect adequate professional performance due to a lack of empathy, kindness, compassion, and active listening skills, in detriment to the quality of care provided (17).

Especially at the beginning of the pandemic, HCWs may have felt worried about infecting their loved ones, may have been afraid of the disease, felt stigmatized and isolated by society, suffered traumatic experiences and ethical dilemmas, and may have been subjected to high levels of stress, anxiety, and depression (20, 21). In addition, in the work environment, many HCWs have lacked personal protective equipment, have had increased patient load, have had to make difficult decisions, have witnessed a high number of deaths of patients under their care, have been forced to double shifts, and have been relocated from their services (22). All this factors have had the potential to undermine the mental health of HCWs, with the consequent risk of developing suicidal ideation and behavior (23). While it is true that the pandemic has fluctuated, a study in Bangladesh (15) found that, from April 2020 to July 2020, the prevalence of suicidal ideation had increased from 5 to 19%, similar figures to those reported by Mortier et al. (24), which range from 4.4 to 13%. In another study, suicidal thoughts had a prevalence of 11% among HCWs, compared to 6% in the general population (25). It should not be disregarded that suicidal ideation is a predictor of future suicide attempts and suicide deaths (26), hence the importance of addressing it at early stages. In this regard, Sahimi et al. (27) and Rodney et al. (21) found that 17% of physicians reported suicidal ideation, of whom 1% had attempted suicide. Furthermore, HCWs are more likely than non-HCWs to succeed in suicide attempts as they have greater access to more lethal drugs and have knowledge about the sufficient dosage to end their lives (28). In the systematic review by Dutheil et al. (20) carried out in 2019, ∼1.0% of physicians attempted suicide and 17% of physicians had suicidal ideation. These figures decreased as the pandemic progressed, especially in European countries. The monitoring of cases throughout the pandemic could require a specific approach to this issue, and also more longitudinal studies should be carried out to assess events in this field. As can be seen, there is wide variability and contradictions between different research results affecting suicide. For this reason, the aim of this review was to identify the main risk factors that may predispose a healthcare professional to suicidal ideation and suicide attempts during the COVID-19 pandemic.

Materials and methods

Study design

A systematic review was conducted following the PRISMA guidelines (Preferred Reporting Items for Systematic reviews and Meta-Analyses) (29). The protocol followed is listed in the International Prospective Register of Systematic Reviews (PROSPERO) with code CRD42022340732. Ethical aspects.

TABLE 1 PECOT format: keywords.

Population	Healthcare professionals
Event	Suicidal tendencies: suicide attempts and suicidal ideation
Comparison	Risk/protective factors
Outcomes	Number of cases, risk vs. protective factors, occupational vs. non-occupational factors, quantification of suicidal tendencies, comparison of levels before vs. during the COVID-19 pandemic, comparison according to type of profession/service
Time	During the COVID-19 pandemic

Research question

What factors may influence a healthcare professional to present suicide attempts and suicidal ideation during the COVID-19 pandemic?

TABLE 2 Search terms.

MeSH† terms	Terms
Health personnel	Healthcare professionals OR Healthcare workers OR Healthcare providers OR Physician* OR Nurse* OR Doctor*
COVID-19	COVID-19 OR Coronavirus OR 2019-ncov OR SARS-CoV-2 OR Cov-19 OR pandemic
Suicide	Suicide OR Suicide Attempt* OR Suicide Completed OR suicidal ideation OR suicidal behavior OR self-harm* OR self-injury

†MeSH, Medical Subject Headings.

Databases and search strategy

The databases used were Pubmed, Scopus, Web of Science, Cumulative Index to Nursing and Allied Health Literature Complete (CINAHL), and PsycINFO. The search strategy used to collect the studies in the aforementioned databases was based on the key words obtained from the PECOT strategy, which yielded the research question: What factors may influence a healthcare professional to present suicide attempts and suicidal ideation during the COVID-19 pandemic? (Table 1).

Following these keywords, the Medical Subject Headings (MeSH) thesaurus was consulted, yielding the descriptors health personnel, COVID-19, and suicide. In order to expand the search for published studies in line with the subject of the study, the use of free terms together with the MeSH descriptors was put in practice through the use of the Boolean operators AND and OR (Table 2).

TABLE 3 Search strategy for each database.

Database	Search strategy	Results
Pubmed	(((((((((Suicide[Title/Abstract]) OR (Suicide Attempt*[Title/Abstract])) OR (Suicide Completed[Title/Abstract])) OR (suicidal ideation[Title/Abstract])) OR (suicidal behavior[Title/Abstract])) OR (self-harm*[Title/Abstract])) OR (self-injury[Title/Abstract])) AND ((((((Healthcare professionals[Title/Abstract]) OR (Healthcare workers[Title/Abstract])) OR (Healthcare providers[Title/Abstract])) OR (Physician*[Title/Abstract])) OR (Nurse*[Title/Abstract])) OR (Doctor*[Title/Abstract]))) AND ((((((COVID-19[Title/Abstract]) OR (Coronavirus[Title/Abstract])) OR (2019-ncov[Title/Abstract])) OR (SARS-CoV-2[Title/Abstract])) OR (Cov-19[Title/Abstract])) OR (pandemic[Title/Abstract])) Filters: from 2020 - 2022	133
Scopus	(TITLE-ABS-KEY (suicide) OR TITLE-ABS-KEY ("suicide attempt*") OR TITLE-ABS-KEY ("suicide completed") OR TITLE-ABS-KEY ("suicidal ideation") OR TITLE-ABS-KEY ("suicidal behavior") OR TITLE-ABS-KEY (self-harm*) OR TITLE-ABS-KEY (self-injury) AND TITLE-ABS-KEY ("Healthcare professionals") OR TITLE-ABS-KEY ("Healthcare workers") OR TITLE-ABS-KEY ("Healthcare providers") OR TITLE-ABS-KEY (physicians) OR TITLE-ABS-KEY (nurses) OR TITLE-ABS-KEY (doctors) AND TITLE-ABS-KEY (covid-19) OR TITLE-ABS-KEY (coronavirus) OR TITLE-ABS-KEY (2019-ncov) OR TITLE-ABS-KEY (SARS-CoV-2) OR TITLE-ABS-KEY (cov-19) OR TITLE-ABS-KEY (pandemic) AND (LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2020)	279
Web of science	TOPIC: (Suicide OR Suicide Attempt* OR Suicide Completed OR suicidal ideation OR suicidal behavior OR self-harm* OR self-injury) AND TOPIC: (Healthcare professionals OR Healthcare workers OR Healthcare providers OR Physician* OR Nurse* OR Doctor*) AND TOPIC: (COVID-19 OR Coronavirus OR 2019-ncov OR SARS-CoV-2 OR Cov-19 OR pandemic) Refined By: Publication Years: 2022 or 2021 or 2020	240
CINAHL	AB (Suicide OR Suicide Attempt* OR Suicide Completed OR suicidal ideation OR suicidal behavior OR self-harm* OR self-injury) AND AB (Healthcare professionals OR Healthcare workers OR Healthcare providers OR Physician* OR Nurse* OR Doctor*) AND AB (COVID-19 OR Coronavirus OR 2019-ncov OR SARS-CoV-2 OR Cov-19 OR pandemic) Refined By: Publication Years: 2022 or 2021 or 2020	89
PsycInfo	tiab(Suicide OR Suicide Attempt* OR Suicide Completed OR suicidal ideation OR suicidal behavior OR self-harm* OR self-injury) AND tiab(Healthcare professionals OR Healthcare workers OR Healthcare providers OR Physician* OR Nurse* OR Doctor*) AND tiab(COVID-19 OR Coronavirus OR 2019-ncov OR SARS-CoV-2 OR Cov-19 OR pandemic) Filters: from 2020 to 2022	48
Date of search 08/08/2022	**Total**	789

Table 3 shows the search strategy used, carried out on 08 August 2022 for each of the above-mentioned databases during the search process.

Selection criteria

The following inclusion criteria were used for the selection of articles: (1) design criterion: cross-sectional, longitudinal, and interventional studies; (2) language criterion: articles published in English, Spanish, French, and Portuguese; (3) data collection period: articles where data were collected during the COVID-19 pandemic and; (4) outcome measure criterion: articles measuring any of the following values/indicators: number of cases or proportion of suicidal tendencies, risk factors vs. protective factors, occupational vs. non-occupational factors, comparison of levels before vs. during the COVID-19 pandemic, comparison according to type of profession/service/level of exposure to COVID-19. On the other hand, the exclusion criteria were (1) language reasons (language other than English, Spanish, French, and Portuguese); (2) low scientific-technical quality after applying the quality assessment tool; (3) by type of article (published conference proceedings, conference abstracts, and theses or studies including animals); (4) population: students who do not perform healthcare practices; and (5) studies in which the collection date, study population, or measurement instrument could not be determined.

Data collection and extraction

For data collection and extraction, two researchers independently searched the databases according to agreed keywords. They eliminated duplicate studies and selected articles that could be included according to the previously established criteria after reading the title and abstract. Then, these two authors reviewed the full text of the studies that could potentially be included in the review and the decision

to include or exclude them in the review was made at this stage by consensus, with a third author having the discretion to include or not a study in case of discrepancy between the two authors. For the selection report, the two authors collected information from the studies regarding authorship, year of publication, country and date of data collection, overall objective, study design, population, measurement instrument, and main results; in addition, the results of the Joanna Briggs Institute (JBI) critical appraisal tool were added.

Methodological quality assessment

Two reviewers independently determined the methodological quality of the selected studies using the critical appraisal tools for non-randomized studies of the JBI of the University of Adelaide (30). These tools allow assessing the methodological quality of a study and determining the extent to which a study had minimized the possibility of bias in its design, development, and/or analysis. The versions for cross-sectional quantitative studies (eight items) and for case control studies (10 items) were used, setting the cut-off point at 6/8 for the former and 8/10 for the latter to accept their inclusion in this review (Supplementary material).

Results

Literature search

The primary search in the databases yielded 789 citations. After eliminating duplicates ($n = 288$), titles and abstracts of 501 articles were screened. Of these, 414 citations were discarded upon reviewing title and abstract. After having read the full text of the 87 remaining citations, 53 were discarded, either because they contained repeated data ($n = 2$), the population was not HCWs ($n = 8$), the data were collected before the pandemic by COVID-19 or the date of collection was not stated ($n = 8$), the tool was not detailed ($n = 3$), because of the type of study ($n = 12$), because the study was not related to the objective ($n = 17$), and for low quality ($n = 3$). The flow diagram is presented in Figure 1.

Study characteristics

Table 4 presents the study characteristics of the 34 selected articles. Of the total number of studies, five were conducted in China, five in Spain, four in the United States, four in the United Kingdom, two in Australia, and one in other countries (Bangladesh, Belgium, Brazil, Chile, Colombia, Egypt, Germany, India, Iran, Malaysia, Pakistan, Republic of Ireland, Russia, and Turkey). Regarding the data collection period, in 32 of the 34 studies it was carried out during the year 2020, preferably in the first and second quarter of the year, coinciding with the first wave of the pandemic. Regarding the sample, 5 of the 34 studies only included nurses and 3 of the 34, only physicians; the rest included two or more healthcare professions. Finally, regarding the measurement instrument, 12 of the 34 studies used item 9 of the PHQ-9, 8 of the 34 used the C-SSRS, 5 used a dichotomous question on whether they had suicidal thoughts, and the rest used other instruments (SSEV, question 17 of the SRQ-20, BSSI, CES-D-SI, SIS, CIS-R, Self-Injurious Thoughts and Behavior Interview, and SSI).

The included studies were assessed with the JBI critical appraisal tool, where high mean scores were obtained in all the finally included studies.

Main findings

Suicidal thoughts were reported by 21.7 to 2.4% of HCWs. 0.5 to 12.6% reported at least one lifetime suicide attempt, 0.5 to 3.5% reported a recent suicide attempt, and 3.0 to 0.5% had self-harmed (33, 48, 54).

Major factors associated with increased suicidality include higher rates of depression (27, 32, 33, 36, 37, 39, 40, 55); anxiety (19, 27, 32, 36–39, 52, 55); post-traumatic stress disorder (32, 42); pre-pandemic lifetime mental disorders (24) or previous lifetime suicide attempt; insomnia severity; nightmare frequency; poorer subjective health (32, 33, 36, 47, 60); and burnout (32). In addition, other personal factors predisposing to suicidal thoughts include being female (58); having friends or family members infected with COVID-19 (24, 32, 56); living alone; having poor physical health (32); being single (27, 39), divorced, legally separated, or widowed (24); higher alcohol consumption (32, 34); psychotropic drug use (34, 42); and change in vitamin D levels (45). Younger age is considered a risk factor for some participants (32, 35), a protective factor for others (39), and shows no clear age pattern for the rest (35). Regarding work-related factors during the pandemic, suicidal ideation was associated with financial concerns (24, 32, 34), assessing one's working conditions as poor (34) or perceived lack of preparedness of the health care facility (24); having had job functions changed (51); having been isolated or quarantined for COVID-19 (24, 56); having been moved to a specific workplace related to COVID-19; being an auxiliary nurse (24) or a nurse (44, 46); reporting high workload (34) or stress (56); feeling perceived discrimination (43, 50) and not feeling support from family (47) or superiors (52); and reporting an increased post-pandemic burden (34). As for HCWs coping with COVID-19, no differences in suicidal ideation were found between nurses with and without direct contact with persons with COVID-19 (33, 49, 57), although another study presents

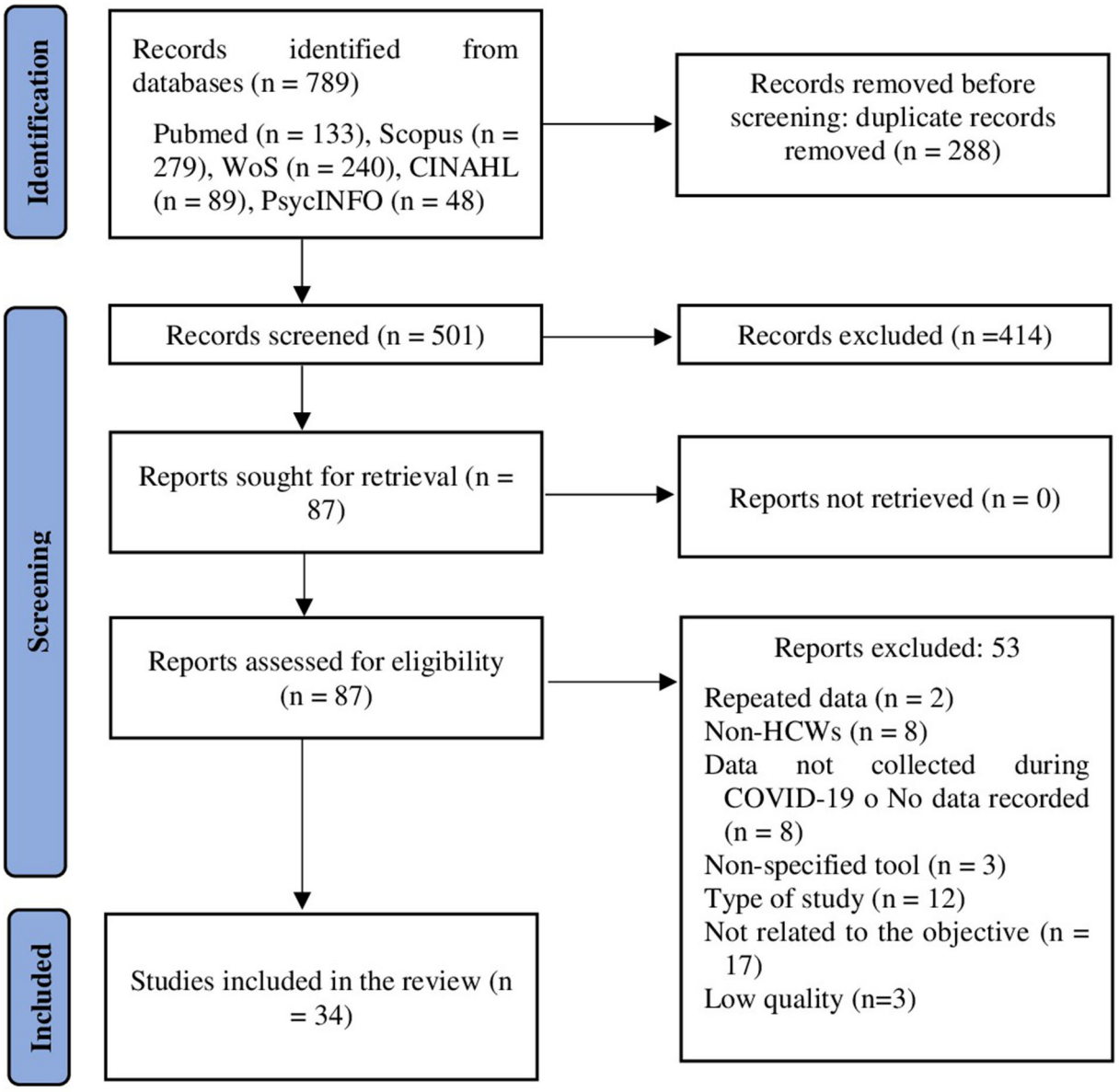

FIGURE 1
Identification of studies *via* databases (PRISMA flow diagram).

discrepancies indicating that frontline HCWs reported a clearly higher presence of thoughts of death (35, 37, 38).

Finally, factors such as having dependent children (32), having a per capita income of more than three minimum monthly wages (34) or higher than 2200 euros (24), resilience and self-perceived social support (35), not having an infected family member, and lower work stress had protective effects on suicidal ideation (47). In addition, HCWs with more than 10 years of service had a significantly lower rate of current suicidal ideation (27).

Discussion

This study sought to review the factors that may protect or predispose HCWs to suicide attempts and suicidal ideation during the COVID-19 pandemic. The results suggest that there are a number of personal, social, and occupational factors that may predispose HCWs to develop and tend to suicidal ideation, as well as others that may reduce the number of suicidal thoughts and tendencies, such as support systems and certain personal factors.

TABLE 4 Characteristics of the studies included in the systematic review.

Studies	Context	Main aim	Type of study	Population	Instrument	Main outcomes	JBI
Brady et al. (31)	Republic of Ireland (November 2020 to January 2021)	To quantify the mental health of nursing home staff during the COVID-19 pandemic in the Republic of Ireland	Cross-sectional study	390 nurses	C-SSRS	Suicidal ideation and suicide planning were reported, respectively, by 13.8% (95% CI, 10.4−17.3%) and 9.2% (95% CI, 6.4−12.1%) of participants with no between group differences.	7/8
Bismark et al. (32)	Australia (August–October, 2020)	To identify the prevalence and predictors of (a) thoughts of suicide or self-harm among HCWs during the COVID-19 pandemic and (b) help-seeking among those HCWs with thoughts of suicide or self-harm.	Cross-sectional study	7,795 HCWs	PHQ-9 (question 9)	10.5% of HCWs reported thoughts of suicide or self-harm. HCWs with these thoughts experienced higher rates of depression, anxiety, post-traumatic stress disorder and burnout than their peers. The odds of suicide or self-harm thoughts were higher among HCWs who had friends or family infected with COVID-19 (OR = 1.24, 95% CI = [1.06, 1.47]), were living alone (OR = 1.32, 95% CI = [1.06, 1.64]), younger (?30 years cf. >50 years; OR = 1.70, 95% CI = 1.36-2.13), male (OR = 1.81, 95% CI = [1.49, 2.20]), had increased alcohol use (OR = 1.58, 95% CI = [1.35, 1.86]), poor physical health (OR = 1.62, 95% CI = [1.36, 1.92]), increased income worries (OR = 1.81, 95% CI = [1.54, 2.12]) or prior mental illness (OR = 3.27, 95% CI = [2.80, 3.82]). Having dependent children was protective (OR = 0.75, 95% CI = [0.61, 0.92]). Fewer than half (388/819) of the HCWs who reported thoughts of suicide or self-harm sought professional support.	7/8
Höller et al. (33)	Germany (February–April, 2021)	To examine (1) the psychological burden and (2) suicidal ideation and its associated risk factors one year after the COVID- 19 pandemic begun	Cross-sectional study	1,311 nurses	SSEV	21.7% of HCWs reported recent (in the last 4 weeks) suicidal ideation and 0.5% reported a recent suicide attempt. 44.5% of HCWs reported lifetime suicidal ideation and 12.6% reported at least one life-time suicide attempt. Only depression, perceived burdensomeness, agitation and previous lifetime suicide attempt were associated with suicidal ideation. No differences in suicidal ideation were found between nurses with versus without direct contact with people with COVID-19.	7/8

(Continued)

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TABLE 4 (Continued)

Studies	Context	Main aim	Type of study	Population	Instrument	Main outcomes	JBI
Oliveira et al. (34)	Brazil (June–July, 2020)	To identify the prevalence of and factors associated with suicidal ideation among nursing professionals from a municipality in southern Brazil.	Cross-sectional study	890 nurses	SRQ-20 (question 17)	The observed prevalence of suicidal ideation was 7.4%. Suicidal ideation was inversely related to per capita income > 3 minimum monthly wages (PR: 0.28; 95% CI: 0.11–0.68), and positively related to the use of psychotropic drugs (PR: 3.14; 95% CI: 1.87–5.26). In addition, suicidal ideation was also associated with assessing one's working conditions as poor (PR: 2.16; 96% CI: 1.13–4.13), reporting a heavy burden at work (PR: 1.93; 95% CI: 1.08–3.43), reporting increased burden post-pandemic (PR: 2.03; 95% CI: 1.13–3.64), and problems with alcohol (PR: 2.56; 95% CI: 1.31–4.96).	8/8
Mortier et al. (24)	Spain (May–September, 2020 and October–December, 2020)	To estimate four-month STB incidence among Spanish HCW active during the first wave of the Spain COVID-19 pandemic; and to investigate individual-and population-level associations of a wide range of potential risk factors with STB incidence.	Cross-sectional study	4,809 HCWS	C-SSRS (modified)	Suicidal thoughts and behaviors incidence was estimated at 4.2%. Risk factors significantly associated with suicidal thoughts and behaviors incidence were pre-pandemic lifetime mental disorders (OR range 1.59–2.53), being an auxiliary nurse (OR = 2.07), being single, divorced, legally separated, or widowed (OR = 1.72). Having a pre-pandemic monthly income level higher than 2200€ was a protective factor (OR range 0.49–0.53). Interpersonal stress (OR range = 1.23–1.57) was strongly associated with STB, followed by personal health-related stress and stress related to the health of loved ones (OR range 1.30–1.32), and by the perceived lack of preparedness of the healthcare center (OR = 1.34). Other significantly associated risk factors were financial factors (OR range 1.26–1.81), having been isolated or quarantined for COVID-19 (OR = 1.53), and having changed to a specific COVID-19 related work location (OR = 1.72).	7/8

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TABLE 4 (Continued)

Studies	Context	Main aim	Type of study	Population	Instrument	Main outcomes	JBI
Ortiz-Calvo et al. (35)	Spain (April–June, 2020)	To study the potential effect of self-perceived social support and resilience on the mental health outcomes of a large sample of HCWs from Spain during the initial COVID-19 pandemic outbreak	Cross-sectional study	2,372 HCWS	C-SSRS (modified)	The rate of death thoughts was 7%, and higher among HCWs who reported a history of prior mental health problems (21%). Resilience and self-perceived social support were inversely associated with death thoughts. Death thoughts did not show a clear age pattern. Women reported death thoughts more frequently than men. Frontline HCWs reported distinctly higher presence of death thoughts.	7/8
Que et al. (36)	China (May–July, 2020)	To examine the relationship between COVID-19-related traumatic event exposure and suicidal ideation among hospital HCWs, and identify mediating roles of sleep disturbances in this relationship	Cross-sectional study	16,220 hospital HCWs	PHQ-9 (question 9)	13.3% of HCWs reported suicidal ideation n the past month. Insomnia severity ($\beta = 0.309$, $p < 0.001$), nightmare frequency ($\beta = 0.455$, $p < 0.001$), depressive symptoms ($\beta = 0.358$, $p < 0.001$), and anxiety symptoms ($\beta = 0.371$, $p < 0.001$) were positively associated with the risk of suicidal ideation.	7/8
Salman et al. (37)	Pakistan (first wave)	To assess suicidal ideation and its predictors among Pakistani HCWs during the early phase of the COVID-19 pandemic	Cross-sectional study	398 HCWs	PHQ-9 (question 9)	14.3% prevalence of suicidal ideation among Pakistani HCWs. Participants' occupation, their duty during the pandemic, working experience, anxiety and depression were found be associated with suicidal ideation ($p < 0.05$). HCWs directly engaged in managing COVID-19 patients were 2.25 times more likely to have suicidal ideation than the second-line health professionals.	7/8
Abdelghani et al. (38)	Egypt (March–May, 2020)	To explore the newly termed phenomenon, coronaphobia, and identify its associated correlates among physicians during their battle against the COVID-19 pandemic in Egypt.	Cross-sectional study	426 physicians	A question was asked (Yes/No)	10.1% of HCWs reported self-harm thoughts during pandemic. Frontline workers had more self-harm thoughts, compared to second-line workers (13.6% vs. 9.4%, respectively). Excessive anxiety and fears of COVID-19 virus infection were found to be associated with suicidal thoughts and intense feelings of hopelessness	6/8

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TABLE 4 (Continued)

Studies	Context	Main aim	Type of study	Population	Instrument	Main outcomes	JBI
Al-Humadi et al. (39)	United States (April–May, 2020)	To establish the incidence of depression, suicidal thoughts, and burnout; to identify factors associated with the development of these mental health issues; to examine differences between attending and resident physicians; and to examine differences between female and male physicians	Cross-sectional study	225 physicians	PHQ-9 (question 9)	The rate of suicidal ideation for attending and resident/fellow physicians was 7.1% and 6.2%, respectively. No difference was found between resident/fellow and attending physician rates of suicidal ideation ($t = 0.641$; $P = 0.522$). 5.8% of married participants presented suicidal ideation, compared to 7.4% of single workers. Rate of suicidal ideation for female resident/fellow and attending physicians was 6.9% and 5.6%, respectively. Internal medicine and other non-surgical specialties had the highest rates of suicidal ideation (10.2%). Suicidal ideation was positively associated with number of times on call in the last month (OR: 1.17, 95% CI [1.04, 1.32], $P = 0.02$), a history of being diagnosed or treated for depression or anxiety (OR: 1.17, 95% CI [1.04, 1.32], $P = 0.01$), and younger age (OR: 0.07, 95% CI [.04, 0.14], $P = 0.05$).	8/8
Alvarado et al. (40)	Chile (May–August, 2020)	To evaluate HCWs' mental health and its associated factors during the pandemic in Chile	Cross-sectional study	1,934 HCWs	C-SSRS	12.2% of respondents reported wishing that they were dead. Among women, this figure was significantly higher (13.6%) than among men (8.0%). Suicidal ideation was reported by 2.3% of participants, with no significant differences by sex or place of work. HCWs who reported a wish to be dead scored significantly higher on the GHQ-12 (22.6 ± 5.8 vs. 15.4 ± 5.9; $p < 0.001$) and the PHQ-9 (15.1 ± 5.9 vs. 7.7 ± 5.0; $p < 0.001$).	8/8
Amsalem et al. (41)	United States (September–December, 2020)	To examine rates of depression, GAD, PTSD, and moral injury among United States HCWs in the COVID-19 era.	Longitudinal study (0, 30, and 90 days)	350 HCWs	PHQ-9 (question 9)	65/350 participants (19%) reported suicidal thoughts and 35 of them (10% of the entire sample) endorsed "several days". Rates of PHQ-9 depression and suicidal ideation did not significantly change over time ($F = 2.4$, $P = 0.091$, and $F = 1.9$, $P = 0.149$, respectively).	7/8

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TABLE 4 (Continued)

Studies	Context	Main aim	Type of study	Population	Instrument	Main outcomes	JBI
Ariapooran et al. (19)	Iran (2020)	To evaluate the prevalence of Secondary Traumatic Stress and comparing depression, anxiety, and suicidal ideation in nurses with and without STS symptoms during the COVID-19 outbreak	Cross-sectional study	315 nurses (hospitals)	BSSI	There were inter-group differences in nurses with and without STS symptoms regarding Suicidal Ideation ($F = 2.424$; $p < 0.091$). Nurses with STS symptoms received higher scores in depression, anxiety, and SI than the ones without STS symptoms.	6/8
Bruffaerts et al. (42)	Belgium (April–July, 2020)	To examine the prevalence of STB in HCWs in Belgium, the country with the highest suicide rate within Europe	Cross-sectional study	6,409 HCWs	C-SSRS (modified version)	Prevalence was 3.6% death wish, 1.5% suicide ideation, 1.0% suicide plan, and 0.0% suicide attempt ($n = 2$). Also, substance use disorder or post-traumatic stress disorder (PTSD) were more than twofold associated with suicide ideation and/or plan.	7/8
Campo-Arias et al. (43)	Colombia (October—November, 2020)	To examine the association of perceived discrimination related to COVID-19 with psychological distress in HCWs in the Colombian Caribbean region	Cross-sectional study	150 HCWs	CES-D-SI	Perceived discrimination scores showed positive correlations with suicide risk in nursing assistants ($r_s = 0.35$) and physicians ($r_s = 0.31$).	6/8
Dobson et al. (44)	Australia (April–May, 2020)	To examine psychological distress in healthcare workers (HCWs) during the COVID-19 pandemic in April-May 2020.	Cross-sectional study	320 HCWs	PHQ-9 (question 9)	Twenty-three participants (8.1 %) reported suicidal ideation during the 2-week reporting period, being higher among nurses (14.7%), among men (21.7%), and among HCWs not on the frontline (7.6%).	7/8
Duru (45)	Turkey (January 2019–January 2020 and January–April, 2021)	To evaluate the effect of the COVID-19 pandemic on the physical well-being and mental health of ICU HCWs	Cross-sectional study	51 ICU HCWs tertiary care hospital	SIS	SIS scores indicate absence of suicidal ideation. A change in Vit D levels was positively correlated with SIS scores ($r = 0.381$, $P = 0.006$).	8/8

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TABLE 4 (Continued)

Studies	Context	Main aim	Type of study	Population	Instrument	Main outcomes	JBI
Greenberg et al. (46)	UK (June–July, 2020)	To identify the rates of probable mental health disorder in staff working in ICUs in nine English hospitals during June and July 2020.	Cross-sectional study	709 ICU HCWs	PHQ-9 (question 9)	13% of respondents reported having thoughts that [they] would be better off dead, or of hurting [themselves] in some way, several days or more frequently in the past 2 weeks. A significantly higher proportion of nurses (19%) than physicians (8%) or other clinical staff (10%) ($\chi^2 = 26.8$, degrees of freedom [df] = 8, $P < 0.002$) reported these thoughts.	8/8
Hong et al. (47)	China (February, 2020)	To assess the immediate psychological impact on frontline nurses in China.	Cross-sectional study	4,692 Frontline nurses	PHQ-9 (question 9)	About 6.5% respondents had suicidal ideation. A poorer subjective health (poor: OR = 7.56; fair: OR = 3.38), not enough support from family (OR = 2.05) or hospital authorities (OR = 1.54), and less opportunities for reflecting opinions through mass media (OR = 1.47) were shown to be risk factors. Family member not infected (OR = 0.15) and lower job-related stress (low: OR = 0.40; medium: OR = 0.61) had protective effects on suicidal ideation	8/8
Lamb et al. (48)	UK (April–June, 2020)	To report preliminary findings on the prevalence of, and factors associated with, mental health and well-being outcomes of HCWs during the early months (April–June) of the COVID-19 pandemic in the UK	Cross-sectional study	4,378 HCWs (Non-clinical 32.3%)	CIS-R	In the past 2 months, 8.5% (95% CI 7.3 to 9.8) of participants had considered taking their own life, while 2.0% (95% CI 1.4 to 2.7) had attempted suicide, and 3.0% (95% CI 2.3 to 3.9) had harmed themselves.	8/8
Majumder et al. (49)	UK (April–May, 2020)	To explore the effects of the pandemic on the psychological wellbeing of UK HCWs, as well as the coping mechanisms used and the workplace support that they found helpful	Cross-sectional study	533 HCWs	*Ad hoc* questionnaire	2.6% reported thoughts of self-harm (2.3% frontline vs. 3.9 non-frontline) and 1.7% experienced suicidal thoughts (1.6% frontline vs. 1.9 non-frontline). No statistically significant differences were found in any of the cases.	6/8

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TABLE 4 (Continued)

Studies	Context	Main aim	Type of study	Population	Instrument	Main outcomes	JBI
Mediavilla et al. (50)	Spain (May–June, 2020)	To explore the association between perceived discrimination and mental health outcomes in a large sample of HCWs in Spain	Cross-sectional study	2,053 HCWs	C-SSRS	5.6% reported death thoughts. Perceived discrimination was associated with a 2-fold increase in risk of reporting death thoughts (OR = 2.0, 95 percent CI: 1.4, 3.1).	7/8
Mediavilla et al. (51)	Spain (Aprol–June, 2020)	To analyse the association between three work-related stressors and mental health outcomes in a large sample of Spanish HCWs during the initial COVID-19 outbreak.	Cross-sectional study	2,370 HCWs	C-SSRS	7% reported death wishes and 17% of them reported active suicidal ideation. Death wishes were also more frequent among those who changed their job functions. Prior history of mental health problems was associated in adjusted models with the probability of reporting death wishes (OR = 3.9, 95% CI: 2.3, 6.3).	7/8
Mortier et al. (52)	Spain (Mar–Jul, 2020)	To investigate the prevalence and correlates of suicidal thoughts and behaviors among hospital HCWs during the first wave of the Spain COVID-19 outbreak	Cross-sectional study	5,450 HCWs	C-SSRS (modified)	Thirty-day suicidal thoughts and behaviors prevalence was estimated at 8.4% (4.9% passive ideation only, 3.5% active ideation with or without a plan or attempt). A total of $n = 6$ professionals attempted suicide in the past 30 days. In adjusted models, 30-day suicidal thoughts and behaviors remained significantly associated with pre-pandemic lifetime mood (OR = 2.92) and anxiety disorder (OR = 1.90). Significant modifiable factors included a perceived lack of coordination, communication, personnel, or supervision at work, and financial stress.	7/8
Mosolova et al. (53)	Russia (May, 2020 and Oct, 2020)	To assess the range of psychopathological symptoms and risk factors in frontline HCWs during spring and autumn outbreaks of the new coronavirus infection in Russian Federation	2 Cross-sectional study	2,195 HCWs	PHQ-9 (question 9)	2.4% of HCWs reported suicidal thoughts. Risk factors female gender, younger age, being a physician, working for over a week, living outside of Moscow or Saint Petersburg, being vaccinated against COVID-19.	7/8

(Continued)

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TABLE 4 (Continued)

Studies	Context	Main aim	Type of study	Population	Instrument	Main outcomes	JBI
Murata et al. (54)	United States (April–July, 2020)	To assess its mental health impact across the lifespan in the United States in adolescents, adults, and HCWs	Cross-sectional study	1,672 HCW	Self-Injurious Thoughts and Behavior Interview	In HCWs the prevalence was 5.6% lifetime non-suicidal self-injurious behavior, 4.0% lifetime suicidal ideation, 18% lifetime actual suicide attempt and 19% lifetime suicidal ideation or behavior.	7/8
Parthasarathy et al. (55)	India (July–September, 2020)	To examine whether the nature of occupation, socio-demographic variables, life-style, family support, substance use and suicidality correlate with anxiety and depression among HCWs	Cross-sectional study	5,995 HCWs	2 questions: Suicidal thoughts and attempts (Yes/No)	HCWs with anxiety and depression have reported an increase in suicidal thoughts but not attempts after the onset of the pandemic. HCWs with anxiety and depression have reported an increase in suicidal thoughts but not attempts after the onset of the pandemic.	7/8
Sahimi et al. (27)	Malaysia (March 2020)	To investigate suicidal ideation in terms of the rate and associated factors in a sample of Malaysian HCWs during the early-phase of the COVID-19 pandemic.	Cross-sectional study	171 HCWs	PHQ-9 (question 9)	The proportion of HCWs with current suicidal ideation was 11.1%. Factors significantly associated with current suicidal ideation were single status ($P = 0.017$), higher levels of health anxiety ($P = 0.234$), and higher severity of depression ($p < 0.001$). Participants with more than 10 years of service duration had a significantly lower rate of current suicidal ideation ($P = 0.013$). Clinical depression was the most significant factor associated with current suicidal ideation ($p < 0.001$, $OR = 55.983$, 95% CI = 9.015–347.671) followed by mild (subthreshold) depression ($P = 0.001$, $OR = 115.984$, 95% CI = 2.977–85.804). Service duration of more than 10 years was associated with significantly less suicidal ideation ($P = 0.049$, $OR = 0.072$, 95% CI = 0.005–0.993).	8/8

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TABLE 4 (Continued)

Studies	Context	Main aim	Type of study	Population	Instrument	Main outcomes	JBI
Xu et al. (56)	China (February–March, 2020)	To investigate the prevalence of suicidal and SSI and its related factors in hospital staff during the COVID-19 pandemic.	Cross-sectional study	11,507 HCWs 46 hospitals	A question was asked about SSI and PHQ-9 (question 9)	6.47% (744) of the hospital staff reported SSI. The SSI prevalence in doctors, nurses, technicians, and administrators were 6.26%, 6.68%, 6.37%, and 5.56%, respectively. Marital status, work hours per day, sleep hours per day, frontline department family members or relatives infected, community members infected, probability of infection, willingness to work in a COVID-19 ward, attendance of parties, concerns on COVID-19 progress, confidence in defeating COVID-19, prediction for lasting time, almost all the psychological characteristics and most items in perceived stress and support scales showed significant differences between hospital staff with and without SSI ($P < 0.05$).	7/8
Young et al. (18)	United States (April, 2020)	To quantify the rates of psychological distress among HCWs during the COVID-19 pandemic and to identify job-related and personal risk and protective factors	Cross-sectional study	1,326 HCWs	PHQ-9 (question 9)	5% (64 of 1,326) endorsed suicidal ideation. Those respondents with a self-reported psychiatric history reported more frequent suicidal ideation than those without such history (48 of 572 [8%] vs. 16 of 754 [2%], respectively; $p < 0.001$).	8/8
Cai et al. (57)	China (February, 2020)	To compare the psychological impact of the COVID-19 outbreak between frontline and non-frontline medical workers in China	Case-control	1,173 frontline and 1,173 non-frontline medical workers	A question was asked ("Once/several times" or "Never")	No significant difference was observed in terms of suicidal ideation (12.0% vs. 9.0%, adjusted *OR* = 1.25, 95% CI = 0.92–1.71) between frontline medical workers than non-frontline medical workers.	10/10

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TABLE 4 (Continued)

Studies	Context	Main aim	Type of study	Population	Instrument	Main outcomes	JBI
Mamun et al. (58)	Bangladesh (April, 2020)	To investigate the suicidality and its associated risk factors of HCWs by comparing with that of general population as it is anticipated that the HCWs may have higher suicidality as of being exposed to critical situation and higher mental health sufferings	Cross-sectional study	834 HCWs	A question was asked (Yes/No)	About 6.0% of HCWs had suicidal behavior, with no detectable differences within the groups (i.e., general population and HCWs). Regression analysis showed that being female, being divorced, and having no child were emerged as independent predictors for suicidality. There was no significant association between the personal protective equipment related or patient-care related variables and suicidal behavior of the HCWs. Majority of the participants sometimes had fear of death although no significant relation of the factor was found with suicidality.	6/8
Rathod et al. (59)	UK (May–July, 2020 and Oct-Dec, 2020)	To investigate the psychological impact of COVID-19, resultant restrictions, impact on behaviors and mental wellbeing globally	Cross-sectional study	3,933 HCWs	A question was asked (Yes/No)	Most of the key HCWs have higher likelihood of suicidal thoughts and worries about coronavirus compared to others. Suicidal thoughts increase amongst almost all individuals with pre-existing health conditions. Individuals with pre-COVID-19 suicidal thoughts show lower likelihood of following government advice, communications with friends and family, coping activities, confidence on coping, but higher likelihood of doing risky activities, with higher scores on PHQ-9, GAD-7, and IES-R.	7/8
Xiaoming et al. (60)	China (February, 2020)	To investigate the psychological status of hospital HCWs and provide references for psychological crisis intervention in the future	Cross-sectional study	8,817 hospital HCWs	SSI	The prevalence of SSI was 6.5%. Various epidemic-related attitudes and behaviors were independent factors for SSI, such as the need for psychological assistance before or during the epidemic (OR = 1.826, 95% CI = 1.310–2.545; OR = 2.277, 95% CI = 1.636–3.171), unconfident about defeating COVID-19 (OR = 2.435, 95% CI = 1.184–5.005), ignorance about the epidemic (OR = 2.559, 95% CI = 1.451–4.531), willingness of attending parties (OR = 2.235, 95% CI = 1.339–3.731), and poor self-rated health condition (OR = 5.228, 95% CI = 3.650–7.489) among hospital HCWs ($P < 0.05$).	8/8

JBI, Joanna Briggs Institute; HCWs, Healthcare Workers; OR, Odds Ratio; CI, Confidence Interval; UK, United Kingdom; GAD, Generalized Anxiety Disorder; PTSD, Posttraumatic Stress Disorder; PHQ-9, Patient Health Questionnaire (9 items); BSSI, Beck Scale for Suicidal Ideation; C-SSRS, Columbia Suicide Severity Rating Scale; CES-D-SI, Suicidal Ideation Scale of the Center for the Epidemiological Study of Depression; SIS, Suicidal Ideation Scale; SSEV, Suicide Ideation and Behavior Scale; SSI, Self-Harm Ideation; CIS-R, Clinical Interview Schedule; SRQ-20, Self-Reporting Questionnaire.

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In previous studies, suicidal behaviors were found to have increased during the pandemic in the general population and in samples of HCWs (61). This already corroborates findings from pre-pandemic studies where suicide rates among HCWs were already higher than those reported in the general population, with differences between men and women, especially among female physicians. There is a wide variability in the prevalence of suicidal ideation and suicide attempts in the different samples consulted within a COVID-19 (38) pandemic setting. This phenomenon could be explained by the variability of the samples, by the impact of disease control measures in each country, as well as by the difference in the levels of stress, anxiety, fear, and depression experienced by HCWs during the pandemic (62). Indeed, in the meta-analytic study by Dragioti et al. (63) of one hundred and seventy-three studies conducted between February and July 2020, the COVID-19 pandemic was found to have a greater impact on mental health in people living in low-income countries, in those who had adopted more restrictive measures, and in more vulnerable populations. Rudenstine et al. (64) consider that the risk factors influencing the general population are those that affect material and economic variables, the social level, and those related to accessing vital resources. In the case of HCWs, these factors may have a different relevance during the pandemic and others may become more relevant, so synergistic relationships may be established between them (55).

In this line, there are a number of factors associated with higher suicidality such as higher rates of depression (27, 32, 33, 36, 37, 39, 40, 55); anxiety (19, 27, 32, 36–39, 52, 55); post-traumatic stress disorder (32, 42); pre-pandemic lifetime mental disorders (24) or previous lifetime suicide attempt; insomnia severity; nightmare frequency; a poorer self-perceived health (32, 33, 36, 47, 60); and burnout (32). In most cases, all these risk factors have increased in impact during the COVID-19 pandemic and, as Mamun and Ullah (65) estimate, approximately 90% of suicides are due to psychological distress in the face of continued exposure to highly stressful situations.

Although most suicidal ideation is due to problems related to psychological distress, the explanation may be varied and multicausal (60, 66). HCWs have been repeatedly exposed to death and pain during the COVID-19 pandemic (67), and as postulated by Smith and Cukrowicz (68), constant exposure to pain and death may favor suicidal behavior and ideation. This may suggest that work environments where there is a higher risk of infection may favor a worsening of the mental health of particularly exposed HCWs (69). In this case, there is certain controversy as to the higher or lower prevalence of suicide rates among frontline HCWs compared to other types of workers. Some studies (33, 49, 57) have found no statistically significant differences in terms of suicidal ideation rates between HCWs working on the front line and those without direct contact. Others, on the other hand, have indeed found differences in this regard (24, 35, 37, 38). In the latter case, this could be justified by a change in the work environment, the functions to be carried out, and a greater perception of risk in relation to the disease. Studies such as the one by Salman et al. (37) estimated that HCWs working on the front line are up to 2.25 times more likely to have suicidal ideation. Changing functions or work location has also been considered by Mediavilla et al. (51) as another risk factor, since it can worsen the mental health of HCWs. In fact, even before the pandemic, there were services in which suicide rates were higher than in others, such as the case of HCWs working in the operating room (70). Other authors found that Internal medicine and other non-surgical specialties had the highest rates of suicidal ideation (39). Other factors such as having been hospitalized due to COVID-19 infection, having had family members infected with COVID-19, and self-perceived probability of contracting COVID-19 may be predisposing factors to the uncertainty caused by the disease (71). In this regard, in a case study of press reports, being infected with COVID-19 was the most common reported reason for suicide, followed by work-related stress, fear of COVID-19 infection, fear of transmitting the virus to others, anxiety about witnessing overwhelming death, and mental distress (14).

On the other hand, a series of factors do not show a clear trend between studies. This is the case of age, sex, or the type of HCW studied. As indicated by Mamun et al. (58), Alvarado et al. (40), Jahan et al. (14), and Mosolova et al. (53), being female may be a risk factor that increases the rates of suicidal ideation compared to males, but other studies such as the one by Bismark et al. (32) and another one by Dobson et al. (44) differ from these conclusions and postulate that males offer higher ideation rates than females. To overcome this dichotomy, homogeneous samples should be compared to avoid possible biases. Being younger is considered a risk factor for some studies (32), a protective factor for others (39), and shows no clear age pattern for the rest (35). In relation to the type of role of the HCW, the prevalence of suicidality may vary. In the study by Mortier et al. (52) in Spain, an auxiliary nurse was 2 times more likely to develop suicidal thoughts and behaviors. In the case of the study by Greenberg et al. (46), 1 in 5 nurses reported suicidal thoughts compared to 1 in 10 physicians. Likewise, in the study by Mosolova et al. (53), the group with the highest risk was that of physicians, compared to the rest of HCWs. In contrast, in the study by Xu et al. (56), physicians, nurses, technicians, and administrators showed a similar prevalence. In this vein, the study by Dobson et al. (44) carried out in Australia (April–May, 2020) on a sample of 320 HCWs, suicidal ideation was more present among nurses. The differences between groups may respond to the fact that nurses may have a more intense nurse-patient relationship than other professionals because of the long hours they spend with patients.

Just as some factors have proven to be predisposing to suicidal tendencies and behaviors, there are others that can be considered protective. In many cases, these factors are related to the support system that the HCW has at the individual, family, and work level. Factors such as having dependent children

(32), per capita income > 3 minimum monthly wages (34) or higher than 2200 euros (24), resilience and self-perceived social support (35), no family member infected, and lower job-related stress had protective effects on suicidal ideation (47). In addition, HCWs with more than 10 years of service duration had a significantly lower rate of current suicidal ideation (27).

All in all, the findings of this review show that the context surrounding the COVID-19 pandemic at the social, occupational, family, personal, and public health levels may have had an impact on suicidal ideation and suicide attempts in the general population and, in particular, in healthcare workers as a result of the factors they are exposed to in their professional performance and the social and healthcare context that surrounds them. It is true, though, as previously mentioned, that suicidal ideation and suicide attempts will not only depend on the extrinsic factors that affect the healthcare worker in a pandemic context, but internal factors related to previous health problems, adequate support networks, financial solvency, among others, are also particularly relevant.

Limitations

This systematic review is not without limitations. Firstly, most of the included studies were cross-sectional and used hetero-administered instruments *via* online surveys. In this sense, population characteristics, methodological differences, heterogeneous samples, etc. meant that the resulting findings were very heterogeneous. Thirdly, the timing of data collection and measures of confinement/isolation was different in each study, hence the data were considered inadequate for meta-analysis. Finally, the health system, the allocation of resources for mental health promotion, as well as the adoption of preventive measures adopted by different countries may differ, and these deviations may influence the comparability of indicators.

Conclusion

There are a number of underlying factors such as higher rates of depression, anxiety, pre-pandemic lifetime mental disorders or previous lifetime suicide attempt, living alone, having problems with alcohol and/or other drugs, etc. that favor the emergence of suicidal tendencies and ideation in times of COVID-19. Similarly, there are a series of factors that the pandemic may have precipitated, such as economic concerns, assessing one's working conditions as poor, having infected family members or friends, changes in services or functions, feeling discriminated against or stigmatized by society. Other factors such as age, sex, or type of HCW differ between studies.

Data availability statement

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

Author contributions

FF-C, RA-C, JG-S, and JV-L: conceptualization and writing–review and editing. BP-C, JV-L, and JG-I: data curation. BP-C, FF-C, RA-C, JV-L, and JG-I: formal analysis. BP-C and FF-C: investigation. RA-C, JG-S, JV-L, and JG-I: methodology. RA-C, JG-S, and JG-I: project administration. BP-C, FF-C, RA-C, JG-S, JV-L, and JG-I: resources. BP-C and RA-C: software. RA-C, JG-S, and JV-L: supervision. FF-C, RA-C, JG-S, and JG-I: validation. BP-C, JG-S, JV-L, and JG-I: visualization. BP-C, FF-C, and JG-I: writing–original draft. 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.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.1043216/full#supplementary-material

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Mental health status and its associated factors among female nurses in the normalization of COVID-19 epidemic prevention and control in China

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Objective: To investigate mental health status and its associated factors among female nurses in the normalization of COVID-19 epidemic prevention and control in China.

Methods: Random cluster sampling was applied to recruit 740 female nurses in China. The respondents completed the survey with mobile devices. Demographic questionnaire, Generalized Anxiety Disorder-7, Patient Health Questionnaire-9, Insomnia Severity Index, and The Impact of Event Scale-Revised were used to assess demographic Information, anxiety, depression, insomnia and PTSD symptoms, respectively. The associated factors of mental health status were identified by binary logistic regression analysis.

Results: The prevalence of anxiety and depression was 7.9 and 17.8%, respectively. Insomnia was an associated factor of anxiety (OR = 6.237, 95%CI = 6.055–23.761, $P < 0.001$) and depression (OR = 9.651, 95%CI = 5.699–22.370, $P < 0.001$), while PTSD was an associated factor of anxiety (OR = 11.995, 95%CI = 2.946–13.205, $P < 0.001$) and depression (OR = 11.291, 95%CI = 6.056–15.380, $P < 0.001$), Being married was a protective factor of depression (OR = 0.811, 95%CI = 1.309–6.039, $P < 0.01$).

Conclusion: Female nurses showed problems in mental health. Insomnia, PTSD and marital status were associated with mental health. The hospital management should pay more attention to the unmarried groups, and strive to improve the sleep quality of female nurses and reduce their stress caused by traumatic events.

KEYWORDS

mental health, China, COVID-19, associated factor, female nurse, anxiety, depression

Introduction

Previous studies indicate that nurses faced a wide range of stressors, such as the huge workload caused by the high requirements of the tense system, shift responsibility, work-family conflict, etc. (1), which makes them, especially high-risk nurses, more vulnerable to develop mental problems (2). The outbreak of coronavirus disease 2019 (COVID-19) has arisen mounts of psychological problems to the health care workers in China, especially nurses. They experienced high mental burden and reported more severe degrees of mental health symptoms (3–6). According to the study conducted by Lai et al. the nurses were reported to have a significantly higher level of depression than the physicians do during the COVID-19 (7). Moreover, a study focusing on mental health of medical staff in Xinjiang province of China found nurse were more likely to show psychological problems than clinicians (8).

With the effort of Chinese government, the epidemic situation of COVID-19 has been effectively controlled, but the epidemic situation is still sporadic. China entered the stage of normalized epidemic prevention and control since May 2020 (9). China classified all counties as low-risk for COVID-19 from May 7, 2020, since no domestic cases had been reported on the Chinese mainland for four consecutive days as of May 6, with no new deaths for 22 consecutive days. Correspondingly, the national epidemic prevention and control policy has been changed from the blockade policy at the beginning of the outbreak into the normalization of COVID-19 epidemic prevention and control (10). The general policy is to prevent external input and internal rebound, insist on timely discovery, rapid disposal, precise control and effective treatment. That is, compared with many other countries that are starting to lift restrictions that were first imposed 2 years ago in order to slow the spread of COVID-19 (11), China still has COVID-19 restrictions in the normalization of COVID-19 epidemic prevention and control, such as Regular nucleic acid testing. This has imposed a huge burden on healthcare systems.

Though the severe situation faced by nurses has changed, they still worked under great pressure. It is important to understand the status of mental health of nurse group and associated factors. However, the work concerning the mental health of Chinese female nurses in the normalization of COVID-19 epidemic prevention and control is still missing. Recently, a cross-sectional study investigated the mental health status and its potential impact factors among male and female nurses from low-risk areas under normalized COVID-19 pandemic prevention and control in Jiangsu province, China (11). Prior reports have shown females are more vulnerable to poor mental health problems than males (12–14), and gender differences have been found regarding the influencing factors and influencing factors of mental health (15–17). Besides, female nurses accounted for the vast majority of nurses in China. Harding et al. found that the percentage of female nurses was 91% in New Zealand, 90.4% in the United States, 89% in UK, 88.3% in Australia and 77% in the Netherlands (18). The percentage of Chinese female nurses was 98% in 2017, which is higher compared with that in developed countries (19). However, studies concerning the metal health of Chinese nurses during the period of COVID-19 and normalization of COVID-19 epidemic prevention and control didn't distinguish the gender differences when it comes to the mental health and its associated factors, leading to a consequence that the status of mental health and its associated factors of female Chinese nurses remain still unclear.

Therefore, we aimed to conduct a cross-sectional study to clarify the status of mental health and its associated factors among female nurses in the normalization of COVID-19 epidemic prevention and control in China.

Methods

Participants and procedures

A cross-sectional study was conducted in January 2022. G*Power software version 3.1.9.7 was used to estimate the required sample size of this study. The present study used binary logistic regression analysis to analyze the association between mental health and associated factors. Therefore, F-test (Linear multiple regression: Fixed model, R^2 increase) was employed. Effect size (f^2) was set at 0.15 and alpha value was set at 0.05. Approximately 189 participants would provide 95.07% power to detect a statistical significance.

There were 3 inclusion criteria in this study. They were listed as follows, I. no dyslexia, II. 18 years old or above, and III. working in hospital under the normalization of COVID-19 epidemic prevention and control. The exclusion criterion was that female nurses had a history of mental illnesses. Convenience sampling was applied to recruit participants. According to the inclusion and exclusion criteria, 740 female nurses were recruited from 5 hospitals in Jiangsu Province of China with the efforts of members from the research team. The normalization of COVID-19 epidemic prevention and control in Jiangsu Province is same as other parts of China. Before filling out the online questionnaires, participants were asked if they were willing to take part in the study. Only those who volunteered to this research signed papery informed written consent. Respondents filled out all the scales in a Chinese version of questionnaire website called Wenjuanxing (https://www.wjx.cn/). The questionnaires can only be submitted after all the questions have been answered. All the data was collected *via* their smart mobile phone.

Ethical approval was obtained from the Naval Medical University before the initiation of the research project. Participants were assured their responses were anonymous and confidential. Participants were free to withdraw at any time without penalty.

Measures

Demographics

In the present study, demographic information including age, years of working, medical isolation, night shift last month, vaccine against COVID-19, marital status, professional title, employment type, child status, weekly hours of working and working department were recorded.

Age was divided into two groups (20–22) [younger group (≤30 years old) and middle-age group (>30 years old)]. Years of working was divided in three groups (≤5, 6–10, >10). Medical isolation was categorized as having been isolated or not. The number of night shift last month was divided into two groups (<4, ≥4). Vaccine against COVID-19 was categorized into being vaccinated or not. Marital status was divided into married or unmarried (single, divorced or widowed). Professional title was divided into 2 groups (junior title, intermediate or senior title). Employment type was coded as permanent contract employee or fixed-term contract employee. Child status was categorized into no child and having at least one child. Hours of working per week was divided into two groups (≤40, >40). Working departments were grouped into high-risk and low-risk units. Nurses working in fever clinics, COVID-19 medical unit and emergence department were considered as high-risk people, while the others were identified as low-risk nurses (23).

Generalized anxiety disorder-7

The GAD-7 is a valid and efficient tool for screening anxiety and assessing its severity in clinical practice and research (15). The 7-item questionnaire is used to ask participants how often they are bothered by each symptom during the last 2 weeks. Response options are "not at all" "several days" "more than half the days" and "nearly every day" scored as 0, 1, 2, and 3, respectively. Cut-off scores of 5, 10 and 15 are classified as mild, moderate and severe anxiety (24). Respondents with moderate or severe anxiety are suspected of having anxiety. In the present study, the Cronbach's alpha was 0.960.

Patient health questionnaire-9

The PHQ-9 includes 9 items pertaining to the DSM-IV criteria for depressive disorder (25). Each item is rated on a 4-point Likert scale from 0 to 3 (0-never; 1- several days; 2-more than half the time; and 3-nearly every day) within the last 2 weeks before the completion of the survey. Cut-off scores of 5, 10 and 15 are classified as mild, moderate and severe depression (26). Respondents with moderate or severe anxiety are suspected of having depression. In the present study, the Cronbach's alpha was 0.935.

Insomnia severity index

ISI is a brief self-assessment tool, which has been previously proven as a reliable and valid instrument to quantify perceived insomnia severity (27). It included 7 items, and each item can be rated using a 5-point Likert scale, ranging from 0 to 4. A Higher score indicated a higher severity of insomnia. The total score ranges from 0 to 28. The cut-off score of 8 is defined as the presence of insomnia (28), indicating subjects may have sleep difficulties. In the present study, the Cronbach's alpha was 0.926.

The impact of event scale-revised

The IES-R was used to assess posttraumatic stress symptoms caused by traumatic events. The IES-R scale includes 22 items and consists of three subscales: intrusiveness, avoidance and hyperarousal. The total scores of the scale ranges from 0 to 88. An IES-R total score >33 is identified as having PTSD symptoms (29), suggesting participants may have traumatic experience. In the present study, the Cronbach's alpha was 0.976.

Statistical analysis

Data were analyzed with IBM SPSS (Version 21.0). The significance level was set at $\alpha = 0.05$, and all tests were 2-tailed. Kolmogorov-Smirnov test was applied to check whether the data of anxiety and depression conform to normal distribution. The results shown that the total scores of anxiety and depression weren't normally distributed (all $P < 0.001$). Therefore, Mann-Whitney U-test was used to compare the differences for categorical variables with two groups and the Kruskal-Wallis test was used when having more than two groups. Binary logistic regression analysis was conducted for detecting the associated factors of anxiety and depression.

Results

Demographic characteristics

A total of 740 female nurses were recruited in the present study with the average age of 30.53 ± 6.65 years

old. Demographic Characteristics were listed in Table 1. Most participants were aged 30 or below [433 (58.5%)], had no medical isolation experience [667 (90.1%)], had more than 4 night shifts last month [422 (57.0%)], had been vaccinated with COVID-19 vaccine [681 (92.0%)], were married [473 (63.9%)], had a junior professional title [473 (63.9%)], were fixed-term employees [647 (87.4%)], had at least 1 child [413 (55.8%)], worked in low risk units [662 (89.5%)], worked <40 h per week [520 (70.3%)]. 194 (26.2%) of the participants reported PTSD symptoms, 61 (8.2%) of them had sleep difficulties.

Younger group showed significantly higher scores in anxiety and depression ($P = 0.084$, marginal significance) than older group. Those who worked on night shift more than 4 times last month had significantly higher levels of anxiety and depression. Female nurses with junior professional titles reported significantly serious anxiety. The ones who worked in high risk units had higher scores of anxiety ($P = 0.055$, marginal significance). Female nurses who worked more than 40 h per week reported a significantly higher level of anxiety and depression. Besides, nurses with PTSD symptoms or insomnia reported significantly higher scores of anxiety and depression compared to those without.

Mental health status and its associated factors

The average score of GAD-7 was 3.61 ± 4.06 with 53 (7.2%) and 5 (0.7%) female nurses reporting moderate and severe anxiety respectively, 234 (31.6%) respondents showing mild anxiety. Therefore, 7.9% of our participants were suspected of having symptoms of anxiety. The average score of PHQ-9 was 6.19 ± 5.15. 74 (10.0%) and 58 (7.8%) female nurses reporting moderate and severe depression respectively, 310 (41.9%) respondents showing mild anxiety. Thus, 132 (17.8%) female nurses may have symptoms of depression. In order to explore the associated factors influencing the metal health status of female nurses, binary logistic regression analysis was carried out.

The results of binary logistic regression analysis listed in Table 2 showed that female nurses who reported a higher level of PTSD symptoms had a higher level of anxiety [OR = 6.237, 95%CI = (2.946–13.205), $P < 0.001$] and depression [OR = 9.651, 95%CI = (6.056–15.380), $P < 0.001$]. Besides, having insomnia was associated with a higher level of anxiety [OR = 11.995, 95%CI = (6.055–23.761), $P < 0.001$] and depression [OR = 11.291, 95%CI = (5.699–22.370), $P < 0.001$]. Marital status was also an associated factor influencing female nurses' depression. Married female nurses had a lower level of depression [OR = 0.811, 95%CI = (1.309–6.039), $P < 0.01$).

Discussion

As far as we know, this is the first study concerning the female nurses' mental health status and its associated factors in the normalization of COVID-19 epidemic prevention and control in China. In the present cross-sectional study, we found 7.9% and 17.8% of our participants showed anxiety and depression symptoms, respectively. Furthermore, we found that insomnia, PTSD and marital status were associated factors affecting anxiety and depression.

The outbreak of COVID-19 has arisen a large number of psychological problems to the health care workers in China (8, 30, 31). A review focusing nursing population from December 2019 to March 2020 found that their mental health status was severe (32). Lai et al. conducted a survey about mental health outcomes by GAD-7 and PHQ-9 among health care professionals working with coronavirus-19 patients. According to their findings, 12.7 and 15.5% of the Chinese nurses reported anxiety and depression, respectively (7). In another study by Que et al., 14.9% of the Chinese nurses showed anxious symptoms (GAD-7), and 12.02% of them had depressive symptoms (PHQ-9) (33). Thus, compared with studies during the COVID-19 epidemic from China, the level of anxiety of female nurses in our study was lower than that reported by prior research, whereas the level of depression was higher. When comparing our findings with the findings from other countries, the mental health condition of female nurses in the normalization of COVID-19 epidemic prevention and control of China was better than those of other countries in the period of COVID-19. For example, 21.4% of Japanese nurses involved with COVID-19 patients showed anxiety and 19.7% of them had depression (34). 43 and 26% of American nurses reported anxiety and depression during COVID-9 pandemic, respectively (35). Besides, the study from Iran found 38.8 and 37.4% nurses during COVID-19 had anxiety and depression symptoms (36). However, no study has reported the prevalence of female nurses' mental problems in the normalization of COVID-19 epidemic prevention and control. Moreover, in comparison to the prevalence of mental problems during the non-epidemic stage, our finding was higher (37–39), indicating although the mental health of female nurses has become better during the normalization stage, mental health problems still remain prevalent, suggesting special attention should be paid to female nurses.

Zhang et al. found that nurses experienced less psychological stress during the normalization of COVID-19 prevention and control (40). They pointed out that the reduction was related with the experience of fighting against COVID-19 epidemic, effective response to the epidemic and the stable condition of the COVID-19 epidemic. Therefore, female nurses in the present study reported less anxiety symptoms than those in the previous study. Female nurses need to contact with various patients or even access the blood samples

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TABLE 1 Characterization and distribution of anxiety and depression.

Variables	Respondents	Anxiety			Depression		
	N (%)	M ± SD	Z / χ^2	*P*	M ± SD	Z / χ^2	*P*
Age							
Younger group (≤30)	433 (58.5%)	3.37 ± 4.04	−2.17	0.030	5.96 ± 5.24	−1.73	0.084
Middle-aged group (>30)	307 (41.5%)	3.95 ± 4.08			6.50 ± 5.02		
Medical isolation							
Yes	73 (9.9%)	3.30 ± 3.95	−0.86	0.390	5.57 ± 5.14	−0.80	0.421
No	667 (90.1%)	3.64 ± 4.07			6.23 ± 5.15		
Night shifts last month							
<4	318 (43.0%)	3.10 ± 3.78	−2.76	0.006	5.46 ± 4.89	−3.43	0.001
≥4	422 (57.0%)	4.00 ± 4.22			6.73 ± 5.28		
Vaccine shots							
Yes	681 (92.0%)	3.63 ± 4.03	−0.70	0.487	6.21 ± 5.14	−0.51	0.614
No	59 (8.0%)	3.42 ± 4.38			5.92 ± 5.27		
Years of working							
1–5 years	268 (36.2%)	3.68 ± 4.13	3.92	0.141	6.25 ± 5.32	1.78	0.410
6–10 years	242 (32.7%)	3.25 ± 3.86			5.83 ± 4.94		
>10 years	230 (31.1%)	3.92 ± 4.17			6.50 ± 5.16		
Marital status							
Unmarried	267 (36.1%)	3.68 ± 4.03	−0.62	0.536	6.61 ± 5.41	−1.58	0.114
Married	473 (63.9%)	3.58 ± 4.08			5.95 ± 4.99		
Professional title							
Junior	473 (63.9%)	3.41 ± 4.00	−2.16	0.031	6.00 ± 5.19	−1.53	0.126
Intermediate and senior	267 (36.1%)	3.99 ± 4.14			6.51 ± 5.07		
Employment type							
Permanent	647 (87.4%)	4.09 ± 4.24	−1.33	0.185	6.47 ± 5.07	−0.79	0.428
Fixed-term	93 (12.6%)	3.55 ± 4.03			6.15 ± 5.16		
Child status							
No child	327 (44.2%)	3.54 ± 3.96	−0.23	0.822	6.31 ± 5.33	−0.33	0.740
Have children	413 (55.8%)	3.68 ± 4.14			6.09 ± 5.01		
Working department							
High-risk units	78 (10.5%)	4.45 ± 4.29	−1.92	0.055	6.74 ± 4.87	−1.24	0.217
Low-risk units	662 (89.5%)	3.52 ± 4.02			6.12 ± 5.18		
Weekly hours of working							
≤40 h	520 (70.3%)	3.31 ± 3.97	−3.75	<0.001	5.78 ± 5.11	−3.93	<0.001
>40 h	220 (29.7%)	4.34 ± 4.19			7.14 ± 5.13		
PTSD							
Yes	194 (26.2%)	7.37 ± 4.12	−14.42	<0.001	10.64 ± 4.99	−13.80	<0.001
No	546 (73.8%)	2.28 ± 3.09			4.60 ± 4.19		
Insomnia							
Yes	61 (8.2%)	7.56 ± 4.92	−7.06	<0.001	12.15 ± 5.32	−8.64	<0.001
No	679 (91.8%)	3.26 ± 3.78			5.65 ± 4.79		

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TABLE 2 Associated factors of mental health status identified by binary logistic regression analysis.

Variables	Anxiety			Depression		
	OR	95% CI	*P*	OR	95% CI	*P*
Age						
Younger group (≤30)	1 [Reference]			1 [Reference]		
Middle-aged group (>30)	0.835	0.251–2.785	0.770	0.703	0.282–1.752	0.449
Medical isolation						
Yes	1 [Reference]			1 [Reference]		
No	1.526	0.569–4.092	0.401	0.804	0.366–1.765	0.586
Night shifts last month						
<4	1 [Reference]			1 [Reference]		
≥4	0.813	0.418–1.584	0.543	0.728	0.449–1.181	0.198
Vaccine shots						
Yes	1 [Reference]			1 [Reference]		
No	1.287	0.398–4.164	0.674	1.277	0.529–3.084	0.587
Years of working						
1–5 years	1 [Reference]			1 [Reference]		
6–10 years	1.673	0.362–7.722	0.510	1.054	0.351–3.159	0.926
>10 years	0.775	0.249–2.416	0.661	1.046	0.446–2.453	0.918
Marital status						
Unmarried	1 [Reference]			1 [Reference]		
Married	0.807	0.295–2.208	0.676	0.811	1.309–6.039	<0.01
Professional title						
Junior	1 [Reference]			1 [Reference]		
Intermediate and senior	1.033	0.335–3.181	0.955	1.377	0.599–3.166	0.452
Employment type						
Permanent	1 [Reference]			1 [Reference]		
Fixed-term	0.684	0.242–1.937	0.475	1.442	0.676–3.075	0.343
Child status						
No child	1 [Reference]			1 [Reference]		
Have children	0.651	0.207–2.048	0.463	0.853	0.352–2.070	0.725
Working department						
High-risk units	1 [Reference]			1 [Reference]		
Low-risk units	1.315	0.555–3.113	0.534	0.524	0.239–1.151	0.108
Weekly hours of working						
≤40 h	1 [Reference]			1 [Reference]		
>40 h	0.473	0.166–1.349	0.161	0.761	0.404–1.433	0.397
PTSD						
Yes	1 [Reference]			1 [Reference]		
No	6.237	2.946–13.205	<0.001	9.651	6.056–15.380	<0.001
Insomnia						
Yes	1 [Reference]			1 [Reference]		
No	11.995	6.055–23.761	<0.001	11.291	5.699–22.370	<0.001

during the outbreak of COVID-19, which may increase their risk of being infected by COVID-19 virus. Previous research confirmed that fear of being infected, or infecting others was associated with nurses' depression (41), which might explain why our participants had a more severe level of depression.

Moreover, we found insomnia, PTSD and marital status were associated factors affecting anxiety and depression of female nurses, which is consistent with previous literature (42–45). A review by Taylor et al. concluded that insomnia was a strong risk factor for depression and anxiety (46). Moreover, people with insomnia reported higher levels of anxiety and depression than those without insomnia and were 17.35 and 9.82 times as likely to have clinically significant anxiety and depression, respectively (47). Therefore, insomnia could predict mental health problems of female nurses. Earlier studies indicated that medical care workers were more likely to develop mental health problems due to their traumatic experience (48, 49). A systematic review by Naushad et al. implied that measures for medical care workers to prevent PTSD would be good for decreasing adverse psychological outcomes (44). Hence, PTSD symptom was an associated factor of mental health problems. In line with previous results (50–52), those who were unmarried had a higher level of depressive symptoms, and the possible explanation was that they might receive less support from family (42).

In a study focusing on mental health of medical staff in Xinjiang province of China based on the normalization of COVID-19 epidemic prevention and control (8). Researchers reported that being a nurse, poor health condition, living with elderly parents, less social support, and negative coping style were associated with experiencing worse mental health outcomes. Furthermore, Chen et al. conducted a cross-sectional study concerning potential impact factors of mental health among nurses under normalized COVID-19 pandemic prevention and control in Jiangsu province of China (10). They found that Having 11–15 years of working experience and being a fixed-term contract nurse were associated factors of nurses' mental health outcomes, while supporting-Wuhan working experience and having mental health preparation course training were protective factors. Our results revealed insomnia and PTSD symptom were associated factors of female nurses' anxiety and depression, while marital status was a protective factor of depression. We focused Chinese female nursing staff and expanded the associated factors of mental health in health-care workers under normalized COVID-19 pandemic prevention and control of China.

The results of the present study have profound implications for the amelioration of Chinese female nurses' mental health problems in the normalization of COVID-19 epidemic prevention and control practically. On the one hand, this study provided empirical data about prevalence of anxiety and depression among the female nursing staff under the regular COVID-19 epidemic prevention and control, suggesting the policy makers should pay more attention and design interventions to prevent mental problems of female nurses even under the normalization stage. On the other hand, our findings also detected associated factors influencing mental health of female nurses, which may provide potential preventive measures of anxiety and depression. Measures focusing on promoting sleep quality and decreasing stress from traumatic events such as meditation, music, mind-body bridging and yoga (53–56) must be taken to maintain good status of mental health among female nurses. Moreover, the unmarried female nursing staff needs more care from their colleagues, superiors and family members.

Several limitations in current study need to be mentioned. First of all, the cross-sectional design failed to confirm the causal relationship between insomnia, PTSD, marital status and mental problems. Longitudinal studies are needed in the future study to determine the casual associations between variables. Second, the participants were only from Jiangsu Province, China and were recruited through convenience sampling, which may limit the sample representativeness of the present study. It is better to recruit participants with random cluster sampling from other areas of China to increase the external validity of the present results. Third, our respondents completed the self-reported survey with mobile devices, which might lead to self-reported biases and social desirability response bias. Multi-informant measures are needed in further research to collect information from both self-report and other-report data with the purpose to avoid underestimation or overestimation of the associations. Fourth, the respondents of the present research were all female nurses, which limited the generalization of our results. Hence, our results can only be applied to female nursing staff. Moreover, it had to be noticed that the use of odds ratio may overestimate the association of associated factors with mental health of female nurses in our cross-sectional study.

Conclusion

Our findings demonstrated that under the normalization of COVID-19 epidemic prevention and control, anxiety and depression were prevalent in Chinese female nurses, with a prevalence of 7.9 and 17.8%, respectively. Insomnia and PTSD were associated factors of mental health status, and being married was a protective factor of depression. Chinese hospital management should make effort to improve female nurses' sleep quality and reduce their subjective stress caused by traumatic events. Besides, more attention should be paid to the unmarried group.

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

XM, WDo, and JZ contributed to the writing of this article and the statistical analysis. TH leaded the whole study, including carrying out this study, and putting forward the study. FZ contributed to the final analyses and critical work on the final versions of the article. WDe and ZL edited and proofread the manuscript. All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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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Longitudinal study of mental health changes in residents affected by an initial outbreak of COVID-19 in China

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Introduction: The COVID-19 pandemic is ongoing, and the world continues to work to defeat it. We designed this study to understand the longitudinal change in the mental health of residents who experienced the initial disease outbreak in China and to explore the long-term influencing factors.

Methods: The Perceived Stress Scale (PSS), Generalized Anxiety Scale (GAD-7), and Patient Health Questionnaire-9 (PHQ-9) were administered to the same sample four times: during the initial outbreak (T1), 1 month later (T2), 18 months later (T3), and 26 months later (T4).

Results: A total of 397 participants completed all of the follow ups. The mean PSS scores among the four time points showed significant differences ($F = 183.98$, $P < 0.001$), with the highest score at T1 (15.35 ± 7.14), a sharp decline at T2 (11.27 ± 6.27), an obvious rebound at T3 (15.17 ± 7.46), and finally a slight decrease at T4 (14.41 ± 7.99). Among the four mean GAD-7 scores, significant differences were also found ($F = 242.0$, $P < 0.001$), with the trend that from T1 (7.42 ± 6.03) to T2 (7.35 ± 5.88), the scores remained steady, while they showed an apparent decline at T3 (5.00 ± 5.30) and no obvious change at T4 (4.91 ± 4.81). There were no significant differences among the mean PHQ-9 scores ($F = 1.256$, $P < 0.284$). The long-term influencing factors differed for stress, anxiety and depression, but all three were influenced by a history of psychosis at T4, quarantine status and whether the participants' family members were infected during the initial outbreak.

Discussion: The survey revealed that repeated outbreaks in other areas also had an impact on those who experienced the initial outbreak, with a return of stress, a decline in anxiety, and no change in depression, which provides direction for interventions in the future.

KEYWORDS

anxiety, COVID-19, depression, mental health, follow-ups

1. Introduction

On January 23, 2020, Wuhan became the city first affected by the Hubei Province outbreak of COVID-19. One week after the unprecedented catastrophe, on January 30, the World Health Organization (WHO) declared the outbreak a public health emergency of international concern (1). At the initial stage, little was known about this new virus, and effective treatment was lacking. The infected patients usually suffered from severe respiratory symptoms, and the death rate was relatively high (2). Because of these factors, individuals experienced various mental health problems immediately after the initial outbreak, and the most common symptoms included acute stress reactions, anxiety, and depression (3–6), which also became the main focus of research on the impact of COVID-19 on mental health.

However, with the continual evolution of the virus and the development of vaccines, the symptoms of infection eased and became mild or even asymptomatic (7). Many Western countries gradually lifted the COVID-19 precautions that were in place to prevent the spread of the pandemic, such as social distancing, mask wearing, public and private gatherings, and reopened schools (8–10). However, in contrast to Western countries, China continued to enforce strict policies to prevent and contain COVID-19 because of the country's large population and limited medical resources (11). The "Dynamic zero-COVID" policy was instituted, meaning that once an individual became infected, he or she was isolated in a designated location, and close contacts were sought out immediately and isolated for at least 14 days, regardless of whether their nucleic acid detection results were negative (12). The extended period of isolation inevitably led to little social interaction, an inability to work, heavy financial pressures and even bankruptcy (13), which might bring about a psychological burden and lead to symptoms of anxiety and depression (14). Moreover, people were easily infected because of the highly contagious nature of the newly evolved virus (15). Therefore, the risk of infection was high, and new outbreaks of COVID-19 continue to make the risk a stressor for the public in China. Hence, it is vital to study the mental health change trend during the repeated outbreak of COVID-19 from the aspects of stress, anxiety and depression.

Although it has been more than 2 years since the pandemic was declared, local COVID-19 outbreaks in China have continued, including one in Nanjing and the more recent and severe outbreak in Shanghai (16). Figure 1 shows the trajectory and number of infected persons in China. With the number of infected persons increasing at different times, little is known about the mental health of the public since the initial outbreak. Although studies have been conducted using longitudinal methods to investigate the impact of COVID-19, these studies have focused only on short-term influences. One report revealed a statistically but not clinically significant reduction in psychological impact 4 weeks after the outbreak (17). Another study found no increase in the prevalence of anxiety and depression 2 months after the COVID-19 outbreak compared with pre-outbreak data (18). Meanwhile, Li et al. found that compared with the level of stress measured during the initial outbreak, acute stress declined 2 months later, while the rates of depressive and anxious symptoms increased (19). Few studies have focused on the long-term impact of COVID-19 on psychological status, with the longest follow-ups being 6 months to 1 year following the outbreak; the sample in these studies was heterogeneous (20, 21), which may have decreased the reliability of the results.

It has been reported that mental health problems, such as anxiety and depression in persons who experience major disasters (22), might persist for a long time. However, only a small number of studies have examined the psychological distress of the general public in Hubei Province (23–25), which was the first severely impacted area, and these studies were all cross-sectional surveys without follow-up data. Considering the recent conditions, especially the outbreak in Shanghai and the strict "Dynamic zero-COVID" policy, residents from Hubei Province who experienced the initial outbreak of COVID-19 still face the danger of coming into contact with infected persons. We hypothesized that the mental health of these local residents might show a distinct trend over time. Although many individuals may not experience the next outbreaks in other cities, the news and concerns about being infected by others coming from outbreak areas and the change of life brought by the Dynamic zero-COVID policy place unrelenting pressure on them. Hence, longitudinal analyses of this special group's adaptation to uncertain conditions during the pandemic are important, as the processes of cultivating an individual's resilience might change dynamically over time (26).

Therefore, we designed this longitudinal study to understand the changes in mental health from the aspects of stress, anxiety and depression among Hubei Province residents at the initial outbreak (T1), 1 month after the outbreak (T2), 18 months after [T3, the phase of another relatively large-scale outbreak in Nanjing that resulted in 1,272 newly infected individuals (27)], and 26 months after (T4, the phase of the largest-scale outbreak in China to date in Shanghai) among the same sample of Chinese residents who had experienced the initial outbreak in Hubei Province. The objective of this study was to describe the change in mental health over time among the individuals who came from the area most severely impacted by the pandemic and to explore whether the rebound of the pandemic in other cities might have an impact on them. Moreover, we also expected to discover the long-term influencing factors associated with their mental health. Only by understanding the characteristics of psychological changes and the related influencing factors can we make further plans for the subsequent management of COVID-19 and face challenges more confidently.

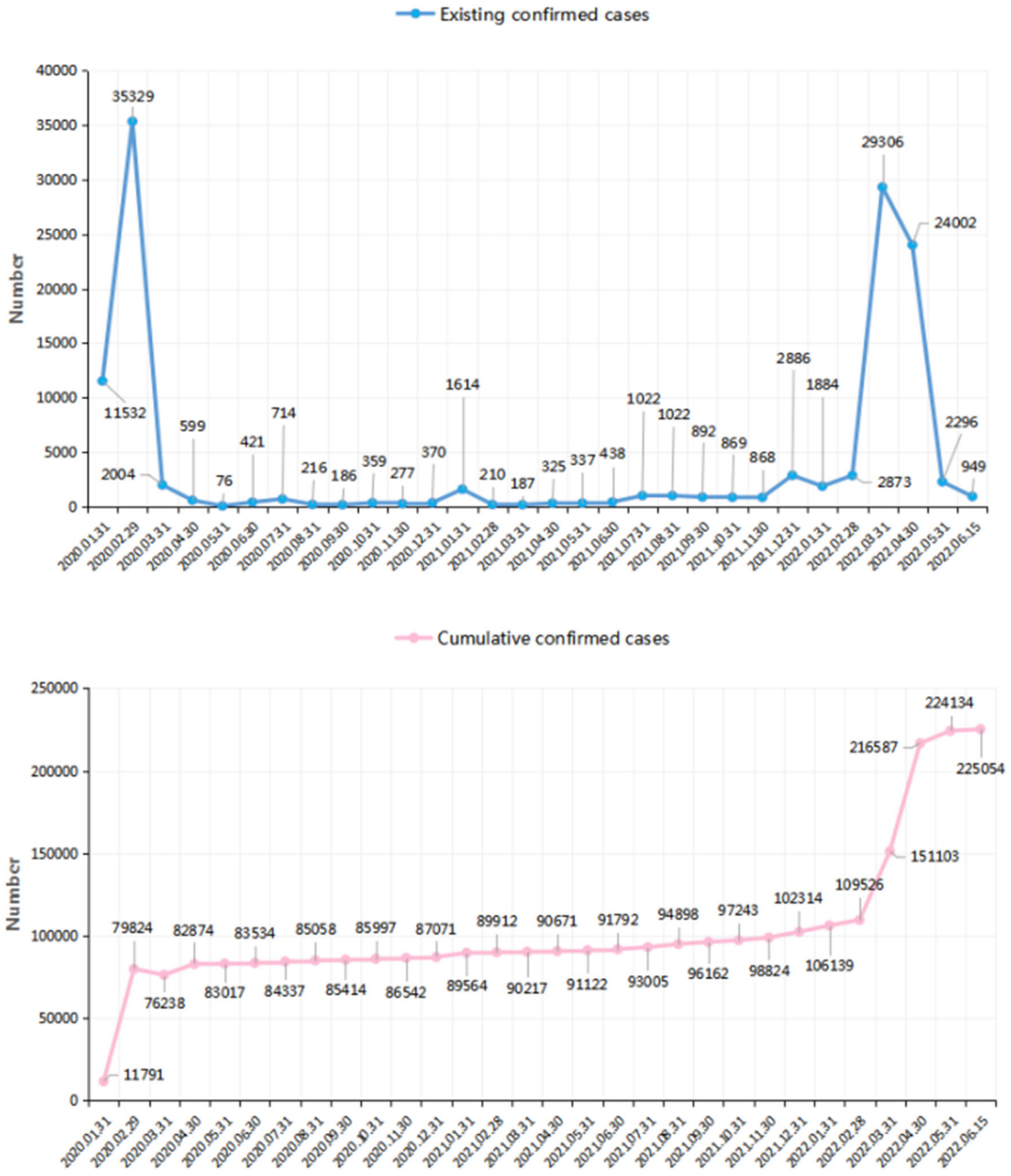

FIGURE 1
The confirmed cases of patients infected of COVID-19 in China over time (the number came from the data released by the National Health Commission of the People's Republic of China. http://www.nhc.gov.cn/xcs/yqtb/list_gzbd.shtml).

2. Materials and methods

2.1. Participants

This prospective study was initiated when the WHO announced COVID-19 as a Public Health Emergency of International Concern (PHEIC) on January 30, 2020, and was continued until February 19, 2020, representing the most severe period of the pandemic (T1) when the number of people infected with COVID-19 had reached 72,458 (28). The follow-up surveys were conducted from March 1–15, 2020 (T2), July 30 to August 13, 2021 (T3), and April 3–17, 2022 (T4).

Only adult (aged ≥18 years) residents of Chinese nationality who had lived in Hubei Province since the COVID-19 outbreak were recruited; those who had left Hubei since the outbreak started were excluded. The first survey was conducted using convenience and snowball sampling. We sent the first batch of questionnaires to several community WeChat groups whose members consisted mostly of residents living in Hubei and encouraged everyone to forward the questionnaire link to as many groups as possible. At the end of the questionnaires, there was an invitation to participate in the follow-up surveys. If participants responded positively, they were asked to provide their WeChat account information. If they declined, no follow-up surveys were sent to them. The links for the second, third and fourth surveys were sent to the participants through their WeChat accounts to collect longitudinal data. When sending the second link, we referred to the date when the participant answered the questionnaire for the first time to ensure that the time interval was close to 1 month. Considering the occupational particularity, we added an item asking whether they were medical staff; if they answered yes, their data were excluded.

When planning the sample size, we referred to M. Kendall's sample size estimation method, which states that the sample size should be 5–10 times the maximum number of questionnaire items (29). There were 26 questionnaire items in total; thus, the sample for this study should include 130–260 people. Considering the possibility of invalid questionnaires, the sample size was expanded by 20%. Finally, the sample size of this study was estimated to be 156–312 people. Because this is a cohort study, the research result was considered acceptable if the final sample size reached the above range. A total of 1,962 participants were recruited for the first survey. The concrete flow of subject loss is shown in Figure 2. Among the participants, only 453 provided their WeChat account information. As a result, the sample size at T1 was only 453. After we sent the second, third, and fourth surveys to these subjects, the number of subjects who returned their questionnaires was 448 at T2, 411 at T3, and 397 at T4, respectively. There was no difference in demographic characteristics among subjects at any of the four times.

Consent to participate in our survey was obtained *via* an online informed consent form provided on the first page of the questionnaire. If participants were willing to take part in the study, they chose the agree button to proceed to the questionnaire. If they selected disagree, they were returned to the home screen. All subjects were recruited voluntarily. The research design received institutional review board (IRB) approval from The Fourth People's Hospital of Chengdu.

2.2. Measures

2.2.1. Questionnaire on demographic characteristics and experiences related to the pandemic

The questionnaire on demographic characteristics included questions on gender, age, marital status, highest education, employment status, and history of psychosis. Experiences related to the pandemic referred to whether participants had been infected with COVID-19, whether their family members had

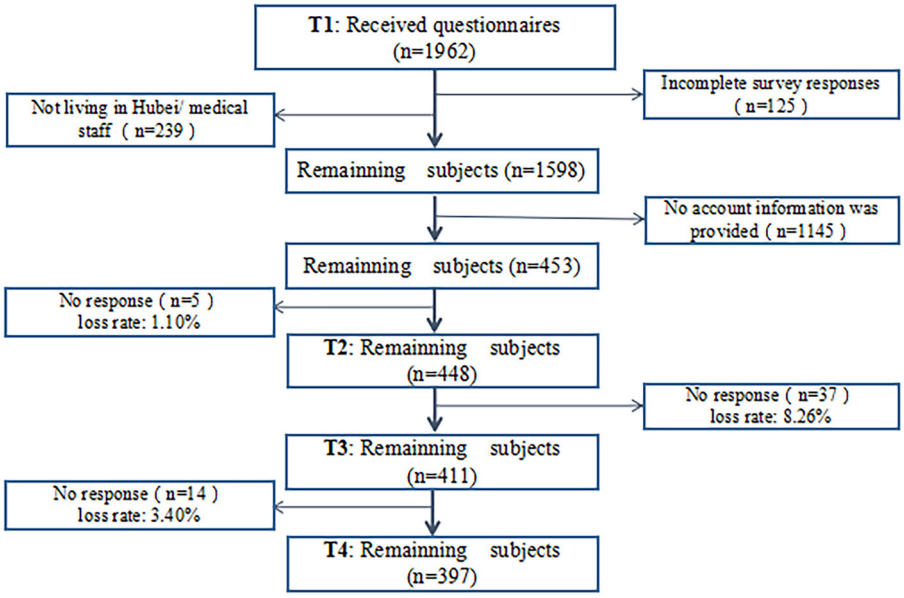

FIGURE 2
The concrete flow of subject loss.

been infected with COVID-19, and whether they had been quarantined during the pandemic.

2.2.2. Self-perceived health status

To determine the subjects' self-perceived health status, we added a single item based on a 5-point evaluation: 1 point indicated a very good physical condition; 2 points indicated a good physical condition; 3 points indicated an average physical condition; 4 points indicated a poor physical condition, and 5 points indicated a very poor physical condition.

2.2.3. Perceived Stress Scale (PSS)

The PSS (30) is a self-assessment scale developed by Cohen et al. to assess the degree of stress an individual has felt in the past month. The PSS-10 used in this study included 10 items, including 6 items with negative descriptions (items 1, 2, 3, 6, 9, and 10) and 4 items with positive descriptions (items 4, 5, 7, and 8). Each item is scored on a 5-point scale ranging from 0 to 4. The total score is the sum of the scores for all items. The higher the score is, the greater the stress the individual has experienced. The Chinese version of the scale has proven to have good reliability and validity, with a Cronbach's alpha value of 0.83 (31).

2.2.4. Generalized Anxiety Scale (GAD-7)

The GAD-7 (32) consists of seven items, each scored from 0 to 3 points; the total score ranges from 0 to 21 points, where 0 to 4 points indicates no anxiety, 5–9 points indicates mild anxiety, 10–14 points indicates moderate anxiety, and 15–21 points indicates severe anxiety. The scale has been used in China for many years and has proven to have good reliability and validity in determining the severity of anxiety. The Cronbach's alpha value of this scale is 0.898 (32).

2.2.5. 9-item Patient Health Questionnaire (PHQ-9)

The PHQ-9 (33) consists of 9 items, each scored 0–3 points; the total score ranges from 0 to 27 points, where 0–4 points indicates no depression, 5–9 points indicates mild depression, 10–14 points indicates moderate depression, 15–19 points indicates moderately severe depression, and 20–27 points indicates severe depression. The scale has been used in China for many years and has proven to have good reliability and validity in determining the severity of depression. The Cronbach's alpha value of this scale is 0.86 (34).

2.3. Statistical analysis

We summed each total score according to the calculation rules of each scale. The mean scores are presented as the mean ± SD. To describe the longitudinal change in the mean PSS, GAD-7, and PHQ-9 scores among different time points, repeated-measures ANOVA was used. If the results of Mauchly's test led to the rejection of sphericity, Greenhouse–Geisser correction was used to adjust the degrees of freedom for the averaged tests of significance. The effect sizes were indicated by the partial eta squared value. Additionally, *post-hoc* tests for paired comparisons with Bonferroni correction were conducted to determine which mean scale scores differed significantly from others at different time points. To detect the disparity among the four time points in the rates of different levels of anxiety and depression, we used the method of crosstabs (2*4). Because the expected count for each tab was over 5, the Pearson chi-square was used to test whether there was a significant difference among the four time points. If the *P*-value of the chi-square was <0.05, we considered it to be a significant difference, and then further paired comparisons of the rates were conducted. The α level with Bonferroni correction was used to determine the significance. As a result, a *P*-value of <0.0125 was considered statistically significant. To build a model of the influencing factors of stress, anxiety, and depression, considering that the total scores of the above three scales were all close to a normal distribution (please see the results of normality test in Supplementary file), we used multiple linear regression with the enter method and included all independent variables to obtain comprehensive results. A *P*-value of <0.05 was considered statistically significant. The statistical software used for all analyses was SPSS, version 20.0 (IBM-SPSS Inc., Armonk, NY, USA).

3. Results

3.1. Demographic characteristics and experiences related to the pandemic at different time points

The survey included 397 participants who completed all four follow-ups, including 83 men (20.9%) and 314 women (79.1%). The average age at T1 was 44.26 ±11.38 years, ranging from 19 to 78 years. At T1, 5 participants reported a history of psychosis, including 2 with depression, 1 with bipolar disorder, and 2 with anxiety disorder. At T2, the number increased to 9, which included another 4 subjects newly diagnosed with psychosis, including 1 with depression and 3 with anxiety disorder. At T3, another 7 subjects reported a history of psychosis, including 2 with depression, 1 with drug-induced mental disorder, and 4 with anxiety disorders. At T4, the number of subjects diagnosed with psychosis was 24, with 8 newly increased subjects, including 6 with depression and 2 with anxiety disorder (all diagnoses were made by a psychiatrist). The change in the remaining

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TABLE 1 Demographic and related pandemic information distribution of participants at different time points ($n = 397$).

Variables and assignment	T1, *N* (%)	T2, *N* (%)	T3, *N* (%)	T4, *N* (%)
Gender				
Man (1)	83 (20.9)	–	–	–
Woman (2)	314 (79.1)			
Marriage				
Unmarried (1)	44 (11.1)	44 (11.1)	44 (11.1)	42 (10.6)
Married (2)	331 (83.4)	331 (83.4)	331 (83.4)	333 (83.9)
Divorced (3)	13 (3.3)	13 (3.3)	13 (3.3)	13 (3.3)
Widowed (4)	9 (2.3)	9 (2.3)	9 (2.3)	9 (2.3)
Highest education				
Primary school (1)	0	0	0	0
Junior middle school (2)	16 (4.0)	16 (4.0)	16 (4.0)	16 (4.0)
Secondary specialized school (3)	12 (3.0)	12 (3.0)	12 (3.0)	12 (3.0)
High school (4)	19 (4.8)	19 (4.8)	19 (4.8)	19 (4.8)
Junior college (5)	45 (11.3)	45 (11.3)	45 (11.3)	45 (11.3)
Undergraduate (6)	259 (65.2)	259 (65.2)	259 (65.2)	259 (65.2)
Graduate (7)	46 (11.6)	46 (11.6)	46 (11.6)	46 (11.6)
Employment status				
Employed (1)	349 (87.9)	349 (87.9)	348 (87.7)	344 (86.6)
Not working (2)	48 (12.1)	48 (12.1)	49 (12.3)	53 (13.4)
History of psychosis				
Yes (1)	5 (1.3)	9 (2.3)	16 (4.0)	24 (6.0)
No (2)	392 (98.7)	388 (97.7)	381 (96.0)	373 (94.0)
Self-perceived health conditions				
Very good (1)	48 (12.1)	48 (12.1)	46 (11.6)	46 (11.6)
Good (2)	201 (50.6)	201 (50.6)	201 (50.6)	195 (49.1)
Average (3)	140 (35.3)	140 (35.3)	142 (35.8)	146 (36.8)
Poor (4)	8 (2.0)	8 (2.0)	8 (2.0)	10 (2.5)
Very poor (5)	0	0	0	0
COVID-19 infection-self				
Yes (1)	6 (1.5)	8 (2.0)	9 (2.3)	11 (2.8)
No (2)	391 (98.5)	389 (98.0)	390 (97.7)	386 (97.2)
Isolation or not				
Yes (1)	133 (33.5)	137 (34.5)	163 (41.1)	188 (47.4)
No (2)	264 (66.5)	260 (65.5)	234 (58.9)	209 (52.6)
COVID-19 infection-family member				
Yes (1)	35 (8.8)	38 (9.6)	40 (10.1)	52 (13.1)
No (2)	362 (91.2)	359 (90.4)	357 (89.9)	345 (86.9)

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TABLE 2 Repeated-measures ANOVA: the disparity among the four time-points on the mean scores of PSS, GAD-7, and PHQ-9 ($n = 397$).

	T1 (Mean ± SD)	T2 (Mean ± SD)	T3 (Mean ± SD)	T4 (Mean ± SD)	F	p	η^2
PSS	15.35 ± 7.14	11.27 ± 6.27	15.17 ± 7.46	14.41 ± 7.99	183.98	<0.001	0.317
GAD-7	7.42 ± 6.03	7.35 ± 5.88	5.00 ± 5.30	4.91 ± 4.81	242.00	<0.001	0.379
PHQ-9	6.62 ± 5.52	6.58 ± 5.65	6.46 ± 5.58	6.50 ± 5.77	1.256	0.284	0.003

demographic characteristics and the experiences related to the pandemic at different time points are shown in Table 1.

3.2. Results of the mean scores of the PSS, GAD-7, and PHQ-9 over time

The mean scores of the PSS, GAD-7, and PHQ-9 are shown in Table 2. Repeated measures ANOVA demonstrated that there were significant differences in the PSS and GAD-7 scores among the four time points [$F_{(1.96,777.64)} = 183.98$, $p < 0.001$; $F_{(1.49,590.26)} = 242.00$, $p < 0.001$]. There were no significant differences in the PHQ-9 scores among the four time points [$F_{(1.88,743.10)} = 1.256$, $p = 0.284$]. Through the pairwise comparisons, the order for PSS scores at different time points was: T1/T3 > T4 > T2. The order for GAD-7 scores was: T1/T2 > T3/T4. The concrete results of pairwise comparisons are listed in the footnote of Figure 3 to demonstrate which means of the variables differed from others at various time points.

Figure 3 illustrates the change trend in the mean scores of the PSS, GAD-7 and PHQ-9. The figure shows that the mean PSS score was the highest at T1, then declined sharply at T2, showed an obvious rebound at T3, and finally decreased slightly at T4. Regarding the mean GAD-7 score, from T1 to T2, the line remained flat, while it showed an apparent decline at T3 and remained flat at T4. For the mean PHQ-9 score, the line remained flat without significant change.

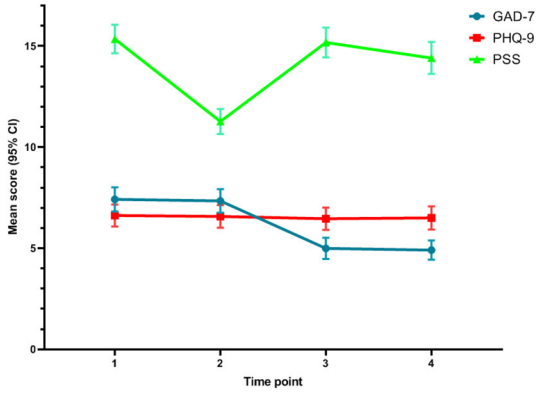

FIGURE 3
The disparity among the four time-points on the mean scores of PSS, GAD-7, and PHQ-9. The results of paired comparisons on PSS: The score at T1 was significantly higher than that at T2 ($P < 0.001$). The scores at T1 and T3 were not significantly different ($p = 0.243$). The mean score at T1 was significantly higher than that at T4 ($P < 0.001$). The score at T3 was significantly higher than that at T2 ($P < 0.001$). The score at T4 was significantly higher than that at T2 ($P < 0.001$). The score at T3 was significantly higher than that at T4 ($P < 0.001$). The results of paired comparisons on GAD-7: The scores at T1 and T2 were not significantly different ($p = 0.310$). The score at T1 was significantly higher than that at T3 ($P < 0.001$). The score at T1 was significantly higher than that at T4 ($P < 0.001$). The score at T2 was significantly higher than that at T3 ($P < 0.001$). The score at T2 was significantly higher than that at T4 ($P < 0.001$). The scores t T3 and T4 were not significantly different ($P = 1.000$). The results of paired comparisons on PHQ-9: There were no significant differences between any scores on any stage ($P > 0.05$).

3.3. The rates of different degrees of anxiety and depression over time

Table 3 shows the rates of different degrees of anxiety and depression among the four time points. The rates of no anxiety, mild anxiety, moderate anxiety, and severe anxiety among the four time points were all significantly different (no anxiety: 39.5% at baseline vs. 40.1% at month 1 vs. 60.7% at month 18 vs. 61.0% at month 26, $\chi^2 = 70.277$, df = 1, $p < 0.001$; mild anxiety: 26.3% at baseline vs. 26.7% at month 1 vs. 19.1% at month 18 vs. 19.1% at month 26, $\chi^2 = 12.065$, df = 1, $p = 0.007$; moderate anxiety: 20.7% at baseline vs. 20.2% at month 1 vs. 13.4% at month 18 vs. 14.4% at month 26, $\chi^2 = 12.173$, df = 1, $p = 0.007$; severe anxiety: 13.6% at baseline vs. 13.1% at month 1 vs. 6.8% at month 18 vs. 5.5% at month 26, $\chi^2 = 23.643$, df = 1, $p < 0.001$). However, the rates of different degrees of depression showed no significant difference among the four time points ($p > 0.05$). To understand the differences between any two rates, we also used paired comparisons, and the detailed comparison results are listed in the footnote of Figure 4.

3.4. Multiple linear regression analysis of influencing factors of the PSS, GAD-7, and PHQ-9 total scores at T4

To explore the long-term influencing factors on the mental health of the subjects, we only considered the PSS, GAD-7, and PHQ-9 scores at T4 as the dependent variables. The

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TABLE 3 Chi-squared test: the rates of different degrees of anxiety and depression symptoms among different time points.

	T1, % (*n*)	T2, % (*n*)	T3, % (*n*)	T4, % (*n*)	χ^2	*p*
GAD-7						
No anxiety	39.5 (157)	40.1(159)	60.7 (241)	61.0 (242)	70.277	<0.001
Mild anxiety	26.3 (104)	26.7 (106)	19.1(76)	19.1 (76)	12.065	0.007
Moderate anxiety	20.7 (82)	20.2 (80)	13.4 (53)	14.4 (57)	12.173	0.007
Severe anxiety	13.6 (54)	13.1 (52)	6.8 (27)	5.5 (22)	23.643	<0.001
PHQ-9						
No depression	46.9 (186)	45.1 (179)	46.1 (183)	45.6 (181)	0.271	0.965
Mild depression	27.5 (109)	28.7 (114)	28.0 (111)	28.0 (111)	0.159	0.984
Moderate depression	14.6 (58)	13.9 (55)	14.1 (56)	14.9 (59)	0.205	0.977
Moderately severe depression	8.8 (35)	9.3 (37)	9.1 (36)	8.3 (33)	0.272	0.965
Severe depression	2.3 (9)	3.0 (12)	2.8 (11)	3.3 (13)	0.800	0.849

reason we skipped the process of analyzing influencing factors at other time points is that previous studies have investigated these factors at similar times (19–21). To avoid repeated results, we only analyzed the longest time point as we have known to discover whether some new factors could be screened out. We also wanted to know whether previous pandemic-related experiences still have a significant impact on mental health after a long time. In the regression models, we selected demographic characteristics and pandemic experiences as the independent variables. Table 1 shows the assignments of these categorical variables entered into the models, in which numbers in the brackets after the variables' names represent the specific values.

Table 4 shows the results of the influencing factors of the PSS score. The results suggest that the main factors that influenced the subjects' feelings of stress were age, history of psychosis at T1/T4, self-perceived health condition, infection of family members by COVID-19 at T1/T4, and quarantine status at T1/T2/T3/T4 ($P < 0.05$). Table 5 shows the results of the influencing factors of the GAD-7 score. The main factors affecting the subjects' anxiety were infection of family members by COVID-19 at T1, quarantine status at T1, COVID-19 infection at T2, and history of psychosis at T4 ($P < 0.05$). Table 6 shows the results of the influencing factors of the PHQ-9. The main factors affecting the subjects' depression were age, self-perceived health condition, infection of family members by COVID-19 at T1/T3, quarantine status at T1/T3, history of psychosis at T4, and employment status at T4 ($P < 0.05$). The *F*-values (25, 371) in the regression equation were 12.461, 21.405, and 16.105 ($P < 0.001$) for PSS, GAD-7, and PHQ-9 scores, respectively, which demonstrates the statistical significance of the regression equations. The coefficients of determination (expressed as R^2) were 0.456, 0.591, and 0.520 for regression models of PSS, GAD-7, and PHQ-9 scores. The screened influencing factors can effectively explain 45.6, 59.1, and 52.0% of the variance in the feelings of stress, anxiety, and depression of the subjects, respectively.

4. Discussion

This study aimed to understand the change trend in mental health over time and the long-term influencing factors of the residents who experienced the initial outbreak of the COVID-19 pandemic. A total of 397 participants completed all follow-ups, and the results showed that mental health changes, including stress, anxiety, and depression, differed from each other and that the depression level showed minor changes during the pandemic. Simultaneously, the long-term predictors of stress, anxiety, and depression included various demographic characteristics and experiences related to the pandemic.

Notably, the mean PSS score decreased dramatically 1 month after the initial outbreak of COVID-19 compared with the score at T1, demonstrating that the residents living in Hubei gradually adapted to the stress caused by the pandemic in the short term. The findings are similar to those reported by Li et al., which revealed that the prevalence of probable acute stress decreased among college students in China when the pandemic was under control 6 weeks after the outbreak (19). Wang et al. found that there were no significant temporal changes in the levels of stress between the initial phase and 4 weeks later during the COVID-19 pandemic in China (17). The potential explanations for the varied results could be the differences in scales, measures, and the time when the surveys were conducted, either immediately after the outbreak or later during the pandemic (35). However, to our knowledge, this is the first study that analyzed the long-term stress of a distinct

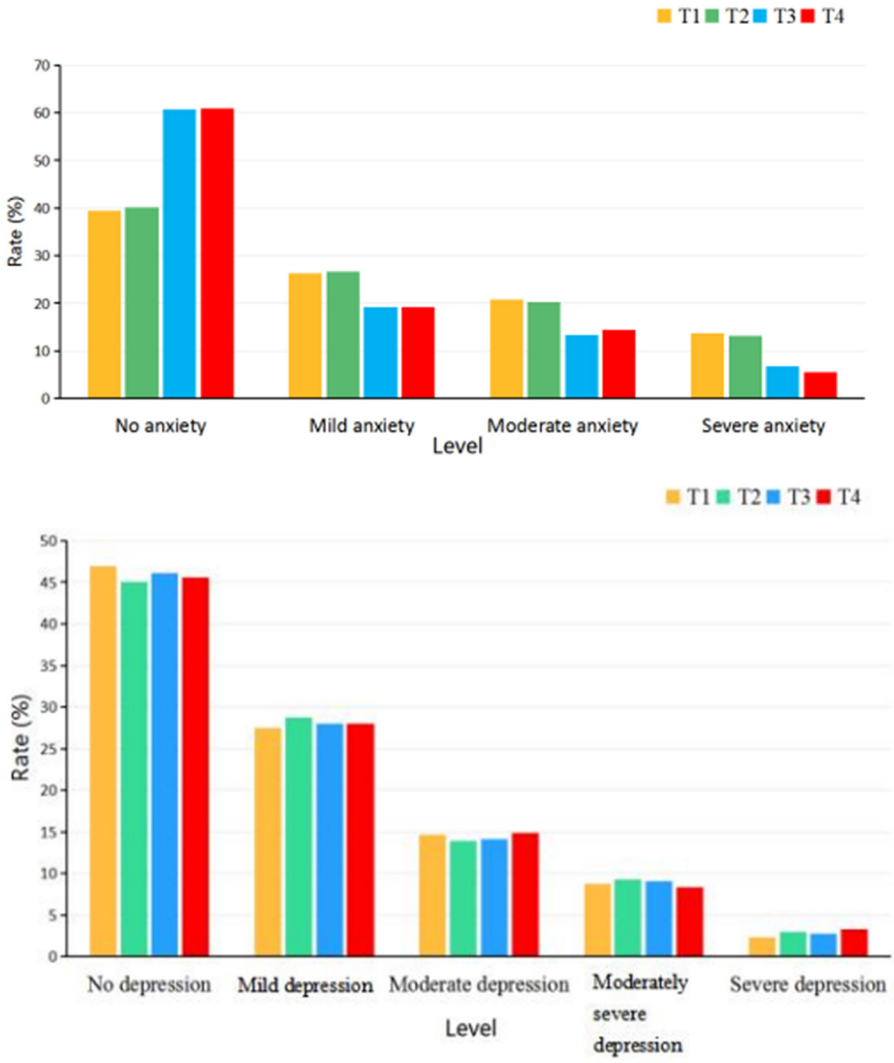

FIGURE 4
The rates of different degrees of anxiety and depression symptoms among different time points. The paired comparisons of the rates of no anxiety: T1 vs.T2 showed no significant difference (χ^2= 0.021, df = 1, p = 0.942); T3 vs.T4 showed no significant difference (χ^2= 0.005, df = 1, p = 1.000); T3 is higher than T1 and T2 significantly (χ^2= 37.547; 33.876, df = 1, $p < 0.0125$); T4 is higher than T1 and T2 significantly (χ^2= 36.399; 34.709, df = 1, p <0.0125). The paired comparisons of the rates of mild anxiety: T1 vs.T2 showed no significant difference (χ^2= 0.026, df = 1, p = 0.936); T3/T4 showed no significant difference compared with T1 and T2 (χ^2= 5.632; 6.416, df = 1, p = 0.022; 0.014). The paired comparisons of the rates of moderate anxiety: T1 vs.T2 showed no significant difference (χ^2= 0.031, df = 1, p = 0.930); T3 vs.T4 showed no significant difference (χ^2= 0.169, df = 1, p = 0.758); T3 is lower than T1 significantly (χ^2= 7.506, df = 1, p = 0.008); T3 vs.T2 showed no significant difference (χ^2= 6.584, df = 1, p = 0.013); T4 showed no significant difference compared with T1 and T2 (χ^2= 4.666; 5.651, df = 1, p = 0.039; 0.025). The paired comparisons of the rates of severe anxiety: T1 vs.T2 showed no significant difference (χ^2= 0.044, df = 1, p = 0.917); T3 vs.T4 showed no significant difference (χ^2= 0.544, df = 1, p = 0.556); T3 is lower than T1 and T2 significantly (χ^2= 10.022; 8.786, df = 1, p = 0.002; 0.004); T4 is lower than T1 and T2 significantly (χ^2= 14.900; 13.412, df = 1, $p < 0.0125$).

group during the pandemic. We found that 1.5 years later, a new outbreak could still induce an acute feeling of stress, with the PSS score at T3 showing no significant difference compared with the score at T1, even though the pandemic mainly affected other provinces. When the outbreak with the highest number of infected individuals occurred 26 months later in another province, it still provoked a stress reaction, which could be verified by the rebound of the PSS score at T4, and the reaction was relatively smaller than that at T3. The reason for this might be that repeated outbreaks of the pandemic have made people languid. Although the large infection numbers could still trigger their stress reaction, their energy was exhausted to some extent. However, the results remind us that the impact of the pandemic on people's stress cannot be ignored, especially among those who experienced the initial outbreak. The repeated outbreaks in other areas

TABLE 4 Multiple linear regression analysis of influencing factors of PSS.

Variable	Regression coefficients	Standard error of regression coefficient	Standardized regression coefficient	*t*	*p*	95% CI
Constant	100.411	24.359		4.122	<0.001	(52.511, 148.311)
Age	−0.088	0.039	−0.125	−2.273	0.024	(−0.164, −0.012)
History of psychosis at T1	−10.947	2.929	−0.153	−3.737	<0.001	(−16.707, −5.186)
History of psychosis at T4	−5.686	2.426	−0.100	−2.343	0.020	(−10.456, −0.915)
Self-perceived health conditions	2.314	0.469	0.201	4.936	<0.001	(1.392, 3.235)
COVID-19 infection-family member at T1	−5.634	1.135	−0.200	−4.963	<0.001	(−7.867, −3.402)
COVID-19 infection-family member at T4	−6.641	1.800	−0.142	−3.690	<0.001	(−10.180, −3.102)
Isolation or not at T1	−5.217	0.737	−0.309	−7.080	<0.001	(−6.666, −3.768)
Isolation or not at T2	−8.060	3.595	−0.101	−2.242	0.026	(−15.128, −0.992)
Isolation or not at T3	−5.984	1.438	−0.185	−4.160	<0.001	(−8.813, −3.156)
Isolation or not at T4	−5.049	1.330	−0.154	−3.796	<0.001	(−7.664, −2.434)

$F_{(25,371)} = 12.461$ ($p < 0.001$), $R = 0.676$, $R^2 = 0.456$.

TABLE 5 Multiple linear regression analysis of influencing factors of GAD-7.

Variable	Regression coefficients	Standard error of regression coefficient	Standardized regression coefficient	*t*	*p*	95% CI
Constant	67.790	12.734		5.324	<0.001	(42.751, 92.830)
COVID-19 infection-family member at T1	−5.052	0.594	−0.298	−8.513	<0.001	(−6.219, −3.885)
Isolation or not at T1	−5.611	0.385	−0.551	−14.567	<0.001	(−6.368, −4.853)
COVID-19 infection-self at T2	−4.943	2.388	−0.073	−2.070	0.039	(−9.640, −0.247)
History of psychosis at T4	−5.419	1.268	−0.158	−4.273	<0.001	(−7.913, −2.925)

$F_{(25,371)} = 21.405$ ($p < 0.001$), $R = 0.768$, $R^2 = 0.591$.

served as triggers, which could be explained by the flashback symptoms and the cues associated with their experience in the first outbreak, which may function as warning signals to avoid future danger (36).

We also discovered that the mean score of anxiety at baseline was similar to that 1 month later. However, anxiety at T3 showed obvious differences, manifested by a significant decrease 18 months after the outbreak, and it remained at a low level 26 months after the initial outbreak. The same trajectory could also be found in the corresponding rates of various levels of anxiety. Similar to other longitudinal studies over a short period, Wang et al. reported no significant longitudinal changes in anxiety levels 4 weeks after the outbreak among the general population in China (17), and Hyland et al. also found no significant changes in the prevalence of anxiety during the 6-week lockdown caused by COVID-19 in the Republic of Ireland (37). However, different from others' results that disclosed common anxiety remaining among different types of populations due to the long-term impact of COVID-19 (38, 39), we found that anxiety showed an obvious decrease in the long term. One reason might be the special sample in our study and the

TABLE 6 Multiple linear regression analysis of influencing factors of PHQ-9.

Variable	Regression coefficients	Standard error of regression coefficient	Standardized regression coefficient	*t*	*p*	95% CI
Constant	62.342	16.510		3.776	<0.001	(29.876, 94.807)
Age	−0.064	0.026	−0.126	−2.443	0.015	(−0.116, −0.012)
Self-perceived health conditions	0.972	0.318	0.117	3.061	0.002	(0.348, 1.597)
COVID-19 infection-family member at T1	−4.840	0.770	−0.238	−6.290	<0.001	(−6.354, −3.327)
COVID-19 infection-family member at T3	−7.296	3.359	−0.090	−2.172	0.030	(−13.901, −0.691)
Isolation or not at T1	−4.869	0.499	−0.399	−9.750	<0.001	(−5.851, −3.887)
Isolation or not at T3	−2.209	0.975	−0.095	−2.266	0.024	(−4.127, −0.292)
History of psychosis at T4	−7.456	1.644	−0.182	−4.534	<0.001	(−10.690,−4.222)
Employment status at T4	2.924	0.999	0.173	2.928	0.004	(0.960, 4.888)

$F_{(25,371)} = 16.105$ ($p < 0.001$), $R = 0.721$, $R^2 = 0.520$.

special control policy in China. Another probable explanation might be that the repeated outbreak of COVID-19 has exhausted the worries of local residents, and their symptoms have gradually changed into depression. The unique finding could also be echoed by the change trend of depression described below.

Regarding the change trend of depression, we found that in both the short term and the long term, the depression level did not change significantly. Although some studies also revealed a relatively stable level of depression (17, 37) in a short time after the outbreak of COVID-19, Yuan et al. discovered a significant improvement in the prevalence of depression 3 months after the outbreak in China (40). Other studies conducted in northern Spain or Southeast Asia demonstrated that the depressive symptoms persisted after 1.5 years of COVID-19 (41, 42). However, our findings make up the margin of longer-term follow-up after the outbreak of COVID-19, and indicate that the symptoms of depression among the residents who experienced the initial pandemic were difficult to eliminate with the background of repeated outbreaks in contrast to the trend of anxiety. A meta-analysis by Robinson et al. also showed that the reduction in depression over time during the COVID-19 pandemic was less pronounced than the reduction in anxiety (43). The trend of depression over time conforms to the finding of Du et al., who demonstrated that when people experience stress, anxious emotions occur first, and with the continuation of stress, this emotion gradually evolves into depressive symptoms (44). These results suggest that we should pay attention to the long-term mental health of residents experiencing catastrophic emergencies because a post-disaster psychological crisis can persist for a long time, and the onset can be delayed (45, 46). Although the "Dynamic zero-COVID" policy in China could control the spread of the virus to the maximum extent, the impact of the large-scale shutdown inevitably increased the burden on the economy, which induced negative emotions in the residents (47). Considering these results, we recommend that policymakers adjust policies appropriately in the future to minimize the negative impact of pandemic precautions.

Regarding the long-term influencing factors of stress, anxiety, and depression, we found that all these forms of psychological distress were associated with the subjects' quarantine status and whether their family members were infected during the initial outbreak. Many studies also reported that people who had been quarantined due to the pandemic showed poor mental health status (25, 48, 49). Additionally, we found that each isolation experience at a different time point could increase the long-term risk of stress, indicating that quarantine status is a great predictor of mental pressure, and the isolation experience at T3 could also predict depression. Due to the social attributes of human beings, all humans are at risk of psychological harm when in isolation (50). After people experienced the first isolation, which produces a negative psychological state, repeated isolation undoubtedly triggers subsequent negative emotions, including loneliness and sadness (51). Regarding the infection of family members, similar to the findings reported by Chen et al., people who worried about their family members being infected with COVID-19

had a higher prevalence of anxiety (52). Strong family and social support reduces anxiety and depression (53). When family members were infected, they faced separation from their support system, which had an adverse impact on their mental health, and family members' infection at T3 also increased individuals' depressive symptoms.

We also found that the subjects with a history of psychosis at T1 might experience more symptoms of stress, and those with a history of psychosis at T4 showed more symptoms not only of stress but also of anxiety and depression. Luo et al. also found that a history of mental illness was a risk factor for acute stress responses (54), and the outbreak of this pandemic was undoubtedly a crisis for those with a history of mental illness, which could affect their access to medical treatment and worsen their mental symptoms (5). Many of these individuals developed psychosis 1.5 years after the initial outbreak. The newly developed illness undoubtedly added to an individual's worried state of mind, which was exacerbated when outbreaks recurred. It is likely that this population was more vulnerable than the general population when facing these disease-related stressors (55). This fact reminds us that we must conduct crisis intervention services as early as possible and provide alternative medical treatment programs for this group to avoid mental health issues and increased social burden (56). During public health crises that require isolation and quarantine, such as COVID-19, psychological interventions such as cognitive behavioral therapy delivered *via* the internet could play a key role in treating these special groups (57).

Our results revealed that the poorer the condition individuals perceived themselves to be in and the younger their age was, the greater their probability of feeling stressed and depressed. The results were similar to those of Chen et al., who also reported that self-perceived health status tended to be positively associated with changes in stress and depression scores from 1 week to 1 month after the COVID-19 outbreak (58). One reasonable explanation is that the participants were not optimistic about their health, and they were more worried that their bodies could not resist the virus, which could make them more sensitive to the threat than ordinary people. As Wang et al. found, being satisfied with one's own health could be a protective factor for people's mental health during the pandemic (17). Among all the demographic factors, we found that gender, marriage, and education did not play a significant role in predicting the mental health of these subjects after a long time post-pandemic, which indirectly indicates the importance of pandemic-related experience factors. However, we found that the demographic factor of age is special, consistent with other longitudinal studies, indicating that depression was more common in younger populations (37, 51, 59). Considering the special condition of China, we believe that the reason for younger age triggering more stress might be that the older subjects in our study might have experienced the SARS pandemic, which occurred in 2003, while the younger subjects might not have. Thus, the sudden onset of the pandemic became a strong stressor for them.

Other single factors for the risk of anxiety and depression included being infected at T2 and being unemployed at T4. Xiao et al. also reported that COVID-19 infection might have long-term impacts on local residents' mental health (60). When people escaped successfully from the initial infection and were infected 1 month later, they inevitably enperienced a lingering fear, which might contribute to the relatively high scores on the anxiety scales. Many studies have indicated that the loss of important resources, such as employment and income, might cause chronic mental health problems (61–63); thus, unemployment status could be a long-term predictor of depression.

4.1. Limitations

(1) The online survey method we used might lead to non-response bias or reporting/selection bias, which could be reflected by the phenomenon that females predominated in this survey, and not all independent variables such as the gender were found to contribute to the depression model; (2) The method of Bonferroni correction used in this study might be too conservative, and it is prone to have type II errors; (3) The use of self-reported rating scales limits the diagnosis of anxiety and depression, and the scores of the scales could only suggest probable anxiety and depression. If a diagnostic interview was used, some subjects would not have met the criteria for diagnosis. However, these scales have proven to have good sensitivity and specificity, and they have been effectively used in clinical studies. Because of the voluntary nature of participation, only one-quarter of the participants in the first survey agreed to take part in the follow-up surveys, resulting in a small sample size, which might prevent the conclusions from being generalized to the larger population.

4.2. Conclusions

This long-term longitudinal survey revealed that the symptoms of stress among residents who experienced the initial outbreak of COVID-19 decreased in the short term, while the symptoms of anxiety and depression did not change significantly. In the long term, repeated outbreaks in other areas also impacted this distinct group, with a return of stress, a decline in anxiety, and no change in depression. The long-term influencing factors differ for stress, anxiety, and depression, but all three are influenced by a history of psychosis at T4, quarantine status and whether their family members were infected during the initial phase of 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 Ethics Committee of the Fourth People's Hospital of Chengdu. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

ND: conception, design, and drafting of the manuscript. ND, YX, YJOY, YGL, TG, CYL, CY, YLH, FYL, LZ, MZ, LSL, and JH: conduction. ND, YGL, and TG: statistical analysis. YGL and CYL: administrative, technical, or material support. YX: critical revision of the manuscript for important intellectual content. All authors read and approved the final paper.

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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Supplementary material

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A study on differences about the influencing factors of depressive symptoms between medical staff and residents during 2022 city-wide temporary static management period to fighting against COVID-19 pandemic in Shanghai

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Objectives: Our study aimed to identify the latent class of depressive symptoms in the Shanghai population during the city-wide temporary static management period and compare differences in the factors influencing depressive symptoms between medical staff and residents.

Methods: An online cross-sectional survey was conducted with 840 participants using questionnaires, including Patient Health Questionnaire-9 (PHQ-9), Generalized Anxiety Disorder-7 (GAD-7), Pittsburgh Sleep Quality Index (PSQI), and self-compiled questionnaire (demographic characteristics and internet usage time). Latent class analysis (LCA) was performed based on participants' depressive symptoms. The latent class subgroups were compared using the chi-square test and *t*-test. Logistic regression was used in our study to analyze the factors influencing depressive symptoms within the medical staff group and residents group and then compare their differences.

Results: Two distinct subgroups were identified based on the LCA: the group with low-depressive symptoms and the group with high-depressive symptoms. There were significant differences between the two groups ($P < 0.05$) on age, education level, marital status, internet usage time, identity characteristics (medical staff or residents), family income level, living style, overall quality of sleep, and anxiety levels. Furthermore, logistic regression analysis results showed that compared with the residents group, the participants in the group of medical staff with "increasing internet usage time" and the

"daytime dysfunction" would have nearly two times the possibility of getting serious depressive symptoms.

Conclusions: There are differences in the factors influencing depression symptoms between medical staff and residents during the 2022 city-wide temporary static management period to fighting against the COVID-19 pandemic in Shanghai. We should pay special attention to those with increasing internet usage time and daytime dysfunction in medical staff working in a special environment such as the COVID-19 pandemic.

KEYWORDS

COVID-19, depressive symptoms, latent class analysis, medical staff, residents

Introduction

The World Health Organization (WHO) declared a global pandemic of the Coronavirus Disease 2019 (COVID-19) on March 11, 2020 (1). A lockdown policy is one of the most important non-pharmaceutical interventions (NPI) measures to control the spread of COVID-19 (2). As one of the biggest cities in China, Shanghai announced a city-wide temporary static management (all citizens must be stationary in their location, limitation of movement) in March 2022. Temporary static management for more than 2 months reduced unnecessary face-to-face social contact, finally becoming the most powerful intervention to control the pandemic by limiting the spread of infectious sources. However, a sudden cessation of interpersonal communication has changed common daily lifestyles, and people under static management had to adapt to sudden social isolation. Previous reports showed that changes in daily lifestyle brought about by COVID-19 led to a higher tendency of severe emotional distress and depression. These psychological consequences not only exist for a short time during the pandemic period but may also extend for several months after the infection.

There are many scales and questionnaires for assessing the psychological state including the assessment of the anxiety and depression level of the affected people suffered these disastrous events. The Patient Health Questionnaire-9 (PHQ-9) is a widely used screening tool for depression episodes. The cut-off point for PHQ-9 is 10 points which could identify high-risk individuals for depression episodes (3). Yet trajectories of depressive episodes are complicated and might originate from the interaction of internal and external factors, including genetic, psychological, and environmental risk factors (4). Early screening of depressive symptoms by cut-off value may decrease the sensitivity of the screening test. Consequently, a subgroup of individuals with suspected depressive symptoms (below the cut-off value) would have been ignored, especially under city-wide static management. Latent class analysis (LCA) is a robust probabilistic approach which bases on the characteristics of the data. LCA can provide a more sensitive and effective classification to identify the subpopulation of individuals with a potential for depression episodes whose PHQ-9 scores are under 10 points cut-off (5).

Under the circumstance of this sudden static management, many complicated risk factors affected the occurrence and development of depression. A depression and anxiety online survey in America during the COVID-19 pandemic showed that males were 1.42 times more likely to suffer from depression than females. In addition, Hispanics (2.52 times higher), medical staff (2.40 times higher), those surrounded with their children at home (1.42 times higher), and those with income <US $60,000 (1.43 times higher) had higher odds of depression (6). Furthermore, an extended number of days in quarantine and lack of physical exercise were associated with increased depression (7). Recent studies found that loneliness strongly predicted depressive symptoms during COVID-19-related static management (8). However, the background of these previous studies was not based on thorough city-wide static management.

Noteworthily, unlike residents stuck at home to fight against COVID-19 pandemic, frontline medical staff had to isolate themselves from their families, experience physical exhaustion, loneliness, and panic of uncertainty for nearly 2 months. They have high workloads and long working hours, high risk of infection (9), social stigmatization, concern about spreading the virus to their families (10, 11) and lack of more social contact (12). The COVID-19 pandemic has had a significant psychological impact on health professionals (13, 14), so the factors influencing depressive symptoms in medical staff may differ from those for residents. Our study was designed to identify the latent class of depression symptoms in Shanghai population during the city-wide temporary static management, and investigate and compare the difference in the factors influencing depressive symptoms between front-line medical staff and the residents.

Materials and methods

Participants

This was a web-based survey study and implemented across Shanghai from April 4 to June 3, 2022.

This study used a snowball non-probability/convenience sampling method. Although random sampling was used in the initial selection of survey subjects, the final samples were all non-probability samples, so non-probability sampling was adopted. The questionnaires were sent to the participants via a survey APP (a questionnaire application called "wenjuanxing"). The response of the participants in questionnaires was automatically saved in APP. This study was approved by the ethics committee of the Children's Hospital of Fudan University, Shanghai and was complied with the Declaration of Helsinki.

In 2 months, a total of 840 responses were received. Participation in the survey was voluntary, and confidentiality of the responses was ensured.

Measures

The survey consists of four parts: depressive symptoms, anxiety, sleep quality, and a self-compiled questionnaire (demographic characteristics and whether participants have noticed an increase in internet usage time). We assessed anxiety, sleep quality, and depressive symptoms for all participants using the Chinese versions of PHQ-9, Generalized Anxiety Disorder-7 (GAD-7), and Pittsburgh Sleep Quality Index (PSQI), which have good validity and reliability as stated below.

PHQ-9 is widely used to screen for depressive symptoms and assess the severity of depressive symptoms in the population. It contains nine items, each based on the duration of depressive symptoms over a 2-week period. Each item is scored as follows: 0 = not at all; 1 = several days; 2 = more than half of all the days; 3 = nearly every day; The scores of the nine items are added, and higher total scores indicate more severe depression symptoms. The Cronbach's alpha for this questionnaire was 0.80 (3).

GAD-7 mainly assesses the severity of anxiety symptoms in the past 2 weeks, including seven items covering the main feelings and physical discomforts of anxiety symptoms. According to the duration of anxiety symptoms, GAD-7 is divided into 0–3 grades: 0, Not at all; 1, Some days; 2, More than half the days; and 3, Nearly every day for scoring. The total score is the sum of seven items. The higher the total score, the more severe the anxiety symptoms (15). The Cronbach's alpha for this questionnaire was 0.92 (16).

PSQI has been widely used in the survey of sleep quality in various populations. PSQI contains 19 self-reported items that constitute seven aspects of sleep problems, including sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, subjective sleep quality, hypnotic drugs, and daytime function, and each dimension is scored 0–3 points. The sum of the seven component scores is the global score of PSQI (0–21 points). Higher total PSQI scores indicate worse sleep quality. The Cronbach's alpha for this questionnaire was 0.75 (17).

Statistical analysis

Data analysis was performed with R version 4.1.3. The method of multiple imputations was employed on variables with no more than 20% missing value, and the predictive mean matching (PMM) method was adopted using the "mice" package (18).

The normality of the data was analyzed using the Kolmogorov–Smirnov test and Q-Q plots. Normally distributed variables were expressed as the mean (standard deviation [SD]), while non-normally distributed variables were expressed as the median (interquartile range [IQR]). Categorical variables were expressed as frequencies (n) and percentages (%).

The "poLCA" package (19) in R was used for latent class analysis. The PHQ9 items were recoded into binary variables for the LCA. Items with a score of 1 were denoted as 0, and a score of 2 or more as 1. An exploratory approach was adopted starting from a two-class model, and the analysis was performed by increasing the number of classes. Model fit indices (the Akaike information criterion (AIC), Bayesian information criterion (BIC), and Maximum Log-likelihood) were used to evaluate the best model. A low value for AIC and BIC or a high value for Maximum Log-likelihood indicated a better model (20). In addition, the entropy (21), which indicates the degree of accuracy of the model that defines the classes, was employed to select the most optimal model. In this study, the posterior probability was used as the index of certainty classification. The posterior probability represents the probability that a person will be assigned to the high or low depressive symptom group based on the severity of their depressive symptoms. The value of the best-fit class is close to 1, meanwhile the value of the other classes is close to 0, indicating a higher certainty of classification. When the posterior probability of the model is <90%, we ceased adding a class to fit the model (22).

To describe the characteristics of different latent classes, the *t*-test was used for normally distributed continuous variables, the Wilcoxon test was used for non-normally distributed continuous variables, and the chi-square test was used for categorical variables. We used boxplots to show differences in total PSQI score and total GAD-7 score among latent classes.

With the latent category groupings as the dependent variable, and multiple factors influencing depressive symptoms as independent variables, univariate logistic regression analyses were conducted separately in the medical staff group and residents group to examine variables associated with depressive symptoms.

Results

Characteristics of the participants

A sum of 840 participants were investigated, including 120 medical staff and 720 residents. Table 1 presents the baseline characteristics of the whole participants and participants with different identities, including medical staff or residents. The median age of all the participants was 40.0 years (SD = 12.14), and 302 (36.0%) were males.

A total of 578 participants (68.8%) had a bachelor's degree or higher, 591 (70.4%) were currently married, 575 (68.5%) had lower-middle monthly incomes (<10,000 RMB, Chinese Yuan), 634 (75.5%) were living with family, and 266 (31.7%) reported increasing internet usage time. The median total PSQI and PHQ-9 scores were 5 and 4.5, respectively. There were differences in age, education level, marital status, living style, total GAD-7 score, and total PHQ-9 score between medical staff group and residents group ($P < 0.05$).

Model fit indices of LCA

Model fit indices for models with different latent classes are listed in Table 2. LCA with 1–8 classes was applied. The results indicated that the AIC and BIC decreased as the classification number increased, the Maximum Log-likelihood increased with an increasing classification number, and the two-class model had the highest entropy value (0.88). Additionally, the posterior probability of each class

TABLE 1 Characteristics of participants.

Variables	All participants ($N = 840$)	Medical staff ($N = 120$)	Residents ($N = 720$)	*P*-value
Age	40.00 ± 12.14	32.77 ± 7.76	41.14 ± 12.32	<0.001**
Gender				0.076
Male	302 (36.0)	34 (28.3)	268 (37.2)	
Female	538 (64.0)	86 (71.7)	452 (62.8)	
Education (with bachelor's degree or higher)				<0.001**
Yes	578 (68.8)	118 (98.3)	460 (63.9)	
No	262 (31.2)	2 (0.7)	260 (36.1)	
Married				0.001*
Yes	591 (70.4)	68 (56.7)	523 (72.6)	
No	249 (29.6)	52 (43.3)	197 (27.4)	
Increasing internet usage time				0.458
Yes	266 (31.7)	42 (35.0)	224 (31.1)	
No	574 (68.7)	78 (65.0)	496 (68.9)	
Monthly income				0.069
Low-income (<10,000 RMB)	575 (68.5)	76 (63.3)	499 (69.3)	
Middle-income (10,000–30,000 RMB)	231 (27.5)	42 (35.0)	189 (26.2)	
High-income (>30,000 RMB)	34 (4.0)	2 (1.7)	32 (4.4)	
Living Style				<0.001**
Alone	131 (15.6)	34 (28.3)	97 (13.5)	
With family	634 (75.5)	57 (47.5)	577 (80.1)	
In the company	75 (8.9)	29 (24.2)	46 (6.4)	
Total score of GAD-7	3.00 [0.00, 6.00]	4.00 [0.75, 6.00]	2.00 [0.00, 6.00]	0.033*
Total score of PSQI	5.00 [3.00, 8.00]	6.00 [3.75, 8.00]	5.00 [3.00, 8.00]	0.223
Total score of PHQ-9	4.50 [1.00, 8.00]	6.00 [2.00, 9.00]	4.00 [1.00, 8.00]	0.005*

*p<0.05; **p<0.001.
GAD-7, Generalized Anxiety Disorder-7; PSQI, Pittsburgh Sleep Quality Index; PHQ-9, The Patient Health Questionnaire-9; RMB, Chinese Yuan.

TABLE 2 Fit statistics for latent class models from two to eight classes.

Model	Maximum Log-likelihood	AIC	BIC	Entropy
1-class	−4,742	9,502	9,545	NA
2-class	−3,643	7,325	7,415	0.88
3-class	−3,472	7,003	7,140	0.81
4-class	−3,439	6,956	7,141	0.76
5-class	−3,431	6,960	7,192	NA
6-class	−3,421	6,960	7,239	NA
7-class	−3,414	6,966	7,293	NA
8-class	−3,402	6,962	7,336	NA

AIC, Akaike information criterion; BIC, Bayesian information criterion.

was >90% only in the two-class model. Other models had posterior probabilities <90%. Therefore, we selected the two-class model to maximize the accuracy of the latent class.

Definition of LCA

As shown in Figure 1, the response probabilities of participants in class 1 were low, indicating that they had better mental health status in the static management and had a potential to effectively regulate their inner mental health, so they were labeled as the low depressive symptoms group.

In contrast, the response probabilities of those in class 2 were high, indicating that these participants had poorer mental health status during the static management and could not effectively regulate and control emotions, so they were labeled as the high depressive symptoms group.

Comparison of characteristics of the participants between high and low depressive symptoms groups

As shown in Table 3, age, education level, marital status, internet usage time (whether increased), identity characteristics (medical staff or residents), family income level, and living style were significantly different in the low depressive symptoms group and high depressive symptoms group ($P < 0.05$). In addition, the total GAD-7 and PSQI scores were significantly different between the two groups (Figure 2). Furthermore, the score of each subscale of PSQI was also significantly different between the two groups (Table 4).

Logistic regression analysis of latent classes of depressive symptoms in the medical staff group and residents group

Table 5 shows the results of the logistic regression analyses used to calculate odds ratios for variables associated with depressive symptoms in medical staff group and residents group. The category classification was adopted as the dependent variable, and the low depressive symptoms group was used as the reference group.

The results showed that compared with the low symptoms group, the medical staff in the high depressive symptoms group were more likely to have increasing internet usage time (OR = 3.86, 95%CI: 1.60-10.45, P=0.004), worse subjective sleep quality (OR = 5.57, 95%CI: 2.66–11.66, $P < 0.001$); longer sleep latency (OR = 2.04, 95%CI: 1.25–3.32, $P < 0.001$), shorter sleep duration (OR = 1.97, 95%CI: 1.18–3.30, $P = 0.010$), less habitual sleep efficiency (OR = 2.54, 95%CI: 1.53–4.20, $P = 0.032$), more serious sleep disturbance (OR = 8.88, 95%CI: 3.17–24.86, $P < 0.001$), more severe daytime dysfunction (OR = 6.22, 95%CI: 3.20–12.09, $P < 0.001$), and higher GAD7 score (OR = 2.41, 95%CI: 1.80–3.24, $P < 0.001$).

Residents in high depressive symptoms group were more likely to have good education level (OR = 2.11, 95%CI: 1.55–2.88, $P < 0.001$), increasing internet usage time (OR = 1.97, 95%CI: 1.43–2.74, $P < 0.001$), middle income level (OR = 1.55, 95%CI: 1.10–2.18, $P = 0.012$), worse subjective sleep quality (OR = 5.47, 95%CI: 4.11–7.27, $P < 0.001$), longer sleep latency (OR = 2.03, 95%CI: 1.69–2.44, $P < 0.001$), shorter sleep duration (OR = 1.30, 95%CI: 1.11–1.52, $P = 0.001$), less habitual sleep efficiency (OR = 1.20, 95%CI: 1.02–1.40, $P = 0.028$), more serious sleep disturbance (OR = 8.17, 95%CI: 5.41–12.34, $P < 0.001$), more use of sleeping medication (OR = 2.22, 95%CI: 1.37–3.62, $P < 0.001$), more severe daytime dysfunction (OR = 3.95, 95%CI: 3.19–4.89, $P < 0.001$), and higher GAD7 score (OR = 2.03, 95%CI: 1.84–2.23, $P < 0.001$). In contrast, age (OR = 0.95, 95%CI: 0.94–0.97, $P < 0.001$) and marital status (OR = 0.69, 95%CI: 0.50–0.96, $P = 0.031$) were protective factors for depressive symptoms.

We noticed that, compared with the residents group, the participants in the group of medical staff with "increasing internet usage time" and the "daytime dysfunction" would have nearly two times the possibility of getting serious depressive symptoms. After adjusting the age, gender, education, marriage, monthly income, lifestyle and total score of GAD-7, the participants in the group of medical staff with "increasing internet usage time" and the "daytime dysfunction" would also have nearly two times the possibility of getting serious depressive symptoms (increasing internet usage time: OR = 3.84, 95%CI: 1.58–10.42, $P < 0.001$ VS OR = 1.72, 95%CI: 1.23–2.42, $P < 0.001$; daytime dysfunction: OR = 7.09, 95%CI: 3.72-15.91, $P < 0.001$ VS OR = 3.91, 95%CI: 3.16-4.91, $P < 0.001$).

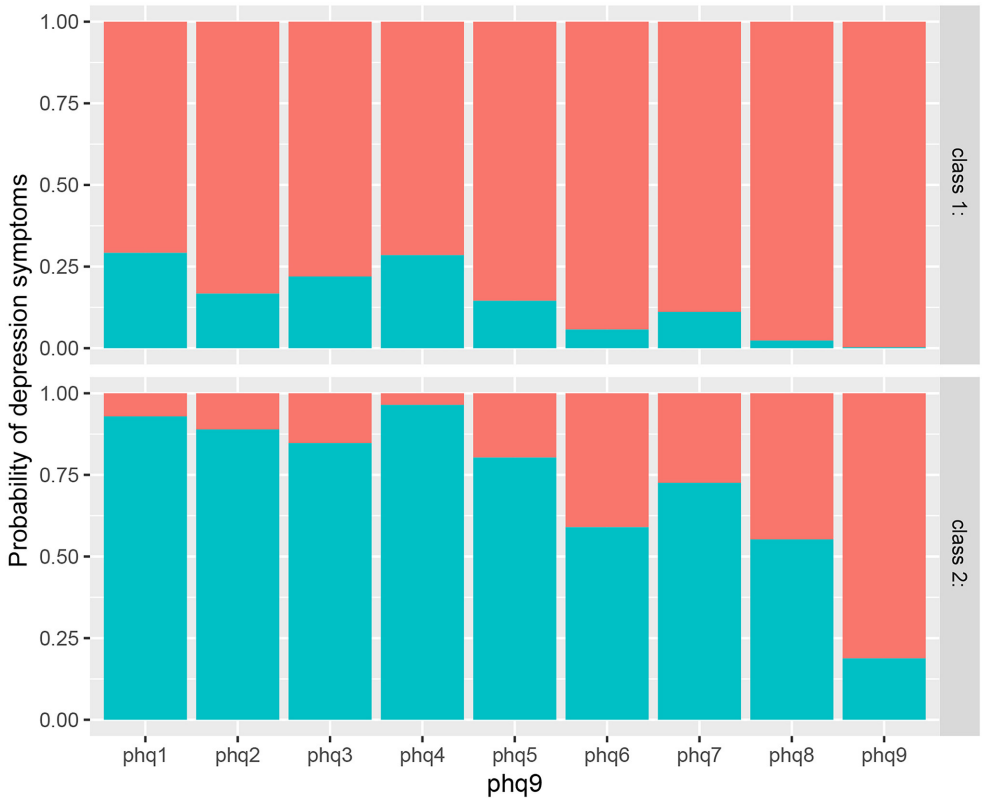

FIGURE 1
Response probability values of latent classes of depressive symptoms in participants.

Discussion

Understanding the factors influencing depressive symptoms during the city-wide static management period to fight against the COVID-19 pandemic is important for early identification and intervention. As far as we know, this study is the first attempt to investigate the difference in influencing factors of depressive symptoms between medical staff and residents during the 2022 COVID-19 pandemic in Shanghai. A number of studies have shown that COVID-19 pandemic was likely to trigger and aggravate mental health problems, including depressive symptoms (7, 23, 24). We found that during the city-wide static management period for COVID-19, medical staff had higher depressive symptoms than residents.

We used LCA to identify two meaningful classes: the high depression symptoms group (463/840, 55.1%) and low depression symptoms group (377/840, 44.9%). The number of people in the two groups was roughly the same, indicating great differences in the psychological adjustment and adaptability of participants during the pandemic. LCA is a flexible statistical method that aims to detect heterogeneity by analyzing individual behavior patterns and finding common types within the population (25). AIC BIC, Maximum Log-likelihood, entropy, and posterior probability are the most commonly used evaluation indexes in selecting the optimal latent class model. Most previous studies applied no more than three of the five common evaluation indexes (26–28). We selected the optimal model using all five evaluation indexes for a more reliable and comprehensive evaluation.

The analysis of characteristics of low and high depressive symptom groups showed that younger adults, people with higher education levels, married participants, increasing internet usage time, medical staff, and those living away from family were prone to experience more severe depressive symptoms. Previous evidence showed similar results that younger people, women, individuals with lower educational and socioeconomic backgrounds, and individuals living alone were more likely to suffer more severe depression symptoms (29). Our results are partially the same as their study. However, we observed an opposite effect of the level of education compared to previous evidence. In a normal social environment, compared with the participants with higher levels of education, those with lower levels of education have the potential to undergo more challenges and stress (such as job loss, loan foreclosures, and

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TABLE 3 Comparison of demographic characteristics between two latent groups.

Variables	Low depressive symptoms group ($N = 377$)	High depressive symptoms group ($N = 463$)	*P*-value
Age	43.47 ± 13.11	37.08 ± 10.45	<0.001**
Gender (male/female)	137/240	165/298	0.890
Education (with bachelor's degree or higher) (yes/no)	224/153	354/109	<0.001**
Married (yes/no)	280/97	311/152	0.030*
Increasing internet usage time (yes/no)	86/291	180/283	<0.001**
Identity characteristics			0.014*
Medical staff	41 (10.9)	79(17.1)	
Residents	336 (89.1)	384(82.9)	
Monthly income			0.081
Low-income (<10,000 RMB)	273 (72.4)	302 (65.2)	
Middle-income (10,000–30,000 RMB)	90 (23.9)	141 (30.5)	
High-income (>30,000 RMB)	14 (3.7)	20 (4.3)	
Living style			0.002*
Alone	52 (13.8)	79 (17.1)	
With family	304 (80.6)	330 (71.3)	
In the company	21 (5.6)	54 (11.7)	

*p < 0.05; **p < 0.001.
RMB, Chinese Yuan.

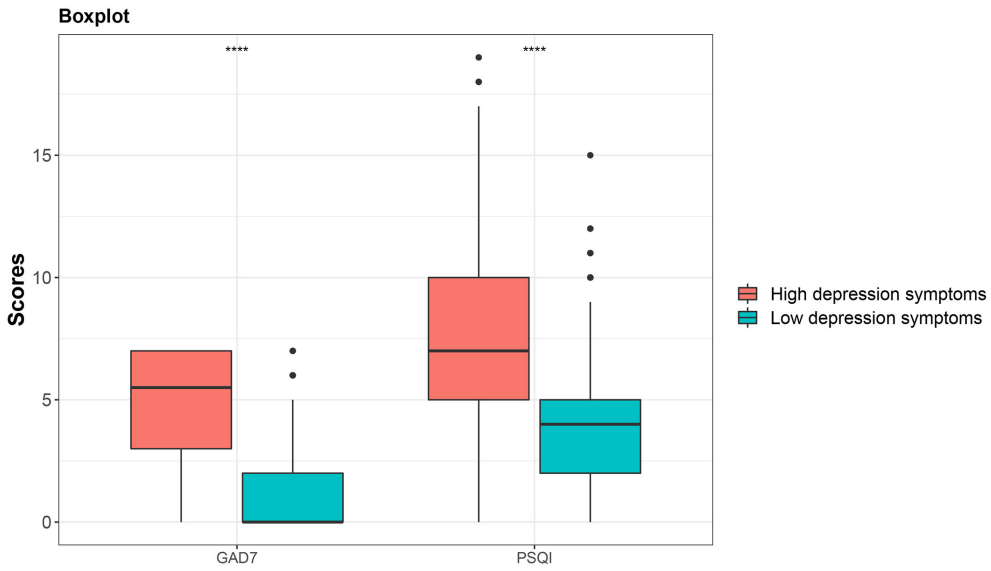

FIGURE 2
Comparison of total score of GAD7 and total score of PSQI between the low depressive symptoms group and high depressive symptoms group.

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TABLE 4 Comparison of each PSQI subscale among two latent groups.

Variables	Low depressive symptoms group (N = 377)	high depressive symptoms group (N = 463)	P-value
Subjective sleep quality			<0.001**
0	121 (32.1)	28 (6.0)	
1	222 (58.9)	193 (41.7)	
2	34 (9.0)	187 (40.4)	
3	0 (0.0)	55 (11.9)	
Sleep latency			<0.001**
0	188 (49.9)	129 (27.9)	
1	141 (37.4)	178 (38.4)	
2	42 (11.1)	95 (20.5)	
3	6 (1.6)	61 (13.2)	
Sleep duration			<0.001**
0	251 (66.6)	278 (60.0)	
1	74 (19.6)	62 (13.4)	
2	41 (10.9)	76 (16.4)	
3	11 (2.9)	47 (10.2)	
Habitual sleep efficiency			<0.001**
0	253 (67.1)	269 (58.1)	
1	78 (20.7)	117 (25.3)	
2	24 (6.4)	30 (6.5)	
3	22 (5.8)	47 (10.2)	
Sleep disturbance			<0.001**
0	106 (28.1)	13 (2.8)	
1	255 (67.6)	300 (64.8)	
2	16 (4.2)	136 (29.4)	
3	0 (0.0)	14 (3.0)	
Sleeping medication			<0.001**
0	370 (98.1)	418 (90.3)	
1	3 (0.8)	18 (3.9)	
2	2 (0.5)	13 (2.8)	
3	2 (0.5)	14 (3.0)	
Daytime dysfunction			<0.001**
0	185 (49.1)	26 (5.6)	
1	126 (33.4)	152 (32.8)	
2	58 (15.4)	168 (36.3)	
3	8 (2.1)	117 (25.3)	

**p<0.001.
PSQI, Pittsburgh Sleep Quality Index.

other financial burdens), leading them to develop more negative emotional responses to stressors (30). In our study, the higher risk of depression for the residents with middle and high education than those with lower education may be related to the special environment of long-term stagnation of social communication where they were.

Notably, the medical staff were more inclined to express depressive symptoms, and the proportion of high depressive symptoms among medical staff (65.8%) was higher than that of residents (53.3%). Medical staff are busy at the front line of the epidemic almost daily, bearing the double physical and psychological burden. Therefore, we should give more care and tolerance to front-line medical staff to maintain their mental health.

Furthermore, we also found that the total PSQI score and each subscale of PSQI in the high depressive symptom group were higher than those in the low depressive symptom group. Huang et al. reported that the severity of depression will increase significantly when the cut-off of the PSQI global score reaches five (31). The relationship between sleep disorders and depression has also been reported in various nations and populations. Chronic sleep disorders have great influence on both physical and mental health. Long-term sleep disturbance in adults was associated with more severe depressive symptoms (32). Poor subjective sleep quality was strongly associated with various depression symptoms, causing poor quality of life among obese patients (33). The children with excessive daytime sleep tended to have parent-reported symptoms of depression and attention deficit (34). Our results are consistent with previous studies that have demonstrated strong associations between depression and other sleep disturbance like sleep latency and efficiency (35–38).

Logistic regression analysis revealed that the medical staff group and residents group shared two common risk factors of depression: "increasing internet usage time" and "daytime dysfunction." Leménager et al. indicated that longer internet surfing might be associated with greater emotional disturbance, such as depression and current anxiety (39). We also found that "increasing internet usage time" and "daytime dysfunction" were nearly twice as likely to lead to more severe depressive symptoms in the medical staff group than in the residents group. Therefore, medical staff on the front line of the fight against the epidemic should better adjust their work and rest schedules, eliminate their dependence on mobile phones and the internet, and improve their energy during the day to avoid depression symptoms.

Nevertheless, our study has several potential limitations. First, it was a cross-sectional study, thereby weakening the dynamic analysis of depressive symptoms. Second, the questionnaires assessing mental health conditions used in our study were all self-rating scales that may not objectively

TABLE 5 Association between variables and depressive symptoms in medical staff group and residents group.

Variables	Medical staff		Residents	
	OR (95%CI)	*P*-value	OR (95CI)	*P*-value
Age	0.99 (0.95–0.05)	0.831	0.95 (0.94–0.97)	<0.001**
Gender (male/female)	1.12 (0.49–2.67)	0.792	0.98 (0.72–0.32)	0.890
Education (with bachelor's degree or higher) (yes/no)	1.95 (0.08-50.18)	0.640	2.11 (1.55–2.88)	<0.001**
Married (yes/no)	1.04 (0.48–2.22)	0.930	0.69 (0.50–0.96)	0.031*
Increasing internet usage time (yes/no)	3.86 (1.60–10.45)	0.004*	1.97 (1.43–2.74)	<0.001*
Monthly income				
Low-income (<10,000 RMB)	Reference	Reference	Reference	Reference
Middle-income (10,000–30,000 RMB)	0.75 (0.34–0.66)	0.475	1.55 (1.10–2.18)	0.012*
High-income (>30,000 RMB)	0.46 (0.02–12.00)	0.590	1.46 (0.71–3.08)	0.311
Living style				
Alone	Reference	Reference	Reference	Reference
With family	0.82 (0.33–0.99)	0.665	0.76 (0.49–0.17)	0.217
In the company	1.06 (0.37–3.14)	0.911	2.07 (0.98–4.62)	0.064
PSQI				
Subjective sleep quality (A)	5.57 (2.66–11.66)	<0.001*	5.47 (4.11–7.27)	<0.001**
Sleep latency (B)	2.04 (1.25–3.32)	0.004*	2.03 (1.69–2.44)	<0.001**
Sleep duration (C)	1.97 (1.18–3.30)	0.010*	1.30 (1.11–0.52)	0.001*
Habitual sleep efficiency (D)	1.85 (1.05–3.24)	0.032*	1.20 (1.02–0.40)	0.028*
Sleep disturbance (E)	8.88 (3.17–24.86)	<0.001*	8.17 (5.41–12.34)	<0.001**
Sleeping medication (F)	2.55 (0.85–7.59)	0.093	2.22 (1.37–3.62)	0.001*
Daytime dysfunction (G)	6.22 (3.20–12.09)	<0.001*	3.95 (3.19–4.89)	<0.001**
Total score of GAD-7	2.41 (1.80–3.24)	<0.001*	2.03 (1.84–2.23)	<0.001**

*p<0.05; **p<0.001.
GAD-7, Generalized Anxiety Disorder-7; PSQI, Pittsburgh Sleep Quality Index; RMB, Chinese Yuan.

represent the true prevalence of depression, anxiety, or sleep disorders. Diagnostic assessment tools will be added in further study. Finally, the results cannot be extrapolated to other countries and regions which adopt other levels of static management to control the COVID-19 pandemic.

The authors are also members of the doctors fighting against the COVID-19 pandemic. Just like most medical staff working on the front line, they have experienced the challenges of the 2 months, they waved goodbye to their families and rushed to the battlefield. Medical staff are also ordinary people and will get depressed once the stress is unbearable. The mental world of human beings is too fragile, and a person is normal because he is in a normal environment. In the special period of COVID-19 pandemic, we should learn to adjust our work and rest, reduce internet usage time, especially the medical staff who work hard at the front line.

Conclusion

There are differences in the factors influencing depression symptoms between medical staff and residents during the 2022 city-wide temporary static management period to fighting against the COVID-19 pandemic in Shanghai. We should pay special attention to those with increased internet usage time and daytime dysfunction in medical staff working in a special environment such as the COVID-19 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 Ethics Committee of the Children's Hospital of Fudan University, Shanghai. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

YZ and YT contributed to the conception of the study, implementation of the survey, data analysis, chart production, and manuscript drafting. XB and QD carried out literature search and data analysis. CH, TL, and WZ provided assistance for the analysis with constructive discussions. JSu and JSh contributed significantly to the design of the study, data analysis, and finish the revised manuscript. All authors have read and approved the final manuscript. All authors contributed to the study conception and design.

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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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Governance in mental healthcare policies during the COVID-19 pandemic in Mexico

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The COVID-19 pandemic has become the greatest burden of disease worldwide and in Mexico, affecting more vulnerable groups in society, such as people with mental disorders (MD). This research aims to analyze the governance processes in the formulation of healthcare policies for people with MD in the face of the COVID-19 pandemic. An analytical qualitative study, based on semi-structured interviews with key informants in the healthcare system was conducted in 2020. The study followed the theoretical-methodological principles of the Governance Analytical Framework (GAF). The software ATLAS.ti-V.9 was used for inductive thematic analysis, classifying themes and their categories. To ensure the proper interpretation of the data, a process of triangulation among the researchers was carried out. The findings revealed that in Mexico, the federal Secretary of Health issued guidelines for mental healthcare, but there is no defined national policy. Decision-making involved multiple actors, with different strategies and scopes, depending on the type of key-actor and their level of influence. Majority of informants described a problem of implementation in which infection control policies in the psychiatric population were the same as in the general populations which decreased the percentage of access to healthcare during the pandemic, without specific measures to address this vulnerable population. The results suggest that there is a lack of specific policies and measures to address the needs of people with mental disorders during the COVID-19 pandemic in Mexico. It also highlights the importance of considering the role of different actors and their level of influence in the decision-making process.

KEYWORDS

governance, policy-makers, mental disorders, decision-making, public policy

1. Introduction

Currently, the pandemic due to the new coronavirus COVID-19 is the cause of the greatest burden of the disease worldwide as well as in Mexico (1). Due to the characteristics of its spread and the health measures for its control, it can increase the vulnerability of people with mental disorders (MD). Different measures of social isolation can affect the

mood of these people with the consequent aggravation of their different psychopathological conditions. Consequently, the families and institutions that are protected by these people must offer specific assistance and monitoring to each of them (2). Governments in all countries have formulated various policies in health systems to address the Public Health Emergency of International Concern (PHEIC) due to COVID-19, but responsiveness has represented a global challenge (3). This situation highlighted the lack of cohesion that exists between the institutions of the Mexican National Health System (NHS). The Mexican NHS is composed and financed by both the public and private sectors. The public sector provides care to (1) people affiliated with social security (who receive a formal salary) through the Mexican Institute of Social Security (IMSS—from now on acronyms are in Spanish), the Institute of Security and Social Services of State Workers (ISSSTE), the Armed Forces (SEDENA and SEMAR) and the Mexican Petroleum (PEMEX). This represents 48.3 million people funded by employers, workers and the federal government; and (2) people without social security (who do not have a formal salary) who receive care from the Secretary of Health, Federal (SSA) or States' (SESA), and which are the object of this study. Up until the year 2019, the healthcare of these 58 million people had been financed in two ways, (1) by the federal government and the state governments through the System of Social Protection of Health and its program "Popular Insurance" ("Seguro Popular"), and/or (2) the out-of-pocket expenses of the user at the point of service (4).

At that time, when the COVID-19 pandemic was declared (March 2020), the NHS was implementing a new scheme for the provision of health services to the population without social security. This has implied stagnation in the programmed implementation of the reform strategies for the period 2019–2024, and instead, the mitigation of the pandemic was established as a priority programmatic axis (5). As a central strategy of the response, a process called "hospital reconversion" was carried out, which prioritized COVID-19 care first, without defining or informing users of procedures for monitoring the routine demand for medical services in general.

In addition, half of the people who receive medical care due to some MD, especially severe, do so in psychiatric hospitals, which suffer from low budget and resources to provide quality care (6, 7), furthermore, in a pandemic context people with mental pathology have a greater probability of getting sick with another chronic pathology than the general population (8–10). In consequence, the Mexican NHS has two challenges to guaranteeing care in psychiatric hospitals. On one hand, there are long-stay psychiatric hospitals with a confined population. On the other hand, psychiatric hospitals with functioning like that of a general hospital. First, patients are more vulnerable to being infected; in such a situation, measures should be taken to prevent contagion in a gated community (11), in the latter, they must also ensure the continuity of psychiatric care that allows treatment adherence, especially for serious conditions, monitoring the risk of aggressiveness toward oneself or others, as well as detecting symptoms associated with living in quarantine such as stress, anxiety or depression due to the current pandemic (12).

Several studies have reported strategies to ensure the medical care of the mentally ill during the epidemic with measures such as reducing the length of stay, reducing visits to admitted patients, reducing outpatient care and in hospitalized patients, timely detection of high-risk or suspected COVID-19 patients and isolation of positive patients (12–14). In Mexico, the strategy of offering psychosocial support was aimed at the general population that does not have COVID-19, people with COVID-19 who are isolated at home and/or in hospital, the population that referred COVID-19, relatives and caregivers of patients with COVID-19, health personnel and lifeguards before the emergency; it included psychological first aid and crisis intervention, as well as emotional support. This strategy considers it essential to try to have a telephone number for psychological or psychiatric emergencies and to provide care to mental health personnel (15). But it is unknown what the scope of this national strategy has been within the country, how decision makers adopted it or formulated new policies for the protection and care of people with MD on the understanding that comprehensive mental health policies must be implemented to respond to the daily healthcare needs of the people with MD, while still responding in the same way, to health emergencies, such as the current pandemic (7, 16, 17).

One way to address and support policy decision-making is through strengthening health system governance (18–20). Globally, governance in healthcare refers to the implementation of policies and practices that promote equitable health systems (21, 22). Other international organizations equate the concept of governance with stewardship, or co-management, to refer to concerted actions that promote and protect public health (23), or with an intersectoral governance approach, that refers to the coordination of multiple sectors to address health problems (24, 25). These definitions have a normative approach. In this research an approach to governance as an intermediate analytical variable is proposed, a generalizable concept, which refers to the process of agreement in decision-making, in which all the actors of the health system, suppliers and consumers intervene, with well-defined roles, to meet the demands of mental healthcare, with the focus of patient-centered care based on evidence, responsibility and accountability (25, 26). Incorporating this governance approach poses challenges for health systems in their communities, providing essential services both in the short term (after a disaster or pandemic, for example, the COVID-19) and in the long term in terms of public health. The role and critical nature of healthcare facilities means that they have significant impacts on communities, and the decisions affect the natural system in which we all live and have an impact on the future environmental. These impacts do not affect communities in the same way. Vulnerable populations such as people with MD suffer the effects on the environment due to factors such as access to resources and social determinants of health that influence health risks and outcomes. Populations with MD are less able to deal with the consequences for human health. In this sense, the approach of the Governance Analytical Framework (GAF) in the field of public health, visualizes governance as a social fact, endowed with analyzable and interpretable characteristics: the problem from a governance approach, the actors, social norms, the process, and the nodal points (27). Therefore, it will be the approach that we used.

The objective of this research is to analyze the governance process implemented in the formulation of policies for healthcare of people with mental disorders in the face of the COVID-19 pandemic.

TABLE 1 Governance Analytical Framework (GAF).

Governance element	Categorical definition	Categorical dimension	Analytical properties or subcategories	Qualitative indicators
1. Governance problem	Phenomenon under analysis	Health problem	Characterization and/or scope of health outcomes	Tracer(s)
2. Key actor: Actors of the healthcare system	Every individual involved in the institutional network of mental healthcare, with (or without) resources of power	Type of actor	Strategic Actor	Yes/No
			Stakeholder	Yes/No
		Academic and managerial background	Profession/Academic Degree	Undergraduate/Postgraduate
			Managerial Type	Technical/Human/Conceptual
			Managerial Level	High, Low
		Leadership skills	Management	High, Middle, Low
			Administrative	High, Middle, Low
			Governance	High, Middle, Low
		Status	Formal	Yes/No
			Informal	Yes/No
		Positioning	Facilitator/Opponent	Yes/No (Unknown)
3. Process (decision making). Interview Guide: Level of involvement of the key actor and power in the formulation of public policies in mental health	Power Resources: Ability/capacity to push, impede or disrupt the functioning of rules or procedures in the formulation and implementation of mental healthcare policies and programmes	Power resources in Mental Health Policy	Symbolic Resources	Yes/No
			Monetary Resources	Yes/No
			Social Capital Resources	Yes/No
		Level of Power (Nature of the transaction)	Negotiation	Yes/No; High/Middle/Low
			Direction or Management	Yes/No; High/Middle/Low
			Distribution or Sharing	Yes/No; High/Middle/Low
			Reciprocity	Yes/No; High/Middle/Low
		Application of power level (in practice)	Knowledge of the legal framework and capacity to modify it	Yes/No; High/Middle/Low
			Level of involvement in the formulation of mental healthcare policies	Yes/No; High/Middle/Low
			Ability to obtain and decide on the use and allocation of resources	Yes/No; High/Middle/Low
			Capacity to monitor strategies -development and outcomes -implementation of policies	Yes/No; High/Middle/Low
			Level of participation in human resources training and capacity building needs.	Yes/No; High/Middle/Low
			Capacity to convene governmental and non-governmental organizations in society	Yes/No; High/Middle/Low
			Capacity to generate and disseminate information on mental health	Yes/No; High/Middle/Low
			Involvement in the mechanism of transparency and accountability	Yes/No; High/Middle/Low

(Continued)

TABLE 1 (Continued)

Governance element	Categorical definition	Categorical dimension	Analytical properties or subcategories	Qualitative indicators
4. Nodal points: Spaces and rules where actors interact and how they are applied in practice	Spaces (or interfaces) where several processes, stakeholders and norms converge, producing different effects on a studied problem	Level of agreement in the interaction process	Formal Norms: constitutive/regulatory	Yes/No
			Actors' Behavior	Proactive/Passive
			Modifications by collective action	Interaction/Transaction
				Conflictive/Collaborative
		Scenario of interaction	Negotiation spaces	Physical/Virtual
			Effects	Isolated/Interactive
			Scope	Local/State/National
5. Social norms: Rules that influence decision-making processes	Successions through which the interrelationship between stakeholders, norms and nodal points pass	Social Norms (game rules or decisions)	Standards: Formal, Informal	Yes/No
			Legally recognized	Dependent/Independent
			Stakeholder practice	Acknowledged Yes/No
			Stakeholder authority	Yes/No

A theoretical-methodological approach to its constituent elements.
Own elaboration.

2. Materials and methods

A qualitative research methodology used since the 1960s, is proposed. It is a systemic and essentially critical methodology in all its phases, from its data collection instruments to the quality criteria, such as classic validity and reliability. Given the intricate web of variables (antecedents, intervening and interacting), a critical analysis is essential throughout the research process (28). By applying this methodology, precise information is obtained on how the different social actors perceive, interact and make decisions in the formulation of policies for the care of people with MD, according to the thematic categories of analysis proposed in the GAF: the problem, the actors, the social norms, the process, and the nodal point, (see Table 1), with the method described in the Figure 1.

3. Societal benefits of the research

The results of this article allow us to observe, beyond its initial objective, some key aspects that may be of marked interest for the future responses to certain societal challenges in the field of Governance and Global Mental Health:

First, we have realized the importance of developing a comprehensive holistic model (although adaptable to the characteristics of each territory) of Global Health, encompassing a global vision of planetary challenges (32). This requires the integration of interactions between multiple actors, from both bottom-up and top-down perspectives, anchored in an integrative governance framework and supported by an interdisciplinary and intersectoral approach (33, 34).

Secondly, through this article we realize that new, more inclusive (35) and reflexive (36) governance models are necessary to face the complexity of contemporary Global Health challenges. On the one hand, inequalities affect the health and wellbeing of populations at global, regional, and national levels. An inclusive approach to governance in Global Health is a potential way to include all key actors and thus reduce inequalities (33, 35).

Finally, in a multi-actor and multi-scale environment, it is imperative to establish the foundations of a methodological framework in empirical bioethics that can serve as a starting point for building a reflective governance model in the field of Global Health. This process of ongoing critical thinking involves "mapping, framing and shaping" the dynamics of interests and perspectives that could jeopardize a collaborative scenario (36). Finally, the conclusion of this article clearly shows us the need to develop governance models in the field of Global Health with clearly defined social purposes, allowing key actors to collectively build sustainable decision-making processes, more adapted to the needs of populations and our planet.

4. Results

4.1. The problem from a governance approach

In Mexico, the SSA, as the sole governing body of the NHS, issued guidelines and recommendations for mental healthcare during the COVID-19 pandemic. They recommended providing continuous healthcare for the mentally ill, but no defined national policy or specific actions for such care were issued. The mental healthcare scenario included multiple actors with different strategies throughout the country, and of different scopes, depending on both the type of key actor

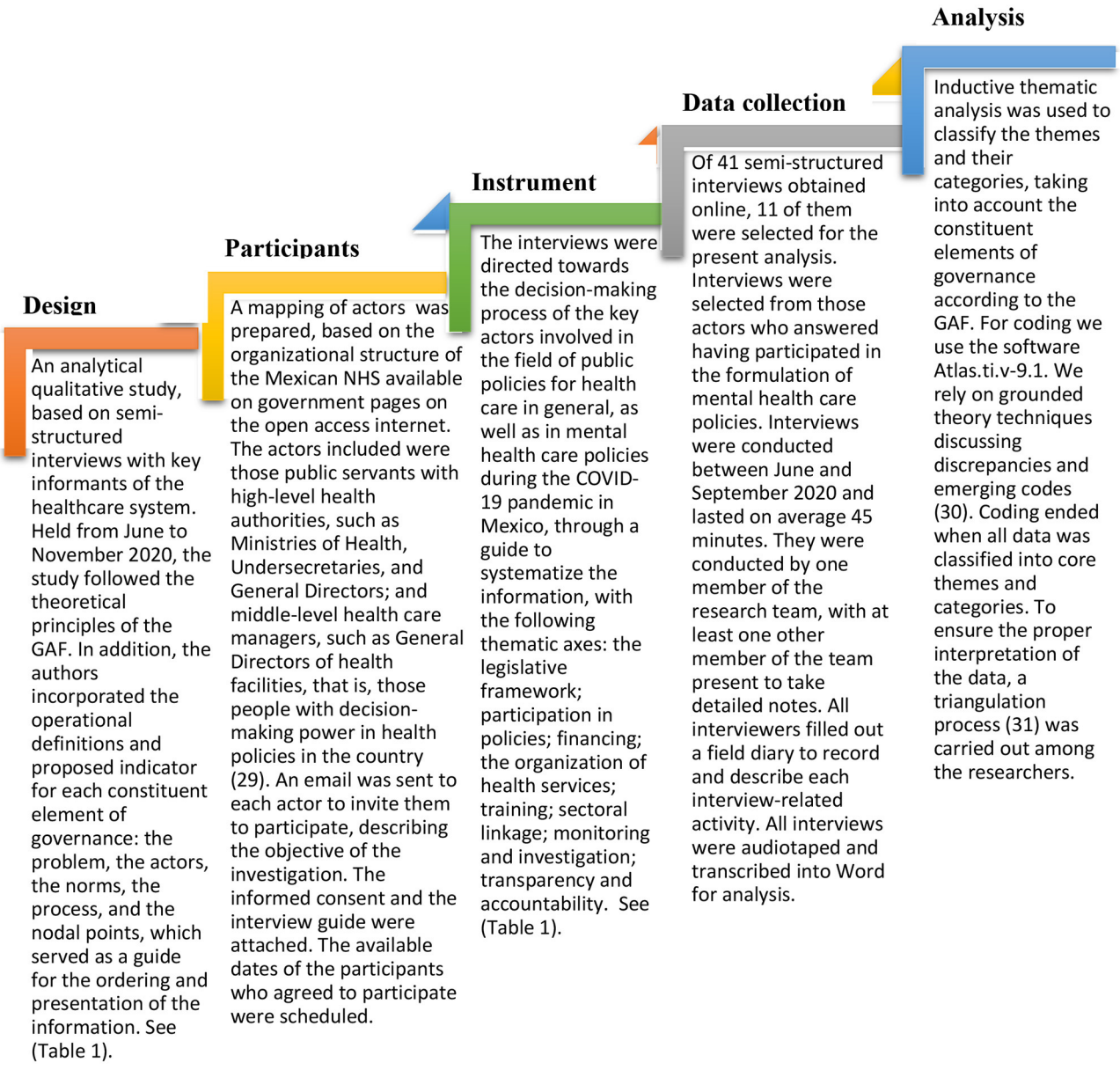

FIGURE 1
Applied research methodology.

and the characteristics that accompany their decision-making, as shown in the analysis of the interviews, according to the analytical categories.

4.2. The key actors of the Mexican NHS

Eleven key actors of the NHS, three participants from the federal level (27%) and eight from the state level (73%), according to the other geographical regions of the country (37). The stakeholder mapping included six actors from the SESA, three actors from the ISSSTE and two actors from the SSA.

According to his position in the Mexican NHS, four actors were Ministries of Health, one Undersecretary, two General Directors, two Medical Directors, and two Medical Subdelegates. The state and federal high-level health authorities are those who participate in the policymaking. The participation of local or municipal actors was not found. Table 2 shows the characteristics of the participants.

The actors recognized having leadership in the formulation of main policies. The Ministries and Undersecretaries acknowledged leadership in decision-making and in managerial skills, concerning the direction of policies in their field of competence. Directors and Medical Subdelegates, administrative skills for the development and implementation of policies were identified (see Table 3). Although all actors positioned themselves as facilitators of federal

TABLE 2 Characterization of the key actors in the Mexican healthcare system.

Category of analysis	Key actors in mental healthcare policy										
	NOE1ss	FE2ss	CS1ss	OE1ss	CN1ss	OE3ss	FE1ss	NOE8ss	NOE2is	SE1is	FE6is
Type of actor											
Strategic Actor	+	+	+	+	+						
Stakeholder						+	+	+	+	+	+
Academic and managerial background											
Profession degree											
Academic degree	+	+	+	+	+	+	+	+	+	+	+
Leadership skills											
Management	+++	+++	+++	+++	+++	+++	+	+	++	++	++
Administrative	+++	+++	+++	+++	+++	+++	+	+	++	++	++
Governance	+	+++	+++	++	++	+	+	+	+	+	+
Status											
Formal	+	+	+	+	+	+	+	+	+	+	+
Informal											
Positioning											
Facilitator	+	+	+	+	+	+	+	+	+	+	+
Opponent											

NOE1ss, Actor 1, Northwest region, Secretary of Health; FE2ss, Actor 2, Federal, Secretary of Health; CS1ss, Actor 1, South Central region, Secretary of Health; OE1ss, Actor 1, Western region, Secretary of Health; CN1ss, Actor 1, North Central region, Secretary of Health; OE3ss, Actor 3, Western region of Mexico, Secretary of Health; FE1ss, Actor 1, Federal, Secretary of Health; NOE8ss, Actor 8, Northwest region, Secretary of Health; NOE2is, Actor 1, Northwest region, Institute of Security and Social Services of State Workers; SE1is, Actor 1, Southeast region, Institute of Security and Social Services of State Workers; FE6is, Actor 6, Federal, Institute of Security and Social Services of State Workers.
+ Feature presence.
+ Low level, ++ Middle level, +++ High level.

policies on mental health, it was discerned that two actors remained passive, regardless of decisions.

4.3. Decision-making process, social norms, and nodal points

The constitutive norms are the basis for the decisions of most stakeholders, who can interact and agree on the overall health decision-making process, as they are state and federal health authorities. Table 3 shows the characteristics of the actors according to the interactive decision-making process, and excerpts of interviews are presented as evidence. The Ministries identified themselves as responsible for the formulation of policies for the protection and care of people with MD and considered them within the vulnerable population group. While the directors, mentioned their actions in a more local scenario of concern, participating in internal regulations such as protocols of specific attention to COVID-19 in specialized mental health institutions:

> *"The regulations emanate mainly from the Mexican Constitution. Hence derived the Constitution of the State of..., the Federal Health Law, the State Health Law and the Health Sector Plan which is where we take all the elements... to be able to implement the different policies... of this secretariat." Actor-CS1ss*

> *"... a protocol for COVID, we were the first to do it. And yes, in that sense we are a bit of a reference. Those are the public policies to face Covid, and well, there is a national policy of restructuring the National Mental Health Program that is to invest more in primary healthcare, make the second level and we are the third level of care." Actor-FE1ss*

Decision-makers adopted different measures using power resources through transactions of different natures and scopes, targeting different population groups (see Table 3).

> *"... concerning mental disorders, although we have taken action, we have fallen short because of the confinement in which the population has been. We try to push some programs through health services... they have a specific area that has to do with mental health to support them through video claims..." Actor-CS1ss*

> *"... the Health Caravans, which are mobile medical units that go to those rural communities which do not have quick access to a Health Center, and through them all those vulnerable, disabled people and those you mentioned are promoted and monitored." Actor-OE1ss*

About funding, seven of the actors expressed having the power to decide the use and allocation of resources (see Table 3).

TABLE 3 Social norms and scope of decision-making by key actors in Mexico's health system.

Category of analysis	Key actors in mental healthcare policy										
	NOE1ss	FE2ss	CS1ss	OE1ss	CN1ss	OE3ss	FE1ss	NOE8ss	NOE2is	SE1is	FE6is
Process (decision-making)											
Power resources											
Symbolic	+	+				+	+	+	+	+	+
Monetary	+			+	+	+			+		+
Social capital	+	+	+	+	+						
Level of power											
Negotiation											
Direction	++	+++	+++	+	++	+		+			+
Distribution				+					+	+	+
Reciprocity							+				
Application of power											
Knowledge of the legal framework	+++	+++	+++	+++	+++	++	+	+	+	++	++
Capacity to modify the legal framework	+++	++	+++	+++	+++	+	+	+	+	+	+
Level of involvement in the policy formulation	++	+++	+++	+	++	+	+	+	+	+	+
Allocating resources for policies	+++	+	+++	++	++	+	+	+	+	+	+
Monitoring development and implementation policy	++	+	++	++	++	++	++	+	++	++	++
Human resources training/capacity building	+++	+	+++	+	+++	++	++	+	+++	++	+++
Capacity to convene organizations	++	+++	++	+	++	++	+	+	+	+	++
Generate and disseminate information	++	+++	++	++	++	++	+	+	+	+	+
Apply mechanisms of transparency	+++	+++	+++	+++	+++	+++	++	++	++	++	++
Apply mechanisms of accountability	++	+++	++	++	++	+	+	+	+	+	+
Nodal points											
Formal norms											
Constitutive	*	*	*	*	*	*		*	*		*
Regulatory	*	*	*	*	*	*	*	*	*	*	*
Actors' behavior											
Proactive	*	*	*	*	*	*	*				
Passive									*	*	

(Continued)

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TABLE 3 (Continued)

Category of analysis	Key actors in mental healthcare policy										
	NOE1ss	FE2ss	CS1ss	OE1ss	CN1ss	OE3ss	FE1ss	NOE8ss	NOE2is	SE1is	FE6is
Modification by collective action											
Interaction		*		*	*	*	*	*	*	*	*
Conflictive											
Collaborative	*			*				*		*	
Transaction	*		*								
Negotiation spaces											
Physical		*					*	*			
Virtual	*	*	*	*	*	*	*	*	*	*	*
Effects											
Isolated						*	*	*	*	*	
Interactive	*	*	*	*	*		*				*
Scope											
Local						*	*	*	*	*	
State	*		*	*	*						*
Federal		*									
Social norms											
Formal	*	*	*	*	*	*	*	*	*	*	*
Informal	*					*	*	*		*	

NOE1ss, Actor 1, Northwest region, Secretary of Health; FE2ss, Actor 2, Federal, Secretary of Health; CS1ss, Actor 1, South Central region, Secretary of Health; OE1ss, Actor 1, Western region, Secretary of Health; CN1ss, Actor 1, North Central region, Secretary of Health; OE3ss, Actor 3, Western region of Mexico, Secretary of Health; FE1ss, Actor 1, Federal, Secretary of Health; NOE8ss, Actor 8, Northwest region, Secretary of Health; NOE2is, Actor 1, Northwest region, Institute of Security and Social Services of State Workers; SE1is, Actor 1, Southeast region, Institute of Security and Social Services of State Workers; FE6is, Actor 6, Federal, Institute of Security and Social Services of State Workers.

*Feature presence. + Low level, ++ Middle level, + + + High level.

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> *"... here we also had to redistribute the budgets of all the items that arrive.., make a redistribution of all those funds, of the economics, to allocate them to priority actions that were going to have to do with the care of COVID and of course from the epidemiology area of each of the health regions of the hospitals' local care protocols were established to be able to define the treatment strategy..." Actor-OE3ss*

Regarding the organization of healthcare services during the pandemic, to support the guidelines for action in mental health issued by the Federal Ministry of Health, most of the actors involved reported actions under a proactive and interactive behavior but of local scope:

> *"In the hospital we made a protocol for the management of this pandemic, among the things we required was the protective equipment for the staff, modify any of the facilities of the hospital; from toilets at the entrance to inside hospital areas, such as two special offices for potential COVID patients; we decreased the admission to 30%, and the flow of outpatient patients and made calls, that is, consultations by video call,... basically it is the follow-up of patients through electronic methods to prevent them from entering, respiratory and psychiatric triage, our two lines of attention to the public and COVID people..." Actor-FE1ss*

Regarding the capacity for education and intersectoral action, some actors described high levels of participation of various sectors of activity in mental health policy formulation:

> *"... the National Committee for Health Safety, is a collegiate body that was established in 2002 and whose... attributions or functions are precisely to coordinate the preparation and response to phenomena... that can produce threats to health security, I have coordinated the different working groups that depend directly on me which are eight general directors... who work in coordination with us the National Center for Blood Transfusion and... Psychiatric Care Services,... and the... National Commission Against Addictions." Actor-FE2ss*
>
> *"... they gave us the task of coordinating the other institutions of the state: the IMSS, the ISSSTE, the private hospitals, the National Defense Secretariat so that through... we concentrate this information and make a report; from the clinical area we pass it to epidemiology of the Ministry of Health and... all this is the final report that is taken to the cabinet and to the office of the secretary or the governor where the decisions of public policies are made." Actor-OE3ss*

In terms of research, most actors exercised their power in capacities to control the development and implementation of health policies in general:

> *"We rely a lot on expert people like people from the National Institute of Public Health, people from UNAM who are developing models at the national level, we are making measurements daily to see our trends in hospital occupancy, our trends of increase in cases, lethality, mortality." Actor-OE3ss*

However, only one actor mentioned the ability to generate and disseminate mental health information:

> *"... we are, as a psychiatric hospital, the largest in the country and in that sense our voice is heard; we are... reference for the other hospitals, and... for... vulnerable groups, we are always in contact, they come to us here... Indigenous... beaten women, the people who are,... in street situation and patients living with... HIV, people living with these psychosocial conditions." Actor-FE1ss*

In regard to transparency and accountability, all actors expressed transparency mechanisms:

> *"As for the Secretariat, there are messages from the governor, from the Ministry of Health in different media, including social networks, and already in the hospital there are many posters and this kind of thing.... I don't know at the level of the Secretary of Health; I know they have a very strict level of control of resources and transparency, but I don't know if they implemented new strategies." Actor-NOE8ss*

Figure 2 summarizes the findings, explaining the research problem, the solution, and the theoretical contribution of the present study.

5. Discussion

The results of this study show the heterogeneity in decision-making for the protection and care of people with mental disorders in the context of a health emergency such as the current COVID-19 pandemic. A legislative framework lacking a General Mental Health Law at the national level in Mexico, makes it unclear what actions should be taken to guarantee healthcare access for people with mental disorders, as dictated by the Magna Carta [Const.], 2021 (38). The World Health Organization, in its reports called "Mental Health Atlas", has stated on more than one occasion the need to address the problem of mental health in a comprehensive manner (with public policies, legislation and financing). In these reports, the region made up of the United States and Canada leads the way with improved scores for the indicators regarding the enactment and updating of laws and the implementation of public policy on mental health (39).

The fact that the Mexican NHS is fragmented in terms of the structure and function of healthcare services, further intensified the problem and limited the responsiveness of decision-makers to decentralize guidelines to state and local contexts. This resulted in the implementation of diverse strategies across the country, and of varying scope, depending mainly on the resources that key actors put at stake, but generally showing a local scope of their actions with little connectivity between the different NHS settings.

Concerning mental healthcare strategies, as reported in the literature, they were more focused on clinical care in the context of the pandemic, i.e., for the population presenting symptoms associated with lockdown and social distancing (40–42), while healthcare services for people with specific MD decreased during the pandemic. Healthcare institutions found it necessary to reduce inpatient and outpatient care processes to implement processes

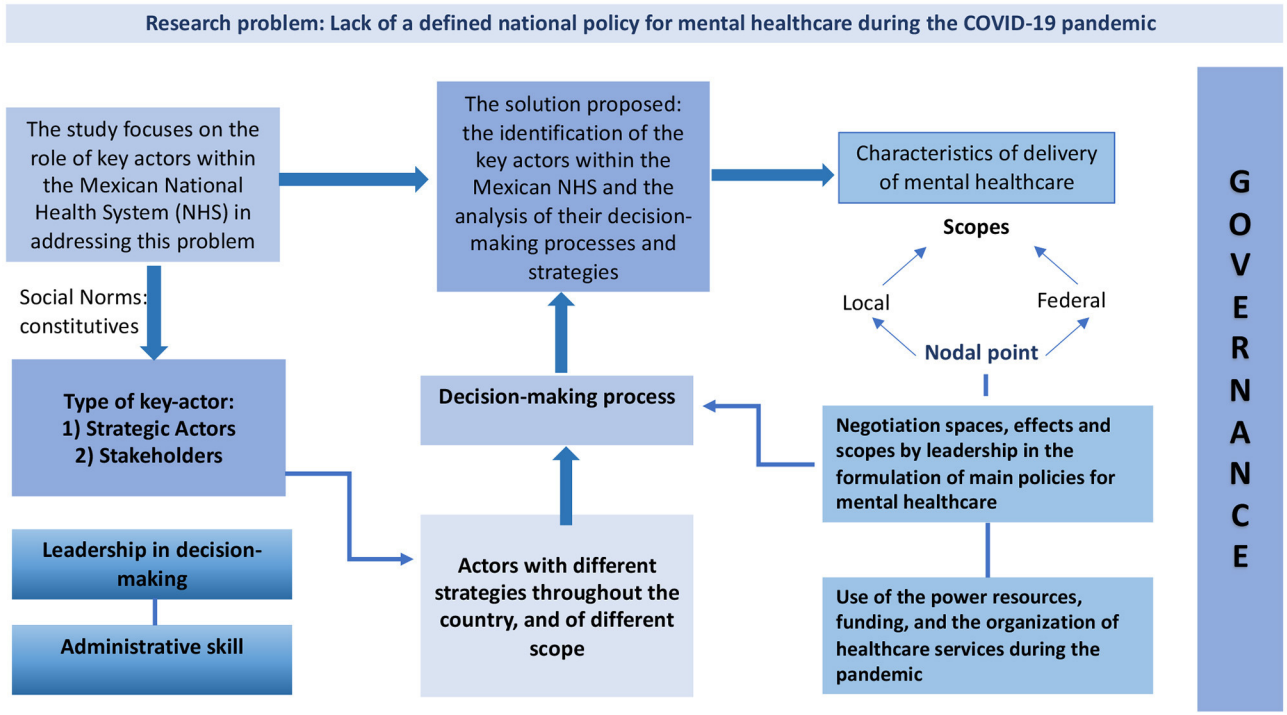

FIGURE 2
Theoretical contribution of the research: examination of the governance approach to mental healthcare during a pandemic, México, 2020.

for the detection, monitoring and surveillance of COVID-19 cases. The decline in care for people with MD conflicts with strategies recommended in the scientific literature (43, 44). Leaving these people in a scenario of increased vulnerability, as they may develop greater disease awareness and greater exposure to infectious diseases, such as COVID-19 (45), and less access to available healthcare services, may intensify pre-existing inequality (6, 9, 43).

Thus, the COVID-19 health crisis has shown that the health system in Mexico, as in most countries, was not sufficiently prepared to respond in a reliable and timely manner to the problem (46), and in the case of mental healthcare for people with MD, the problem was even more evident because the access to services became more difficult, and the alternative use of digital/telephonic services was not sufficient (9, 43, 47). Furthermore, those most in need of mental healthcare are those whose livelihoods have been made even more precarious because of social disparities, in turn, few of them will seek help because their basic needs are not met by the mental healthcare systems (9). In contrast, a study in Brazil reported that, the reorganization of healthcare services integrating mental care is necessary to provide care access and continuity of care for people with MD (42).

The fragility of governance in decision-making for the protection and care of people with MD in health crisis scenarios, is partly due to the absence of a specific legislative framework. Indeed, although mental healthcare is included in the Magna Carta, it does not make a clear reference to this type of problem. Mental healthcare service mentions that the Law will define the bases and modalities for access to health services [GLH] (48), which highlights the urgent need for such a law (49).

In the current scenario and concerning the care of people with MD, we found no evidence of any call for decision-makers to interact in decision-making spaces, much less those responsible for mental healthcare. Another aspect to consider in this pandemic context is the fact that to provide continuity of clinical care, the healthcare system could resort to telematic services, but the bill to provide legal protection to health professionals and users of these services has been canceled in Mexico (50). This absence of a legal regulatory framework can also be observed in the countries of the European Union (51–53).

On the other hand, despite the decentralization of healthcare services in Mexico, unilateral and centralized decision-making enforced during the pandemic, diminished proactive interest in participating in the actions described in the policies (54). While the NHS follows—according to key informant actors—official constitutive-regulatory norms, our analyses show leadership capacity as an essential characteristic of the decision-maker to undertake the formulated actions and a key element to strengthening healthcare system governance (55–57). Further, it is mandatory that all levels of government invest in mental healthcare, not only to offset the pandemic but also to support thriving in the future for people with MD (9, 58–60).

Strengthening governance in healthcare systems involves knowing, convening, and agreeing to make proactive decisions in the formulation of comprehensive and equitable policies, including care for the most vulnerable groups in society, such as those with MD (61). A process that requires leading decision makers with strong social values (62) to design suitable strategies to overcome the barriers to access to mental healthcare services (63). It is evident that, the sectoral and multi-scalar healthcare structure of

the NHS in Mexico gives greater complexity to the analysis of the decision-making process in the field of mental healthcare, due to the interaction of multiple actors with differing interests, roles and levels of responsibility. To adapt the healthcare services to the care needs of the population in the absence of a national policy of mental healthcare, decision-makers must create an adaptative team management, with cohesion, collaboration, leadership, guidance and direction from management in providing sustained, efficient, and equitable delivery of mental healthcare for people with MD during a sanitary emergency such as the COVID-19 pandemic (41).

In summary, the study shows that the lack of a national mental health law in Mexico and the fragmented structure of the healthcare system have made it difficult for decision-makers to provide adequate care for people with mental disorders during the COVID-19 pandemic. The focus of mental healthcare strategies has been primarily on addressing symptoms associated with lockdown and social distancing, rather than on providing care for people with specific mental disorders. This has led to a decline in access to care for people with mental disorders, which has made them more vulnerable to the pandemic. The study also highlights the need for a specific legislative framework to guide decision-making in the protection and care of people with mental disorders during health crises. Additionally, it emphasizes the importance of leadership capacity and proactive decision-making in strengthening governance in the healthcare system and investing in mental healthcare to support the wellbeing of people with mental disorders in the future.

The limitations of this study include: (1) a limited sample size of key-actors, which could restrict the generalizability of the findings to the larger population of Mexico. (2) The fact that it was based on self-reported data, which could be subject to bias or inaccuracies in the recall. (3) The study only focuses on one specific aspect of governance, which may not fully capture the complexity and nuances of decision-making in the health system. (4) It is possible that the study only considered the perspectives of certain groups of actors and not others, which could limit the scope of the findings. (5) It is a qualitative study, which makes it difficult to generalize the findings. (6) The study only analyzes the situation of a particular health emergency, which makes it difficult to generalize the findings to other types of emergencies. Despite these limitations, the results of the study can be considered reliable in terms of reflecting the way decisions are typically made in the health system in Mexico.

Data availability statement

The datasets presented in this article are not readily available due to the informed consent with the participants, in which it was agreed that their data would not be shared apart from the research team.

Ethics statement

This study was approved by the Committee for Ethics in Investigation of the National Institute of Psychiatry (Mexico), 17 June 2020. Protocol code CEI/C/017/2020. All participants provided valid informed consent to get involved in the study, verbally, which was recorded at the time of the interviews.

Author contributions

LDC contributed to the design, data analysis, and interpretation and writing of the first and subsequent drafts of the paper. JCSH contributed to the data analysis and interpretation and writing of the first and subsequent drafts of the paper. OOGR, EON, and MSSD contributed to the interpretation and writing of subsequent drafts of the paper. 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.

Publisher's note

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Burnout and associative emotional status and coping style of healthcare workers in COVID-19 epidemic control: A cross-sectional study

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Objective: The aim of this study was to evaluate the prevalence of burnout, clinical anxiety, depression, and insomnia and to estimate the associations of adverse emotional status, coping style, and level of self-efficacy with burnout of healthcare workers in the Shenzhen Longgang District Frontline District Headquarters of COVID-19 epidemic control, China.

Methods: In this cross-sectional study, 173 staff completed the anonymous questionnaires of the Maslach Burnout Inventory, Patient Health Questionnaire-9 (PHQ-9), Generalized Anxiety Disorder 7-item Scale (GAD-7), Insomnia Severity Index (ISI), General Self-efficacy Scale, and Simplified Coping Style Questionnaire electronically (https://www.wjx.cn/) in June 2022. Hierarchical logistic regression was used to explore the associated factors of burnout in this study.

Results: The prevalence of burnout in our participants (defined as high emotional exhaustion or high depersonalization) was 47.40%, and reduced personal accomplishment was 92.49%. The prevalence of clinically significant depression (the cutoff score of $\geq$15), anxiety (the cutoff score of $\geq$10), and insomnia (the cutoff score of $\geq$15) was 11.56, 19.08, and 19.08%, respectively. There was a degree of overlap between burnout and other measures of adverse mental status, most notably for anxiety (odds ratio, 27.049; 95% CI, 6.125–117.732; $p < 0.001$). Hierarchical logistic regression demonstrated that burnout was strongly associated with anxiety (OR = 23.889; 95% CI, 5.216–109.414; $p < 0.001$) and negative coping style (OR = 1.869; 95% CI, 1.278–2.921; $p < 0.01$) independently.

Conclusion: Medical staff involved in COVID-19 epidemic control in the post-epidemic era were at high risk of burnout, and most of them were in low personal accomplishment. Reducing anxiety and improving coping style by medical management institutions from the system level may be effective in alleviating burnout in healthcare workers.

KEYWORDS

burnout, coping style, anxiety, depression, insomnia, self-efficacy

Introduction

Viral infections are related to mental health. In the context of the coronavirus disease 2019 (COVID-19) pandemic, people may experience great changes in fear, stress, and daily lives. Depression, anxiety, and insomnia are very common mental health problems during the COVID-19 pandemic (1, 2). Some surveys showed a high prevalence of burnout (3, 4), depression (5, 6), anxiety (5, 6), and insomnia (6–9) in health professionals in the past. In 2020, the prevalence of major depression and anxiety increased by more than 20%, respectively, worldwide and significantly in countries seriously affected by COVID-19. With the continued spread of COVID-19, researchers predicted that the incidence rate of depression and anxiety may increase again (10).

Burnout is defined as an excessive reaction to stress caused by one's environment that may be characterized by feelings of emotional and physical exhaustion, coupled with a sense of frustration and failure. Before the outbreak of the COVID-19 epidemic, medical staff faced a general problem of burnout, which became more prominent during the epidemic (11). More than half of primary care practitioners in China during the COVID-19 epidemic control reported fatigue (12). Socio-demographic factors could be related to burnout (13); in addition, negative emotional states such as depression and anxiety could affect burnout (14), and sleep quality (15), different coping styles (16), and levels of self-efficacy (17, 18) might be protective or risk factors of burnout. There can be complex relationships among these variables. There is a need for more evidence as to which factors are protective, as well as which are at risk of burnout independently. However, less information is available on the association between burnout and mental status, coping style, and self-efficacy in health professionals, especially those who had been involved in COVID-19 prevention and control for a long time in Shenzhen, China.

Healthcare wokers in the Longgang District Frontline Headquarters of COVID-19 epidemic control came from hospitals and public health institutions in Shenzhen, worked on call and in a relatively isolated and closed centralized place after the outbreak of the COVID-19 pandemic. Over the last 2.5 years, medical staff needed to be ready at any time if the epidemic occurred again. The working hours were longer than before (12), the working conditions were more severe (12), and these staff continued to be in a state of high stress and uncertainty. A previous study in Hong Kong and Canada showed that the SARS pandemic outbreak changed primary care practitioners' work environments and lifestyles (19). These medical staff could be at high risk of burnout and negative emotional and insomnia distress. What was the prevalence of their emotional and sleep status? How about the risk of burnout? Do their emotional status, coping style, and self-efficacy possibly affect the incidence of burnout? As the COVID-19 epidemic lasts longer, our bodies and minds can adjust and adapt. Whether the prevalence of mental problems and burnout will increase or not during the late stage of the COVID-19 pandemic needs to be explored in the study.

In this study, we surveyed burnout, mental status, coping style, and levels of self-efficacy by using the Maslach Burnout Inventory-Human Services Survey (MBI-HSS), Patient Health Questionnaire-9 (PHQ-9), Generalized Anxiety Disorder 7-item Scale (GAD-7), Insomnia Severity Index (ISI), General Self-efficacy Scale (GSES), and Simplified Coping Style Questionnaire (SCSQ) among healthcare workers in the Shenzhen Longgang District Frontline Headquarters of COVID-19 epidemic control, China. These health workers worked in a relatively isolated place, which was convenient for sampling and could be representative of the medical staff involved in COVID-19 prevention and control in Longgang District, Shenzhen.

The main aim of this study was to explore the independent relative impact of emotional status, coping style, sleep quality, and self-efficacy on the outcome of burnout, as well as examine the degree to burnout was related to the job nature of healthcare workers and other relevant socio-demographic and occupational factors. A secondary aim was to explore the rates of mental problems and burnout among healthcare workers in China more than 2 years after the outbreak of COVID-19 and establish the degree of overlap between burnout status and anxiety, depression, and insomnia. It was hypothesized that high levels of burnout and anxiety, depression, and insomnia were reported in participants, and negative coping, low levels of self-efficacy, and adverse emotional status would be associated with high rates of burnout.

Materials and methods

The design was a cross-sectional anonymous survey in the in the Shenzhen Longgang District Frontline Headquarters of COVID-19 epidemic control in June 2022. We released research-related notices in advance in the WeChat work group, and then participants were sent the anonymous questionnaires electronically (https://www.wjx.cn/), which they completed and returned after informed consent. Staff with a history of anxiety disorder and major depressive disorder were excluded from this survey.

Measures

We collected the socio-demographic characteristics of participants including age, gender, education, marriage, family income, professional position, years since qualified, work nature and length of staying in the Shenzhen Longgang District Frontline Headquarters of COVID-19 epidemic control, physical condition, smoking, and drinking.

Patient Health Questionnaire-9

The PHQ-9 contains nine items which are scored on a four-point Likert scale from 0 indicating "not at all" to 3 indicating "nearly every day" and then summed (20). This scale was developed based on DSM-IV criteria for diagnosing major depressive disorders and was used to assess the frequency of depressive symptoms in the past 2 weeks. The range of scores was from 0 to 27, with higher scores representative of worse depression. A cutoff score of $\geq$15 has been recommended for its good internal consistency and reliability. Depression was defined as a total score of more than or equal to 15 on PHQ-9. Overall Cronbach's alpha of the Chinese version of the PHQ-9 in the general population was 0.86 (21). The reliability in this sample was good ($\alpha = 0.906$).

Generalized Anxiety Disorder 7-item Scale

The GAD-7 contains seven items which are scored on a four-point Likert scale from 0 indicating "not at all" to 3 indicating "nearly every day" and then summed (22). This scale is a self-report questionnaire and assesses symptoms of anxiety over the last 2 weeks. All scores were 0–21, with higher scores indicating worse anxiety. A cutoff score of ≥10 on GAD-7 is used to define anxiety in this study. The reliability in the current sample was good ($\alpha = 0.938$).

Insomnia Severity Index

The ISI is a self-report questionnaire (23), which was a four-point Likert scale, with responses weighted 0–3 for frequency. The score ranged from 0 to 28, with higher scores indicative of severe insomnia. A cutoff score of ≥15 means meeting the diagnostic criteria of clinical insomnia and was used in this study. The reliability and validity of the Chinese Translation of Insomnia Severity Index (C-ISI) are good.

Maslach Burnout Inventory

The MBI (24) as the gold standard for evaluating burnout syndrome severity includes 22 items which are scored on a seven-point scale from 0 indicating "never" to 6 indicating "every day". It is a self-report inventory divided into three subscale dimensions, namely emotional exhaustion (EE), depersonalization (DP), and low personal accomplishment (PA). Greater than 26 for EE, >9 for DP, or <33 for reduced PA means high risk on each dimension. "Burnout" is diagnosed if one has high-risk levels of EE (≥27) or DP (≥10) and given the lack of evidence for PA as a predictor.

General Self-efficacy Scale

The GSES (25) contains 10 items which are scored on a four-point Likert scale from 1 to 4. A total score is the average score of ten items, with a higher score indicative of better self-efficacy.

Simplified Coping Style and Questionnaire

The SCSQ (26) consists of two dimensions: positive coping and negative coping, and contains 20 items which are scored on a four-point Likert scale from 0 indicating "not adopted" to 3 indicating "always adopted". This self-report scale is scored by the average score of the positive coping dimension and negative coping dimension separately. The positive coping dimension consists of items 1–12, which mainly reflect the characteristics of positive response, such as "try to see the good side of things" and "seek hobbies and actively participate in sports activities". The dimension of negative coping consists of items 13–20, which mainly reflect the characteristics of negative coping, such as "relieving worries by smoking and drinking" and "thinking that time will change the status quo, the only thing to do is to wait". The tendency of coping refers to the standard score of positive coping minus the standard score of negative coping.

Statistics

Statistical analysis was performed by using the Statistical Package for the Social Sciences, Release 25.0 (SPSS; IBM Corp, Armonk, NY). Descriptive data were shown in the form of the mean (SD) and n (%). Socio-demographic characteristics, the prevalence rate of depression, anxiety, insomnia, burnout, coping style, and level of self-efficacy were described. Only variables showing significant association (i.e., $p < 0.05$) in univariate analyses (chi-square and independent group t-tests) were then entered into a hierarchical logistic regression model to determine their independent associations with burnout. A p-value of <0.05 was considered statistically significant.

Ethics statement

This current study was submitted to and approved by the Control and Prevention Command Office of the COVID-19 pandemic in Longgang District, Shenzhen city, Guangdong Province, and the Longgang Center for Chronic Disease Control of Shenzhen and adhered to the Declaration of Helsinki. All participants provided informed consent before completing the online survey, by reading the instructions along with this study's purpose and significance of the survey. They were guaranteed confidentiality and were asked to choose "yes" or "no" for participating in the survey. If they chose "no", they would not have to continue the study. Otherwise, the survey would go on. All participants in this study were above the age of 18.

Results

Socio-demographic data

Their socio-demographic characteristics of the 173 participants are presented in Table 1. Of the 173 participants in the present study, 99 (57.23%) were women. The mean age was 35.44 ± 7.69 years with a range from 21 to 57 years. 67.05% ($n = 116$) of participants were married. Of these health professionals, 33.53% ($n = 58$) were medical care personnel, and 59.54% ($n = 103$) were public health personnel. More than half of them (53.76%) worked for more than 10 years since they qualified. Approximately, 31.79% ($n = 55$) worked in the epidemiological survey, and 58.96% ($n = 102$) had worked for more than 1 year in the control of COVID-19.

The prevalence and the degree of overlap of anxiety, depression, insomnia, and burnout

The average score in PHQ-9, GAD-7, and ISI was 7.55 ± 5.38, 5.71 ± 4.84, and 9.29 ± 6.20, respectively. Approximately 11.56% ($n = 20$) of individuals reported clinical depression, 19.08% ($n = 33$) participants showed clinical anxiety, and 19.08% ($n = 33$) scored in clinical insomnia. The proportion of the participants scoring in the high risk for each of the three MBI dimensions measured was as follows: EE 34.68% ($n = 60$), DP 41.62% ($n = 72$), and reduced

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TABLE 1 Characteristics of participants of health professionals ($N = 173$).

Variable		*n* (%)	%
Gender	Male	74	42.78
	Female	99	57.23
Age group (year)	<30	42	24.28
	30–39	79	45.66
	≥40	52	30.06
Educational level	High school and below	5	2.89
	College	143	82.66
	Postgraduate degree	25	14.45
Family income	Low	43	24.28
	Medium	116	67.05
	High	14	8.09
Years since qualified	<5	47	27.17
	5–10	33	19.08
	>10	93	53.76
Physical condition	Well	79	45.66
	General	84	48.56
	illness	10	5.78
Smoking	Yes	18	10.40
Drinking	Yes	40	23.12

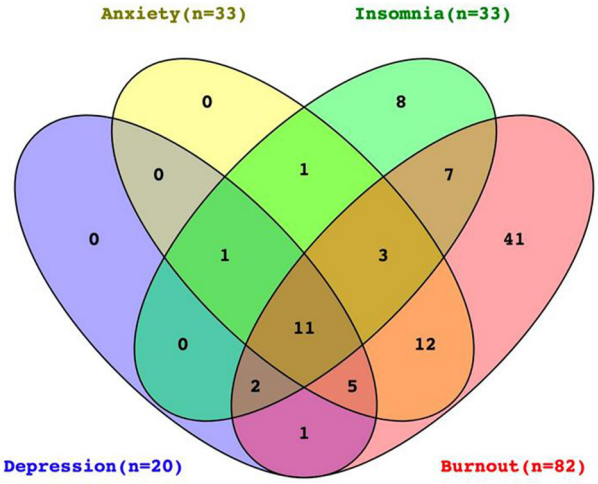

FIGURE 1
Venn diagram illustrates the degree of overlap between burnout status and clinically significant scores for depression, anxiety, and insomnia for participants with complete data on all four measures ($N = 173$). Ellipses of four colors, respectively, represent different adverse mental statuses. Yellow represents anxiety ($n = 33$), purple is depression ($n = 20$), green is insomnia ($n = 33$), and red is burnout ($n = 82$). The public collection part of ellipses means participants had two or more mental problems at the same time, and the figure in the ellipse represents the number of participants with this kind of psychological problem.

PA 92.49% ($n = 160$). The proportion meeting the criterion for burnout in this study (EE or DP) was 47.40% ($n = 82$). The average score of the positive coping in the SCSQ was 1.59 ± 0.59. The average score of the negative coping in the SCSQ was 1.22 ± 0.54. The tendency of coping was 0.37 ± 0.64. The average score of the GSES was 2.36 ± 0.61.

There was a significant degree of overlap between burnout status and clinically significant level of depression ($n = 14$), insomnia ($n = 23$), and anxiety ($n = 31$), most notably for anxiety (odds ratio, 27.049; 95% CI, 6.125–117.732; $p < 0.001$). A total of 11 participants were at risk of burnout, clinical depression, anxiety, and insomnia at the same time (Figure 1).

Univariate analyses

Table 2 shows the association between burnout and socio-demographics of participants, adverse mental health status, coping style, and self-efficacy. The results indicate that participants with smoking present significantly reduced PA compared with no smoking. Participants reporting low PA were less likely to cope actively. Participants in reduced PA showed a significantly low level of self-efficacy. Low PA was not related to the job nature of healthcare workers and other occupational and socio-demographic factors (except for smoking). More than 90% of participants in the present study showed a high risk of reduced PA regardless of their emotional status and sleep quality. There was no significant association between depression, anxiety, or insomnia with reduced PA.

Participants with low income were more likely to be at high risk of burnout compared with the ones with high income. Participants working in the epidemiological survey showed a significantly high risk of burnout than others. Compared with participants with no illness, the ones with illness presented a significantly high risk of burnout. Participants reporting burnout were more likely to be depressive, insomniac, and coping negatively, compared with staff not at high risk of burnout. There was no significant difference in the level of self-efficacy between the group with burnout and the group without burnout. No significant findings were presented in the association of age, gender, marital status, educational level, profession, years since qualified, years of controlling COVID-19, drinking, and smoking with burnout.

Hierarchical logistic regression

Those variables significantly associated with burnout in the univariate analysis entered the hierarchical logistic regression model for burnout. Socio-demographics and adverse mental states of depression, anxiety, and insomnia were added in model 1, and other variables significantly associated such as negative coping style were added in model 2. There was a significant additional improvement in fit for the models for burnout outcomes after the negative coping style was added, with increases in Nagelkerke Pseudo R^2 of 0.052 for burnout. In model 1, the result showed that the work nature of the epidemiological investigation was associated

TABLE 2 Comparison in the associated factors of burnout and reduced PA ($N = 173$).

Variable		Reduced PA (*n*, %)	Burnout (EE or DP) (*n*, %)
Age group (year)	<30	39, 92.86	20, 47.62
	30–39	74, 93.67	40, 50.63
	≥40	47, 90.38	22, 42.31
χ^2		0.498	0.873
p		0.779	0.646
Gender	Male	66, 89.19	36, 48.65
	Female	94, 94.95	46, 46.46
χ^2		2.022	0.081
p		0.155	0.776
Marital status	Others	53, 92.98	29, 50.88
	Married	107, 92.24	53, 45.69
χ^2		0.030	0.413
p		0.862	0.521
Education	High school and below	5, 100.00	2, 40.00
	College	131, 91.61	67, 46.85
	Postgraduate degree	24, 96.00	13, 52.00
χ^2		1.009	0.339
p		0.604	0.844
Household income	Low	41, 95.35	26, 60.47
	General	107, 92.24	53, 45.69
	High	12, 85.71	3, 21.43
χ^2		1.441	6.868
p		0.487	0.032*
Profession	Medical care personnel	54, 93.10	23, 39.66
	Public health personnel	95, 92.23	55, 53.40
	Others	11, 91.67	4, 33.33
χ^2		0.053	3.834
p		0.974	0.147
Years since qualified	<5	44, 93.62	24, 51.06
	5–10	32, 96.97	15, 45.45
	>10	84, 90.32	43, 46.24
χ^2		1.667	0.354
p		0.434	0.838
Work nature	Epidemiological survey	50, 90.91	34, 61.82
	Sampling	46, 92.00	20, 40.00
	Others	64, 94.12	28, 41.18
χ^2		0.474	6.740
p		0.789	0.034*
Years of controlling COVID-19	<0.5	39, 95.12	21, 51.22
	0.5–1	28, 93.33	16, 53.33
	>1	93, 91.17	45, 44.12
χ^2		0.693	1.104
p		0.707	0.576
Physical condition	Well	73, 92.41	28, 35.44
	General	79, 94.05	48, 57.14
	With illness	8, 80.00	6, 60.00
χ^2		2.539	8.365
p		0.281	0.015*
Smoking	No	14, 77.78	71, 45.81
	Yes	146, 94.19	11, 61.11
χ^2		6.253	1.515
p		0.012*	0.218
Drinking	No	36, 90.00	58, 43.61
	Yes	124, 93.23	24, 60.00
χ^2		0.463	3.314
p		0.496	0.069
Depression	No	142, 92.81	63, 41.18
	Yes	18, 90.00	19, 95.00
χ^2		0.201	20.552
p		0.654	0.000***
Anxiety	No	129, 92.14	51, 36.43
	Yes	31, 93.94	31, 93.94
χ^2		0.124	35.427
p		0.725	0.000***
Insomnia	No	130, 92.857	59, 42.14
	Yes	30, 90.91	23, 69.70
χ^2		0.146	8.132
p		0.703	0.004**
Tendency of coping (*z*-value)		160, −0.089 ± 1.095	82, −0.421 ± 1.065
t		−3.780	−4.955
p		0.000***	0.000***
Level of self-efficacy		160, 2.32 ± 0.602	82, 2.28 ± 0.589
t		-3.390	−1.590
p		0.001**	0.114

(Continued)

TABLE 2 (Continued)

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

with two times the risk of endorsing burnout. Anxiety was an independent risk factor for burnout. In model 2, the work nature of the epidemiological investigation was not still associated with the high risk of burnout, whereas anxiety was still associated with the high risk of burnout, and coping style was significantly negatively correlated with the high risk of burnout. Physical condition, depression, and insomnia were not independent risk factors of burnout. The results are presented in Table 3.

Discussion

We studied 173 healthcare workers participating in our survey on the topic of burnout and associative emotional status and coping style. This study confirmed a lower prevalence of depression, anxiety, and insomnia among health professionals during the COVID-19 pandemic, compared with the reviews of the prevalence of mental status among healthcare workers by Mahmud et al. (27) and by Sahebi et al. (28) and also with the review of the prevalence of mental health problems among the global population (29). However, our findings of the prevalence rate of anxiety and insomnia were higher, and the rate of depression was lower than that reviewed by Xiong et al. (30). The significant level of heterogeneity of prevalence could be due to the stigma of psychological problems among medical staff, psychological measurement tools, cutoff value, and the phases and conditions of the COVID-19 pandemic in different studies. This study chose a high threshold value, and the physical and mental status of participants in this study could adapt and adjust more than 2.5 years after the COVID-19 outbreak, which may partly explain the lower prevalence rate of depression, anxiety, and insomnia. Whether the prevalence of psychological problems will be decreasing or not in future needs to be confirmed by other studies, and further research is needed in the area.

The findings presented that nearly half of the health professionals in our study had experienced a high risk of burnout. In addition, approximately a third, over 40%, and more than 90% of these workers showed severe levels of EE, DP, and low PA, respectively. These values of EE, DP, and PA were slightly different in the studies (31–34). Hyman et al. found a higher EE value and a lower DP and reduced PA in anesthesiologists than in our survey. A national cross-sectional study in China before the outbreak of COVID-19 showed that the high-risk rate of burnout was 44.2% (32). In one other study, 9.7% of Indian healthcare workers during the early stage of the COVID-19 pandemic were showing a high risk of burnout (35), which was lower than our result. The average age of subjects in our study was 35 years old; however, some research showed that being relatively young often tended to a high risk of burnout (34). The discrepancy in the prevalence rates of burnout in the given study could be associated with the COVID-19 pandemic time, place, and other conditions such as work factors. This study was carried out during the COVID-19 pandemic, and we think COVID-19 is an important influencing factor of burnout; however, the present research cannot completely rule out the influence of work factors on burnout, and further research is needed to clarify the relationship between work factors and burnout.

It was worth noting that our study showed a relatively high value in reduced PA than other studies (32, 35, 36). Not like the associated factors of burnout in this finding, the high level of reduced PA of healthcare workers for controlling the epidemic was not related to negative mental emotions of depression or anxiety and insomnia. The level of self-efficacy and coping style affected the PA value of participants. Subjects with reduced PA showed a low level of self-efficacy. Healthcare workers with a low sense of achievement were more likely to adopt negative coping such as smoking in the present study. PA was associated with job satisfaction. The high level of reduced PA in our study could be attributed to the fact that participants were involved in work of COVID-19 prevention and control for more than 2 years, rather than the daily work that they are good at. Otherwise, these professionals worked in centralized isolated conditions, isolated from society and family, in a hall where the sun did not shine and they could not tell day from night. Furthermore, they had to sacrifice personal time and spend more time on work and needed to participate in epidemic response as needed at any time. Medical staff in epidemic control had to waste time on complex paperwork required for reporting and meetings. Inevitably, little work value and too much energy consumption among participants in this study would lead to low personal accomplishment.

A significant relationship had been observed between anxiety, depression, insomnia, passive coping, and burnout in our study. This study showed a high overlap between anxiety and burnout. The results presented that participants with a high risk of burnout were highly comorbid with anxiety especially, and anxiety was a significant independent high-risk factor of burnout. Emotional illness was one of the key obstacles for medical staff (37). The study by Reitz et al. revealed reducing the detrimental effect of anxiety may reduce the risk of burnout among healthcare providers (38). In one other study, Sun et al. tested that anxiety and depression as a potential moderating effect worsened occupational burnout (39). Furthermore, Deneva et al. verified a significant positive correlation between burnout and depression (40). In contrast to the reports earlier, in the present study, depression was not significantly independent relative to burnout. The contradictory results need further research to explore the relationship between burnout and depression. However, the consensus in previous and present studies was that there was a clear correlation between anxiety and burnout. Ameliorative strategies to reduce anxiety could be used to mitigate burnout among healthcare workers. Not like other studies, the results in the present study did not show any significantly associated socio-demographic factors such as age, gender, marital status, or occupation of burnout.

Coping passively was an independent risk associated with burnout observed in the present study. Liu et al. and Yu et al. similarly reported that burnout was positively associated with passive coping styles among Chinese nurses (41, 42). Coping style plays a mediating role in burnout (43), for example, negative coping styles mediate the association between burnout and anxiety symptoms in Chinese physicians (44). Although some surveys explored the relationship between burnout and coping or adverse mental status, less was available about how the level of self-efficacy affected burnout among healthcare workers. The high risk of burnout in vascular surgery trainees was associated with

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TABLE 3 Hierarchical logistic analysis of burnout and significant factors associated.

Variables	Model 1			Model 2		
	OR (CI)	B	*P*	OR (CI)	B	*P*
Household income						
Low	–	–	–	–	–	–
General	Reference	Reference	Reference	Reference	Reference	Reference
High	–	–	–	–	–	–
Work nature						
Epidemiological survey	2.380 (1.074–5.273)	0.867	0.033*	2.072 (0.905–4.743)	0.729	0.085
Sampling	0.664 (0.273–1.618)	−0.409	0.368	0.554 (0.218–1.403)	−0.591	0.213
Others	Reference	Reference	Reference	Reference	Reference	Reference
Physical condition						
Well	–	–	–	–	–	–
General	Reference	Reference	Reference	Reference	Reference	Reference
With illness	–	–	–	–	–	–
Depression						
Anxiety	32.050 (7.127–144.122)	20.434	0.001**	23.889 (5.216–109.414)	3.173	0.000***
Insomnia						
Negative coping	–	–	–	1.869 (1.261–2.770)	0.625	0.002**

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

higher levels of depression and lower levels of self-efficacy reported by Janko et al. (45). Yao et al. (46) showed that self-efficacy as an important and protective factor did a mediating effect of stress on job-related burnout. In contrast, this study explored the relative impact of self-efficacy on the outcome of burnout, and no significant relationship had been observed between self-efficacy and burnout.

There are some innovations in this study. First, the survey was carried out in a centralized isolated environment and a special work mode of long-term separation of participants from family. Those subjects faced high stress and uncertainty. Second, many studies had noticed anxiety, depression, and insomnia in medical staff, and we further explored the association between burnout and adverse emotional status, insomnia, coping style, and level of self-efficacy. The results showed that the incidence of burnout was high, especially the low PA, which is rare in other studies. Finally, this study is realistic and has a certain reference value for similar research work in future.

In the past 2 years and more during the COVID-19 pandemic, it was difficult for most humans, especially the medical staff to manage epidemic prevention. No one could tell them when the epidemic would end and when they could return to their original jobs. China faces and will face multiple peaks of COVID-19 infection like the rest of the world. Healthcare workers are committed to guarding the life and health of the public, and it needs to pay attention to their mental health, dilute medical exception theory, and ease emphasis on personal responsibility. It is important to assess the mental status and adopt multiple coping strategies and improve self-efficacy to deal with burnout during and after the COVID-19 pandemic.

Care and support for medical staff should be strengthened. Health authorities and institutional leaders should take the responsibility for promoting the health of the medical workplace and improving the health of the medical staff from the system level. The psychological health problems of the staff need to be paid attention to. Medical administrators need actively understand and coordinate to solve the actual difficulties and needs of the medical staff and take a systematic approach to solve the burnout and mental problems of the medical staff, such as eliminating the stigma of psychological problems, providing psychological resources, actively creating a good working environment, limiting working hours, reducing workload, and providing individually tailored mental health protection.

Limitations

Although there are important discoveries revealed by this study, there are also limitations. First, this is a cross-sectional survey with a small sample size, which limits the generalizability of the results. Second, our results can only present an association rather than causation between anxiety, coping style, and burnout. Third, it is hard to fully rule out reporting errors by self-reported data, and subjects may be affected by recall bias and high social expectations for medical staff, who bear more personal responsibilities, medical missions, or commitments, face the stigma of mental health problems, and find it more difficult to actively express their psychological discomfort. Finally, although younger people were more affected by major depressive disorder and anxiety disorders, our results may not be generalized to all professionals as

the study sample was relatively young (mean = 35 years) and might face greater social and occupational stress and burnout in China.

Conclusion

This study confirmed the previous findings that burnout was very common among medical staff. Participants involved in COVID-19 epidemic control in the post-epidemic era were at high risk of burnout, and most of them were in low personal accomplishment. Anxiety and negative coping styles were significantly and independently associated risk factors for burnout among healthcare workers. Reducing anxiety and improving coping style may effectively alleviate burnout in healthcare workers. Medical management institutions should provide care and support from the system level for medical staff.

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 Longgang Center for Chronic Disease Control, Shenzhen. The patients/participants provided their written informed consent to participate in this study.

Author contributions

CY and CW conceived and designed the experiments. CY and XW performed the experiments. XZ and WL analyzed the data. CY, XW, and CW wrote the manuscript. 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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Association between use of psychotropic medications prior to SARS-COV-2 infection and trajectories of COVID-19 recovery: Findings from the prospective Predi-COVID cohort study

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Psychological disturbances are frequent following COVID-19. However, there is not much information about whether pre-existing psychological disorders are associated with the severity and evolution of COVID-19. We aimed to explore the associations between regular psychotropic medication use (PM) before infection as a proxy for mood or anxiety disorders with COVID-19 recovery trajectories. We used data from the Predi-COVID study. We followed adults, tested positive for SARS-CoV-2 and collected demographics, clinical characteristics, comorbidities and daily symptoms 14 days after inclusion. We calculated a score based on 16 symptoms and modeled latent class trajectories. We performed polynomial logistic regression with PM as primary exposure and the different trajectories as outcome. We included 791 participants, 51% were men, and 5.3% reported regular PM before infection. We identified four trajectories characterizing recovery dynamics: "Almost asymptomatic," "Quick recovery," "Slow recovery," and "Persisting symptoms". With a fully adjusted model for age, sex, socioeconomic, lifestyle and comorbidity, we observed associations between PM with the risks of being in more severe trajectories than "Almost Asymptomatic": "Quick recovery" (relative risk (95% confidence intervals) 3.1 (2.7, 3.4), "Slow recovery" 5.2 (3.0, 9.2), and "Persisting symptoms"11.7 (6.9, 19.6) trajectories. We observed a gradient of risk between PM before the infection and the risk of slow or no recovery in the first 14days. These results suggest that a pre-existing psychological condition increases the risk of a poorer evolution of COVID-19 and may increase the risk of Long COVID. Our findings can help to personalize the care of people with COVID-19.

KEYWORDS

latent class trajectory analyses, symptom score, psychotropic medication, depressive symptoms, anxiety, mental health, COVID-19, cohort study (or longitudinal study)

1. Introduction

The severity of COVID-19 is heterogeneous and can range from asymptomatic to extreme severity and death (1). During the first weeks of the infection, the COVID-19 disease often presents clinically with mild symptoms and recovery at the end of the second week. However, the severity of COVID-19 may vary in some people with aggravation or persistent symptoms, now known as long COVID (2). A study that analyzed the acute symptoms reported that specific symptoms such as fatigue might predict hospital care and respiratory support (3). A cohort study showed that individuals older than 65 had a higher risk of persistent symptoms after the acute Covid infection phase, such as respiratory insufficiency, hypertension, kidney problems, memory complaints and mental health conditions (4).

People with a more severe gravity at an early stage have a higher risk of developing chronic symptomatology in the long term (5). Therefore, early symptoms are essential to predict future long COVID: more than five symptoms during the first week of infection is associated with a higher risk of developing long COVID (6). Galal et al. created a symptom score that, at the acute stage, was correlated with long COVID symptoms (7). Using a score of symptoms can help analyze the severity of the disease.

The COVID-19 pandemic had a significant impact on the mental health of the population (8, 9). There is evidence of the impact of COVID-19 symptoms on short and long-term psychological symptoms (10, 11). A recent study revealed the association between psychological distress and concomitant COVID-19 symptoms (12). Moreover, there is some evidence of the effect of depression on immunity (13). While there is much evidence of how COVID-19 infection and lockdown influence mental health trajectories, there is evidence of a higher risk of COVID-19 infection in people with pre-existing psychological comorbidity (14). However, it is unknown whether people with psychological disorders could evolve differently concerning COVID-19 symptoms.

Therefore, the objective of this study was to analyze the role of anxiety or mood disorders as a determinant of COVID-19 symptom trajectories.

2. Method

2.1. Participants

The Predi-COVID study is an ongoing hybrid cohort of people with confirmed SARS-CoV-2 infection. Participants were invited to Predi-COVID if they were SARS-CoV-2 positive and older than 18 years old. Inclusion was performed at the time of acute illness, at the hospital or home, either with or without symptoms, between May 2020 and June 2022. Due to the unknown about the spread of this pandemic, the sample size was not determined *a priori*. The baseline assessment consisted of data collected *via* phone calls and online questionnaires about demographics, epidemiological factors, lifestyle, comorbidity, and biomarkers. In addition, there were questions about medications, including the use of psychotropic medications. Then, there were daily questionnaires for 14 days about general health status and COVID-19-related symptoms. More details about the study are described elsewhere (15). The National Research Ethics Committee approved the study. All participants signed informed consent.

2.1.1. Inclusion criteria

We included adult participants from the study with a positive PCR who had completed the baseline questionnaires and information about each medication they took regularly and had participated in at least one out of the14 days of the daily assessment.

2.2. Study design

This study is a secondary data analysis of the Predi-COVID study. It is a longitudinal latent class trajectory analysis with a follow-up of 14 days.

2.3. Outcome and main exposure

The outcome was 14-day trajectories of a total number of COVID-19-related symptoms. Filling an e-questionnaire proposed daily for 14 days after baseline, the participants answered questions about 16 symptoms (Supplementary Table 1). We then calculated a score representing the severity of the disease based on the 16 symptoms. The symptoms were: fatigue/feel bad, cough, cough aggravation, sore throat, loss of taste/smell, diarrhea, muscle aches, chest pain, pain scale, fever, difficulty breathing, increased breath difficulties, eating or drinking difficulties, skin rashes, conjunctivitis, and other symptoms. The fatigue/feel bad question had three possible answers: "I feel well," "I feel fatigued/tired, and "I feel bad." We assigned 0, 0.5 and 1 points, respectively. The pain scale asked to quantify pain chest from zero (no pain) to 10 (maximal pain). The values <2, ≥ 2 and < 3, ≥ 3 were recoded to 0, 0.5 and 1, respectively. For the 14 questions left, the possible answers were yes (reported symptom) or no (no reported symptom), and we assigned 1 and 0 values, respectively. The possible values of the score go from 0 points (no reported symptoms) to 16 points (all symptoms at a maximum value reported).

The primary exposure was the use of psychotropic medications (PM) at least three times a week before the COVID-19 diagnosis and assessed by a trained nurse during the inclusion phone call. The team checked the self-reported PM using information from each patient's list of declared medications. It classified them into antidepressants, anxiolytics, anticonvulsants, hypnotics and antipsychotic medication using the Anatomical Therapeutic Chemical codes.

2.4. Covariates

We assessed demographic, psychosocial and comorbidity at baseline as possible determinants of latent classes. Age was analyzed continuously. Smoking status was categorical (current, former and never smoker). Education was categorized into low (only primary) education and medium-high (secondary school and above). Income was categorized into low income (lowest income tertile) and moderate-high income (second and third income tertile). Work status was classified as unemployed and employed with the question "Do you have a professional activity?"

BMI was calculated as weight/height^2 (kg/m^2) and categorized as obesity with a BMI ≥ 30 kg/m^2 and no obesity with a BMI < 30 kg/m^2. Physical activity was calculated as the average of usual winter and summer physical activity, including walking, cycling,

gardening, cleaning and sport. It was categorized as low physical activity (first tertile) and moderate high physical activity (second and third tertile).

Diabetes was defined as a self-reported medical diagnosis or taking diabetes oral medication or insulin. Multimorbidity was defined as two or more chronic conditions among 16 conditions (self-reported hypertension, chronic heart disease, chronic lung disease, asthma, renal disease, moderate or severe liver disease, mild liver disease, chronic neurological disorder, cancer, chronic pulmonary disease, obesity, diabetes, rheumatic disease, malnutrition, COPD, other). Weight loss was defined as unintentional weight loss of 3 kg or more in the last 6 months before the COVID-19 infection. Polypharmacy was defined as taking two or more medications at least three times a week for any condition out of COVID-19.

2.5. Missing data

We assumed that missing data were missing at random. We described the percentage of missing data for each variable, and we applied multiple imputations to deal with missing data with the chained-equation approach (R package Mice) (16). The imputation model was performed by choosing the best predictors for missing data for each time point with the function "Quickpred" (17) and other relevant confounders and outcome variables. We imputed baseline predictors and missing values of symptoms for calculating scores. The symptom score was calculated from day 0 to day 14 *a posteriori* with the imputed symptom values in each imputed dataset. Then, we deleted the imputed values of scores of a day when the participant did not answer any of the questions about symptoms on that day. We generated 40 imputed datasets with 20 iterations. We tested the plausibility of imputed data with summary statistics.

2.6. Statistical analysis

We tested the distribution of continuous variables, and we described the numerical variables as mean (SD) when they were normally distributed and median (IQR) when they were not, and categorical variables with frequency (percentage).

We performed a latent class trajectory analysis (18) with one class, symptom trajectories as the outcome, and the day (ranging from 0 to 14) as the fixed and random effects. We tested four different structures assuming linearity or not: linear, non-linear Beta cumulative distribution function, non-linear Quadratic I-splines with five knots placed at quantiles of Y and non-linear I-splines with four equidistant nodes. We chose the model that had the lowest AIC. Then, we run seven models with the selected structure, each with one to seven classes. We applied the function grid and checked if the model achieved convergence. We chose the best model based on the following criteria the Bayesian Information Criterion (BIC) (the smallest the best), entropy (values from 0 to 1) should be equal or superior to 0.6 with each class should have at least 5% of the subjects (18, 19). We estimated for each individual the probability of correct classification with their posterior classification. We also described the baseline characteristics stratified by classes. We plotted the best model and then described the latent class associated with the lowest risk of disease severity.

We performed multinomial univariate logistic regression models. The trajectory of symptoms was the dependent variable, and PM was the determinant. We chose the class with the lowest trajectory regarding the number of symptoms at baseline as the reference. We progressively added confounders in the models. To be considered a confounder, the variable should be associated with the outcome symptom trajectory) and the exposure (psychological disturbances). Model 1 was adjusted for sex and age. Model 2 was further adjusted for work, income, smoking status, BMI, physical activity and multimorbidity. We did not include weight loss because we considered as a collider and polypharmacy was highly correlated with multimorbidity. We calculated the relative risk ratio as the exponentiated pooled coefficients of the imputed data sets and 95% confidence intervals according to Rubin's rules. We used R Studio (R version 4.0.2) for all the analyzes, "lcmm" R package for trajectory analysis and "nnet" R package for multinomial analysis. We used an alpha <0.05 to define statistical significance.

Study method and results are reported following the "Strengthening the Reporting of Observational Studies in Epidemiology" in Supplementary material (STROBE) (20).

3. Results

There were 1,037 adult participants in this cohort study positive for SARS-CoV-2. We excluded 75 participants that did not provide baseline data. We further excluded and participated in the baseline questionnaires. Then, we excluded 171 participants who did not participate in any of the daily questionnaires. Finally, we analyzed 791 participants (Supplementary Figure S1). Missing data ranged from 0 to 44%. The mean (SD) age of the population was 40.0 (12.5) years; 403 (51%) were men. Forty-two participants (5.3%) reported PM. We found that people who reported PM also reported more baseline symptoms, current smoking, and multimorbidity. We did not observe differences in sex, age, education, income, BMI, physical activity, blood group and diabetes (Table 1).

By comparing men and women, we found that men reported fewer baseline symptoms, were more frequently obese and inactive and were more regularly current smokers with diabetes and polypharmacy than women (Supplementary Table S2).

After testing the latent class model with four different link functions, we found the AIC were 30,958, 22,367, 24, 263 and 21,667 for linear distribution, beta distribution (concave, convex or sigmoïd transformations), spline distribution (5 equidistant knots) and spline with 3 equidistant nodes, respectively. We chose the model with the lowest AIC value, the spline with 3 knots at quantiles. Then, by fitting seven models with 3-equidistant spline models with trajectories from 1 to 7. Supplementary Table 3 details the result of the process of selection of classes. It shows the model with 3 knots fitted with 1 to 7 trajectories. The spline model with 3 knots and four symptom trajectories was chosen (lowest BIC and more than 5% in each class).

Figure 1 shows the four symptom trajectories. "Almost asymptomatic" characterized people with very few baseline symptoms with a course of symptoms that did not increase or decrease. "Quick recovery" characterized people who seemed to recover remarkably well, with slight to moderate symptoms that tended to decline to achieve the same level as "Almost asymptomatic." "Slow recovery" characterized people with mild to moderate baseline symptoms, with

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TABLE 1 Characteristics of the sample population stratified by the use of psychotropic medications.

Characteristic	All sample (*n*=791)	Use of psychotropic medications (*n*=42)	No use of psychotropic medications (*n*=749)	*p* value
Symptoms, number	3.7 (±2.8)	5.5 (±2.6)	3.6 (±2.8)	<0.001
Men	403 (51%)	23 (55%)	380 (55%)	0.727
Age, years	40.0 (±12.5)	43.0 (±11.7)	39.8 (±12.5)	0.105
Only primary school	407 (51%)	19 (45%)	388 (51%)	0.503
Lowest tertile income (<3,000€/month)	128 (16%)	6 (14%)	122 (16%)	0.898
Unemployed	163 (21%)	11 (26%)	152 (21%)	0.469
BMI, mean (SD), kg/m2	25.5 (±4.7)	26.2 (±4.6)	25.5 (±4.7)	0.316
Obesity	114 (14%)	6 (14%)	108 (14%)	1.000
Physical activity (MET-h/week)	14.5 (±10.0)	15.1 (±10.6)	14.5 (±10.0)	0.707
Lowest tertile of physical activity	248 (31%)	14 (33%)	234 (31%)	0.910
Current smoker	144 (18%)	13 (31%)	131 (18%)	0.016
Former smoker	147 (19%)	11 (26%)	136 (19%)	0.016
Never smoker	500 (63%)	18 (43%)	482 (63%)	0.016
Blood group A	286 (36%)	10 (24%)	276 (36%)	0.122
Diabetes	22 (3%)	3 (7%)	19 (3%)	0.199
Multimorbidity	72 (9%)	11 (26%)	61 (9%)	<0.001
Weight loss	99 (13%)	8 (19%)	91 (13%)	0.282
Polypharmacy	62 (8%)	8 (19%)	54 (8%)	0.013

MET, metabolic equivalent task. **p* value calculated with Chi squared test among classes for categorical variables and non-paired t test for continuous variables.

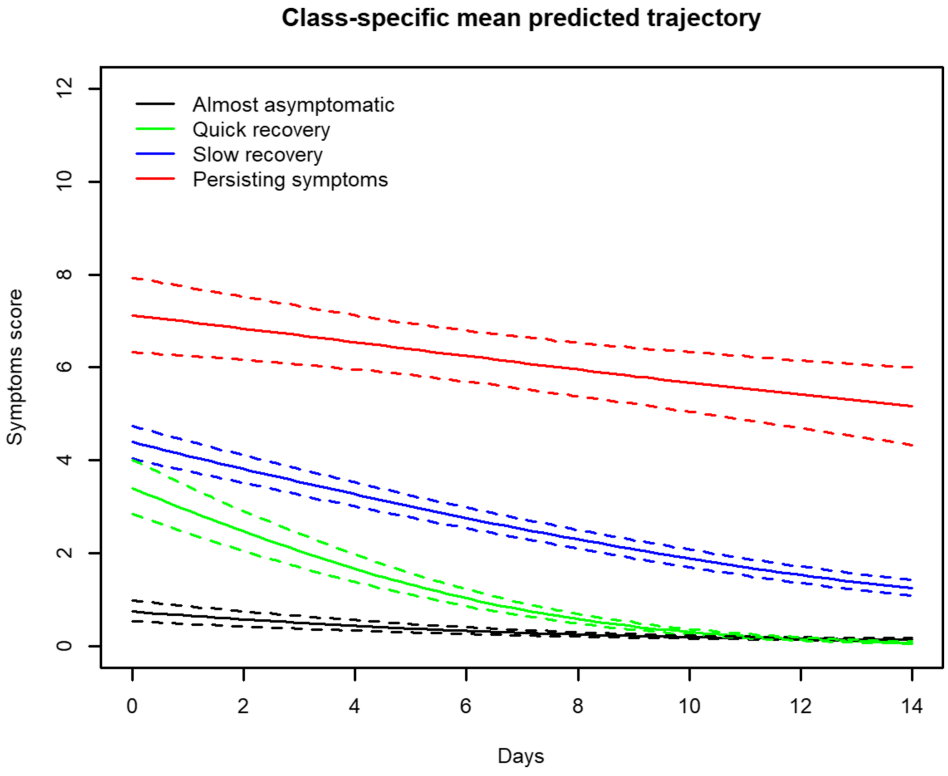

FIGURE 1
Symptom trajectories of 791 adults tested positive for SARS-CoV-2. The symptoms were reported (asked from a list of 16 symptoms) at baseline and every day after the baseline during 14 days.

a tendency to recover but less quickly than that observed in the "Quick recovery symptom trajectory. "Persisting symptoms" characterized people who started with moderate or severe symptoms and failed to recover in 2 weeks, remaining at a high abnormal level of symptoms at the end of the follow-up.

Our model showed that the mean of the true positives was 0.81, with true positives ranging from 0.88 ("Persisting symptoms "trajectory given "Persisting symptoms") to 0.72 ("Quick recovery" given "Quick recovery"). The mean of the false positives was 0.06 and ranged from 0.18: "Almost asymptomatic" given "Quick recovery" to 0: "Persisting symptoms "given "Almost asymptomatic" and "Persisting symptoms"given "Quick Recovery (Supplementary Figure S2).

The symptom score ranged from 0 to 13 points at baseline, and the median (IQR) was 3.5 (1.5, 5.5) points and varied according to the trajectory. Supplementary Figure S3 shows baseline symptoms for the total sample and by symptom trajectory. The most frequent symptoms at baseline in the total sample were muscle ache (44.6%), other symptoms (41.0%) and cough (36.8%). Baseline symptoms were more frequent in the "Persisting Symptoms" trajectory than in other trajectories. In particular, the pain was frequent in the "Persisting symptoms"trajectory (69.4%) and less frequent in the other trajectories (11.6, 24.2 and 33.5% in the "Almost asymptomatic," "Quick recovery," and "Slow recovery" trajectories, respectively. Also, fatigue was overrepresented in the "Persisting Symptoms" trajectory.

Table 2 shows the general characteristics of people in each trajectory. The "Almost asymptomatic" symptom trajectory ($n = 264$) showed the lowest frequency of PM (n = 4, 2%) and the lowest mean number of symptoms at baseline (1.0 (±1.3)). In this trajectory, men were more represented ($n = 161$, 66%), people had the lowest frequency of unintentional weight loss ($n = 18$, 7%), and were more frequently unemployed ($n = 64$ (26%).

"Quick recovery" trajectory ($n = 178$) was characterized by a low frequency of PM (n = 7, 4%) and a higher frequency of baseline symptoms (5.3 (±2.0)) than "Almost asymptomatic," the lowest mean age (37.3 (±11.3)), the lowest frequencies of diabetes ($n = 2$, 1%), multimorbidity (n = 11, 6%) and polypharmacy ($n = 10$, 6%).

"Slow recovery" trajectory ($n = 306$) with similar baseline mean symptoms (5.0 (±2.4)) to "Quick recovery," had higher frequencies of PM ($n = 23$, 7%), and weight loss (n = 53, 17%) compared to "Almost Asymptomatic."

"Persisting symptoms" trajectory ($n = 54$) presented the highest mean number of symptoms at baseline among the other trajectories (6.8 (±3.0)), and compared to other trajectories had the highest frequencies of PM ($n = 8$, 15%), women ($n = 36$, 67%), diabetes ($n = 5$, 9%), multimorbidity ($n = 10$, 19%), weight loss ($n = 10$, 19%), and polypharmacy ($n = 8$, 15%). They also had the lowest frequencies of unemployment ($n = 7$, 13%).

We found that the most frequent psychotropic medication was Sertraline, and the most frequent type of psychotropic was

TABLE 2 Characteristic s of the population by trajectory of symptoms.

Variable	All sample (n=791)	Almost asymptomatic (n=244)*	Quick recovery (n=178)	Slow recovery (n=315)	Persisting symptoms (n=54)	p value
	N (%) or Mean (±SD)	N (%) or Mean (±SD)	N (%) or Mean (±SD)	N (%) or Mean (±SD)	N (%) or Mean (±SD)	
Psychotropic medications	42 (5%)	4 (2%)	7 (4%)	23 (7%)	8 (15%)	<0.001
Symptoms at baseline	3.7 (±2.8)	1.0 (±1.3)	4.3 (±2.0)	5.0 (±2.4)	6.8 (±3.0)	<0.001
Men	403 (51%)	161 (66%)	84 (47%)	140 (44%)	18 (33%)	<0.001
Age, mean (SD), years	40.0 (±12.5)	40.5 (±13.5)	37.3 (±11.3)	40.6 (±12.5)	43.5 (±10.3)	0.003
Only primary school	407 (51%)	127 (52%)	101 (57%)	157 (50%)	22 (41%)	0.184
Lowest tertile income (<3,000€/month)	128 (16%)	42 (17%)	28 (16%)	52 (17%)	6 (11%)	0.737
Unemployed	163 (21%)	64 (26%)	35 (20%)	57 (18%)	7 (13%)	0.047
BMI, mean (SD), kg/m^2	25.5 (±4.7)	25.7 (±4.5)	25.3 (±4.4)	25.3 (±4.7)	26.8 (±6.0)	0.121
Obesity	114 (14%)	41 (17%)	25 (14%)	39 (12%)	9 (17%)	0.489
Physical activity, mean (SD) (MET-h/week)	14.5 (±10.0)	14.7 (±10.3)	14.1 (±9.7)	14.5 (±9.7)	14.9 (±10.9)	0.927
Lowest tertile of physical activity	248 (31%)	77 (32%)	58 (33%)	94 (30%)	19 (35%)	0.842
Current smoker	144 (18%)	51 (21%)	27 (15%)	59 (19%)	7 (13%)	0.551
Former smoker	147 (19%)	38 (16%)	38 (21%)	60 (19%)	11 (20%)	0.551
Never smoker	500 (63%)	155 (64%)	113 (63%)	113 (63)	11 (67%)	0.551
Blood group A	286 (36%)	99 (41%)	60 (34%)	107 (34%)	20 (37%)	0.362
Diabetes	22 (3%)	8 (3%)	2 (1%)	7 (2%)	5 (9%)	0.013
Multimorbidity	72 (9%)	21 (9%)	11 (6%)	30 (10%)	10 (19%)	0.051
Weight loss	99 (13%)	18 (7%)	18 (10%)	53 (17%)	10 (19%)	0.003
Polypharmacy	62 (8%)	20 (8%)	10 (6%)	24 (8%)	8 (15%)	0.178

MET, metabolic equivalent task.

antidepressants (Supplementary Table S4). The density distribution of the symptom score at baseline was different in the population with or without PM, with a median value of 3 and 5 for the population without and with PM, respectively. (Supplementary Figure S4). The percentage of people taking PM varied according to the trajectory of symptoms, being more frequent in the symptom trajectories "Persisting Symptoms" and "Slow Recovery" and, in particular, it was antidepressants and anxiolytics (Supplementary Figure S5).

Table 3 shows the association of PM with the risk of belonging to a symptom trajectory using a multivariate polynomial analysis. The dependent variable was the trajectory with the "Almost Asymptomatic" as the reference level, and the predictor was PM. With the most adjusted model, we found that PM was significantly associated with a higher risk of belonging to "Quick recovery" [RR 3.1 (95% CI 2.7, 3.4)], "Slow recovery" [RR 5.2 (95% CI 3.0, 9.2)] and "Persisting Symptoms" [RR 11.7 (95% CI 6.9, 19.6)] than "Almost asymptomatic" trajectory.

4. Discussion

In this cohort study, PM was associated with more severe symptom trajectories. In people with PM, we observed poorer recovery during the first 2 weeks after the infection, even after adjusting for relevant confounders. We identified four trajectories of COVID-19 severity, with a score reflecting the reported total number of symptoms. We found that the symptom trajectories and recovery were heterogeneous and identified groups of people within these trajectories. This study is the first to perform latent class trajectory analysis of early COVID-19 symptoms.

Carrat et al. found among a group of risk factors that preexisting anxiety was associated with COVID-19-Like Symptoms (21). Castro et al., in a retrospective longitudinal analysis, found that people with preexisting mood disorders had a higher risk of COVID-19 mortality risk beyond day 12 after hospitalization (hazard ratio 1.540, 95% CI = 1.054, 2.250)) (22). Jeon et al. found that preexisting mental disorders were not associated with a higher susceptibility to COVID-19 infection but with mortality (23). Finally, Nishimi et al. studied 263,697 fully vaccinated patients and found that preexisting psychiatric disorders were associated with an increased incidence of COVID-19 infection (24). A systematic review and meta-analysis in COVID-19 found an association (cross-sectional or longitudinal) between preexisting mood or sleep disorders with a higher susceptibility to infection (pooled odds ratio 27 studies (95% confidence intervals) 1.67, (1.12, 2.49)), higher severity (21 studies 1.40 (1.25, 1.57)) and increased risk of death (29 studies 1.47 (1.26, 1.72)) (25). Our results agree with this previous research showing a more severe form of COVID-19 in people with increased psychological distress. These associations between anxiety or mood disorders and COVID-19 infection are likely bidirectional (26). Finally, a recent report analyzing 9,979 individuals diagnosed with COVID-19 showed that bedridden for more than 7 days had a higher risk of future depression than those who were never bedridden. These results highlight the bidirectional associations between depression and COVID-19 severity (27).

TABLE 3 Use of psychotropic medications to predict belonging to a trajectory: multivariate polynomial analysis.*

	Quick recovery (n=178)	Slow recovery (n=315)	Persisting symptoms (n=54)
Models[a]	RR (95% CI)[b]	RR (95% CI) [b]	RR (95% CI) [b]
Model 0	2.5 (0.8, 7.2)	4.7 (3.5, 6.5)	10.4 (3.0, 35.9)
Model 1	2.8 (2.8, 2.9)	5.2 (2.8, 9.5)	11.6 (3.9, 34.1)
Model 2	3.1 (2.7, 3.4)	5.2 (3.0, 9.2)	11.7 (6.9, 19.6)

Abbreviations: RR = relative risk. 95% CI = 95% confidence intervals. [a]Almost Asymptomatic was the reference level for trajectories. Model 0: Only main predictor; Model 1 = Model 0 adjusted by age and sex (not in stratified sex models); Model 2 = Model 1 adjusted by work status, income, education, smoking status, BMI, physical activity and multimorbidity. [b]Confidence intervals were calculated according to Rubin's rules.

Previous reports on COVID-19 found particular trajectories of psychological disorders, identifying groups of individuals sharing a specific evolution over time (28, 29). A cross-sectional analysis including 938 health care workers found a higher prevalence of psychological disorders (stress, depression, and anxiety) in COVID-19 infected health workers (30).

A recent study found that psychological distress during the first wave of COVID-19 was associated with the belief of having had a COVID-19 infection, reporting a higher number and more severe symptoms attributed to COVID-19 (12). Taquet et al., using electronic health data, including 62,354 people with a COVID-19 diagnosis, found that psychological disturbances had bidirectional associations with COVID-19 infection. There was an association between a pre-existing psychiatric condition and incident COVID-19 [relative risk = 1.5 (95% CI 1.5–1.71)] (26). Another study also used health records and found a similar association between pre-existing psychological disorders and higher risk for COVID-19 infection, hospitalization and mortality. The most substantial effect was observed in depression and future infection risk. They found an adjusted odds ratio of 7.64, 95% CI: 7.45–7.83, $p < 0.001$) (14). With data from the UK Biobank, Wang et al. found an association of preexisting mental disorders and COVID-19 incidence and severity. Anxiety [OR 1.29 (95% CI 1.17–1.42)] and depression [OR 1.22 (95% CI 1.13–1.31)] were associated with a higher risk of infection. Depression was also associated with a higher mortality risk post COVID-19 [OR 1.57 (95% CI 1.16–2.13)] (31).

An observational study on adults with psychiatric diagnoses and severe COVID-19 disease found that taking functional inhibitors of acid sphingomyelinase, a type of psychotropic, was associated with lower mortality in severe COVID-19 cases (32). We could not analyze whether there were differences according to the psychotropic medications due to the small number of people taking them in our sample.

Our findings agree with these studies, and we found, in addition, an association between PM and symptom trajectories. Among psychotropic medications, we observed that antidepressant and anxiolytics were overrepresented in the most severe symptom trajectories. Our results suggest that the symptoms trajectory would vary depending on the type of psychiatric diagnosis, observing more pronounced differences with more depression or anxiety diagnoses than psychotic or neurologic disorders. We think that the relationship between psychological disturbance and COVID-19 is bidirectional. The effect of PM on the symptom trajectories was higher in magnitude in "Persisting symptoms," suggesting that mood disorders/anxiety are associated with greater disease severity and poorer recovery.

We observed that pain and fatigue were over-represented in the "Persisting symptoms" trajectory. This finding aligns with two previous research that has shown associations between depressive

symptoms and post-COVID-19 fatigue (33) and pain symptoms (34) 3 months and 1 year after COVID-19 infection, respectively. Our findings show that the early evolution of COVID-19 can help predict later evolution.

We found that the overall tendency was to reduce symptoms, but with different recovery curves, some people achieved an almost total recovery while others achieved only partial recovery. Our findings align with a study that characterized trajectories of symptoms in the first weeks post-infection from SARS-CoV-2. They found similar results, although their analysis was about individual symptom trajectories and not a total score to assess overall disease severity (2). The healthiest group corresponds to "Quick recovery." We also found that unemployed people were mainly in the less risky "Almost asymptomatic" trajectory. These findings can be explained because unemployed people were less exposed to the virus.

We identified four distinct symptom trajectories. Previous research in a population of COVID-19 patients, 94% hospitalized and a mean age of 64 years, showed that men were more at risk of developing severe COVID-19 disease. They also observed that testosterone levels in men were inversely associated with severity (35). We found that "Almost asymptomatic" were over-represented by men. A possible explanation is that our population was much younger (mean age 39 years) and primarily asymptomatic or with mild disease (77%) compared to the previous study.

The underlying mechanisms that could explain the association between depression and COVID-19 severity are that they share inflammatory pathways with an increase in inflammatory biomarkers such as TNFα, interleukin 1-β and interleukin-6 (36). A possible mechanism for explaining the association between pre-existing anxiety and COVID-19 severity could be a higher neutrophil/lymphocyte ratio in patients with anxiety. Through a cortisol elevation, psychosocial stress is also associated with decreased immunity and a decrease in some cytokines (37). In animal models, the associated anxiety-induced reduction of immunity is not restricted to the cellular but also the humoral response (38).

Finally, there is evidence of the association of olfactory function through nasal inflammation and neuropsychiatric diagnoses, which is relevant because of the olfactory compromise of COVID-19 and perhaps due to vaccination (39, 40).

4.1. Strengths and limitations

This study has several strengths. In this cohort study, the questionnaires were online, and the COVID-19 diagnosis was ascertained with a PCR test. We analyzed a large sample size representing a large set of COVID-19-related symptoms tracked during 14 days with an innovative methodology to simultaneously characterize disease severity and recovery.

This study also has several limitations. The symptoms, determinants and confounders were self-reported, which could introduce reporting bias. Only 5% of the population reported PM, which limited the analysis to the total sample, making it impossible for relevant stratified analysis. The observed associations are strong in magnitude, but these results would now require confirmation in other populations, where this type of medication is frequent. We observed missing data and loss of follow-up, which might introduce biases. However, we performed multiple imputations with a state-of-the-art method. Multiple imputation techniques help reduce the bias if a complete-case analysis is performed. They also help increase the power of the analysis because each time there is an unanswered question in a questionnaire, there is a loss of information for calculating the total score (41). Our population did not include much older people, and few participants were recruited at the hospital, making it difficult to directly compare with previous works performed in hospital-based cohort studies with more severe cases. However, this study provides significant findings for the general population. Finally, with the unpredictable evolution of the pandemic due to vaccine discovery, the virus mutations and the surveillance or lack of it, likely, our findings may not fully represent what is going to be the future disease trajectories (42).

4.2. Conclusion

This study described four distinct symptom trajectories of COVID-19 with different recovery timing. We also showed that PM before the infection was associated with a greater risk of disease severity and a poorer recovery in the first 2 weeks. In addition to all the established risk factors of COVID-19, our findings could help identify at-risk individuals and personalize prevention strategies and care in case of infection to SARS-COV-2. The results of our study can be generalizable to a similar adult population of European origin.

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 National Research Ethics Committee of Luxembourg (CNER). The patients/participants provided their written informed consent to participate in this study.

Author contributions

GA contributed to the data curation, formal analysis, methodology, visualization, and writing the original draft. AF contributed to the conceptualization, data curation, and review and editing. AE contributed to data curation and review and editing. NL contributed to writing the original draft and reviewing and editing. MO contributed to conceptualization and review and editing. GF contributed to conceptualization, funding acquisition, methodology, supervision, and review and editing. 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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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1055440/full#supplementary-material

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The relationships of preventive behaviors and psychological resilience with depression, anxiety, and stress among university students during the COVID-19 pandemic: A two-wave longitudinal study in Shandong Province, China

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Introduction: Studies have shown that the psychological impact of the COVID-19 pandemic may lead to long-term health problems; therefore, more attention should be paid to the mental health of university students. This study aimed to explore the longitudinal effects of preventive behaviors and psychological resilience on the mental health of Chinese college students during COVID-19.

Methods: We recruited 2,948 university students from five universities in Shandong Province. We used a generalized estimating equation (GEE) model to estimate the impact of preventive behaviors and psychological resilience on mental health.

Results: In the follow-up survey, the prevalence of anxiety (44.8% at T1 vs 41.2% at T2) and stress (23.0% at T1 vs 19.6% at T2) decreased over time, whereas the prevalence of depression (35.2% at T1 vs 36.9% at T2) increased significantly ($P < 0.001$). Senior students were more likely to report depression (OR = 1.710, $P < 0.001$), anxiety (OR = 0.815, $P = 0.019$), and stress (OR = 1.385, $P = 0.011$). Among all majors, medical students were most likely to report depression (OR = 1.373, $P = 0.021$), anxiety (OR = 1.310, $P = 0.040$), and stress (OR = 1.775, P <0.001). Students who wore a mask outside were less likely to report depression (OR = 0.761, $P = 0.027$) and anxiety (OR = 0.686, $P = 0.002$) compared to those who did not wear masks. Students who complied with the standard hand-washing technique were less likely to report depression (OR = 0.628, $P < 0.001$), anxiety (OR = 0.701, $P < 0.001$), and stress (OR = 0.638, $P <0.001$). Students who maintained a distance of one meter in queues were less likely to report depression (OR = 0.668, $P < 0.001$), anxiety (OR = 0.634, $P < 0.001$), and stress (OR = 0.638, $P < 0.001$). Psychological resilience was a protective factor against depression (OR = 0.973, $P < 0.001$), anxiety (OR = 0.980, $P < 0.001$), and stress (OR = 0.976, $P < 0.001$).

Discussion: The prevalence of depression among university students increased at follow-up, while the prevalence of anxiety and stress decreased. Senior students and medical students are vulnerable groups. University students should continue to follow relevant preventive behaviors to protect their mental health. Improving psychological resilience may help maintain and promote university students' mental health.

KEYWORDS

COVID-19, college students, depression, anxiety, stress, resilience, longitudinal study

1. Introduction

Historically, humans have experienced various health emergencies caused by pandemics and epidemics worldwide. By 30 January 2020, the WHO had declared the COVID-19 outbreak to be a public health emergency of international concern (1). To efficiently address the COVID-19 outbreak, the Chinese government implemented rapid and comprehensive public health emergency interventions. From 24 January 2020, all 31 provincial-level regions in China with confirmed COVID-19 cases activated a Level 1 public health emergency response (2). To prevent the spread of the disease, the Chinese Government delayed the re-opening of all schools, including universities. Therefore, university students in China have been required to stay at home, in isolation, for longer periods of time, which may increase their risk of depression (3). Previous studies have shown that the COVID-19 pandemic has exerted negative psychological effects on people (4–6). Several cross-sectional studies have shown that Chinese university students experienced varying degrees of mental health problems during COVID-19 (7–9). One study has suggested that the psychological impact of the pandemic may lead to long-term health problems (10). Therefore, greater attention should be paid to the mental health of university students.

Wearing a mask (11), maintaining hand hygiene (12), and maintaining physical distance from others (13) during COVID-19 have been recognized as effective pandemic prevention measures and are strongly advocated by the WHO. The Chinese government implemented laws mandating these preventive behaviors (14, 15). Studies have found that engaging in preventive behaviors affects mental health. University students in Ethiopia who engaged in poor prevention practices were twice as likely to experience psychological problems due to COVID-19 (16). A study by Green et al. with university students in Pakistan showed that higher levels of fear of COVID-19 were linked to greater adherence to COVID-19 preventive behaviors (17). However, Ikram et al. showed that wearing a mask was a predictor of poor mental health among Asian Indians (18). In contrast, Abir et al. found that Bangladeshis who did not wear masks and who did not comply with WHO precautions were more likely to report psychological ill health (19). Guan et al. (20) found that positive preventive behaviors showed protective effects against anxiety among Chinese university students (20).

In the context of the COVID-19 pandemic, psychological resilience may be a potential factor affecting university students' mental health. Psychological resilience is the process and outcome of successful adaptation to difficult or challenging life experiences (21). A high level of resilience protects against various mental health conditions (22). Previous studies have shown that psychological resilience has been negatively correlated with depression, anxiety, and stress during COVID-19 (23–25). A study of young adults in Turkey during COVID-19 showed that resilience mediated the effect of finding meaning in life on young people's psychological, emotional, and social wellbeing. Therefore, resilience might modify the adverse effect of the coronavirus pandemic on young people's mental wellbeing (26). A study of Korean adults by Kim et al. showed that individual resilience had an effect on mental health after the COVID-19 outbreak (27). Additionally, a study conducted in Minnesota and Hong Kong found that individual resilience was associated with positive mental health during COVID-19 (28). Azizah et al. (29) found that lower levels of psychological resilience during the COVID-19 pandemic were associated with increased levels of depression, anxiety, and stress among university students (29). Similarly, Tan et al. (30) reported that psychological resilience had a strong positive effect on university students' mental health during the pandemic (30).

Most extant studies on the mental health of university students during COVID-19 have employed cross-sectional designs (31–33), with few studies conducting longitudinal investigations. Theoretically, existing research has shown that individual psychological factors and behaviors could affect health (34). However, to date, no study has longitudinally examined the relationship between preventive behaviors, psychological resilience, and mental health (depression, anxiety, and stress). Thus, this study explored longitudinal changes in mental health and the longitudinal effects of preventive behaviors and psychological resilience on the mental health of university students in Shandong Province, China during COVID-19 (as shown in the conceptual model in Figure 1). We conducted a large-scale longitudinal survey and followed up with the same population of students before and after the winter holiday and COVID-19 vaccination. We aimed to identify trends in the development of depression, anxiety, and stress to accomplish the abovementioned research purposes, and to provide stronger statistical evidence than can be obtained from cross-sectional data.

2. Methods

2.1. Study design and participants

This prospective study was conducted at five universities in Shandong Province. Various majors (such as art, science, medicine,

and agriculture) offered at the five universities were selected via stratified random sampling according to geographical location (east, middle, or west) and college category (key or general). Students from one class were randomly selected from each year of each selected major to participate.

A total of 4,832 students (valid response rate: 82%) completed the initial survey between 20 October 2020 and 6 November 2020 (T1); participants were on-campus, non-graduating students who were returning to campus after having studied under the pandemic-preventive order for approximately two months. During the second wave of the survey from 18 January to 25 January 2021 (T2), 4,408 students (valid response rate: 91.54%) completed the survey. During this period, the Chinese government began to provide COVID-19 vaccines for all citizens; this was also the time at which students returned home for the winter vacation after completing their autumn term of study on campus. Using the student numbers of the university students to match initial and follow-up responses, a total of 2,948 students were found to have participated in both the T1 and T2 surveys and were selected as our study participants.

2.2. Procedures

Due to limited resources and the implementation of social distancing, the survey was completed through the China Survey Star website. Informed consent was obtained from every student who participated in the study. Full-time counselors organized the administrative processes for both waves, and electronic questionnaires were distributed to class groups, where students were asked to fill them out within a specified time frame. Only one response was permitted from any IP address. For the second wave, counselors followed up with the students *via* WeChat and phone. After the data were collected, invalid sets of responses were removed, as identified by one of the three following criteria being met: (1) the response time was <120 s; (2) information on sociodemographic characteristics was missing or not relevant to the survey; or (3) the responses were illogical.

2.3. Measurement

2.3.1. Sociodemographic characteristics

The sociodemographic characteristics measured included gender (male vs. female), age, year of university study (1st year, 2nd year, 3rd year, or 4th/5th year), major (science, engineering, agriculture, liberal arts, art, or medicine), ethnicity (Han Chinese vs. minority), and student leader (yes or no).

2.3.2. Preventive behaviors

According to the WHO, preventive behaviors for COVID-19 include hand-washing, wearing a mask, and maintaining social distancing (35). Preventive behaviors were measured using the following questions: "Have you been wearing a mask outside in the past 2 weeks?" (yes/no), "Have you followed standard hand-washing techniques in the last 2 weeks?" (yes/no), and "Have you been standing one meter apart in line for the last 2 weeks?" (yes/no).

2.3.3. Depression anxiety stress scale

The DASS-21 was used to assess participants' levels of depression, anxiety, and stress. The scale consists of seven items on each dimension (depression, anxiety, and stress). Response options range from 0 to 3 (0 = *did not apply to me at all*, 1 = *applied to me to some degree, or some of the time*, 2 = *applied to me to a considerable degree or a good part of the time*, and 3 = *applied to me very much or most of the time*) (36). Additionally, because the DASS-21 is a short version of the original 42-item DASS instrument, DASS-21 scores were multiplied by 2 to characterize the level of severity relative to the population. Depression severity was classified into five categories: normal (0–9), mild (10–13), moderate (14–20), severe (21–27), and very severe (28+). Similarly, for anxiety, the categories were normal (0–7), mild (8–9), moderate (10–14), severe (15–19), and very severe (20+). Stress scores were categorized as normal (0–14), mild (15–18), moderate (19–25), severe (26–33), or very severe (34+) (37). The scores obtained on these three subscales were dichotomized (38). Specifically, students falling in the moderately, severely, and extremely severely depressed, anxious, and stressed categories were considered to be depressed, anxious, and stressed, respectively; others were considered to be not depressed, not anxious, and not stressed, respectively. Cronbach's alpha values in the current study for the depression, anxiety, and stress subscales were 0.915, 0.876, and 0.892, respectively, at T1, and 0.928, 0.901, and 0.917, respectively, at T2, indicating good internal consistency.

2.3.4. Psychological resilience (CD-RISC-10)

Psychological resilience was assessed using the Connor-Davidson Resilience Scale (CD-RISC-10), which consists of 10 items with 5 response options ranging from 0 (*never*) to 4 (*almost always*) (39, 40). The CD-RISC-10 is widely used to assess an individual's perception of their ability to thrive under adversity. Total scores range from 0 to 40, with higher scores indicating greater resilience. The CD-RISC-10 has been shown to have satisfactory validity and reliability in Chinese university students (41). In this study, Cronbach's α was 0.971 at T1 and 0.979 at T2.

2.3.5. Statistical analysis

First, we described the characteristics of participants at TI and T2 and used the chi-square test and paired *t*-tests to examine changes in depression, anxiety, stress, psychological resilience, and related variables for participants at both time points. Second, the longitudinal effect of psychological resilience on depression, anxiety, and stress was analyzed using generalized estimating equations (GEEs), and three models were built to control for confounding variables. Demographic characteristics were included in Model 1; demographic characteristics and pandemic preventive behaviors were included in Model 2; and demographic characteristics, pandemic preventive behaviors, and psychological resilience were included in Model 3. All statistical

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TABLE 1 Changes in COVID-19-related variables between T1 and T2.

Variables	T1	T2	χ^2/t	*P*
Gender				
Male	1,072 (36.4%)	1,072 (36.4%)		
Female	1,876 (63.6%)	1,876 (63.6%)		
Age	19.85 ± 1.449	20.20 ± 1.521	−9.061[b]	<0.001
Year of study				
1st year	762 (25.8%)	762 (25.8%)		
2nd year	661 (22.4%)	661 (22.4%)		
3rd year	796 (27.0%)	796 (27.0%)		
4th/5th year	729 (24.7%)	729 (24.7%)		
Major				
Science	502 (17.0%)	502 (17.0%)		
Engineering	830 (28.2%)	830 (28.2%)		
Agriculture	145 (4.9%)	145 (4.9%)		
Liberal arts	1,041 (35.3%)	1,041 (35.3%)		
Art	254 (8.6%)	254 (8.6%)		
Medicine	176 (6.0%)	176 (6.0%)		
Ethnicity				
Han	2,834 (96.2%)	2,834 (96.2%)		
Minority	113 (3.8%)	113 (3.8%)		
Student leader				
Yes	798 (27.1%)	798 (27.1%)		
No	2,150 (72.9%)	2,150 (72.9%)		
Wearing a mask outside				
No	277 (9.4%)	66 (2.2%)	21.228[a]	<0.001
Yes	2,671 (90.6%)	2,882 (97.8%)		
Compliance with the standard hand-washing technique				
No	684 (23.2%)	472 (16.0%)	416.307[a]	<0.001
Yes	2,264 (76.8%)	2,476 (84.0%)		
Maintaining a distance of one meter in queues				
No	1,161 (39.4%)	646 (21.9%)	340.813[a]	<0.001
Yes	1,787 (60.6%)	2,302 (78.1%)		
Psychological resilience	29.25 ± 8.406	29.22 ± 8.532	0.450[b]	0.653

[a]Chi-square test, [b]t-test.

tests were performed using IBM SPSS 26.0. Statistical significance was set at $P < 0.05$.

3. Results

3.1. Description of the sample and study variables

A total of 2,948 university students who completed both the baseline and follow-up surveys were included in the analyses.

TABLE 2 Prevalence of and change in depression, anxiety, and stress at T1 and T2.

	T1	T2	χ^2	*P*
Depression				
No (≤9%)	1,909 (64.8%)	1,861 (63.1%)	674.018[a]	<0.001
Yes (≥10%)	1,039 (35.2%)	1,087 (36.9%)		
Anxiety				
No (≤7%)	1,628 (55.2%)	1,734 (58.8%)	660.175[a]	<0.001
Yes (≥8%)	1,320 (44.8%)	1,214 (41.2%)		
Stress				
No (≤14%)	2,269 (77.0%)	2,370 (80.4%)	428.475[a]	<0.001
Yes (≥15%)	679 (23.0%)	578 (19.6%)		

Detailed sample demographics, along with data on preventive behaviors and psychological resilience at both time points, are shown in Table 1. University students who participated at both T1 and T2 were mostly women (63.6%). Participants were aged 19.85 ± 1.449 years at T1 and 20.20 ± 1.521 years at T2. The proportion of students who wore a mask outside was 90.6% at T1 and 97.8% at T2; the rate of compliance with the standard hand-washing technique was 76.8% at T1 and 84.0% at T2; and the proportion of students who maintained a one-meter distance in queues was 60.6% at T1 and 78.1% at T2. In all three cases, the proportion increased at T2. The average psychological resilience score at T2 was 29.22 ± 8.532, which was lower than that at T1 (29.25 ± 8.406; $P = 0.653$). As shown in Table 2, the prevalences of depression, anxiety, and stress at T1 were 35.2, 44.8, and 23.0%, respectively. Rates of anxiety (44.8% at T1 vs. 41.2% at T2) and stress (23.0% at T1 vs. 19.6% at T2) decreased over time, whereas the rate of depression (35.2% at T1 vs. 36.9% at T2) increased significantly ($P < 0.001$).

3.2. Association of pandemic preventive behaviors and psychological resilience with depression

The findings of the GEE analysis of depression are presented in Table 3; Model 3 represents the results after controlling for sociodemographic characteristics and preventive behavior. Gender, year of university study, major, preventive behavior-related variables, and psychological resilience were significantly associated with depression. Specifically, women were less likely to report depression than men (OR = 0.686, $P < 0.001$), while students in their 4th or 5th year of university (OR = 1.710, $P < 0.001$), as well as those majoring in liberal arts (OR = 1.238, $P = 0.012$), art (OR = 1.286, $P = 0.032$), or medicine (OR = 1.373, $P = 0.021$), were more likely to report depression over time. Those who wore a mask outside (OR = 0.761, $P = 0.027$), complied with the standard hand-washing technique (OR = 0.628, $P < 0.001$), maintained a distance of one meter in queues (OR = 0.668, P <0.001), and had high psychological resilience scores (OR = 0.973, $P < 0.001$) were less likely to report depression over time.

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TABLE 3 Longitudinal associations of epidemic preventive behaviors and psychological resilience with depression based on GEE.

Variables	Model 1			Model 2			Model 3		
	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*
Gender									
Male	Ref.			Ref.			Ref.		
Female	0.701	0.624, 0.787	<0.001	0.684	0.607,0 0.770	<0.001	0.686	0.609,0.774	<0.001
Age	1.039	1.002, 1.078	0.039	1.040	1.002, 1.079	0.040	1.003	0.966, 1.043	0.862
Year of study									
1st year	Ref.			Ref.			Ref.		
2nd year	1.122	0.955, 1.318	0.161	1.121	0.953, 1.320	0.168	1.117	0.948, 1.316	0.187
3rd year	1.376	1.184, 1.599	<0.001	1.333	1.145, 1.552	<0.001	1.332	1.143, 1.551	<0.001
4th/5th year	1.761	1.512, 2.051	<0.001	1.719	1.472, 2.007	<0.001	1.710	1.464, 1.998	<0.001
Major									
Science	Ref.			Ref.			Ref.		
Engineering	1.123	0.947, 1.331	0.181	1.164	0.981, 1.381	0.083	1.150	0.968, 1.368	0.112
Agriculture	1.076	0.814, 1.422	0.606	1.079	0.813, 1.431	0.601	1.090	0.820, 1.450	0.552
Liberal arts	1.205	1.024, 1.419	0.025	1.255	1.064, 1.480	0.007	1.243	1.052, 1.469	0.011
Art	1.204	0.961, 1.507	0.106	1.327	1.057, 1.667	0.015	1.285	1.021, 1.618	0.033
Medicine	1.355	1.047, 1.753	0.021	1.382	1.063, 1.797	0.016	1.373	1.055, 1.788	0.018
Ethnicity									
Han	Ref.			Ref.			Ref.		
Minority	0.854	0.641, 1.137	0.280	0.894	0.670, 1.194	0.448	0.878	0.658, 1.170	0.373
Student leader									
Yes	Ref.			Ref.			Ref.		
No	1.109	0.981, 1.253	0.097	1.092	0.965, 1.236	0.165	1.085	0.957, 1.229	0.201
Wearing a mask outside									
No				Ref.			Ref.		
Yes				0.716	0.563, 0.912	0.007	0.761	0.598, 0.969	0.026
Compliant with the standard hand-washing technique									
No				Ref.			Ref.		
Yes				0.648	0.555, 0.757	<0.001	0.628	0.538, 0.735	<0.001
Maintaining a distance of one meter in queues									
No				Ref.			Ref.		
Yes				0.682	0.595, 0.782	<0.001	0.668	0.582,0 0.766	<0.001
Psychological resilience							0.973	0.966, 0.979	<0.001

3.3. Association of pandemic preventive behaviors and psychological resilience with anxiety

The GEE results for anxiety, presented in Table 4, demonstrate that, in Model 3, women were less likely to report anxiety (OR = 0.752, $P < 0.001$). Participants in their 2nd year of study (OR = 0.815, $P = 0.019$) were less likely to feel anxiety than those in their 1st year. Participants majoring in medicine were more likely to report anxiety than those majoring in science (OR = 1.310, $P = 0.040$). University students who wore a mask outside (OR = 0.686, $P = 0.002$), complied with the standard hand-washing technique (OR = 0.701, $P < 0.001$), maintained a one-meter distance in queues (OR = 0.634, $P < 0.001$), and had high psychological resilience scores (OR = 0.980, $P < 0.001$) were less likely to report anxiety over time.

TABLE 4 Longitudinal associations of epidemic preventive behaviors and psychological resilience with anxiety based on GEE.

Variables	Model 1			Model 2			Model 3		
	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*
Gender									
Male	Ref.			Ref.			Ref.		
Female	0.766	0.684, 0.858	<0.001	0.750	0.668,0.841	<0.001	0.752	0.670,0.845	<0.001
Age	1.054	1.017,1.092	0.004	1.054	1.017,1.093	0.004	1.0270	0.990, 1.066	0.155
Year of study									
1st year	Ref.			Ref.			Ref.		
2nd year	0.818	0.702, 0.952	0.010	0.809	0.693,0 0.943	0.007	0.806	0.690,0.940	0.006
3rd year	0.930	0.806,1.073	0.318	0.891	0.771,1.030	0.120	0.888	0.768, 1.027	0.110
4th/5th year	1.221	1.055,1.413	0.007	1.176	1.014,1.364	0.032	1.169	1.007, 1.356	0.040
Major									
Science	Ref.			Ref.			Ref.		
Engineering	0.995	0.846,1.171	0.950	1.029	0.873,1.214	0.731	1.018	0.863,1.202	0.829
Agriculture	0.858	0.655,1.125	0.269	0.854	0.650,1.122	0.256	0.857	0.652,1.127	0.270
Liberal arts	1.117	0.956,1.305	0.164	1.163	0.993,1.362	0.062	1.152	0.982, 1.351	0.082
Art	0.858	0.655,1.125	0.269	1.281	1.028,1.596	0.027	1.249	1.000,1.559	0.050
Medicine	1.288	1.007,1.649	0.044	1.321	1.027,1.700	0.030	1.310	1.018,1.686	0.036
Ethnicity									
Han	Ref.			Ref.			Ref.		
Minority	1.039	0.793,1.361	0.782	1.097	0.834,1.441	0.509	1.082	0.824, 1.421	0.569
Student leader									
Yes	Ref.			Ref.			Ref.		
No	1.053	0.936,1.184	0.390	1.033	0.918,1.163	0.587	1.028	0.912, 1.158	0.651
Wearing a mask outside									
No				Ref.			Ref.		
Yes				0.657	0.515,0.838	0.001	0.686	0.538, 0.874	0.002
Compliance with the standard hand-washing technique									
No				Ref.			Ref.		
Yes				0.715	0.613,0.834	<0.001	0.701	0.600, 0.817	<0.001
Maintaining a distance of one meter in queues									
No				Ref.			Ref.		
Yes				0.644	0.564,0.735	<0.001	0.634	0.555, 0.724	<0.001
Psychological resilience							0.980	0.974, 0.987	<0.001

3.4. Association of pandemic preventive behavior and psychological resilience with stress

Table 5 presents the GEE analysis for stress. Model 3 included demographic variables, pandemic preventive behaviors, and psychological resilience. Women were less likely to report stress over time (OR = 0.656, $P < 0.001$). Participants in their 4th or 5th year of study were more likely to report stress over time than those in their first year (OR = 1.385, $P = 0.011$). Those majoring in liberal arts (OR = 1.358, $P = 0.002$), art (OR = 1.373, $P = 0.021$), or medicine (OR = 1.775, $P \leq 0.001$) were more likely to report stress over time. Additionally, people who complied with the standard hand-washing technique (OR = 0.638, $P < 0.001$), maintained a one-meter distance in queues (OR = 0.638, $P < 0.001$), and had higher psychological resilience scores (OR = 0.976, $P < 0.001$) were less likely to report stress over time.

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TABLE 5 Longitudinal associations of epidemic preventive behaviors and psychological resilience with stress based on GEE.

Variables	Model 1			Model 2			Model 3		
	OR	95% CI	*P*	OR	95% CI	*P*	OR	95% CI	*P*
Gender									
Male	Ref.			Ref.			Ref.		
Female	0.672	0.588, 0.768	<0.001	0.653	0.569, 0.749	<0.001	0.656	0.571, 0.753	<0.001
Age	1.075	1.031, 1.122	0.001	1.077	1.032, 1.124	0.001	1.043	0.998, 1.091	0.061
Year of study									
1st year	Ref.			Ref.			Ref.		
2nd year	0.957	0.790, 1.158	0.649	0.954	0.786, 1.158	0.633	0.946	0.779, 1.149	0.575
3rd year	1.111	0.931, 1.325	0.243	1.067	0.892, 1.277	0.476	1.064	0.889, 1.273	0.500
4th/5th year	1.442	1.211, 1.717	<0.001	0.954	0.786, 1.158	0.633	1.385	1.160, 1.652	<0.001
Major									
Science	Ref.			Ref.			Ref.		
Engineering	1.113	0.908, 1.363	0.302	1.153	0.939, 1.415	0.173	1.142	0.930, 1.403	0.205
Agriculture	1.039	0.736, 1.465	0.829	1.043	0.738, 1.474	0.810	1.056	0.748, 1.490	0.759
Liberal arts	1.314	1.082, 1.596	0.006	1.372	1.128, 1.670	0.002	1.363	1.119, 1.661	0.002
Art	1.275	0.978, 1.661	0.072	1.414	1.082, 1.848	0.011	1.374	1.048, 1.800	0.021
Medicine	1.735	1.297, 2.322	<0.001	1.778	1.320, 2.394	<0.001	1.775	1.316, 2.394	<0.001
Ethnicity									
Han	Ref.			Ref.			Ref.		
Minority	0.856	0.606, 1.209	0.377	0.898	0.633, 1.273	0.546	0.883	0.624, 1.251	0.485
Student leader									
Yes	Ref.			Ref.			Ref.		
No	1.084	0.939, 1.251	0.271	1.064	0.920, 1.230	0.401	1.057	0.914, 1.224	0.454
Wearing a mask outside									
No				Ref.			Ref.		
Yes				0.775	0.601, 0.999	0.049	0.823	0.638, 1.062	0.134
Compliance with the standard hand-washing technique									
No				Ref.			Ref.		
Yes				0.654	0.549, 0.779	<0.001	0.638	0.535, 0.760	<0.001
Maintaining a distance of one meter in queues									
No				Ref.			Ref.		
Yes				0.649	0.553, 0.761	<0.001	0.638	0.543, 0.749	<0.001
Psychological resilience							0.976	0.968, 0.983	<0.001

4. Discussion

This study investigated the prevalence of depression, anxiety, and stress among Chinese university students during the COVID-19 pandemic while on campus and when returning home for the winter vacation, with an interval of 3 months between these time points. In addition, the longitudinal association of demographic variabless, preventive behaviors, and psychological resilience with depression, anxiety, and stress were examined. To our knowledge, the present study is the first longitudinal study on the associations between mental health, preventive behaviors, and psychological resilience among university students in China during the COVID-19 pandemic. We found that the prevalence of anxiety and stress decreased over time, whereas the rate of depression increased between the time at which university students were on campus and the time at which they returned home for the winter vacation. Additionally, students' psychological resilience decreased longitudinally and the rate of compliance with preventive behaviors increased.

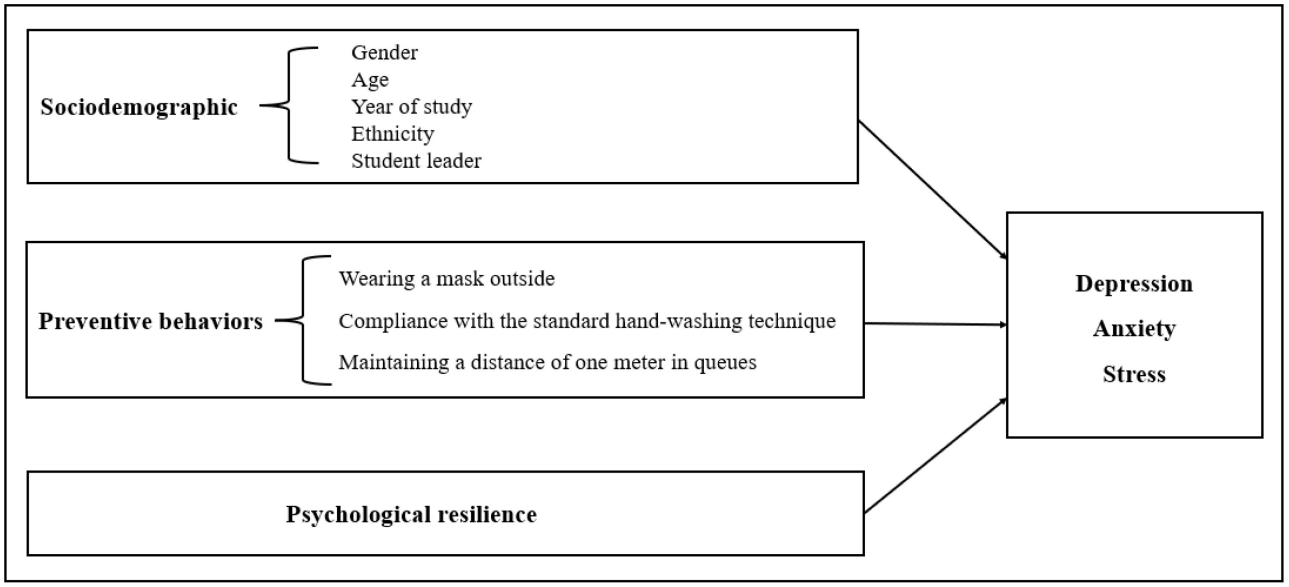

FIGURE 1
The conceptual model of this study.

In this longitudinal survey, we found that students' reported rates of depression significantly increased over time (35.2 vs. 36.9%). This may be because COVID-19 may have lasting effects on university students' psychological health (42, 43), and the risk of psychological disorders may increase over time (44). In addition, it is worth noting that, although our investigation was conducted at a time when the pandemic was under control in China, there was still a risk of imported and sporadic cases. Students' psychological status may have fluctuated with the emergence of cases and this may have led to increased rates of depression. The proportion of students reporting anxiety (44.8 vs. 41.2%) and stress (23.0 vs. 19.6%) decreased over time. A possible reason for this decrease is that, while we were conducting the T2 phase of the survey, the Chinese government began to provide COVID-19 vaccines for all citizens, which may have provided psychological comfort to the students (37). Moreover, students returning home for the winter vacation period would feel more secure at home than at school (45).

We also found that students in their 3rd, 4th, or 5th year of study were more likely to report depression and stress than those in their 1st year, which is consistent with previous research (8). This pattern may be because there is more academic pressure on final-year students. They must be prepared for graduation, employment, and internships, but the prevalence of COVID-19 inevitably affects various matters. Additionally, we found that medical students were more likely to report depression, anxiety, and stress. Higher anxiety levels among medical students than among non-medical students were also found during the SARS-CoV-1 outbreak (46). Even in the absence of a pandemic outbreak, studies have shown that medical students report higher levels of psychological distress than their peers of the same age (47). This distress may arise because medical students are more knowledgeable about illnesses than other students (48), which makes them more likely to develop psychological problems.

Our findings suggest that measures taken to prevent the spread of COVID-19 may have had a protective psychological effect on university students. Consistent with previous studies (49), we found that those who wore a mask outside were less likely to report mental health problems. Similarly, those adhering to standard hand-washing techniques and maintaining a one-meter distance in queues were less likely to report mental health problems (50, 51). These findings highlight the importance of promoting preventive behaviors among university students during the COVID-19 pandemic. We also found that more students complied with preventive behaviors in the second survey than in the first, indicating an increased awareness of prevention among students.

The present study also examined the effect of psychological resilience on depression, anxiety, and stress. Consistent with previous studies (23, 24), we found that greater resilience was negatively associated with depression, anxiety, and stress. This may be because students with high psychological resilience can more clearly understand the meaning of positive coping styles (52). Additionally, being better able to handle negative emotions and respond flexibly to external pressures can help individuals to overcome the effects of negative emotions (53). These results suggest that increasing resilience can reduce depression, anxiety, and stress among university students.

5. Implications

First, universities should pay attention to the mental health of university students during COVID-19, focusing particularly on the mental health problems of male university students, senior students, and those majoring in liberal arts, arts, and medicine, and should provide timely guidance and support. Second, government departments and universities should continue to publicize and provide guidance on preventative behaviors that can reduce the

spread of COVID-19, highlight the importance of protecting university students from the pandemic, and urge students to engage in good preventive behaviors. Finally, universities should encourage students to cultivate psychological resilience through provision of mental health education in order to reduce depression, anxiety, stress, and other psychological problems in the face of major public health emergencies such as COVID-19.

6. Limitations

First, the data used in this study were self-reported, which may have resulted in recall bias. Second, other variables that were not measured in this study, such as coping style, length of time spent in isolation, and other potential factors, may have influenced the results. Third, this study used only "yes/no" responses to measure preventive behavior, which may not be a scientific way to capture this variable. Fourth, the ORs for some variables in this study were close to 1, which may be due to the large sample size that made it easy to achieve statistical significance even for small effects. Finally, findings in relation to university students may not apply to the general population, especially to those with lower levels of education. Despite these limitations, this study used a longitudinal design to reveal the psychological changes in university students on campus and during the winter break during the COVID-19 pandemic and to examine the relationships of these changes with preventive behaviors and psychological resilience. In addition, this study had a large number of participants, enabling significantly reliable conclusions to be drawn.

7. Conclusion

In the period between two surveys, the prevalence of depression among university students increased, and the prevalence of anxiety and stress decreased. Senior students and medical students were more likely to experience psychological problems. Therefore, these groups of students should receive greater attention. Preventive behaviors were significantly associated with depression, anxiety, and stress; therefore, university students should continue to follow relevant preventive behaviors. Furthermore, psychological resilience was a protective factor against depression, anxiety, and stress, suggesting that improving psychological resilience may help maintain and promote university students' 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 Ethical review and ethical approval for the study was obtained from the Institutional Review Board of Public Health and Preventive Medicine at Shandong University (No. LL20200201). Written informed consent was obtained from respondents for inclusion before they participated in the study. The patients/participants provided their written informed consent to participate in this study.

Author contributions

JZ and FK designed the study and collected the data. HeL performed data analysis and drafted the manuscript. RC, HuL, and XX contributed to reviewing the literature. JX, XJ, MP, and JW reviewed and edited the manuscript. SL, JH, and FK revised it critically for important intellectual content and supervised the writing of the manuscript. All authors read and approved the final 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.

Publisher's note

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Pandemic distress associated with segregation and social stressors

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Background: Racial/ethnic minorities are disproportionately impacted by the COVID-19 pandemic, as they are more likely to experience structural and interpersonal racial discrimination, and thus social marginalization. Based on this, we tested for associations between pandemic distress outcomes and four exposures: racial segregation, coronavirus-related racial bias, social status, and social support.

Methods: Data were collected as part of a larger longitudinal national study on mental health during the pandemic (n =1,309). We tested if county-level segregation and individual-level social status, social support, and coronavirus racial bias were associated with pandemic distress using cumulative ordinal regression models, both unadjusted and adjusted for covariates (gender, age, education, and income).

Results: Both the segregation index (PR=1.19; 95% CI 1.03, 1.36) and the coronavirus racial bias scale (PR=1.17; 95% CI 1.06, 1.29) were significantly associated with pandemic distress. Estimates were similar, after adjusting for covariates, for both segregation (aPR=1.15; 95% CI 1.01, 1.31) and coronavirus racial bias (PR=1.12; 95% CI 1.02, 1.24). Higher social status (aPR=0.74; 95% CI 0.64, 0.86) and social support (aPR=0.81; 95% CI 0.73, 0.90) were associated with lower pandemic distress after adjustment.

Conclusion: Segregation and coronavirus racial bias are relevant pandemic stressors, and thus have implications for minority health. Future research exploring potential mechanisms of this relationship, including specific forms of racial discrimination related to pandemic distress and implications for social justice efforts, are recommended.

KEYWORDS

race, segregation, social support, stress, bias

Introduction

Racial/ethnic minorities have faced significant health disparities related to the COVID-19 pandemic, including a greater burden of COVID-19 related hospitalization and death, depression, anxiety, financial strain, and housing insecurity (1–13). Additionally, racial/ethnic minorities have experienced significant racial discrimination related to COVID-19, including harassment, employment discrimination, and violence (14–17). COVID-19 related experiences of racism are particularly pronounced towards Asian-Americans, with one study finding that one in five Asian Americans had direct experiences with overt discrimination, such as physical attacks and xenophobic slurs (18, 19). The experience of these race-related stressors can have

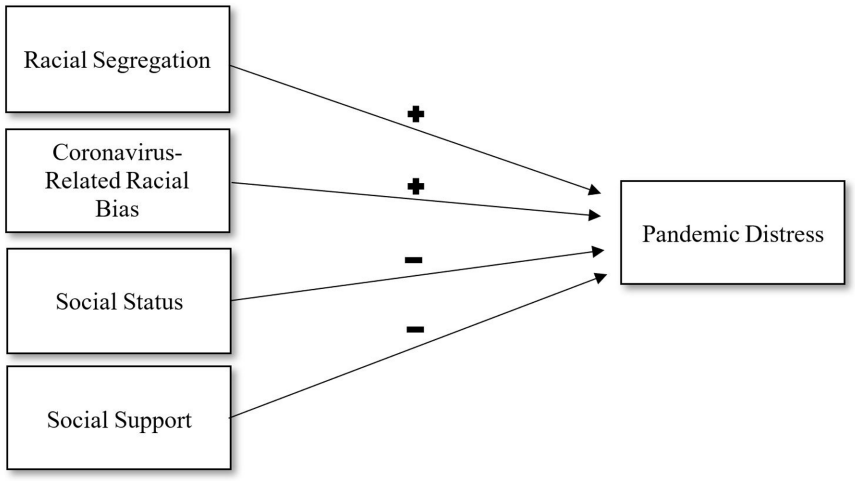

FIGURE 1
Directed acyclic graph for relationships between racial segregation, coronavirus-related racial bias, social status, social support, and pandemic distress. Positive signs indicate hypohesized negative relationships.

important implications for many adverse health outcomes among racial/ethnic minorities.

Minority stress theory, while originally and most commonly focused on sexual minorities (20), has expanded in use to apply to several minoritized groups, including racial/ethnic minorities (21). Racial/ethnic minorities also experience additional social and structural stressors compared to their non-minority counterparts, which can lead to adverse health outcomes. Among racial/ethnic minority groups, this can include interpersonal forms of racism such as being verbally threatened, harassment, and slurs, as well as structural forms of racism such as institutional discrimination, over-policing, and segregation. Interpersonal racism in particular has exacerbated in the context of the Covid-19 pandemic, as growing literature demonstrates that experiences of coronavirus-related racial bias are particularly prevalent among Asian and Black individuals (19, 22–28). Much like racial discrimination and bias in other contexts, these experiences can lead to several adverse mental health outcomes, including depression, anxiety, suicidality, and substance use, which is closely linked to mental health.

Regarding structural factors, racial segregation is an especially impactful form of structural racism associated with numerous adverse mental and physical health outcomes (29–33). Minority communities, particularly Black communities, are disproportionately marginalized through both historical and current segregation (29–32). Segregation is associated with substantially more vulnerability to Covid-19 through several mechanisms, including increased household density, reliance on crowded transportation services, and lower access to healthcare services (34–38). Additionally, segregation exacerbates socioeconomic difficulties through limited access to employment and educational opportunities (34–36). For households in segregated neighborhoods, it is often much more difficult to recover from sudden socioeconomic challenges related to the pandemic, such as healthcare costs or the loss of employment. In tandem, coronavirus-related racial bias and segregation can lead to substantial pandemic distress, and thus have implications for mental and physical health disparities across race/ethnicity.

Social support can be an important buffer against the adverse effects of minority stressors, as there is a wealth of literature demonstrating the benefits of social support in protecting against many adverse mental health outcomes (20, 39–41). Social capital theory posits that social relationships are important resources that can allow for accumulation of capital, including a greater means of coping with adversity (42). When facing difficulties related to the COVID-19 pandemic, social support can provide a greater sense of social cohesion, as well as tangible support for facing socioeconomic challenges related to the pandemic. Additionally, having a stronger sense of social status in one's community can reflect greater social capital, allowing for better community connectedness and more effective coping with challenges. Both social support and social status can be important protective factors against COVID-19 related adversity (20, 39–43).

Based on this, the purpose of our study was to test for associations between pandemic distress outcomes and four exposures: racial segregation, coronavirus-related racial bias, social status, and social support. We hypothesized that racial segregation and coronavirus-related racial bias would be associated with greater pandemic distress, and that higher social status and social support would be associated with lower pandemic distress (Figure 1).

Methods

Sample

Data for the current study consists of a sample of participants recruited as part of a national, longitudinal study on COVID-19, substance use, and mental health (44). Consenting participants were recruited online *via* a Qualtrics Panel and met the following requirements: (1) lived in the U.S., (2) were at least 18 years old, (3)

wrote at least 500 words across their Facebook status timeline, and (4) posted at least 5 posts within the 180 days prior to recruitment into our study. While Facebook use was a requirement for the larger study, no Facebook data is used in the current study. Data was collected between September 2020 and June 2021. The current sample consists of $n = 1{,}309$ participants. This study was considered exempt by the University of Pennsylvania's institutional review board.

Key variables

Our key exposures of interest included segregation, coronavirus-related racial bias, social status, and social support. County-level segregation was measured using the residential segregation index from the U.S. Census American Community Survey 5-year estimates (2016–2020), obtained from the 2020 County Health Rankings. Residential segregation is a dissimilarity index, which measures the percentage of the population within each census tract (i.e., sub-county spatial unit) which would need to change residence to have the same racial demographic percentage as the county overall. Coronavirus-related racial bias was measured using the 9-item Coronavirus Racial Bias Scale (CRBS); and is used to assess beliefs about how COVID-19 negatively affecting attitudes toward one's race/ethnicity (Cronbach's alpha = 0.87) (25). Each item is measured on a 4-point Likert scale where options range from 1 (Strongly disagree) to 4 (Strongly agree). Social status was measured using the single item MacArthur Scale of Subjective Social Status, which asks participants to evaluate where they stand within society (29). This single item uses a 10-point scale, visualized as a ladder, where 1 represents those who are the worst off in society (i.e., the least education and income) and 10 represents those best off in society (i.e., the most education and income). Social support was measured using the 6-item Perceived Social Support scale (F-SozU K-6) (45). All items (e.g.," I receive a lot of understanding and security from others") are measured on a 5-point Likert scale (1 = Strongly disagree and 5 = Strongly agree) (Cronbach's alpha = 0.86).

Our key outcome was pandemic stress, measured using the Pandemic Stress Index (PSI) (46). For bivariate analyses, this index was dichotomized for ease of presentation and interpretability. For regression analyses, we used this index in its original continuous form (Cronbach's alpha = 0.89).

Other variables

Other variables included gender (man, non-binary, woman), age (18–29, 30–39, 40–49, 50 or older), race (Asian/Pacific Islander, Black, White, Other), Ethnicity (Hispanic/Latino, Non-Hispanic Latino), highest education level (High School or less, Some College or Trade School, Two-Year College Degree, Four Year College Degree or more) and annual household income (Less than $30,000, $30,000 to $59,999, $60,000 to $89,999, $90,000 or more).

Missing data

Missingness was overall low for all items (<5%). We conducted intrascale stochastic imputation to impute missing observations for the coronavirus racial bias scale, the social, support scale, and the social status scale. This was appropriate given the low nonresponse for all variables, and good internal consistency of the items (Cronbach's alpha >0.80 for all items).

Bivariate analyses

For bivariate analyses, we tested for differences in a dichotomized pandemic distress measure (dichotomized at its median) across all of our key measures (Racial segregation, coronavirus racial bias, social status, and social support) using Cochran-Armitage tests of trend. Ordinal tests were used due to the non-normality of each of these continuous measures. We also tested associations between pandemic distress and our covariates using a Chi-Square test for binary/multicategorical covariates (gender, race, ethnicity), and a Cochran-Armitage test for ordinal covariates (age, education, income).

Regression analyses

We tested for associations between each of our four key factors and the continuous pandemic distress outcomes using ordinal regression models. Unadjusted cumulative ordinal prevalence ratios were generated testing associations between each factor and pandemic distress. We also generated adjusted ratios using a single model containing all four measures and terms for gender, age, education level, and annual household income. Note that we do not include race or ethnicity as covariates since our main exposures of interest include racism; not only is it conceptually flawed to examine racism independent of race, but analytically the collinearity between race/ethnicity and racism prevents the use of both measures in the same regression model.

Quality assurance and statistical software

We tested regression models for collinearity by measuring the variance inflation factor (VIF) in all models: There was no evidence of collinearity (all VIF < 5) for any of the terms included in the final models. We identified no influential outliers using Leverages and Cook's distances. All analyses were conducted using SAS 9.4 (47).

Results

Sample characteristics

Our analytic sample consisted of 72.4% women, 25.8% men, and 1.8% non-binary participants (Table 1). The sample was 11.7% Black, 8.6% Asian, and 11.6% Hispanic. Examining socioeconomic status, 26.1% of the sample had a 4-year degree or higher, and 52.2% had a household income of $60,000 or more. The median scores for our key variables (all scaled in percentage, ranging form 0% minimum to 100% maximum) were 59% for segregation, 14% for coronavirus racial bias, 55% for social status, and 75% for social support.

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TABLE 1 Sample characteristics and bivariate associations with pandemic distress among an internet-based sample (*n* =1,309).

	Total		Low pandemic distress	High pandemic distress	*p* value
Categorical/ordinal measures					
Gender[1]	*n*	%	%	%	0.0117
Man	338	25.8	26.6	23.4	
Non-Binary	24	1.8	1.2	3.7	
Woman	947	72.4	72.1	73.0	
Age group[2]					0.1658
18–29	350	26.7	25.8	29.5	
30–39	413	31.6	31.8	30.7	
40–49	273	20.9	20.6	21.6	
50 or older	273	20.9	21.7	18.2	
Race[1]					<0.0001
Asian/pacific islander	112	8.6	8.7	8.2	
Black	153	11.7	10.7	14.6	
Other	63	4.8	3.4	9.1	
White	981	74.9	77.2	68.1	
Ethnicity[1]					0.0004
Hispanic/Latino	152	11.6	9.8	17.0	
Non-Hispanic/Latino	1,157	88.4	90.2	83.0	
Highest education level[2]					0.0872
High school or less	100	7.6	8.5	5.2	
Some college or trade school	354	27.0	26.7	28.0	
Two-year college degree	513	39.2	40.0	36.8	
Four year college degree or more	342	26.1	24.8	30.1	
Annual household income[2]					0.0019
Less than $30,000	272	20.8	18.0	29.2	
$30,000 to $59,999	354	27.0	28.4	23.1	
$60,000 to $89,999	281	21.5	21.6	21.0	
$90,000 or more	402	30.7	32.0	26.8	
Indices/scales	*n*	**Median[3]**	**Median[3]**	**Median[3]**	
Social status index %[2]	1,309	55.0 (0.22)	55.5 (0.22)	44.4 (0.33)	<0.0001
Social support index %[2]	1,309	75.0 (0.33)	79.1 (0.29)	70.8 (0.38)	<0.0001
Segregation index %[2]	1,309	59.0 (0.23)	48.7 (0.21)	62.8 (0.24)	0.0115
Coronavirus racial bias scale %[2]	1,309	14.8 (0.37)	11.1 (0.33)	18.5 (0.40)	0.0401

[1]Tested using Chi-square test.
[2]Tested using Kruskal–Wallis test.
[3]Interquartile range provided in parentheses.

Bivariate results

We observed differences in all of our key measures across dichotomized levels of pandemic distress. Participants with higher pandemic distress were characterized by higher median scores for segregation (62.8% compared to 48.7%) and coronavirus racial bias (18.5% compared to 11.1%), as well as lower scores for social status (44.4% compared to 55.5%) and social support (70.8% compared to 79.1%). Higher pandemic distress was also associated with lower income, non-binary gender, and Black, Hispanic, and Other racial identities.

Regression results

All of our key variables were significantly associated with pandemic distress, both before and after adjustment for covariates (Table 2). Higher prevalence of pandemic distress was associated with greater segregation (aPR = 1.15, 95% CI 1.00, 1.31), greater coronavirus racial bias (aPR = 1.12, 95% CI 1.02, 1.24), lower social status (aPR = 0.74, 95% CI 0.64, 0.86), and lower social support (aPR = 0.81, 95% CI 0.73, 0.90). Additionally, non-binary gender (aPR = 1.22, 95% CI 1.02, 1.46) and higher education (aPR = 1.23, 95% CI 1.11, 1.36) were both associated with greater pandemic distress.

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TABLE 2 Segregation, coronavirus racial bias, and covariates associated with pandemic distress among an internet-based sample (n=1,309).

	Unadjusted			Adjusted (for all terms with included estimates)		
	PR	Lower CI	Upper CI	PR	Lower CI	Upper CI
Segregation index %	**1.19**	**1.03**	**1.36**	**1.15**	**1.00**	**1.31**
Coronavirus racial bias scale %	**1.17**	**1.06**	**1.29**	**1.12**	**1.02**	**1.24**
Social status index %	**0.64**	**0.50**	**0.81**	**0.74**	**0.64**	**0.86**
Social support index %	**0.79**	**0.63**	**0.98**	**0.81**	**0.73**	**0.90**
Gender						
Man				Ref.	-	-
Non-binary				**1.22**	**1.02**	**1.46**
Woman				1.03	0.98	1.09
Age group						
18–29				Ref.	-	-
30–39				0.97	0.91	1.03
40–49				0.99	0.93	1.06
50 or older				0.97	0.91	1.04
Highest education level						
High school or less				Ref.	-	-
Some college or trade school				**1.12**	**1.02**	**1.23**
Two-year college degree				**1.15**	**1.05**	**1.26**
Four year college degree or more				**1.23**	**1.11**	**1.36**
Annual household income						
Less than $30,000				Ref.	-	-
$30,000 to $59,999				0.91	0.83	1.00
$50,000 to $89,999				0.95	0.88	1.03
$90,000 or more				0.95	0.87	1.02

Bolded estimates and intervals have a value of $p < 0.05$. PR, prevalence ratio; CI, confidence interval; Ref, reference group.

Discussion

We found that racial segregation and coronavirus-related racial bias were associated with greater pandemic distress, and that social status and social support were associated with lower pandemic distress. This is consistent with much of the overall literature demonstrating that racism, in several structural and interpersonal forms, creates a greater stress burden on racial minorities (14–17, 19, 22, 23, 25–28, 30, 31). In the context of the COVID-19 pandemic, segregation can create a greater stress burden in several ways, but most notably socioeconomic marginalization from access to quality employment, increased housing density due to crowding, and limited healthcare access. Each of these factors can lead to incredible economic and mental health strain. Interpersonal experiences of coronavirus-related racial bias can also lead to poorer social cohesion, a lack of access to community services, and greater vulnerability to race-related violence. Overall, these both represent impactful forms of racism that directly produce health disparities burdening racial/ethnic minorities.

Racial segregation reinforces health disparities by limiting access to resources that impact health—such as education, income, and occupation (32–38). These limitations were exacerbated during Covid-19 where individuals of color who have experienced a lifetime of exposure to racial segregation also experienced worse quality of and access to health care and social support (32, 36). Additionally, racial segregation may create an environment that heightens stress related to discrimination, both experienced and anticipated (e.g., coronavirus racial bias) which can worsen pandemic distress. This can have significant implications for the mental and physical health of racial/ethnic minorities, as these stressors may not only exacerbate depression, anxiety, and other adverse mental health outcomes, but may also affect physical health, such as cardiovascular disease which is well-documented as a long-term outcome of stress (48). Pandemic stress may worsen many health disparities among racial/ethnic minorities compared to their non-minority peers.

Our findings highlight the importance of social status and social support in potentially mitigating pandemic distress. Social support could protect against pandemic strain in several different ways, such as having a network for family and friends that can assist with household needs while one is recovering from COVID-19, feeling less isolated, and having more socioeconomic support to manage the direct and indirect costs of healthcare. A sense of social status in one's community often reflects a level of community connectedness that may confer these benefits as well. In these ways, social status and

support can be directly beneficial to the health of racial/ethnic minorities navigating the challenges of the pandemic (20, 49).

Strengths of our study include a large dataset covering a wide range of participants across race/ethnicity, gender, and age. We utilized both a more general measure of structural racism (segregation) as well as a measure of racism specific to the pandemic (coronavirus-related racial bias), making our findings especially contextually appropriate. Our measures also capture several items covering different dimensions of each key construct, making our overall findings more comprehensive. Finally, our work fills an important gap on a relatively understudied, yet particularly salient topic. Given that the pandemic is still ongoing, and racial inequities in several aspects of health persist, our findings add to a significant area of the literature.

Our research has limitations that should be acknowledged. The use of self-reported measures of social status and social support largely reflect self-perceptions, and thus may differ substantially from social network and community contexts. Despite this limitation, the perceptions of one's social support and status are still quite relevant to health and may be even more predictive of one's mental and emotional health than measures of network and community structure. While we identified significant associations between non-binary gender and greater pandemic stress, this represented a very small proportion of our sample, so it is difficult to generalize. Future research exploring pandemic stress in larger studies of non-binary people is recommended. The restriction to Facebook users does limit the generalizability of the study, as internet users broadly are generally younger and more socioeconomically advantaged than the general population, as more socioeconomically disadvantaged and older populations may not be fully captured. Our study sample demographics are fairly similar to the U.S. population across age and education however, though it is more predominantly female than the general population (50). Finally, social desirability bias is likely to impact the measures used in our study, particularly in the self-reported measures of social status, social support, and coronavirus-related racial bias. Notably however, this does not impact our measure of segregation, as it was not self-reported.

Conclusion

Racial segregation and coronavirus-related racial bias were both associated with greater pandemic distress, while social status and social support were associated with lower pandemic distress. Future research exploring mechanisms of these relationships, such as specific outcomes of segregation that create a greater stress burden on racial minorities, is recommended.

Data availability statement

The anonymized data analyzed in this study is subject to the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND) and made publicly available via OSF at https://osf.io/sa76w/.

Author contributions

RT: conceptualization, methodology, writing- original draft preparation. SG: data curation, writing-reviewing and editing. BC: conceptualization, supervision, writing-reviewing and editing. 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.

Publisher's note

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Satisfaction with care quality and anxiety among family members during nursing home visiting restrictions: The chain mediating effect of emotional regulation and perceived stress

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Introduction: This study aimed to investigate the psychological well-being (perceived stress and anxiety) of Chinese family members during nursing home visiting restrictions and to elucidate the relationships among satisfaction with care quality, emotion regulation, perceived stress, and anxiety.

Methods: An online survey was conducted with a cross-sectional study design. From 18 to 29 January 2022, a total of 571 family members of nursing home residents completed online questionnaires comprising socio-demographic characteristics, satisfaction with care quality, emotion regulation, perceived stress, and anxiety. Mediation analyses were performed to estimate the direct and indirect effects of satisfaction with care quality on anxiety using the PROCESS macro for SPSS.

Results: The results showed that approximately one-quarter of Chinese family members had anxiety symptoms during nursing home visiting restrictions. Satisfaction with care quality affected anxiety *via* three mediating paths: (a) through cognitive reappraisal (effect=0.028); (b) through cognitive reappraisal and perceived stress sequentially (effect=−0.057); and (c) through perceived stress (effect=−0.212). The chain mediating effect (path b) accounted for 23.7% of the total effect.

Conclusions: These findings corroborated our hypothesis that cognitive reappraisal (a kind of emotion regulation strategy) and perceived stress mediated the relationship between satisfaction with care quality and anxiety during nursing home visiting restrictions. Efforts to address family members' psychological well-being by focusing on cognitive reappraisal should be considered.

KEYWORDS

anxiety, perceived stress, emotion regulation, care quality, nursing home visiting restriction, mediation analysis

1. Introduction

Coronavirus disease 2019 (COVID-19) has resulted in unprecedented stress on health care systems across the globe (1). The World Health Organization has reported that, as of 5 December 2022, there have been more than 641 million confirmed cases of COVID-19 globally, including 6, 621,060 deaths (2). Older adults are more likely to contract this disease and having

comorbidities places them at a higher risk of worse outcomes (e.g., complications, intensive care unit admissions, death) compared with general populations (3). In particular, nursing homes are an important, high-risk target for emerging pathogens due to the presence of vulnerable residents and frequent visitors (4). For long-term care facilities, the World Health Organization therefore has announced special infection and prevention control precautions against COVID-19, including visiting restrictions (5, 6).

The visiting restriction measures undoubtedly can prevent the SARS-CoV-2 transmission in nursing homes, meanwhile, it introduces negative psychosocial impacts not only for the residents but also for their family members (7, 8). For example, a qualitative study revealed that nursing home residents and their family members experienced anxiety, severe stress, and grief during the visiting restriction periods (7). Moreover, a cross-sectional survey found that family members of nursing home residents with cognitive impairment reported significantly lower psychosocial and emotional well-being during the COVID-19 lockdown (8). Family members often stay involved in the caregiving role after institutionalization (9) and meaningful family involvement can potentially improve the quality of life of their loved ones who reside in nursing homes (10). The traditional way for family members to be involved is through in-person visits, by which, for example, they can ensure the care quality of their older relatives and maintain family relationships (11). Previous evidence has shown that family members visit more frequently and provide more hands-on assistance when they are concerned about the adequacy of care in nursing homes (12). Family members are reported to be frustrated about not being able to touch their older relatives or participate in their care due to visiting restrictions (7). Nevertheless, the relationship between the satisfaction with care quality and psychological well-being of family members during visiting restrictions remains to be investigated.

Emotion regulation refers to the process by which individuals modify their emotions, their response to the emotions or the situations that elicit emotions in order to respond appropriately to environmental demands (13). In the Stress and Coping Model, individuals use an array of coping strategies to manage specific external and/or internal demands that are appraised as stressful, including regulating emotional responses to the problem (emotion-focused coping) and managing the problem causing the distress (problem-focused coping) (14). The coping processes thereby affect the social, psychological, and/or somatic outcomes of stressful encounters (14). In previous studies, emotion regulation has been proposed as a vital mediator of stress adjustment (15, 16) and links between inappropriate or maladaptive emotion regulation strategies and anxiety had been found in different populations (17–21). Amidst the COVID-19 pandemic, it is of great importance to actively take control of one's emotions to cope with this invisible enemy (22, 23). Effective regulation of emotions can reduce negative emotions, enhance well-being (22), and predict quality of life decline (23). Exploring the role of emotion regulation in promoting psychological well-being can provide significant evidence for developing potential interventions and support services, however, its effect in the relationships of satisfaction with care quality, perceived stress, and anxiety has not yet well understood among Chinese family members of nursing home residents during the visiting restrictions.

This cross-sectional study, therefore, aimed to investigate the level of anxiety in Chinese family members of nursing home residents during visiting restrictions due to COVID-19 pandemic and to elucidate the relationships among satisfaction with care quality, emotion regulation, perceived stress, and anxiety. The hypotheses of this study were as follows: (a) Chinese family members of nursing home residents experienced anxiety symptoms during visiting restrictions; (b) Those who were less satisfied with the care quality had a greater level of anxiety; and (c) Emotion regulation and perceived stress played a chain mediating effect in the relationship between satisfaction with care quality and anxiety.

2. Methods

2.1. Procedure

A cross-sectional study was conducted in family members of nursing home residents from 18 to 29 January 2022. Nursing homes that met the following criteria were recruited: (a) located in Shaanxi province, China, (b) provided both custodial care and skilled care to the residents, and (c) was implementing the policy of visiting restrictions due to COVID-19. With a convivence sampling method, we approached a total of 10 private nursing homes and all their superintendents agreed to participate in this study. The nursing home staff briefly introduced the objectives and procedures of this study to the potentially eligible participants and asked whether they had an interest in participation. Those who agreed to voluntarily participate in this study would complete an online questionnaire anonymously *via* the Sojump platform. To be eligible, the family members had to: (a) be aged 18 years or older, (b) have an older relative (aged 60 years or older) living in the nursing homes, and (c) invest the most hours into the care of their older relative after institutionalization. Those who refused to participate were excluded from this study.

2.2. Measurements

2.2.1. Socio-demographic characteristics

The socio-demographic characteristics (e.g., age, gender, educational level, marital status) of both the family members and their older relatives were collected *via* a self-administrated questionnaire. For family members, their average visiting frequency before nursing home visiting restrictions was surveyed. For residents, the length of stay, number of children, chronic diseases, and disability of activities of daily living (ADL) were collected. Additionally, the relationship between the family member and his/her older relative was surveyed.

2.2.2. Satisfaction with care quality

Satisfaction with care quality was assessed by a single self-reported question: how much are you satisfied with the care quality in the nursing home during the visiting restriction period? Family members responded to this question with answers on a 5-point Likert scale, ranging from 1 (very dissatisfied) to 5 (very satisfied).

Abbreviations: COVID-19, coronavirus disease 2019; ADL, activities of daily living; ERQ, Emotion Regulation Questionnaire; PSS, Perceived Stress Scale; GAD, Generalized Anxiety Disorder.

2.2.3. Emotion regulation

Emotion regulation was assessed by the 10-item Emotion Regulation Questionnaire (ERQ) (24). The ERQ was designed to measure two emotion regulation strategies, namely cognitive reappraisal (6 items) and expressive suppression (4 items). Family members answered each item from 1 (strongly disagree) to 7 (strongly agree). Each facet's scoring is kept separate. The total score ranged from 6 to 42 for cognitive reappraisal and from 4 to 28 for expressive suppression, with a higher score indicating more tendency to use the corresponding emotion regulation strategy. In the current study, the Cronbach's α coefficient for cognitive reappraisal and expressive suppression was 0.951 and 0.906, respectively.

2.2.4. Perceived stress

Perceived stress was assessed by the 4-item Perceived Stress Scale (PSS-4) (25). Family members answered each item from 0 (never) to 4 (very often). The total score of PSS-4 was obtained by reversing the scores on the positive items (items 2 and 3) and then summing across all the items (ranges: 0–16). The higher the score, the more perceived stress. The PSS-4 score of 6 or more indicates a high level of perceived stress (26). In the current study, the Cronbach's α coefficients for the negative items and positive items were 0.828 and 0.870, respectively.

2.2.5. Anxiety

Anxiety was assessed by the 7-item Generalized Anxiety Disorder (GAD-7) (27). Each item was rated on a 4-point Likert scale from 0 (not at all) to 3 (nearly every day). The total score of GAD-7 was computed by summing the ratings on all items (ranges: 0–21). A higher score indicates more anxiety. The severity of anxiety can be divided into minimal (0–4), mild (5–9), moderate (10–14), and severe (15–21). In the current study, the Cronbach's α coefficient for GAD-7 was 0.957.

2.3. Statistical analysis

Statistical analyses were performed by using the software SPSS 25.0 for Windows (IBM Corp., Armonk, NY, United States). Descriptive analyses were conducted to summarize the study variables, and Cronbach's α coefficients were calculated for the questionnaires used (ERQ, PSS-4, GAD-7). Correlation analyses were conducted to examine the bivariate correlations between the main variables (i.e., satisfaction with care quality, emotion regulation, perceived stress, and anxiety). The mediation analysis was performed by using PROCESS macro (Model 6) for SPSS (28). Variables related to the independent (satisfaction with care quality) and dependent (anxiety) variables were adjusted as confounders. Ordinary least-squares framework was used to estimate the total effect, direct effect, and indirect effect, with 5,000 bias-corrected bootstrap resamples. The significance of the effects was evaluated with Sobel test. The 95% confidence intervals (CI) were calculated to determine whether mediating variables helped explain the relationship between independent and dependent variable. If the 95% CI did not include zero, it indicated that the effect was statistically significant. The proportion mediated was calculated by dividing the indirect effect by the total effect. The significance level in the current study was set at 0.05 (two-tailed).

3. Results

3.1. Basic characteristics of the participants

A total of 626 family members of nursing home residents were approached, but 615 were deemed as eligible. Questionnaires were sent to the 615 family members, of which nine refused to participate in and 35 completed the survey faster than 2 s per item (effective response rate = 92.8%). A sample of 571 family members and their older relatives, therefore, was finally included and analyzed in this study. The basic characteristics of the included participants are demonstrated in Table 1. The family members aged from 21 to 83 years (Mean = 42.4, SD = 12.56). Most of them were female (69.2%), obtained a bachelor's degree or above (63.6%), and were married (80.9%). For the family-resident relationships, most of the participants were sons ($n = 146$, 25.6%) or daughters ($n = 223$, 39.1%). Regarding the visiting frequency before visiting restrictions, 77.9% of the family members visited their older relatives at least two to three times per month.

The average age of the residents was 77.6 years (SD = 8.48, range: 60–100 years). Half of the residents were female. Only 12.1% of the residents achieved a bachelor's degree or above. Most of the residents lived in the nursing homes for no more than 1 year (61.8%) and had two or three children (66.1%). Those who were married accounted for half of the total sample (50.6%), while single, divorced, or widowed for another half (49.4%). Totally 78.5% of the residents were reported to have chronic diseases and 60.5% had ADL disability.

3.2. Bivariate correlations

As seen in Table 2, the perceived stress of family members scored at 6.27 on average (SD = 2.68), while the median score for anxiety was 1.00 (interquartile range = 4.00). According to the GAD-7 scoring criteria, 17.3, 4.0, and 3.3% of the family members experienced mild, moderate, and severe anxiety, respectively. Correlation analyses showed that satisfaction with care quality was positively correlated with cognitive reappraisal ($r = 0.122$, $p < 0.01$) but negatively related to the perceived stress ($r = -0.162$, $p < 0.01$) and anxiety scores ($r = -0.162$, $p < 0.01$). Cognitive reappraisal was negatively correlated with perceived stress ($r = -0.233$, $p < 0.01$), meanwhile, perceived stress was positively associated with anxiety ($r = 0.204$, $p < 0.01$).

3.3. Mediation analyses

Results of the mediating effects of cognitive reappraisal and perceived stress between the relationship of satisfaction with care quality and anxiety are illustrated in Figure 1 and Table 3. After controlling for the ADL disability of residents, the age of family members, and expressive suppression, satisfaction with care quality did not directly affect anxiety ($c' = -0.220$, $p = 0.217$); however, it had a direct and significant positive prediction on cognitive reappraisal ($a_1 = 0.753$, $p < 0.05$) and could directly and negatively predict the level of perceived stress ($a_2 = -0.362$, $p < 0.001$). Cognitive reappraisal negatively predicted perceived stress ($d = -0.128$, $p < 0.001$), which further had a positive prediction on anxiety ($b_2 = 0.587$, $p < 0.001$) (Figure 1).

The bootstrap examination results showed that satisfaction with care quality affected anxiety *via* three indirect paths, for which the total

TABLE 1 Basic characteristics of the participants in this study (N=571).

Variables		*n*	%
Family members			
Age[a]		42.4 ± 12.56	
Gender	Male	176	30.8
	Female	395	69.2
Education level	Junior high school or below	60	10.5
	Senior high school	148	25.9
	Bachelor or above	363	63.6
Marital status	Married	462	80.9
	Single/Divorced/Widowed	109	19.1
Relationships	Son	146	25.6
	Daughter	223	39.1
	Grandchild	79	13.8
	Others	123	21.5
Visiting frequency	Almost everyday	52	9.1
	Every 2 or 3 days	82	14.4
	Weekly	202	35.4
	Two to three times per month	109	19.1
	Monthly	61	10.7
	Less than monthly	65	11.4
Anxiety (GAD-7 scores)	Minimal (0–4)	430	75.3
	Mild (5–9)	99	17.3
	Moderate (10–14)	23	4.0
	Severe (15–21)	19	3.3
Residents			
Age[a]		77.6 ± 8.48	
Gender	Male	281	49.2
	Female	290	50.8
Length of stay	<3 months	100	17.5
	3–6 months	132	23.1
	6–12 months	121	21.2
	1–3 year(s)	136	23.8
	>3 years	82	14.4
Education level	Primary school and below	193	33.8
	Junior high school	159	27.8
	Senior high school	150	26.3
	Bachelor and above	69	12.1
Marital status	Married	289	50.6
	Single/Divorced/Widowed	282	49.4
Number of Children	Null	28	4.9
	1	83	14.5
	2	215	37.7
	3	162	28.4
	>3	83	14.5
Chronic disease	Yes	448	78.5
	No	123	21.5
ADL disability	No	217	38.0
	Slight	179	31.3
	Moderate	99	17.3
	Severe	68	11.9
	Unclear	8	1.4

ADL, activities of daily living. [a]The mean and standard division are presented.

effect was −0.240. In path 1, satisfaction with care quality affected anxiety through cognitive reappraisal (effect = 0.028, 95% CI: 0.001, 0.084). In path 2, satisfaction with care quality had an influence on anxiety through cognitive reappraisal and perceived stress sequentially (effect = −0.057, 95% CI: −0.111, −0.013), which accounted for 23.7% of the total effect. In path 3, satisfaction with care quality affected anxiety through perceived stress (effect = −0.212, 95% CI: −0.369, −0.092), accounting for 88.3% of the total effect (Table 3). These findings corroborated our hypothesis that cognitive reappraisal and perceived stress mediated the relationship between satisfaction with care quality and anxiety. Since pre-pandemic visiting frequency of family members may influence their satisfaction with care quality, emotion regulation, perceived stress, and anxiety during visiting restriction, we conducted a stratified analysis by visiting frequency (less than once a week, more than once a week) and similar results were obtained.

4. Discussion

This study investigated anxiety symptoms among Chinese family members of nursing home residents during visiting restrictions and examined its relationships with satisfaction with care quality. We found that approximately one-quarter of the family members of nursing home residents had anxiety symptoms during visiting restrictions. More importantly, our results demonstrated that cognitive reappraisal (a kind of emotion regulation strategy) and perceived stress played a chain mediating role in the relationship between satisfaction with care quality and anxiety, which provides a new perspective for the purpose of promoting the psychological well-being of family members during nursing home visiting restrictions.

We found that approximately one-quarter of the family members had anxiety symptoms, which is comparable to the prevalence of anxiety in general populations during the COVID-19 pandemic reported in a recent meta-analysis of 43 studies (29). Moreover, the mean score for PSS-4 was 6.27, suggesting a high level of self-perceived stress in family members of nursing home residents during visiting restrictions (26). Our findings are in line with a previous qualitative study, in which both residents and their family members experienced anxiety and severe stress due to isolation and distancing during the COVID-19 pandemic (7). The reason why family members felt stressed and anxious can be the inability to visit their old relatives in persons due to the social distancing policies (30). In addition, this study revealed that satisfaction with care quality was negatively related to both perceived stress and anxiety among family members of nursing home residents. Family members generally expected nursing homes to provide high-quality care and support the well-being of their loved ones (31). A previous study found that the quality of nursing home personal care was a major source of stress for family members (32), which echoes the results of the current study.

For the mechanisms of how satisfaction with care quality affects anxiety in family members of nursing home residents, we found three indirect paths although there were no direct effects. Firstly, cognitive reappraisal positively mediated the relationship between satisfaction with care quality and anxiety. Individuals who tend to use cognitive reappraisal are more likely to interpret stressful events in a more optimistic way and make active efforts to repair negative moods (33). A randomized controlled trial reported that cognitive reappraisal as a brief online intervention could ease acute stress and strengthen the mental health of parents during the COVID-19 pandemic (34). In

TABLE 2 Correlations of satisfaction with care quality, emotion regulation, perceived stress, and anxiety[a].

	Mean±SD	Skewness	Kurtosis	1	2	3	4	5
1. Satisfaction with care quality	5.00 (1.00)[b]	−2.114	4.448	1.000				
2. Cognitive reappraisal (ERQ)	30.38 ± 9.82	−0.848	0.076	0.122**	1.000			
3. Expressive suppression (ERQ)	17.58 ± 6.95	−0.306	−0.686	0.074	0.705**	1.000		
4. Perceived stress (PSS-4)	6.27 ± 2.68	−0.492	0.319	−0.162**	−0.233**	0.027	1.000	
5. Anxiety (GAD-7)	1.00 (4.00)[b]	2.062	4.379	−0.162**	−0.070	0.024	0.204**	1.000

SD, standard deviation; ERQ, Emotion Regulation Questionnaire; PSS, Perceived Stress Scale; GAD, Generalized Anxiety Disorder.
[a]Pearson correlation analyses were conducted among cognitive reappraisal, expressive suppression, and perceived stress, while Sperman correlation analyses were conducted for satisfaction with care quality and anxiety.
[b]The median and the interquartile range are presented.
**$p < 0.01$.

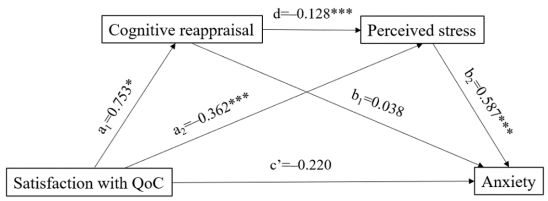

FIGURE 1
The chain mediation analyses of cognitive reappraisal and perceived stress on anxiety (ADL disability of the residents, age of the family members, and expressive suppression were included as covariates. QoC, quality of care, *p<0.05, ***p<0.001).

TABLE 3 Mediating model examination by bootstrap.

	Effect	Boot SE	Boot LLCI	Boot ULCI
Total effect	−0.240	0.708	−0.394	−0.115
Direct effect	−0.220	0.178	−0.570	0.130
Ind1	0.028	0.020	0.001	0.084
Ind2	−0.057	0.025	−0.111	−0.013
Ind3	−0.212	0.069	−0.369	−0.092

SE, standard error; LLCI, lower limit confidence interval; ULCI, upper limit confidence interval.
Ind1: Satisfaction with care quality→Cognitive reappraisal→Anxiety.
Ind2: Satisfaction with care quality→Cognitive reappraisal→Perceived stress→Anxiety.
Ind3: Satisfaction with care quality→Perceived stress→Anxiety.

addition, family members who experienced a higher level of satisfaction with care quality tended to utilize the cognitive reappraisal strategy, which further activates the brain structure (e.g., amygdala) and leads to less anxiety (35). Our study found that family members of nursing home residents scored cognitive reappraisal at a relatively lower level when compared with previous studies (36, 37). This suggests that cognitive reappraisal skills should be cultivated for family members during nursing home visiting restrictions.

Secondly, satisfaction with care quality indirectly affects anxiety through perceived stress, which is the primary path that accounted for 88.3% of the total effect. This mediating role of perceived stress to anxiety is partially consistent with previous studies in other populations (38–40). In college students, perceived stress mediates the association between sleep quality and anxiety symptoms (38) as well as the relationship between facing existential issues (loneliness and death) and anxiety symptoms (39). During the COVID-19 pandemic, Pradhan et al. examined the fear of death among young adults and found that neuroticism positively correlated to death anxiety but this relationship was completely mediated by perceived stress (40). In a qualitative study, almost all family members of people with dementia expressed stress when they were worried about the care quality in nursing homes (41). Findings of the current study verified that family members with higher satisfaction with care quality would experience a lower level of perceived stress and tend to undergo fewer anxiety symptoms.

Thirdly, cognitive reappraisal and perceived stress exerted a chain mediating effect between satisfaction with care quality and anxiety. This path illustrated that cognitive reappraisal acted as a partial mediator between satisfaction with care quality and perceived stress while perceived stress fully mediated the relationship between cognitive reappraisal and anxiety. Family members who were more satisfied with care quality would adopt the cognitive reappraisal strategy more frequently (β=0.753), which negatively predicted perceived stress (β=−0.128). Meanwhile, the lower level of perceived stress, the fewer anxiety symptoms (β=0.587). These results are consistent with the basic viewpoint of the Stress and Coping Model (14). That is, when faced with a stressful encounter, the individual would mobilize coping efforts, which can influence the perception of stress and thereby lead to psychological outcomes (e.g., anxiety) (14). Cognitive reappraisal is generally viewed as a healthy emotion regulation strategy since it attempts to reinterpret an emotion-eliciting situation in a way that alters its meaning and changes its emotional impact (24). This path provided a deeper understanding of the mechanisms of how satisfaction with care quality affects anxiety and reemphasized the vital role of cognitive reappraisal in alleviating anxiety symptoms of family members during nursing home visiting restrictions. Cognitive reappraisal techniques, such as positive reframing, self-distancing, and temporal distancing (42), can be implemented for family members during visiting restrictions. By this way, both the perceived stress and anxiety of family members could be alleviated. In addition, high-quality care and family-resident communication cannot be ignored to minimize the negative effects of nursing home visiting restrictions. It is suggested that feasible and acceptable digital solutions, such as web conferencing, can be promoted in nursing homes during this special period (43). Policies limiting of visitation isolated the family members from their relatives who lived in nursing homes, such interventions can allow family members access to residential care and may further improve their satisfaction with care quality.

To our knowledge, this is the first study to quantitatively investigate the psychological well-being among Chinese family members of nursing home residents during visiting restrictions. The findings contribute to a deeper understanding of the mechanism of how satisfaction with care quality affects anxiety. However, this study had several limitations that should be mentioned for future research.

Firstly, this study was a cross-sectional design in which the interpretation of the direction of associations has been clouded and cause-effect relationships among the variables cannot be deduced. It is suggested to employ interventional experiments or longitudinal studies to validate the mediating effects and provide a better understanding of satisfaction with care quality and anxiety in the future. In addition, the satisfaction of care quality was measured by a single self-reported question, which may not reflect the actual care quality in nursing homes. However, subjective perception is always of great importance in psychological studies. Although the residents were provided with high-quality care in nursing homes, their family members can still experience a low level of psychological well-being (e.g., anxiety) if they perceived the care as dissatisfying. Moreover, the results of this study were not compared to the nursing home situation before visitation restrictions. Some older adults had been living in the nursing homes for a long time, family members may recall the care quality prior to the COVID-19 pandemic when evaluating their satisfaction with care quality. Finally, this study was carried out with a Chinese sample during the COVID-19 lockdown, the applicability of the study results to the populations in other countries should be further validated.

5. Conclusion

The results of this study demonstrate that approximately one-quarter of the family members of nursing home residents experienced anxiety symptoms during visiting restrictions. In addition, the relationship of satisfaction with care quality and anxiety is mediated by cognitive reappraisal (a kind of emotion regulation strategies) and perceived stress, which provides significant evidence for developing potential interventions and support services. Efforts to address family members' psychological well-being by focusing on cognitive reappraisal should be considered.

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 Biomedical Ethics Committee of Xi'an Jiaotong University Health Science Center (2022-0004). The patients/participants provided their written informed consent to participate in this study.

Author contributions

ZH, XQW, and MW contributed to the conception and design of this study. FL and RZ contributed to data acquisition. ZH and XW performed the statistical analysis. ZH, XW, JZ, and YP interpreted the data and drafted the manuscript. All authors contributed to the critical revision of the manuscript and approved the version for publication.

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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.

Publisher's note

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The virus made me lose control: The impact of COVID-related work changes on employees' mental health, aggression, and interpersonal conflict

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Introduction: COVID-related work changes have seriously disrupted employees' familiar routines and hampered their lives and work. Although this topic has drawn rising attention, to our knowledge, limited studies have investigated the impact of COVID-related work changes on employees' mentality and behavior. In this paper, we developed a moderated mediation model based on ego depletion theory to test how and when COVID-related work changes impact employees' mental health, interpersonal conflict, and aggression behavior.

Methods: We collected 536 valid participants by conducting a questionnaire survey in a large Chinese manufacturing company, and tested our proposed theoretical model and hypotheses using SPSS 26.0 and Mplus 8.1.

Results: The empirical results showed that COVID-related work changes would harm employees' mental health and boost their interpersonal conflict and aggression via increasing their ego depletion. Moreover, trait resilience has an intervention in the relationship between COVID-related work changes and employees' ego depletion, which weakens the indirect impact of COVID-related work changes on mental health, interpersonal conflict, and aggression.

Discussion: These findings suggest that although COVID-related work changes were inevitable, managers should take measures to improve the employees' mental status and avoid conflicts promptly while taking steps to keep organizations on track.

KEYWORDS

COVID-related work changes, ego depletion, mental health, interpersonal conflict, aggression, trait resilience

Introduction

The outbreak of the COVID-19 pandemic brings changes to the market, which have posed significant challenges to organizations' daily operations(e.g., workplace lockdowns and mandatory quarantine) (1). In response to those challenges, organizations have to implement arrangements to ensure regular company operations while limiting the spread of the viruses, such measures including downsizing (2), mergers, and restructuring (3, 4). Therefore, employees were forced to adapt to a new and flexible working environment, which reflects employees' work

changes highly related to their organizational restructuring. For instance, employees might experience company relocation, remote work forms, and changes in job contracts (5). Also, different from the work content and procedures in the past, employees had to confront more internet-related additional job demands (6) and complex work situations, such as reduced shifts, paid or unpaid temporary leave, quarantined or self-isolated (7). In fact, these changes are unavoidable. COVID-related work changes have seriously disrupted employees' familiar routines and negatively influenced their psychological as well as behavioral performance. For example, previous studies have confirmed that some of these changes are closely related to employees' emotional exhaustion (8), burnout (9), a decline in work engagement (10), and decreased psychological well-being and productivity (11).

Although the negative effect of COVID-related work changes on employees has drawn rising attention, there are questions that remain to be explored. First, the comprehensive impact of COVID-related work changes on employees' mental health and deviant workplace behavior has not been thoroughly discussed. Most studies on the impact of COVID-related work changes on employees' psychological state and behavior have looked into a specific aspect of work changes, such as changes in working characteristics (i.e., decreased physical activity, lack of communication with coworkers) (12) or workplace adjustment (i.e., working from home, workplace redesign) (13, 14). Hence, it is unclear whether COVID-related work changes impact employee positively or negatively from a broad concept, given that the evidence from the existing literature is inadequate. Second, there has been little research on the mediating mechanisms of the relationship between COVID-related work changes and employees' mental health and deviant workplace behavior. Previous scholars have mainly focused on the concept of work concerns to explain the impact of COVID-related work changes on employees' mental health and negative behavior (15–17). Furthermore, it is unclear whether the effects of COVID-related work changes on mental health and deviant workplace behaviors vary across individuals with different trait resilience. Even though individual trait resilience has been identified as a protective factor buffering the impacts of risk factors under challenging situations (18, 19).

In this study, we develop a moderated mediation model to investigate how and when COVID-related work changes may influence employees' mental health and deviant workplace behavior using ego depletion theory. Specifically, we choose two typical types of workplace deviance, interpersonal conflict and aggression, which are prevalent problems in organizations and seriously damage the well-being of others (20–22). According to ego depletion theory, ego depletion can be characterized as a state that manifests as a reduction of self-capacity or willingness to engage in volitional action caused by a prior exercise of volition (23). In this vein, we assume that employees need to spend plenty of self-control resources to overcome the difficulties and challenges posed by the COVID-related work changes, which can put them in a state of self-depletion. Further, employees with depleted resources are less likely to be able to regulate their negative emotions and aggressive impulses, which leads to decreased mental health but raises engagement in workplace deviant behavior. In addition, as suggested by the ego-depletion theory, individuals with different personalities react differently to resource depletion. Hence, we also consider trait resilience, the ability to bounce back or recover from stress (24, 25), as an individual's difference and examine its moderating effect on the relationship between COVID-related work changes and employee ego depletion. The theoretical model is shown in Figure 1.

This research contributes to the existing literature in three ways. First, we expand on work changes literature by shedding light on the effect of COVID-related work changes on employees' mental health and deviant workplace behavior. Although many previous researchers have examined the relationship between changes in a specific aspect of work and employee positive or negative responses during COVID-19 (9, 26, 27), we explore the comprehensive influence of COVID-related work changes on employees' mental health and deviant workplace behavior. Examining the correlation also extends our knowledge of the antecedents of employees' mental health and deviant workplace behavior. Second, we reveal an intermediate link accounting for the complete process of how COVID-related work changes are associated with mental health and deviant workplace behavior. Such contribution disclose ego depletion as an essential factor in bridging the COVID-related work changes and employee mentality and workplace behavior, thus providing scholars with a deeper understanding of the root cause of their relationship. Third, our study extends the moderating mechanism of the influence of COVID-related work changes on employee mental health and deviant workplace behavior. It is worth mentioning that no specific studies concern the role of resilience factors in the relationship between the COVID-19 outbreak and employees' outcomes, regardless of existing research points to the importance of further exploring the role of trait resilience as a protective factor for one's mental health during the COVID-19 crisis (28). Therefore, our study's contribution lies in extending the concept of trait resilience as it has been applied to literature in the current study.

Theory and hypotheses

COVID-related work changes and ego depletion

COVID-19 brings drastic changes in external employment circumstances that employees need to face. In fact, the pandemic has led to dramatic economic dislocation and disruption in the work process (1), so most corporations suffer from demand–supply-production interruptions (29), which lead to downsizing. The dramatic reduction in labor demand puts employees at great risk of losing their jobs while other job opportunities become scarce (30). Besides coping with the pressures brought by the deterioration of the labor market, employees also need to make adjustments in the face of alternative work arrangements, which provide additional learning challenges. As such, employees are required to be familiar with the new work environment and quickly adapt to various internet technology (31, 32).

Throughout history, people have shown an extraordinary ability to regulate themselves and control impulses. The ability to self-control enables individuals to engage in goal-oriented behavior and achieve ideal long-term results (33). In line with the definition of Baumeister et al. (23), who first put forward the concept of ego depletion, they pointed out that individuals consume their limited resources in the process of self-control. Mental resources such as energy or power are consumed in the process of regulating themselves by coping with stress, regulating emotions, and resist temptation (34). Once such

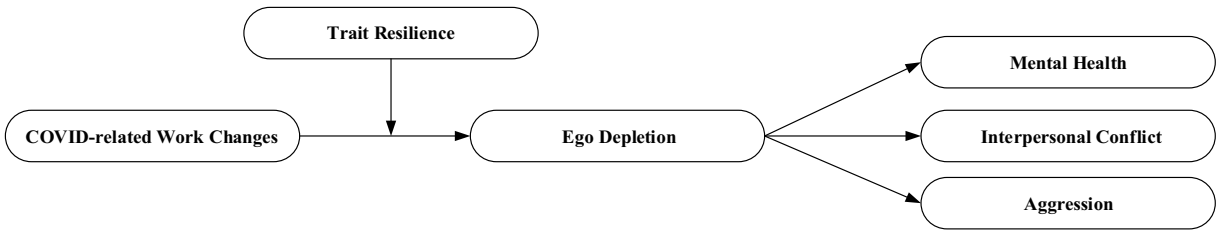

FIGURE 1
Theoretical model.

resources are depleted, individuals will fall into a state called "ego depletion" (23) and then misbehave (35).

This paper argues that COVID-related work changes are positively related to ego depletion. First, according to ego depletion theory, individuals may experience ego depletion because of the excessive consumption of self-regulating resources (23). As mentioned above, stress coping and emotion regulation are the two main channels individuals consume self-regulatory resources, an unavoidable experience during a pandemic. To get through the hardship of the pandemic, employees need to grit their teeth and adapt to the stressful work environment, changeable work arrangement, and unfamiliar work characteristics. The novelty experiences force employees to engage in more self-regulation activities than past, eventually leading to an overconsumption of employees' limited mental resources. Second, ego depletion theory indicates that actions against personal willingness considerably consume self-control resources (23). As new management systems are issued due to COVID-related work changes, companies usually have more restrictions on employees' daily work schedules, such as travel constraints and job deadline constraints. Even though these measurements benefit companies, comparatively, employees' work autonomy has declined. Employees have to familiarize themselves with the new regulations in order to adjust their behavior to new rules. As a result, due to the loss of autonomy in decision-making and actions, employees would engage in more behaviors against their own will and hence fall into a state of ego depletion. Therefore, the following hypothesis is proposed:

> *H1*: COVID-related work changes are positively related to ego depletion.

Ego depletion and mental health

According to the World Health Organization (36), mental health is a state of well-being in which the individual realizes his or her abilities to cope with the normal stresses of life, can work productively and fruitfully and can contribute to his or her community.

Previous studies have shown that employees' mental health is closely related to their work attitude (37, 38) and ultimately affects their work performance (39). However, with the outbreak of the pandemic, the overall mental health level of employees has shown a downward trend (40), which has attracted increasing attention from scholars. For example, Gabriel et al. (41) showed that COVID-19 increased employees' job burnout by aggravating the consumption of work resources, ultimately reducing their work performance.

In this paper, we argue that the state of ego depletion is harmful to employees' mental health. First, based on ego depletion theory, individuals need to consume self-control resources in controlling emotion (23, 42). However, when employees encounter ego depletion, self-control resources are lost (23). Due to limited mental resources, individuals could not regulate their emotions as usual. Thereby, the negative emotions accumulate and ultimately damage their mental health. Second, experiencing ego depletion normally leads to individual cognitive bias, which has been manifested by studies that lead to underestimation of their ability to control the external environment and having more pessimistic expectations for the future (43). Such harmful impacts are not temporary but rather a long-term and ongoing process. Suppose individuals stay in a negative psychological state for the long term without any other psychological support. In that case, psychological problems such as depression (44), anger (45), anxiety (46), and burnout (47) will be induced and, in turn, seriously damage the individual's mental health. Therefore, we propose the following hypothesis:

> *H2a*: Ego depletion is negatively related to mental health.

Ego depletion, interpersonal conflict, and aggression

Interpersonal conflict and aggression are two common types of deviant workplace behaviors (20–22) that are harmful to interpersonal relationships within the workplace to varying degrees (47–51). Precisely, as a dynamic process, interpersonal conflict consists of three essential elements: disagreement, interference, and negative emotions (52). It refers to incompatibility between the interacting parties (52, 53). The difference between workplace aggression and conflict is that formal refers to any physical or verbal specific actions that employees intentionally behave to hurt others (54). Obviously, although it has some similarities with interpersonal conflict, initiative and harmfulness are the main characteristics of aggression (55). Compared with interpersonal conflict, aggression is more harmful to the well-being of others and even organizations.

In this paper, we argue that ego depletion positively relates to interpersonal conflict and aggressive behaviors. First, individuals in a state of ego depletion are more likely to stuck in maladaptive cognition or lose effective regulation of their behaviors (56, 57).

Therefore, owing to the decline of self-control capabilities, employees may vent their emotions by engaging in low-intensity workplace deviant behaviors (i.e., interpersonal conflict), even acting aggressively toward others. Second, individuals in a state of ego depletion are less likely to resist the impulse to violate work norms (58). In general, individuals take full consideration and weigh the conflicts between gaining self-interest and complying with work norms before acting (34). However, individuals in a state of ego depletion are unlikely to make trade-offs because of the lack of self-control resources. They prefer to follow their inner impulse even if these actions violate social norms (44). Therefore, those low in self-control resources are likely to act without thinking about others' feelings or consequences, leading to interpersonal conflict and even physical and verbal aggression against others. Thus, we propose that:

> *H2b*: Ego depletion is positively related to employee interpersonal conflict.
>
> *H2c*: Ego depletion is positively related to employee aggression.

Combining the explanation of Hypotheses 1, 2a, 2b, and 2c, we propose that ego depletion is a potential mechanism mediating the relationship among COVID-related work changes, mental health, interpersonal conflict, and aggression. According to ego depletion theory, prior volitional behaviors that consume excessive resources may adversely affect the individual's subsequent behavior (23). Therefore, employees need to devote excessive resources to assimilate to COVID-related work changes, which forces them to enter a state of ego depletion. At the same time, the state of ego depletion further hurts their mental health and increases inappropriate workplace behaviors (i.e., interpersonal conflict and aggression). Thus, we propose that:

> *H3a*: Ego depletion mediates the relationship between COVID-related work changes and employees' mental health.
>
> *H3b*: Ego depletion mediates the relationship between COVID-related work changes and employees' interpersonal conflict.
>
> *H3c*: Ego depletion mediates the relationship between COVID-related work changes and employees' aggression.

Moderating effects of trait resilience

Trait resilience reflects an ability that assists individuals in adapting to stressful circumstances and recovering from loss, hardship, and adversity (24, 25). In the face of stress, trait resilience equips individuals with resources or energy to assess the hardship and stabilize their emotions (59) to protect better and construct their reservoir of resources. Previous research demonstrates that individuals with high resilience are more able to mitigate negative influences and cope with stress positively than those with low resilience (60, 61).

According to the ego depletion theory, individuals with different traits vary in their ability to mobilize and gather resources (62, 63). Hence, we argue that individuals with high trait resilience are less prone to fall into ego depletion when coping with COVID-related work changes versus those has low. First, individuals with high trait resilience can better mobilize resources to cope with change by shifting negative attention to the positive aspects of events (64, 65). A main reason for employees' negative outcomes caused by the COVID-related work changes is that individuals cannot manage their own mental resources appropriately, so that they are tired to cope with the work changes and cannot maintain self-regulation. Thus, individuals with high trait resilience can cope with COVID-related changes effectively by consuming fewer self-control resources and are less likely to fall into a state of ego depletion. Conversely, individuals with lower trait resilience are more susceptible to shifting personal attention to the negative side of events and have difficulty coping with stress (61). Although they probably invest more resources to adapt to the change, it may have little effect or even more quickly lead to the depletion of self-control resources. Second, trait resilience enables individuals to seek out potential opportunities to access resources even when confronting severe adversity (64). Mitchell et al. (59) confirmed that individuals with varying trait resilience might make contrasting evaluations when faced with the same event. Individuals with high trait resilience tend to extract beneficial and valuable information from events and reject the negative aspects. This allows them to actively replenish their resource base even in the face of adversity (59, 60). Conversely, those low in trait resilience are likely overwhelmed by negative influences, resulting in excessive consumption of self-regulation resources. Hence, we hypothesize the following:

> *H4*: Trait resilience moderates the relationship between COVID-related work changes and ego depletion, and the positive effect will be weaker when trait resilience is higher versus lower.

Previous research suggests that individuals with high trait resilience can actively search for a route in response to uncertain circumstances that do not lend themselves to planning, preparation, rationalization, or logical interpretation. (66, 67). Therefore, we propose that trait resilience can further moderate the effects of COVID-related work changes on employee mental health and workplace deviant behavior. Specifically, employees with higher trait resilience could better handle COVID-related work changes and still maintain the necessary resources. In doing so, abundant resources can provide high-trait resilience employees with the ability to better deal with negative emotions and control their behavior. On the contrary, individuals with low trait resilience are exhausted in their subsequent performance owing to the excessive resources consumed in response to COVID-related work changes, which may aggravate the negative impact of COVID-related work changes on employee psychology and behavior.

> *H5a*: Trait resilience moderates the indirect relationship between COVID-related work changes and mental health, and the negative effect will be weaker when trait resilience is higher versus lower.
>
> *H5b*: Trait resilience moderates the indirect relationships between COVID-related work changes and interpersonal conflict, and the negative effect will be weaker when trait resilience is higher versus lower.

> *H5c*: Trait resilience moderates the indirect relationships between COVID-related work changes and aggression, and the negative effect will be weaker when trait resilience is higher versus lower.

Methods

Samples

During the COVID-19 pandemic, the front-line employees' work environment, methods, and job contents were dramatically changed based on the modification and redesign of workflows. The manufacturing sector was one of the industries that severely affected by the pandemic and with constrict restrictions to cope with the spreading of the virus (68). To ensure the smooth operation of the economy amid the COVID-19, it is imperative for manufacturing enterprises to recall employees to restart production activities. Although companies have adopted a series of isolation measures to ensure the safety of front-line employees, these employees still suffer greater risk of infection than others. Furthermore, the majority of companies had laid off some workers for saving costs because they did not know when the market would recover and when migrant workers would be allowed to come back to work due to the travel restrictions. Such work changes and the concerned of being infected imposes substantial physical and psychological stress on employees. At the same time, the requirement to familiarize themselves with new technologies and environments in a short period can also significantly consume the energy of front-line employees. Therefore, we targeted our research on front-line workers engaged in manufacturing companies' production, service, and logistics operations.

The sample of this study was front-line workers who worked in a large-scale Chinese manufacturing company with many subsidiaries. Most of the subsidiary companies are located in Shandong, Anhui, Sichuan, and Jiangsu. This research project was initiated in China in October 2022, in the immediate aftermath of the localized outbreak of COVID-19 in China. All of these subsidiaries were affected by the COVID-19 pandemic restriction. The cities where they are located reported infection cases during this study in October 2022. In compliance with China's epidemic prevention policy, we conducted an online survey[1] with the help of the HR department instead of issuing questionnaires through offline visits. In the recruitment process, we clarified the content, confidentiality, and voluntary nature of this study, to the participants. After completing the survey, we also offered them a prize in the form of an online lottery. Finally, we gathered 552 employees to participate in this study.

In line with Meade and Craig (69) and Huang et al. (70), we filtered out participants who chose the same options on most questions and completed the questionnaire in less than half the time to ensure the quality of the collected data. Finally, we received 536 valid questionnaires, accounting for 97.10% of the total sample size. Among these samples, 47.01% were male, and 52.99% were female; 31.34% were 36–45 years old, 26.12% were 46–55 years old, and 25.75% were 26–35 years old. In terms of educational level, 27.99% held an associate degree, 26.12% graduated from high school and 21.83% had a bachelor's degree; 39.93% earned 5,000–7,500 Yuan per month, 21.27% earned 2,500–5,000 Yuan per month, and 14.37% earned 7,500–10,000 Yuan per month; 22.95% had worked in this organization for 2–3 years, 21.83% had worked for 1–2 years, and 19.22% had worked for 3–5 years.

Measures

We adopted all the measurements in this study from previous research and translated them into Chinese following the back-translation procedure (71). Participants were required to rate the items with a 5-point Likert scale ranging from 1 = not at all to 5 = fully compliant. The specific measurement items of variables are shown in the Appendix.

COVID-related work changes

We used an 8-item scale from Madero Gómez et al. (72) to assess the employees' perceptions of the effect that COVID-19 has on their work (Cronbach's $\alpha = 0.915$). A representative item is "My workplace has had to modify its operational processes owing to the coronavirus."

Ego depletion

We used a 5-item scale from Twenge et al. (73) to measure ego depletion (Cronbach's $\alpha = 0.877$). A sample item is "My mind feels unfocused right now."

Mental health

We used a 5-item scale from Wu et al. (74) to measure mental health (Cronbach's $\alpha = 0.916$). A sample item is "I have been feeling emotionally stable lately."

Interpersonal conflict

We used a 4-item scale from Spector and Jex (75) to measure interpersonal conflict (Cronbach's $\alpha = 0.821$). A sample item is "Get into arguments with others at work."

Aggression

We used a 4-item scale from Stewart et al. (55) to measure aggression (Cronbach's $\alpha = 0.888$). A sample item is "I say something hurtful to someone at work."

Trait resilience

We used a 3-item scale from Smith et al. (76) to measure trait resilience (Cronbach's $\alpha = 0.825$). A sample item is "I usually come through difficult times with little trouble."

1 https://www.wjx.cn/

Control variables

We controlled the effects of gender, age, education level, monthly income (39), and years of employment to eliminate their possible confounding influence. Previous research has shown that job satisfaction serves as an effective predictor of psychological and behavioral changes (77, 78). To better demonstrate the effects of COVID-related work changes on employees, we adopted a 5-item scale from Judge, Locke, Durham, and Kluger (79) and controlled the effects of job satisfaction in all phases.

Meanwhile, we also controlled the relatively stable traits (i.e., emotional stability and resistance to change). Participants were required to rate their emotional stability using a 5-item scale (Cronbach's $\alpha = 0.866$) from Saucier (80) and their attitudes toward change by answering a 17-item scale (Cronbach's $\alpha = 0.977$) developed by Oreg et al. (81). As opposed to controlling the effects of emotional stability at all stages, resistance to change was only controlled in the path of influence on mediating variables.

Results

We conducted a confirmatory factor analysis to confirm the discriminant validity of the hypothesized model using Mplus 8.1. As shown in Table 1, the fit indexes of the 9-factor model ($\chi^2 = 1821.064$, $df = 1,448$, $\chi^2/df = 1.258$, $CFI = 0.982$, $TLI = 0.981$, $RMSEA = 0.022$, $SRMR = 0.029$) offer a better fit for the collected data than any other models.

Table 2 summarizes the descriptive statistics and correlations of the study variables. COVID-related work changes are positively associated with ego depletion ($r = 0.331$, $p < 0.01$); ego depletion is negatively associated with mental health ($r = -0.393$, $p < 0.01$), and positively associated with interpersonal conflict ($r = 0.355$, $p < 0.01$) and aggression ($r = 0.293$, $p < 0.01$).

Table 3 displays the results for the direct, indirect, and moderate hypotheses and demonstrates their bootstrapped estimates, standard errors, and confidence intervals. COVID-related work changes significantly and positively affect employees' ego depletion ($\beta = 0.229$, $p < 0.001$), which supports Hypothesis 1. Meanwhile, consistent with Hypotheses 2a, 2b, and 2c, ego depletion has a significant and negative impact on mental health ($\beta = -0.313$, $p < 0.001$) and has a significant and negative effect on interpersonal conflict ($\beta = 0.241$, $p < 0.001$) and aggression ($\beta = 0.224$, $p < 0.001$). Consistent with Hypotheses 3a, 3b, and 3c, ego depletion mediates the relationships among COVID-related work changes and mental health, COVID-related work changes and interpersonal conflict, and COVID-related work changes and aggression. Specifically, for mental health, the indirect effect is −0.072 (95% CI = [−0.109, −0.043]); For interpersonal conflict, the indirect effect is 0.055 (95% CI = [0.032, 0.087]); For aggression, the indirect effect is 0.051 (95% CI = [0.026, 0.084]).

Table 3 also reveals that the interaction between COVID-related work changes and trait resilience is negatively related to ego depletion ($\beta = -0.115$, 95% CI = [−0.221, −0.010]). The finding demonstrates that the positive effect of COVID-related work changes on ego depletion significantly varies for individuals with different levels of resistance to change, as shown in Figure 2. Simple slope analysis indicates that the positive effect of COVID-related work changes on ego depletion is weaker for individuals with high trait resilience versus low trait resilience. Thus, Hypothesis 4 is supported.

Table 4 displays conditional indirect effects at values of trait resilience. The results indicate that trait resilience moderates the indirect effects of COVID-related work changes on mental health, interpersonal conflict, and aggression through ego depletion. Ego depletion has a weaker mediation effect on the relationship between

TABLE 1 Confirmatory factor analysis.

Model	χ^2	df	χ^2/df	CFI	TLI	RMSEA	SRMR
Nine-factor model: CWC, TR, ED, MH, IC, AG, RC, JS, ES	1,821.064	1,448	1.258	0.982	0.981	0.022	0.029
Eight-factor model: CWC + AG, ED, TR, MH, IC, RC, JS, ES	2,720.878	1,456	1.869	0.939	0.936	0.040	0.043
Seven-factor model: CWC + AG + IC, ED, TR, MH, RC, JS, ES	4,096.037	1,463	2.800	0.873	0.866	0.058	0.057
Six-factor model: CWC + AG + IC + MH, ED, TR, RC, JS, ES	4,591.417	1,469	3.126	0.850	0.842	0.063	0.061
Five-factor model: CWC + AG + IC + MH, JS + ES, ED, TR, RC	5,299.084	1,474	3.595	0.816	0.807	0.070	0.065
Four-factor model: CWC + AG + IC + MH + ED, JS + ES, TR, RC	6,226.674	1,478	4.212	0.771	0.762	0.077	0.071
Three-factor model: CWC + AG + IC + MH + ED + JS + ES, TR, RC	7,357.644	1,481	4.968	0.717	0.706	0.086	0.084
Two-factor model: CWC + AG + IC + MH + ED + JS + ES + TR, RC	7,835.125	1,483	5.283	0.694	0.682	0.089	0.086
One-factor model: CRWC + AG + IC + MH + ED + JS + ES + TR + RC	12,460.022	1,484	8.396	0.471	0.451	0.117	0.181

N = 536. CWC, COVID-related Work Changes; ED, Ego Depletion; TR, Trait Resilience; MH, Mental Health; IC, Interpersonal Conflict; AG, Aggression; RC, Resistance to Change; JS, Job Satisfaction; ES, Emotional Stability. Same for the following tables.

TABLE 2 Means, standard deviations, and correlations.

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Gender	1.53	0.50	–													
2. Age	3.74	1.09	−0.010	–												
3. Education level	2.98	1.20	0.027	0.017	–											
4. Monthly income	2.99	1.16	0.044	−0.050	0.046	–										
5. Years of employment	3.27	1.52	0.007	−0.030	−0.023	−0.040										
6. RC	2.71	0.96	0.018	0.103*	−0.006	−0.002	0.019	**(0.977)**								
7. JSA	3.33	0.69	0.080	−0.094*	−0.019	−0.037	0.007	−0.105*	**(0.854)**							
8. ES	3.40	0.68	0.108*	−0.065	0.010	0.007	0.012	−0.168**	0.409**	**(0.866)**						
9. CWC	2.40	0.81	−0.050	0.011	0.023	0.039	−0.031	0.167**	−0.219**	−0.244**	**(0.915)**					
10. ED	2.48	0.80	−0.016	0.001	−0.015	0.036	−0.048	0.123**	−0.200**	−0.291**	0.331**	**(0.877)**				
11. TR	3.33	0.75	0.094*	0.008	−0.008	−0.029	0.003	−0.130**	0.295**	0.279**	−0.246**	−0.234**	**(0.825)**			
12. MH	3.64	0.83	0.016	0.106*	−0.012	−0.013	0.080	−0.132**	0.283**	0.342**	−0.387**	−0.393**	0.279**	**(0.916)**		
13. IC	3.03	0.69	−0.022	0.003	0.029	0.045	0.015	0.126**	−0.243**	−0.308**	0.422**	0.355**	−0.251**	−0.331**	**(0.821)**	
14. AG	2.21	0.79	−0.016	−0.102*	0.059	0.025	−0.013	0.108*	−0.211**	−0.260**	0.448**	0.293**	−0.220**	−0.423**	0.333**	**(0.888)**

$N = 536$. Same for the following tables. Internal consistent reliability (alpha) coefficients are shown along the diagonal in bold italics. Gender, 1 = male, 2 = female. Age, 1 = under 18 years old, 2 = 18–25 years old, 3 = 26–35 years old, 4 = 36–45 years old, 5 = 46–55 years old, 6 = over 56 years old. Education level, 1 = junior high school degree or below, 2 = high school, 3 = associate degree, 4 = bachelor degree, 5 = master degree or above. Monthly income, 1 = under 2,500 Yuan, 2 = 2,500–5,000 Yuan, 3 = 5,000–7,500 Yuan, 4 = 7,500–10,000 Yuan, 5 = over 10,000 Yuan. Years of employment, 1 = below 1 year, 2 = 1–2 years, 3 = 2–3 years, 4 = 3–5 years, 5 = 5–10 years, 6 = over 10 years. $^{**}p < 0.01$, $^{*}p < 0.05$.

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TABLE 3 Summary of direct, indirect, and interaction effects.

Paths	Estimates	S.E.	95% CI	Significance
Direct effects				
COVID-related Work Changes → Ego Depletion	0.229	0.039	[0.154, 0.308]	$p < 0.001$
Ego Depletion →Mental Health	−0.313	0.042	[−0.396, −0.228]	$p < 0.001$
Ego Depletion →Interpersonal Conflict	0.241	0.035	[0.175, 0.311]	$p < 0.001$
Ego Depletion →Aggression	0.224	0.042	[0.139, 0.306]	$p < 0.001$
Indirect effects				
COVID-related Work Changes → Ego Depletion→ Mental Health	−0.072	0.017	[−0.109, −0.043]	$p < 0.001$
COVID-related Work Changes → Ego Depletion→ Interpersonal Conflict	0.055	0.014	[0.032, 0.087]	$p < 0.001$
COVID-related Work Changes → Ego Depletion→ Aggression	0.051	0.015	[0.026, 0.084]	$p < 0.001$
Moderate effects				
COVID-related Work Changes * Trait Resilience →Ego Depletion	−0.115	0.053	[−0.221, −0.010]	$p < 0.050$

N = 536. Estimates, bootstrapped estimate; SE, standard error; LL, lower level; UL, upper level; CI, confidence interval. Values for quantitative moderators are the plus/minus one SD from the mean. Same for the following tables.

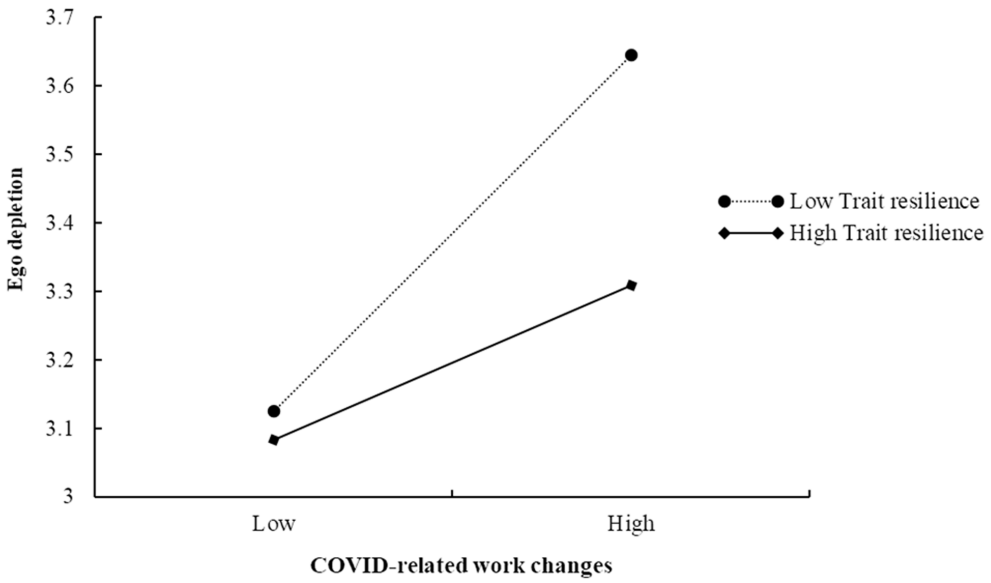

FIGURE 2
The moderating effect of trait resilience on the relationship between COVID-related work changes and ego depletion.

COVID-related work changes and mental health for employees with high-level trait resilience (i.e., conditional mediation effect = −0.036, 95% CI = [−0.086, 0.008]) than for employees with low-level trait resilience (i.e., conditional mediation effect = −0.108, 95% CI = [−0.161, − 0.062]), consistent with Hypothesis 5a. Additionally, the difference in these two effects is 0.036 (95% CI = [0.004. 0.074]). Supporting Hypothesis 5b, ego depletion has a weaker mediation effect on the relationship between COVID-related work changes and interpersonal conflict for employees with high-level trait resilience (i.e., conditional mediation effect = 0.027, 95% CI = [−0.006, 0.069]) compared to employees with low-level trait resilience (i.e., conditional mediation effect = 0.083, 95% CI = [0.050, 0.125]), and the difference between these two effects is −0.028 (95% CI = [−0.056, −0.005]). Supporting Hypothesis 5c, ego depletion has a weaker mediation effect on the relationship between COVID-related work changes and aggression for employees with high-level trait resilience (i.e., conditional mediation effect = 0.026, 95% CI = [−0.005, 0.067]) compared to employees with low-level trait resilience (i.e., conditional mediation effect = 0.077, 95% CI = [0.043, 0.121]), and the difference between these two effects is −0.026 (95% CI = [−0.053, −0.005]).

Discussion

Based on ego depletion theory, we constructed a moderated mediation model to explain how and when COVID-related work changes can influence employees' mental health and their workplace deviant behavior. Specifically, we explained the mediation role of

TABLE 4 Summary of conditional indirect effects at values of trait resilience.

Level	Estimates	S.E.	95% CI
Conditional indirect effects at values of Trait Resilience (COVID-related Work Changes → Ego Depletion→ Mental Health)			
−1 SD	−0.108	0.025	[−0.161, −0.062]
+1 SD	−0.036	0.024	[−0.086, 0.008]
Difference	0.036	0.018	[0.004, 0.074]
Conditional indirect effects at values of Trait Resilience (COVID-related Work Changes → Ego Depletion→ Interpersonal Conflict)			
−1 SD	0.083	0.019	[0.050, 0.125]
+1 SD	0.027	0.019	[−0.006, 0.069]
Difference	−0.028	0.013	[−0.056, −0.005]
Conditional indirect effects at values of Trait Resilience (COVID-related Work Changes → Ego Depletion→ Aggression)			
−1 SD	0.077	0.020	[0.043, 0.121]
+1 SD	0.026	0.018	[−0.005, 0.067]
Difference	−0.026	0.012	[−0.053, −0.005]

employees' ego depletion and the moderate effect of trait resilience. Based on the 536 samples collected from a large manufacturing company, we found that COVID-related work change harms employees' mental health *via* ego depletion. This finding confirms Trógolo et al.'s (82) conclusion that COVID-related work change increases psychological stress, which might harm employees' health. Furthermore, our paper also indicated that COVID-related work changes exert a positive and significant effect on interpersonal conflict and aggression. The result validates Leslie et al.'s (83) survey that COVID-related work change might increase workplace deviant behavior among employees. Additionally, we discovered that trait resilience could weaken the promoting effect of COVID-related work changes on ego depletion and negatively adjust the mediating effect of COVID-related work changes on employees' mental health and deviant workplace behavior through ego depletion.

Theoretical implications

There are several implications of this study. The first contribution lies in extending the literature on work change in the context of COVID-19 by exploring the effects of COVID-related work changes on employees' mental health and workplace deviant behavior. The majority of previous researchers studied the relationship between a specific aspect of COVID-related work changes and employees' attitudes and outcomes, such as working from home (72, 84), virtual teams (31), and virtual meetings (32). However, COVID-related work changes encompass workplace changes, work characteristics, and the workforce (85). As such, it is necessary to conduct a more comprehensive study to explore work change amid COVID-19 and its effect on employees. In our research, we discovered work changes in a broad-scope overview and enriched the research perspective of COVID-related work changes.

Second, this study revealed the underlying mechanism that could explain the influence of COVID-related work changes on employees' mental health and workplace deviant behavior by highlighting the mediating effect of ego depletion. Previous researchers have found that workplace change may lead to work–family conflict, thus affecting the mental health and work performance of employees during COVID-19 (9, 82). However, relatively few researchers have explored COVID-related work changes' impact on employees' psychology and behavior and how this impact occurs. In this study, we constructed a model of how COVID-related work changes affect employees' mental health and deviant workplace behavior through ego depletion, which can better clarify its mechanism.

Third, this study further answers the question of under which conditions COVID-related work changes may have stronger or weaker effects on employees' cognition and behavior. The importance of individual trait resilience in positively responding to the COVID-19 crisis is attracting more research attention (86, 87), and we have reason to believe that trait resilience plays a positive moderating role in the mechanism of the negative impact of work change on employees during COVID-19. Surprisingly, no specific studies concern the moderating role of trait resilience. Thus, we examined the moderating effect of trait resilience on the relationship between COVID-related work changes and employees' mental health and deviant workplace behavior to study employees' mental health and deviant workplace behavior. In doing so, this study provides a complete picture for understanding the effect of COVID-related work changes on employees' mental health and deviant workplace behavior.

Practical implications

This study also provides some practical insights for managers. First, our research findings confirmed that COVID-related work changes would impair employees' mental health and cause them to engage in interpersonal conflict and aggression. Therefore, our study provide hint for managers to understand the causes of employees' mental health problems and inappropriate workplace behavior in the organization. Only by understanding the root of the problem can take the correct actions to solve the issue. For example, managers could build positive organizational climate to keep employees' morale up so that employees will no longer worry about the related changes in their work. Also, organizations need to provide the necessary staff training to strengthen their work technical capacity and thus enhance their confidence in coping with work changes. In addition, managers should take appropriate actions in intervening in interpersonal

conflicts and even aggressive behaviors between employees. At this point, managers should pay more attention to the mental status of employees and communicate with both parties to facilitate the resolution of their conflict.

Second, in this paper, we deemed that employees' emotional and behavioral dysregulation is caused by excessive consumption of self-control resources when dealing with work changes. During this special period, employees may overexert themselves owing to the lack of self-control resources. In this case, it is no longer appropriate for managers to insist on dictatorial leadership, but should consider cultivating a democratic management style that facilitates employees' regaining a sense of control over their work to overcome the negative psychological impact. Meanwhile, as the outbreak situation improves, managers should develop more flexible management forms (i.e., advice seeking, providing more feedback) to give employees some autonomy in their work, which improves the efficiency of organizational operations to a certain extent and helps employees recover from a state of self-attrition.

Third, this study indicated that high trait resilience could effectively weaken the negative effect of COVID-related work changes on employees' mental health and has a positive effect on workplace deviant behavior. Hence, during the COVID-19 pandemic, we suggest that organizations should pay attention to the trait resilience of employees. On the one hand, managers can stimulate employees' trait resilience by establishing reward and punishment system for boosting adaptive performance which is used to measure the responsiveness to changing job requirements (88). On the other hand, leaders should encourage employees to internalize organizational values to improve their trait resilience. Turning work initiative into an internal driving force can help change employees' perception of work changes from stress to challenge. In doing so, their coping attitude toward COVID-19-related work changes would change from negative to positive.

Limitations and future research

Although this study has the aforementioned theoretical and practical implications, there are still some limitations. First, although the current research demonstrates the impact of COVID-related work changes on employees' mental health and workplace deviant behavior, our research design is cross-sectional, limiting our causality inference. Future researchers should explore whether work change always hurts employees' recognition and behaviors by utilizing a longitudinal design or multi-wave data.

Second, this study revealed the underlying mechanism through which COVID-related work changes could damage employee mental health and workplace behavior from the perspective of self-control resources. Future researchers could further examine the effects of COVID-related work changes on employees from other perspectives and reveal the other potential paths. For instance, based on the appraisal theory of stress, scholars could examine how the differences in individuals' subjective assessments of COVID-related work changes affect employees' behavioral and psychological outcomes.

Finally, this research was conducted only in China, which limits the generalizability of the results to some degree. Future researchers could examine whether work change influences employees' mental health and deviant workplace behavior through ego depletion in other countries, particularly in developed countries with entirely different social cultures from China.

Data availability statement

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

Author contributions

CH, RZ, and XiyL contributed to the conception and design of the study. CH organized the database. RZ and XiyL performed the statistical analysis. XiaL wrote sections of the manuscript. CH, XiaL, XiyL, and XW contributed to manuscript revision, read, and approved the submitted version. 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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Appendix

Factor structure
COVID-related work changes [Madero Gómez et al. (72)]

1. The organization where I work has been affected negatively by the emergence of the coronavirus.
2. Production or service processes of the organization where I work will be affected in the next couple of months by the coronavirus.
3. The coronavirus has put my workplace's operations at risk.
4. The coronavirus will be a reason for more absenteeism than normal in my workplace.
5. Imports of raw material in my organization have been negatively affected by the coronavirus.
6. My organization's operations have been negatively affected by the coronavirus.
7. My workplace has had to modify its operational processes due to the coronavirus.
8. My workplace has had to modify its travel policies and guidelines due to the coronavirus.

Ego depletion [Twenge et al. (73)]

1. I feel drained.
2. My mind feels unfocused right now.
3. Right now, it would take a lot of effort for me to concentrate on something.
4. My mental energy is running low.
5. I feel like my willpower is gone.

Mental health [Wu et al. (74)]

1. I have been feeling positive lately.
2. I have been feeling emotionally stable lately.
3. I have been feeling satisfied with life lately.
4. I have been feeling life had been interesting lately.
5. I have been feeling everything to look forward to lately.

Interpersonal conflict [Spector and Jex (75)]

1. Get into arguments with others at work.
2. Other people yell at you at work.
3. People rude to you at work.
4. People do nasty things to you at work.

Aggression [Stewart et al. (55)]

1. Said something hurtful to someone at work.
2. Acted rudely toward someone at work.
3. Lost their temper while at work.
4. Made fun of someone at work.

Trait resilience [Smith et al. (76)]

1. I tend to bounce back quickly after hard times.
2. It does not take me long to recover from a stressful event.
3. I usually come through difficult times with little trouble.

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Socioeconomic inequality in the worsening of psychosocial wellbeing *via* disrupted social conditions during COVID-19 among adolescents in Hong Kong: self-resilience matters

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Background: Adolescents, especially the socioeconomically disadvantaged, are facing devastating psychosocial impact of the COVID-19 pandemic during their critical developmental period. This study aims to (i) examine the socioeconomic patterning of the worsening of psychosocial wellbeing, (ii) delineate the underlying mediating factors (i.e., overall worry about COVID-19, family's financial difficulty, learning problems, and loneliness), and (iii) explore the moderating effect of resilience in the inter-relationship among adolescents under COVID-19.

Methods: Based on maximum variation sampling of 12 secondary schools of diverse socioeconomic background in Hong Kong, 1018 students aged 14-16 years were recruited and completed the online survey between September and October 2021. Multi-group structural equation modeling (SEM) by resilience levels was employed to delineate the pathways between socioeconomic position and the worsening of psychosocial wellbeing.

Results: SEM analysis showed a significant total effect of socioeconomic ladder with the worsening of psychosocial wellbeing during the pandemic in the overall sample ($\beta = -0.149$ [95% CI $= -0.217 - -0.081$], $p < 0.001$), which operated indirectly through learning problems and loneliness (both $p < 0.001$ for their indirect effects). Consistent pattern with stronger effect size was observed in the lower resilience group; nonetheless, the associations were substantially mitigated in the higher resilience group.

Conclusion: In addition to facilitating self-directed learning and easing loneliness during the pandemic, evidence-based strategies to build up resilience among adolescents are critical to buffer against the adverse socioeconomic and psychosocial impacts of the pandemic or other potential catastrophic events in the future.

KEYWORDS

adolescents, COVID-19, psychosocial wellbeing, resilience, socioeconomic inequalities

Introduction

With the emergence of new variants of concern, the COVID-19 pandemic continues to spread across the globe. Apart from the significant disease burden and far-reaching economic consequences, an extensive body of evidence suggests that the pandemic has exposed and amplified the underlying social inequalities in societies. In addition to the higher incidence and mortality in the disadvantaged communities (1) the broader impact of the pandemic on social determinants of health and the associated health inequalities have also been widely observed, (2) even in regions such as Hong Kong with relatively less severe outbreak due to the differential impact of the mandatory COVID-19 containment measures across the socioeconomic ladder (3–6).

In particular, adolescents are facing detrimental psychosocial impact of the COVID-19 pandemic during their critical developmental period (7, 8) especially for the socioeconomically disadvantaged (9, 10) Under the ongoing epidemic, prolonged school closure and stringent social distancing policies exacerbated the psychosocial wellbeing of adolescents and a range of social conditions such as learning opportunities (11, 12) social relationships and connectedness,(13, 14) as well as worries on the pandemic and sense of financial insecurity (15, 16). While most existing studies focus on one specific type of these social conditions, few examined the full picture on how different social conditions during the pandemic are socioeconomically patterned and hence disproportionately worsen the psychosocial wellbeing of adolescents. To inform policy entry points for interventions to mitigate the socioeconomic inequalities in psychosocial wellbeing during the pandemic, it is indispensable to identify the social conditions that are most severely affected by the pandemic among adolescents across the socioeconomic ladder.

Despite the well-documented evidence on the inequitable psychosocial impact of COVID-19, the potential heterogeneity in the socioeconomic patterning of psychosocial wellbeing deserves further investigation into why some adolescents, even if of similar socioeconomic background, have fared better than the others in response to COVID-19. Notably, as highlighted by Dvorsky et al. (17) the resilience of adolescents plays a crucial role in mitigating or even evading the social and mental health challenges under the pandemic, where a higher level of self-resilience facilitates successful adaptation, coping, and recovery in the context of the COVID-19-induced psychosocial distress. While existing COVID-19 studies support the protective effect of resilience on psychosocial wellbeing and its effect modification on certain psychosocial risk factors (18–21), whether resilience status could buffer the impacts of socioeconomic position on psychosocial wellbeing and its determinants remains understudied.

In light of the aforementioned knowledge gaps, the present study aims to (i) assess the association between socioeconomic position and the worsening of psychological wellbeing among adolescents, (ii) delineate how different psychosocial determinants disrupted by the pandemic mediate any observed association between socioeconomic position and the worsening of psychological wellbeing, and (iii) explore the potential moderating effect of resilience on the associations and mediating roles.

Methods

Study population

Data were collected from a purposive sample of 12 secondary schools of different socioeconomic background (see the socioeconomic classifications in Supplementary Table 1) in Hong Kong *via* online survey between September and October 2021 (22). Invitation letters were sent to members of the Hong Kong Association of the Heads of Secondary Schools (established by dedicated secondary school principals with a vision to enhance professionalism and the understanding of education in secondary schools) to recruit all Secondary 3 students enrolled to each participating school (equivalent to Grade 9 in the United States or Year 10 in the United Kingdom). Among the 1,467 enrolled Secondary 3 students, 1,254 students were successfully surveyed with a response rate of 85.48%. According to the pre-determined inclusion criteria on age range, 1,095 students aged 14–16 years who consented to participate were eligible for this study. After excluding 77 students with incomplete responses, 1,018 students were included for analysis.

Measurements

Information on respondents' self-perceived socioeconomic ladder, psychosocial wellbeing and related determinants during COVID-19, resilience status, as well as other socio-demographic and health factors were collected for analyses, with details listed below.

Socioeconomic ladder

The self-perceived family's socioeconomic position of respondents was measured using the social ladder measure of the MacArthur Scale of Subjective Social Status – Youth Version (23). Respondents was asked to mark the rung that best represents where their family would be on a socioeconomic ladder ranging from rung 1 (the worst off) to rung 10 (the best off) on a 10-point Likert scale. The MacArthur Scale of Subjective Social Status – Youth Version was adopted as a previous systematic review showed that it is most strongly associated with health outcomes related to psychological processes (24) whereas, previous studies also showed its superior role over objective socioeconomic measures in predicting health outcomes such as self-rated health, depression, and wellbeing among adolescents (24). The socioeconomic ladder was re-categorized into six groups according to the reported score (i.e., $\leq$3, 4, 5, 6, 7, and $\geq$8) for analysis.

Worsening of psychosocial wellbeing

To assess the change in psychosocial wellbeing, respondents were asked how much more/less they have felt during the pandemic when compared with the time before COVID-19 in terms of (i) relaxed, (ii) confident about future, (iii) cheerful, (iv) anxious/stressed, and (v) hopeless with five ordinal options (i.e., 1= much less; 2 = somewhat less; 3 = about the same; 4 = somewhat

more; 5 = much more), which were adopted and modified from the COVID-19 Adolescent Symptom & Psychological Experience Questionnaire. (25) The five selected items captured both positive and negative emotions for a more comprehensive assessment because psychosocial wellbeing refers not only to a high level of positive affect but also a low level of negative affect (26). The latent construct on the 'worsening of psychosocial wellbeing' was created based on these five items, of which the first three positively worded items were reversely coded for analysis to consistently show the results in one direction.

Psychosocial determinants

Four domains of psychosocial determinants during COVID-19 were analyzed as potential mediators of the association between socioeconomic ladder and the worsening of psychosocial wellbeing, which included (i) overall worry about COVID-19, (ii) family's financial difficulty, (iii) learning problems, and (iv) loneliness.

The first two domains were measured using single-item questions. Regarding overall worry about COVID-19, respondents were asked how worried they were about the local COVID-19 situation with five ordinal options (i.e., 1 = not at all; 2 = slightly; 3 = moderately; 4 = very; 5 = extremely). As for family's financial difficulty, respondents were asked to what extent the changes related to the COVID-19 outbreak have created financial problems for their family with five ordinal options (i.e., 1 = not at all; 2 = slightly; 3 = moderately; 4 = very; 5 = extremely). The latter two domains were measured as latent constructs. Regarding learning problems, respondents were asked to what extent they experienced the following problems including (i) internet access, (ii) finding a quiet place to study, (iii) understanding my school assignments, and (iv) finding someone who could help me with my school work, each with four ordinal options (i.e., 1 = never; 2 = sometimes; 3 = often; 4 = always). Loneliness was measured using the UCLA 3-item loneliness scale (27) on (i) feeling that you lack companionship, (ii) feeling left out, and (iii) feeling isolated from others, each with three ordinal options (i.e., 1= hardly ever; 2 = some of the time; 3 = often).

Resilience

As a potential moderator for stratified analyses, resilience was measured using the 6-item Brief Resilience Scale which assesses the ability to bounce back or recover from adversities and to cope with health-related stressors (28). Responses were rated on a 5-point Likert scale from "strongly disagree" to "strongly agree" with a possible average score ranging from 1 to 5. The score was then divided into the "higher resilience" and "lower resilience" groups using the sample mean score as the cut-off to ensure similar sample size between the two resilience groups.

Statistical analysis

Descriptive statistics of respondents were derived using mean with standard deviations (SD) for continuous variables and count with percentages for categorical variables. Confirmatory

TABLE 1 Basic characteristics of respondents (n = 1018).

	N (%) or Mean ± SD
Resilience	3.14 ± 0.69
Gender	
Female	550 (54.0)
Male	468 (46.0)
Household size	
1	15 (1.5)
2	60 (5.9)
3	228 (22.4)
4	394 (38.7)
5	214 (21.0)
6 or above	107 (10.5)
Baseline health status	
Poor	34 (3.3)
Fair	258 (25.3)
Good	345 (33.9)
Very good	202 (19.8)
Excellent	179 (17.6)
Socioeconomic ladder (10-rung)	
3 or below	112 (11.0)
4	136 (13.4)
5	324 (31.8)
6	209 (20.5)
7	133 (13.1)
8 or above	104 (10.2)
Overall worry about COVID-19	
Not at all	183 (18.0)
Slightly	395 (38.8)
Moderately	310 (30.5)
Very	86 (8.4)
Extremely	44 (4.3)
Family's financial difficulty	
Not at all	260 (25.5)
Slightly	351 (34.5)
Moderately	312 (30.6)
Very	74 (7.3)
Extremely	21 (2.1)
Learning problems	
Internet access	
Never	642 (63.1)
Sometimes	310 (30.5)
Often	45 (4.4)

(Continued)

TABLE 1 (Continued)

	N (%) or Mean ± SD
Always	21 (2.1)
Finding a quiet place to study	
Never	473 (46.5)
Sometimes	369 (36.2)
Often	122 (12.0)
Always	54 (5.3)
Understanding my school assignments	
Never	332 (32.6)
Sometimes	490 (48.1)
Often	128 (12.6)
Always	68 (6.7)
Finding someone who could help me with my school work	
Never	464 (45.6)
Sometimes	390 (38.3)
Often	100 (9.8)
Always	64 (6.3)
Loneliness	
Feeling that you lack companionship	
Hardly ever	563 (55.3)
Some of the time	317 (31.1)
Often	138 (13.6)
Feeling left out	
Hardly ever	629 (61.8)
Some of the time	272 (26.7)
Often	117 (11.5)
Feeling isolated from others	
Hardly ever	680 (66.8)
Some of the time	243 (23.9)
Often	95 (9.3)
Change in psychosocial wellbeing	
Relaxed	
Much less	82 (8.1)
Somewhat less	148 (14.5)
About the same	527 (51.8)
Somewhat more	170 (16.7)
Much more	91 (8.9)
Confident about the future	
Much less	97 (9.5)
Somewhat less	235 (23.1)
About the same	523 (51.4)
Somewhat more	110 (10.8)

(Continued)

TABLE 1 (Continued)

	N (%) or Mean ± SD
Much more	53 (5.2)
Cheerful	
Much less	69 (6.8)
Somewhat less	151 (14.8)
About the same	497 (48.8)
Somewhat more	206 (20.2)
Much more	95 (9.3)
Anxious/stressed	
Much less	92 (9.0)
Somewhat less	124 (12.2)
About the same	440 (43.2)
Somewhat more	270 (26.5)
Much more	92 (9.0)
Hopeless	
Much less	159 (15.6)
Somewhat less	125 (12.3)
About the same	560 (55.0)
Somewhat more	129 (12.7)
Much more	45 (4.4)

factor analyses and reliability tests were performed for the latent constructs (i.e., worsening of psychosocial wellbeing, learning problems, and loneliness) to ensure that each of these latent constructs was well-explained by its corresponding observed variables. The minimum acceptable factor loading of the observed variables is 0.30 (29). Separate correlation matrices of the aforementioned variables and constructs were derived for the overall sample, lower resilience group, and higher resilience group.

The inter-relationship among socioeconomic ladder, psychosocial determinants, and the worsening of psychosocial wellbeing during COVID-19 was examined using structural equation modeling (SEM), with adjustments for gender, household size (i.e., six groups ranging from "1" to "6 or above"), and baseline self-reported health status (i.e., a retrospective recall of health status before COVID-19 based on a five-point scale ranging from "poor" to "excellent"). In addition, multi-group SEM analysis was employed to assess the potential heterogeneity of the inter-relationship across the lower and higher resilience groups, which was tested based on the χ^2 difference between the unconstrained model and structural weight model (i.e., assuming all the paths are equal between the two resilience groups).

We obtained the regression weights of variables as well as the direct and indirect effects on the endogenous variables. Since there are multiple potential mediators in the SEM model, covariance was specified in each of the possible pairs so that the resulted indirect effect of each mediator would be adjusted for the effects of all other mediators. Bootstrapping of 2000 samples and 95% bias-corrected

TABLE 2 Standardized factor loadings of observed variables on latent constructs based on separate confirmatory factor analyses.

Latent construct	Observed variables	Factor loading
Worsening of psychosocial wellbeing (Cronbach's alpha = 0.774)	*Compared with the time before the COVID-19 pandemic, how much more/less have you felt in the following ways during the COVID-19 pandemic?*	
	1. Relaxed	0.603
	2. Confident about the future	0.612
	3. Cheerful	0.865
	4. Anxious/stressed	0.463
	5. Hopeless	0.513
Learning problems	*During the time when your school was closed because of COVID-19, how often did you have the following problems when completing your school work?*	
(Cronbach's alpha = 0.745)	1. Problems with Internet access	0.429
	2. Problems with finding a quiet place to study	0.592
	3. Problems with understanding my school assignments	0.794
	4. Problems with finding someone who could help me with my school work	0.768
Loneliness	*Please indicate how often each of the statements below is descriptive of you during the COVID-19 pandemic.*	
(Cronbach's alpha = 0.896)	1. Feeling that you lack companionship	0.770
	2. Feeling left out	0.961
	3. Feeling isolated from others	0.861

confidence level (CI) were used to estimate the indirect paths. We also estimated the goodness-of-fit of the SEM model, where a root mean square error of approximation (RMSEA) value below 0.08 is deemed having a good model fit (30). Other goodness-of-fit indices, including comparative fit index (CFI), incremental fit index (IFI), and Tucker-Lewis index (TLI), are considered to be satisfactory if they are above 0.90 (31) and superior if they are above 0.95. (30) The adjusted GFI (AGFI) are considered acceptable if the value is above 0.90 (30, 31). SPSS and AMOS version 26 were employed for statistical analyses. All statistical tests were two-tailed with a significant level of 0.05 unless specified.

Results

Table 1 shows the basic characteristics of our 1018 sampled secondary school students aged 14–16 years (54.0% female). Based on the 10-rung socioeconomic ladder, the respective proportions of those who rated ≤3, 4, 5, 6, 7, and ≥8 were 11.0, 13.4, 31.8, 20.5, 13.1, and 10.2%. Regarding the change in psychosocial wellbeing, 22.6% felt less relaxed, 32.6% felt less confident about the future, 21.6% felt less cheerful, 35.6% felt more anxious or stressful, and 17.1% felt more hopeless during COVID-19. Descriptive statistics on resilience, overall worry about COVID-19, family's financial difficulty, learning problems, loneliness, and other demographic factors and health status are also reported in Table 1.

Table 2 presents the standardized factor loadings of the three latent constructs, which ranged from 0.463 to 0.865 for worsening of psychosocial wellbeing (covariance between the last two items was specified as they were negatively worded), from 0.429 to 0.794 for learning problems, and from 0.770 to 0.961 for loneliness. Acceptable reliability was observed for the three latent constructs (Cronbach's alpha = 0.774, 0.745, and 0.896, respectively).

Table 3 displays the correlation matrices of all variables and constructs in the overall sample, lower resilience group, and higher resilience group. The resultant SEM model on the overall sample yielded satisfactory model fit to the data, with χ^2 (df = 104, N = 1018) = 344.517, $p < 0.001$, RMSEA = 0.048, RMR = 0.032 CFI = 0.954, IFI = 0.955, TLI = 0.933, and AGFI = 0.941, suggesting a satisfactory model fit. After adjustment for gender, household size, and baseline health status, significant total effect between socioeconomic ladder and the worsening of psychosocial wellbeing due to COVID-19 was observed (β = −0.149 [95% CI = −0.217 – −0.081], $p < 0.001$). As shown in Figure 1, significant direct effects of the socioeconomic ladder were observed with the worsening of psychosocial wellbeing, family's financial difficulty, learning problems, and loneliness during COVID-19, whereas loneliness, learning problems, and overall worry about COVID-19 were significant predictors of the worsening of psychosocial wellbeing. Specifically, the socioeconomic patterning of the worsening of psychosocial wellbeing operated indirectly through learning problems ($p < 0.001$) and loneliness ($p < 0.001$).

Results from the multi-group SEM analysis showed that the pattern of socioeconomic patterning and predictors of psychosocial wellbeing in the lower resilience group (n = 549) were consistent with that in the overall sample (Figure 2), with stronger effect size in most paths. Nonetheless, the adverse impact of socioeconomic ladder on psychosocial determinants (except for learning problems) and their effects on psychosocial wellbeing were substantially mitigated in the higher resilience group (n = 469). The total effect between socioeconomic ladder and the worsening of psychosocial wellbeing was significant in the lower resilience group (β = −0.166 [95% CI = −0.259 – −0.072], $p < 0.001$) but not in

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TABLE 3 Correlation matrix among observed variables.

		1	2	3	4	5	6	7	8	9
Overall sample ($n = 1018$)										
1	Socioeconomic ladder	1								
2	Overall worry about COVID-19	−0.021	1							
3	Family's financial difficulty	−0.170***	0.237***	1						
4	Learning problems	−0.150***	0.187***	0.267***	1					
5	Loneliness	−0.149***	0.120***	0.177***	0.472***	1				
6	Worsening of psychosocial wellbeing	−0.169***	0.182***	0.175***	0.373***	0.423***	1			
7	Gender	−0.048	0.157***	0.046	0.096**	0.076*	0.125**	1		
8	Household size	0.091**	−0.034	−0.007	0.038	−0.016	0.025	0.004	1	
9	Baseline health status	0.159**	0.073*	0.003	−0.059	−0.109***	−0.143***	−0.042	−0.020	1
Lower resilience group ($n = 549$; 53.9%)										
1	Socioeconomic ladder	1								
2	Overall worry about COVID-19	0.010	1							
3	Family's financial difficulty	−0.139**	0.275***	1						
4	Learning problems	−0.158***	0.170***	0.212***	1					
5	Loneliness	−0.139**	0.137**	0.170***	0.467***	1				
6	Worsening of psychosocial wellbeing	−0.162***	0.210***	0.166**	0.405***	0.472***	1			
7	Gender	0.031	0.096*	0.033	0.083	0.096*	0.067	1		
8	Household size	0.103*	−0.039	0.015	−0.009	−0.002	0.033	0.009	1	
9	Baseline health status	0.082	0.118**	0.045	−0.013	−0.064	−0.056	0.007	−0.017	1
Higher resilience group ($n = 469$; 46.1%)										
1	Socioeconomic ladder	1								
2	Overall worry about COVID-19	−0.044	1							
3	Family's financial difficulty	−0.186***	0.181***	1						
4	Learning problems	−0.073	0.201**	0.324***	1					
5	Loneliness	−0.068	0.076	0.137*	0.405***	1				
6	Worsening of psychosocial wellbeing	−0.083	0.139*	0.139**	0.229**	0.201***	1			
7	Gender	−0.094*	0.219***	0.035	0.050	−0.050	0.114*	1		
8	Household size	0.085	−0.030	−0.039	0.097	−0.049	0.007	−0.007	1	
9	Baseline health status	0.197***	0.040	−0.013	−0.035	−0.056	−0.125*	−0.045	−0.017	1

*p < 0.05; **p < 0.01; ***p < 0.001.

the higher resilience group ($\beta = -0.053$ [95% CI = −0.159 – 0.050], $p = 0.322$). In addition, the significant χ^2 difference (change in $\chi^2 = 48.703$, change in df = 33, $p = 0.038$) between the unconstrained model and structural weight model indicated the difference of models between the lower and higher resilience groups in explaining the paths among socioeconomic ladder, mediators, and the worsening of psychosocial wellbeing. In particular, the indirect effects between socioeconomic ladder and the worsening of psychosocial wellbeing through learning problems ($p = 0.001$) and loneliness ($p < 0.001$) were significant only in the lower resilience group but not in the higher resilience group ($p = 0.140$ and $p = 0.130$, respectively).

Discussion

The present study is the first to employ SEM to examine the socioeconomic patterning and psychosocial risks of COVID-19-related disrupted social conditions among adolescents of different resilience level in Hong Kong. In general, the

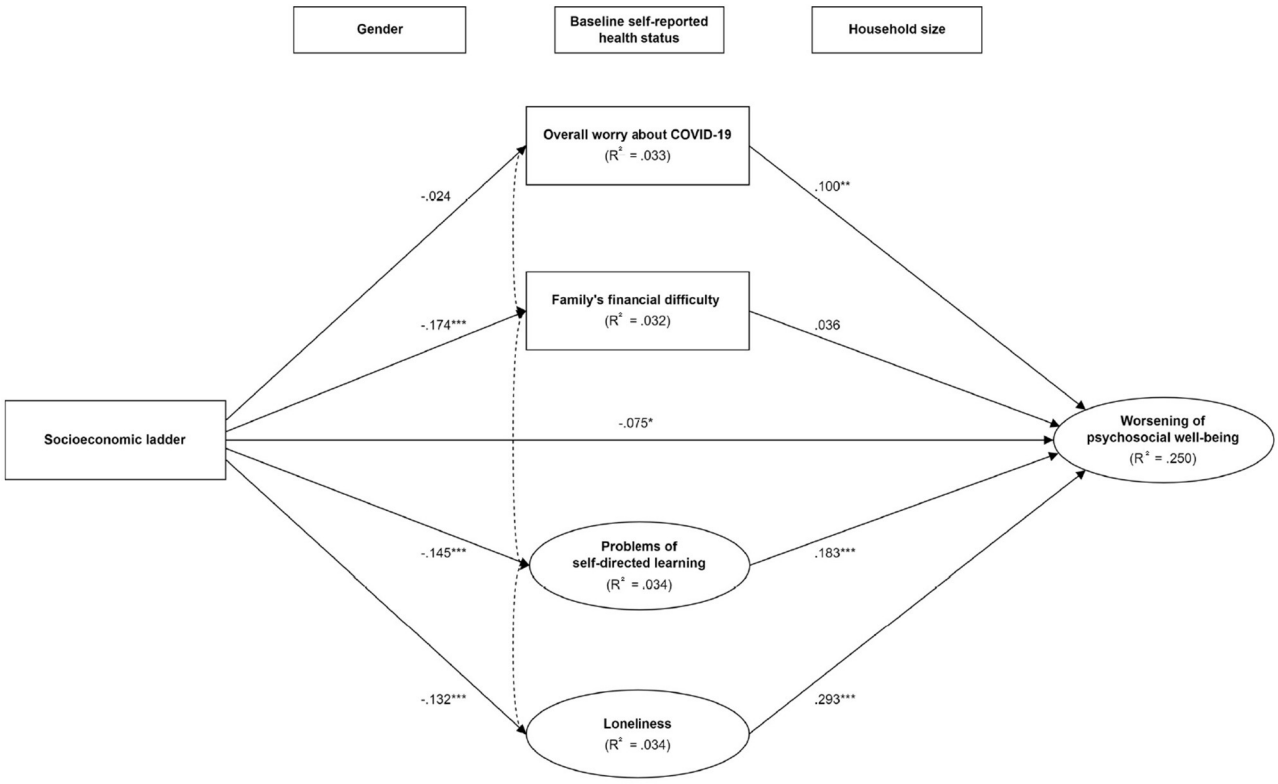

FIGURE 1
The mediating pathways between socioeconomic position and the worsening of psychosocial wellbeing in the overall sample. $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$. Model was adjusted for gender, household size, and baseline self-reported health status. Covariance was specified in each of the possible pairs of mediators. The dotted double arrows between mediators are simplified for better readability.

worsening of psychosocial wellbeing was strongly patterned across the socioeconomic ladder because of the greater learning problems and loneliness experienced by socioeconomically disadvantaged adolescents during the pandemic. Nonetheless, adolescents of higher resilience have fared better in response to COVID-19 and overcome part of the adverse impact of socioeconomic disadvantage on social conditions and hence their psychosocial wellbeing.

Consistent with the existing literature, our findings supported that adolescents of lower socioeconomic position are more vulnerable to psychosocial distress under the pandemic (9, 10). Given that the outbreaks in Hong Kong are relatively well-controlled with 12,650 cases and 213 deaths by the end of 2021 (32), worries about COVID-19 infection and mortality are not likely explanations for the worsening of psychosocial wellbeing. More plausibly, the stronger psychosocial impact on the socioeconomically disadvantaged might have been resulted from the differential socioeconomic impact of stringent containment measures under the "zero-infection" policy (i.e., preventing imported cases from spreading into the community to maintain zero local infection) in Hong Kong. In particular, the prolonged school closure has posed significant but disproportionate challenges to both their learning experience and psychosocial wellbeing (11, 12, 33). Although distance learning serves as a crucial educational resource and platform during the pandemic, research showed that the shifting from face-to-face to online classes by itself is a psychosocial stressor to students (34). Notably, education disruption due to school closure has resulted in poorer learning gains especially among students from low-income families. Local research also showed that the effectiveness of distance learning was patterned by household income levels (35), whereas, limitations of home environment to support self-directed learning (e.g., disturbance by family members as well as a lack of resources and space) were frequently reported even by the middle class during the pandemic (36). Given the buffering effect of distance learning satisfaction against COVID-19-induced psychosocial stressors (37), it comes as no surprise that the socioeconomically disadvantaged adolescents, who faced greater difficulties and dissatisfaction with distance learning during the pandemic, had poorer adjustment in response to COVID-19 and thus suffer from greater psychosocial distress. Our findings echoed with the above studies that the socioeconomic patterning of the worsening of psychosocial wellbeing was partially mediated through the greater learning problems among the socioeconomically disadvantaged.

In addition to learning problems, the extent of loneliness during the pandemic appeared to explain part of the association between socioeconomic position and psychosocial wellbeing among adolescents. While the stringent social distancing measures imposed by the Hong Kong government during the waves of severe local outbreaks [e.g., school closure, prohibition on group gatherings of more than two/four people in public places and

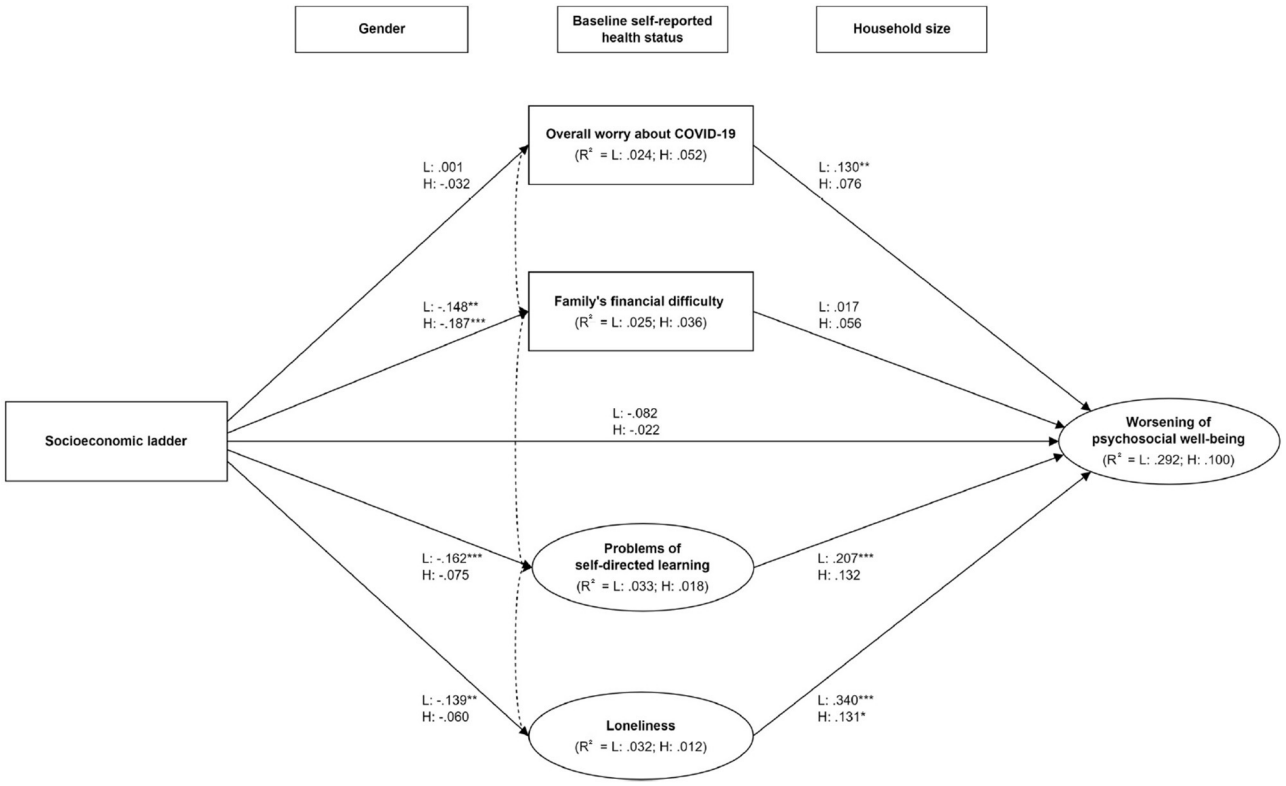

FIGURE 2
The mediating pathways between socioeconomic position and the worsening of psychosocial wellbeing by resilience levels. L: Lower resilience group; H: Higher resilience group. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. Model was adjusted for gender, household size, and baseline self-reported health status. Covariance was specified in each of the possible pairs of mediators. The dotted double arrows between mediators are simplified for better readability.

dine-in services at night, and closure of leisure facilities and entertainment premises, etc. (38)] have served their purpose of containing the spread of COVID-19, they also seriously disrupted the social life of adolescents. As an inadvertent consequence of social distancing measures, loneliness is particularly problematic for adolescents due to the criticality of peer support and the formation of social identity during their developmental stage (39), which in turn exacerbated the psychosocial impacts of COVID-19 (13, 40). The greater susceptibility to loneliness among socioeconomically disadvantaged adolescents could possibly be attributed to the fewer quality time with and perceived support from family and friends when confined at home (16), inadequate private space for social activities (41), higher vulnerability to the harmful use of social media (42), and greater difficulty developing new hobbies to distract themselves from loneliness (43). These speculations accord with the fundamental cause theory that people of lower social status lack capabilities and resources, such as money, space, social capital, digital literacy, and other health and social advantages, to overcome stressors and improve psychosocial wellbeing (44, 45).

Our findings have provided insights on several potential entry points for interventions to buffer the psychosocial impact of further outbreaks and school closures on adolescents. To facilitate self-directed learning, feasible approaches include providing students with broadband internet access and technical support for distance learning, interactive tutorials, and counseling services for need assessment (34, 37), whereas to ease loneliness, addressing maladaptive social cognition as well as enhancing students' emotional awareness and reconciliation *via* improvement on inter-personal and intra-personal skills may be possible options (46, 47). In addition, deep listening and non-judgmental acceptance by parents are crucial to identify emotional issues of adolescents at an early stage (48). Besides, our results on the moderating effect of resilience also highlighted the criticality of resilience building among adolescents, especially after schools re-open as resilience-focused interventions are commonly school-based (49). As suggested by a recent systematic review, schools may be the best setting to develop resilience of students, especially the most disadvantaged group, by providing multiple types of resources including access to material resources and supportive relationships, experience of power and control, social justice, and social cohesion with others, as well as development of desirable personal identity and adherence to cultural traditions (50). In light of this, educators should work with social workers and psychologists to review the current school-based psychosocial support programs, and consider incorporating positive psychology and cognitive behavioral therapy-based approaches into resilience-focused interventions (49). From a more upstream perspective, while the stringent social distancing measures and school closure may be able to protect students from COVID-19 infections, the

tremendous cost of these measures on a wide array of social determinants of health should not be overlooked. Previous research has pointed out that the "zero-infection" approach is highly prone to neglect social and health inequities, which is neither ethical nor feasible in the long run (51). Therefore, in addition to allocating extra resources to support the disadvantaged groups, policy makers should carefully consider the impact on social determinants of health when devising a long-term response to COVID-19 so as to balance disease containment with the psychosocial wellbeing, developmental opportunities, and equity of adolescents.

There are several limitations of the present study. First, the cross-sectional design of our survey could not establish temporality for causal inferences. Second, we adopted purposive sampling of schools due to the difficulty in random sampling under the pandemic. Although the selected schools were not a statistically representative sample, we recruited schools of diverse socioeconomic background with considerations for a balanced gender ratio to maximize the qualitative generalizability of our sample. Third, as the assessment of key variables were based on self-reported responses to survey, our results may be subject to recall bias and social desirability bias. Fourth, the goodness-of-fit of the SEM model may be affected by the inclusion of single-item ordinal mediators (i.e., overall worry about COVID-19 and family's financial difficulty). To this end, we have replicated the SEM analysis without these two mediators and the model fit remained satisfactory with χ^2 (df = 86, N = 1018) = 301.892, $p < 0.001$, RMSEA = 0.050, RMR = 0.033 CFI = 0.957, IFI = 0.958, TLI = 0.940, and AGFI = 0.944. Last, despite adjustment for gender, household size, and baseline health status, residual confounding is possible due to the unavailability of data on history of mental health disorders, lifestyle behaviors, and healthcare access.

Conclusion

Adolescents of lower socioeconomic position, especially those with a lower level of resilience, were at higher risk of experiencing psychosocial distress during the COVID-19 pandemic because of greater learning problems and loneliness under the differential socioeconomic impact of stringent social distancing measures in Hong Kong. In addition to providing distance learning and social support, evidence-based strategies to build up resilience among adolescents are crucial to buffer against the adverse socioeconomic and psychosocial impacts of 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 Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

GKKC contributed to literature search, study design, data analysis, result interpretation, and the write-up of the manuscript. YHC and SMC were responsible for study design, data curation, and result interpretation. TSKL contributed to data collection, coordination, and data analysis. JKC was responsible for study design and provided substantial statistical advice on the analyses. HW and RYNC oversaw the project as the co-Principal Investigators, contributed to study design, and result interpretation. ESCH was responsible for data collection, data analysis, and result interpretation. All authors critically appraised 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.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1136744/full#supplementary-material

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Psychiatric symptoms in Long-COVID patients: a systematic review

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Objective: People who have been infected by COVID-19 showing persistent symptoms after 4 weeks from recovery are thought to suffer from Long-COVID syndrome (LC). There is uncertainty on the clinical manifestations of LC. We undertook a systematic review to summarize the available evidence about the main psychiatric manifestations of LC.

Method: PubMed (Medline), Scopus, CINHAL, PsycINFO, and EMBASE were searched until May 2022. Studies reporting estimation of emerging psychiatric symptoms and/or psychiatric diagnoses among adult people with LC were included. Pooled prevalence for each psychiatric condition was calculated in absence of control groups to compare with.

Results: Thirty-three reports were included in the final selection, corresponding to 282,711 participants with LC. After 4 weeks from COVID-19 infection recovery, participants reported the following psychiatric symptoms: depression, anxiety, post-traumatic symptoms (PTS), cognitive and sleeping disturbances (i.e., insomnia or hypersomnia). The most common psychiatric manifestation resulted to be sleep disturbances, followed by depression, PTS, anxiety, and cognitive impairment (i.e., attention and memory deficits). However, some estimates were affected by important outlier effect played by one study. If study weight was not considered, the most reported condition was anxiety.

Conclusions: LC may have non-specific psychiatric manifestations. More research is needed to better define LC and to differentiate it from other post-infectious or post-hospitalization syndromes.

Systematic review registration: PROSPERO (CRD42022299408).

KEYWORDS

Long-COVID syndrome, COVID-19, mental health, depression, anxiety, posttraumatic stress

Introduction

Long-COVID syndrome (LC) is a condition that can affect people who have recovered from Coronavirus Disease 2019 (COVID-19). This term was introduced to indicate a set of disorders that persist or occur at from 4 weeks after the elimination of the SARS-CoV-2 virus from the body (1). The clinical features of LC are multifaceted; it has been posited that it can affect different organs and systems, causing somatic but also psychological manifestations that impact on quality of life (2).

For most people, mild or moderate COVID-19 lasts for about 2 weeks; in some cases, though, symptoms can persist or develop after healing. Furthermore, also in people with asymptomatic infections later health problems may develop (3–5).

Although progress has been made in the understanding of the clinical and epidemiological features, including the pathogenesis and complications of the acute phase of COVID-19, long-term consequences of the disease remain largely unclear (6).

Additionally, while neuropsychiatric symptoms that manifest acutely during infection, such as depression, post-traumatic symptoms [PTS], sleep and cognitive disturbances or anxiety, have received more attention, the medium- and long-term psychiatric outcomes in COVID-19 patients are still little known and understudied (7, 8).

In the available literature, there are highly heterogeneous research works on this topic, applying widely different sample sizes, inclusion and exclusion criteria, and duration of follow-up. In addition, patient assessment is mainly based on various assessment tools and questionnaires, self-administered in most cases, that do not provide a diagnosis of a condition with definite clinical significance.

Therefore, understanding the medium and long-term impact of COVID-19 is still far from being complete, not only in the context of a multidisciplinary approach, but even more so when focusing on specific areas such as mental health (1).

We undertook this systematic review to summarize the available evidence about the main psychiatric manifestations of LC. A better understanding of the epidemiology of psychopathological manifestations among LC patients is crucial to develop prevention and early interventions.

Methods

This systematic review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The protocol of this systematic review was registered with PROSPERO (CRD42022299408).

Data sources and search strategy

We searched the PubMed (Medline), Scopus, CINHAL, PsycINFO, and EMBASE databases until May 2022, using the strategy outlined in the Supplementary Table 1 of the Appendix. In addition, the list of references of the included studies and of other reviews on related topics was screened to identify any other possible study deserving inclusion, and inadvertently missed during the initial literature search. No restrictions regarding language of publication or publication date were set.

Eligibility criteria

We included experimental and observational studies reporting estimation of rates of emerging psychiatric symptoms and/or psychiatric diagnosis among adult people (i.e., ≥18 years old) with LC, without any restriction on other medical comorbidities or setting of enrolment. We excluded studies on participants already suffering from any psychiatric condition, studies assessing the presence of psychiatric symptoms before 4 weeks from COVID-19 recovery, and previous reviews, case-reports, case-series, editorial, and letters to the editor. We only included studies published in peer-reviewed journals, excluding conference abstracts and dissertations. If data from the same sample were published in multiple works, we considered only that study reporting more exhaustive information. Sample overlap was ruled out through a careful check of the registration codes as well as the place and year(s) of sampling.

Where available, outcome data from participants with other inflammatory or infectious diseases, including COVID-19 but without LC, were used as control group.

Terms and definitions

LC was defined as either the presence or the persistence of any symptom that was not present before the infection after 4 weeks from the COVID-19 recovery. Infection from SARS-CoV-2 and recovery from the infection were defined according to the result of the real-time PCR on nasopharyngeal swab sample, or of broncho-alveolar lavage.

Psychiatric symptoms were collected from self-reporting or from validated psychometric tools. Where a psychiatric diagnosis was reported, it had to be defined according to standard operational diagnostic criteria (the Diagnostic and Statistical Manual of Mental Disorders [DSM] or the International Classification of Diseases [ICD]).

Data collection and extraction

Four Reviewers (P.G., V.S., F.R., and F.C.) working independently preliminarily reviewed titles and abstracts of retrieved articles. The initial screening was followed by the analysis of full texts to check compliance with inclusion/exclusion criteria. All disagreements were discussed until consensus, and if consensus was not possible, another member of the team was consulted (M.M.). A standardized form was used for data extraction. Information concerning the year of publication, country, setting, characteristics of study participants (sample size, age, percentages of men and women), LC status, and the presence of psychiatric conditions in the LC groups (and, where available, in the control group) were collected by two authors (P.G. and V.S.) independently. Extraction sheets for each study were cross-checked for consistency and any disagreement was resolved by discussion within the research group.

Statistical analyses

Where possible (i.e., there were at least two studies providing outcome data for LC and controls), quantitative data among studies were summarized using random effects meta-analysis (9). To summarize continuous outcome data (i.e., the scores

on a psychometric tool), the pooled Hedges' g standardized mean differences (SMDs) and the corresponding 95% confidence intervals (CIs) were applied, while pooled odds ratios (ORs) and the corresponding 95% CIs (10) were used to report on dichotomous outcome data (i.e., presence/absence of psychiatric diagnosis or psychiatric symptoms).

If meta-analysis was not possible, we calculated the pooled prevalence of psychiatric symptoms and/or psychiatric diagnosis among LC patients. These estimates consisted in weighted-mean prevalence, raw mean prevalence, and median prevalence, with the relative lower and upper ranges across the studies included in the final selection.

The analyses were performed in R (11). Statistical tests were 2-sided and used a significance threshold of $p < 0.05$.

Risk of bias assessment and the GRADE

Bias risk in the included studies was independently assessed by three reviewers (P.G., V.S., and F.R.), using the Cochrane risk of bias tool (12). All disagreements were discussed until consensus, and if necessary, another member of the team was consulted (M.M.). Each item on the risk of bias assessment was scored as high, low, or unclear, and the GRADE tool was used to assess the overall certainty of evidence (13). Further information is available in the Supplementary material.

Results

Study characteristics

As shown in Figure 1, from 2078 records screened on title and abstract, 114 full texts were analyzed. The review process led to the selection of 33 studies (3, 4, 6–8, 14–41). These studies, referring to 33 different samples and involving a total of 282,711 LC participants, were included in the final selection and quantitative synthesis.

On an average, across the studies, 48% of participants were females (range 23.1–100%). The mean age of participants was 53.2 years (range 33.7–73.2). The selected studies were conducted in 13 countries: US ($n = 6$; 18.2%); Italy ($n = 5$; 15.2%); Egypt, France, Netherlands, Spain, UK (each $n = 3$; 9.1%); India ($n = 2$; 6.1%); Austria, China, Germany, Iran, Mexico (each $n = 1$; 3.0%).

All the studies were published in the last 2 years: 2021 ($n = 31$; 93.9%); 2022 ($n = 2$; 6.1%).

With respect to the outcomes reported, only 2 studies (6.1%) provided data about psychiatric diagnosis: one study assessed depressive and anxiety disorder (GAD) through a clinical interview, the other study used retrospective screening of the electronic clinical records to investigate prevalence of anxiety and depression, and cognitive impairment, according to the ICD-10 system. The remaining studies ($n = 31$, 93.9%) used self-reporting or other psychometric tools to measure the level of: depression or anxiety ($n = 26$, 78.8%), cognitive impairment ($n = 16$, 48.5%), PTS ($n = 13$, 39.4%), and sleep disturbances ($n = 18$, 54.5%). These studies applied dichotomization into positive/negative at the psychometric assessment based on the scales' cut-off for clinical significance, and the estimated prevalence for each study was calculated as the number of participants with score above the cut-off divided to the total number of participants assessed.

Notably, none of the studies included in the final selection applied a control group without LC. Concerning the severity of COVID-19 infection, 15 studies (45.5%) included patients hospitalized due to COVID-19 infection, 5 studies (15.2%) were performed on patients who had mild infection not requiring hospitalization, and 11 studies (33.3%) included both hospitalized and other managed outpatients. Information about infection severity was missing in 2 studies (6.1%).

All studies characteristics are summarized in Table 1.

Prevalence of psychiatric symptoms across the studies

Table 2 summarize the pooled prevalence estimates for each psychiatric symptom across the studies included in this review, and the population prevalence worldwide. Notably, prevalence of depression, anxiety, cognitive impairment, PTS, and sleep disturbances resulted much higher among LC patients than in the general population (42–46).

Prevalence of depression

Twenty-one studies (63.3%) provided outcome data for depression among LC patients. The weighted mean prevalence across the studies was 0.212, that is quite similar to the unweighted mean and median prevalence (0.254 [range: 0.022–0.902] and 0.220, respectively), consistent with not significant outlier effect played by any of the study in the pooled estimate. Figure 2 shows comparison of the depression prevalence estimates across the studies, and the weighted mean prevalence.

Prevalence of anxiety

Twenty-three studies (69.7%) provided outcome data for anxiety among LC patients. The weighted mean prevalence across the studies was 0.158 and was markedly influenced by the study from Taquet et al. (35) with a far larger sample size. Unweighted mean and median prevalence were 0.313 (range: 0.029–0.646) and 0.296, respectively. Figure 3 shows comparison of the anxiety prevalence estimates across the studies, and the weighted mean prevalence.

Prevalence of cognitive impairment

Sixteen studies (48.5%) provided outcome data for cognitive impairment among LC patients. The weighted mean prevalence across the studies was 0.042 and, again, was markedly influenced by the study from Taquet et al. (35) with the largest sample size and

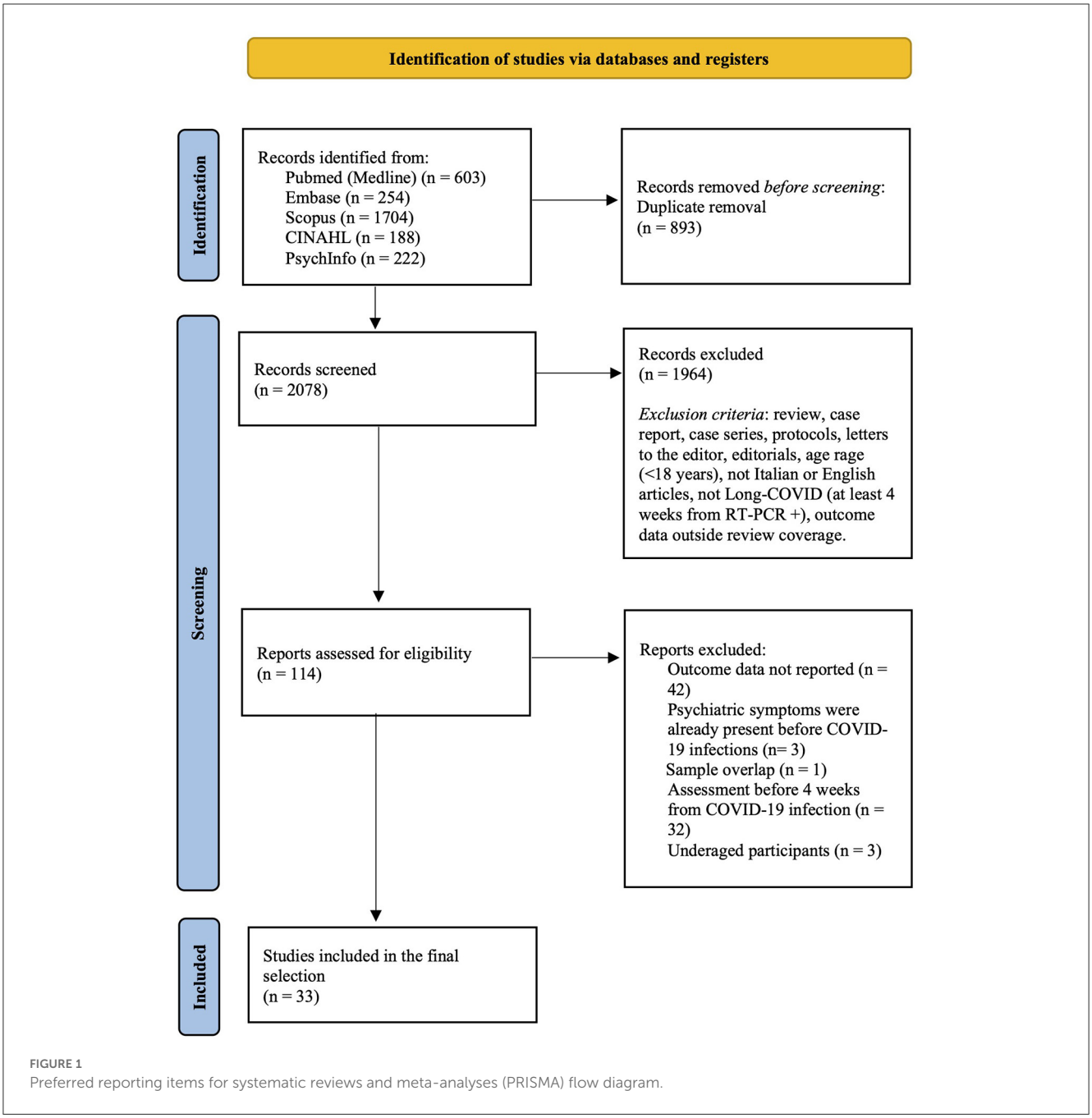

FIGURE 1
Preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram.

providing among the three lowest estimates of anxiety prevalence. Unweighted mean and median prevalence were 0.269 (range: 0.005–0.820) and 0.227, respectively. Figure 4 shows comparison of the cognitive impairment prevalence estimates across the studies, and the weighted mean prevalence.

Prevalence of PTS

Thirteen studies (39.4%) provided outcome data for PTS among LC patients. The weighted mean prevalence across the studies was 0.192. Unweighted mean and median prevalence were 0.218 (range: 0.058–0.788) and 0.130, respectively. Figure 5 shows comparison of the PTS prevalence estimates across the studies, and the weighted mean prevalence.

Prevalence of sleep disturbances

Eighteen studies (54.5%) provided outcome data for sleep disturbances among LC patients. The weighted mean prevalence across the studies was 0.270. Unweighted mean and median prevalence were 0.296 (range: 0.003–0.648) and 0.319, respectively. Figure 6 shows comparison of the sleep disturbances prevalence estimates across the studies, and the weighted mean prevalence.

TABLE 1 Characteristics of the included studies.

Author, year	Country	Study design	Females %	Mean age	N	Severity of COVID-19 infection	P depression (measure)	P Anxiety (measure)	P Cognitive impairment (measure)	P PTS (measure)	P Sleep disturbances (measure)
Ahmed et al. (14)	Egypt	Cohort	54%	46.5	182	Both hospitalized and outpatients	0.374 (SCL-90)	0.619 (SCL-90)	NR	0.286 (PCL-5)	0.648 (PSQI)
Aly and Saber (15)	Egypt	Cross-sectional	100%	73.2	115	NR	NR	NR	0.252 (self-reported)	NR	0.243 (self-reported)
Aranda et al. (16)	Spain	Cohort	30%	64	113	Hospitalized	0.301 (BDI)	0.487 (STAI)	NR	0.788 (IES-R)	0.292 (NR)
Bai et al. (17)	Italy	Cohort	36%	57	377	Both hospitalized and outpatients	0.106 (HADS)	0.188 (HADS)	0.202 (NR)	0.225 (IES-R)	NR
Boesl et al. (18)	Italy	Cohort	67%	45.8	100	Mild	0.615 (BDI)	NR	0.306 (MoCA)	NR	0.337 (ESS)
De Graaf et al. (3)	Netherlands	Cohort	37%	60.8	81	Both hospitalized and outpatients	0.123 (PHQ-9)	0.037 (GAD-7)	0.160 (CFQ-25)	0.062 (PCL-5)	NR
Evans et al. (4)	UK	Cohort	36%	57.9	1077	Hospitalized	0.262 (PHQ-9)	0.235 (GAD-7)	0.139 (NR)	0.117 (PCL-5)	NR
Frontera et al. (19)	US	Case-control	35%	68.5	280	Hospitalized	0.254 (NeuroQoL)	0.511 (NeuroQoL)	0.473 (MoCA)	NR	0.375 (NeuroQoL)
Ganesh et al. (20)	US	Cohort	61%	44	817	Both hospitalized and outpatients	NR	NR	NR	NR	0.200 (PROMIS)
Garjani et al. (21)	UK	Cohort	82%	50	165	Mild	0.504 (NR)†	NR	NR	NR	NR
Gonzàlez-Hermosillo et al. (22)	Mexico	Cohort	35%	51	130	Hospitalized	0.354 (self-reported)	0.392 (self-reported)	0.454 (self-reported)	NR	0.454 (self-reported)
Gouraud et al. (23)	France	Cohort	29%	60	100	Hospitalized	0.220 (HADS)	0.310 (HADS)	NR	NR	NR
Graham et al. (24)	US	Case-control	66%	43.7	50	Mild	0.400 (NR)†	NR	0.820 (PROMIS)	NR	0.360 (PROMIS)
Gramaglia et al. (6)	Italy	Cohort	40%	61	238	Both hospitalized and outpatients	0.294 (MINI)	0.328 (MINI)	NR	0.429 (NR)	NR
Horwitz et al. (7)	US	Cohort	40%	62	126	Hospitalized	NR	NR	0.413 (PROMIS)	NR	0.349 (PROMIS)
Huang et al. (8)	China	Cohort	48%	57	1733	Hospitalized	0.227 (interview)†	NR	NR	NR	0.264 (interview)
Imran et al. (25)	India	Cross-sectional	33%	44.5	103	Hospitalized	0.126 (PHQ-9)	0.214 (GAD-7)	NR	0.087 (PCL-5)	NR
Lemhofer et al. (26)	Germany	Cross-sectional	59%	49.8	365	Mild	NR	0.249 (NR)	NR	NR	0.301 (NR)

(Continued)

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TABLE 1 (Continued)

Author, year	Country	Study design	Females %	Mean age	N	Severity of COVID-19 infection	P depression (measure)	P Anxiety (measure)	P Cognitive impairment (measure)	P PTS (measure)	P Sleep disturbances (measure)
Lombardo et al. (27)	Italy	Cohort	54%	53	303	Both hospitalized and outpatients	NR	NR	0.363 (semi-structured interview)	NR	0.465 (semi-structured interview)
Mendez et al. (28)	Spain	Cohort	41%	57	179	Hospitalized	0.268 (PHQ-9)	0.296 (GAD-7)	0.184 (NR)	0.251 (DTS)	NR
Morin et al. (37)	France	Cohort	42%	60.9	478	Hospitalized	0.206 (BDI)	0.314 (HADS)	0.384 (MoCA, D2-R, Q3PC)	0.142 (PCL-5)	0.536 (ISI)
Naik et al. (29)	India	Cohort	31%	41.6	272	Both hospitalized and outpatients	0.022 (interview)	0.029 (interview)	NR	NR	0.063 (interview)
Rass et al. (30)	Austria	Cohort	39%	55	90	Both hospitalized and outpatients	0.121 (HADS)	0.222 (HADS)	NR	0.100 (PCL-5)	NR
Romero-Duarte et al. (31)	Spain	Cohort	46%	63	794	Hospitalized	0.044 (NR)	NR	NR	NR	0.049 (NR)
Scherlinger et al. (32)	France	Case-control	66%	40	30	Mild	0.100 (Psychological interview)	0.267 (Psychological interview)	NR	0.300 (PCL-5)	NR
Simani et al. (33)	Iran	Cohort	33%	54.62	120	Hospitalized	NR	NR	NR	0.058 (PCL-5)	NR
Sykes et al., (34)	UK	Cohort	34%		134	Hospitalized	0.396 (self-reported)	0.478 (self-reported)	0.097 (self-reported)	NR	0.351 (self-reported)
Taquet et al. (35)	Netherlands	Cohort	58%	39.4	273618	Both hospitalized and outpatients	0.155 (ICD-10)†	NR	0.040 (ICD-10)	NR	NR
Tawfik (36)	Egypt	Cohort	58%	33.7	120	Both hospitalized and outpatients	NR	NR	0.008 (NR)	NR	0.042 (NR)
Van den Borst et al. (38)	Netherlands	Cohort	40%	59	124	Both hospitalized and outpatients	0.117 (HADS)	0.100 (HADS)	NR	0.073 (PCL-5)	NR
Vanichkachorn et al. (39)	US	Cohort	68%	45.7	100	NR	NR	NR	0.005 (NR)	NR	0.003 (NR)
Vannorsdall et al. (40)	US	Cohort	59%	54.5	82	Hospitalized	0.902 (PHQ-9)	0.646 (GAD-7)	0.805 (QDRS)	0.25 (IES-R)	NR
Vassalini et al. (41)	Italy	Cohort	46%	57	115	Hospitalized	0.148 (PHQ-9)	NR	NR	NR	NR

P, prevalence; PTS, post-traumatic symptoms; NR, not-reported; SCL-90, symptom checklist 90; PCL-5, PTSD checklist for DSM-5; PSQI, Pittsburgh sleep quality index; BDI, Beck depression inventory; STAI, state-trait anxiety inventory; IES-R, impact of event scale—revised; HADS, hospital anxiety and depression scale; MoCA, Montreal cognitive assessment; ESS, Epworth sleepiness scale; PHQ-9, patient health questionnaire-9; GAD-7, general anxiety disorder-7; CFQ-25, cognitive failure questionnaire-25; UK, United Kingdom; US, United States of America; NeuroQoL, health-related quality of life for clinical research in neurology; PROMIS, patient-reported outcomes measurement information system; MINI, mini-international neuropsychiatric interview; DTS, Davidson trauma scale; D2-R, D2 test of attention—revised; Q3PC, Q3PC cognitive screening questionnaire; ISI, insomnia severity index; ICD-10, international classification of diseases 10th revision; QDRS, quick dementia rating scale.

† depression and anxiety aggregated prevalence.

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TABLE 2 Pooled prevalence of psychiatric symptoms across the included studies and worldwide prevalence.

Outcome	Weighted mean P	Mean P (min; max)	Median P	N studies (LC participants)	World P
Depression	0.212	0.254 (0.022; 0.902)	0.220	21 (5,079)	0.038
Anxiety	0.158	0.313 (0.029; 0.646)	0.296	23 (28,001)	0.040
Cognitive impairment	0.042	0.269 (0.005; 0.820)	0.227	16 (277,268)	0.011
PTS	0.192	0.218 (0.058; 0.788)	0.130	13 (3,162)	0.036
Sleeping disturbances	0.270	0.296 (0.003; 0.648)	0.319	18 (6,212)	0.038

P, prevalence; min, minimum; max, maximum; LC, Long-COVID syndrome; NA, not available; PTS, post-traumatic symptoms.

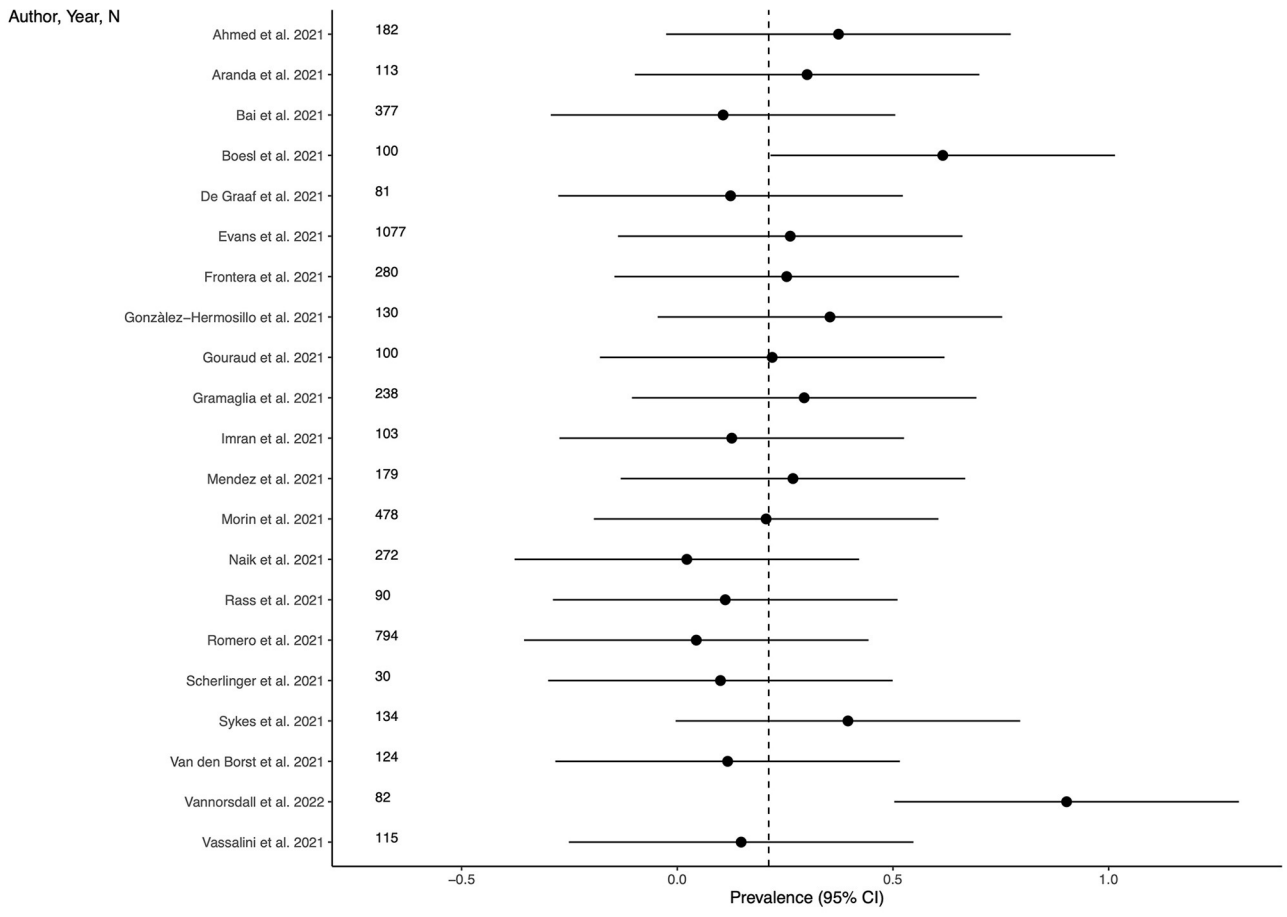

FIGURE 2
Prevalence of depression across the studies and weighted mean prevalence. The vertical dotted line represents the weighted mean prevalence.

Psychiatric symptoms by COVID-19 infection severity

We examined the potential association between the severity of COVID-19 infection and the occurrence of psychiatric symptoms. For this purpose, we considered hospitalization as a proxy for severe infection, and outpatient management as indicator of mild infection. As shown in Table 3, the comparison of the severe, mild, and both mild and severe groups in terms of average prevalence of psychiatric symptoms did not find any statistically significant difference, suggesting that the severity of the infection is not related to the development of later psychiatric symptoms. Further analysis was conducted to compare only mild and severe patients, with the severe group consisting of studies that included at least

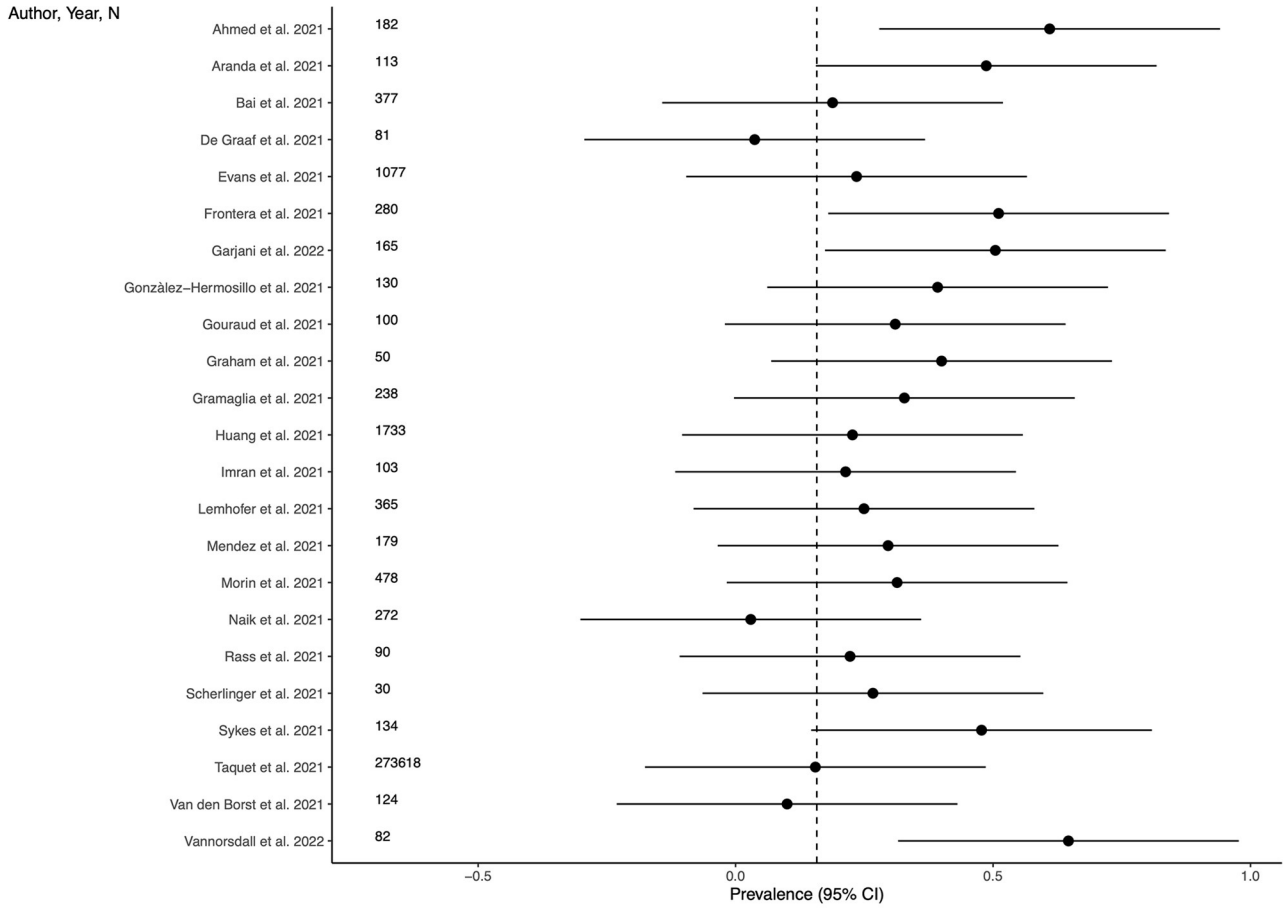

FIGURE 3
Prevalence of anxiety across the studies and weighted mean prevalence. The vertical dotted line represents the weighted mean prevalence.

one hospitalized patient. This analysis confirmed that there were no statistically significant differences in depression, anxiety, PTS, and sleep disturbances, but found inverse association between the severity of the infection and cognitive complaints ($p = 0.048$).

Risk of bias and GRADE

A detailed summary on the risk of bias in all 33 trials has been reported in the Appendix (see Supplementary Figures 1, 2), along with an assessment of the quality of the evidence (see Supplementary Table 2). In the GRADE system, the evidence from observational studies is initially set to low, there are then criteria that can be used either to downgrade or upgrade (see further information in the Appendix). The quality of the evidence is rated very low with serious threats related to the risk of bias and inconsistency.

Discussion

This study set out to investigate the prevalence of psychiatric symptoms among LC patients. We found that the symptoms mostly associated with LC were depression, anxiety, cognitive and sleep disturbances, and PTS. The prevalence of these symptoms among LC patients is remarkably higher than that in the general population.

However, it is necessary to underline that, among the studies included in the final selection, there was one study (35) that had a sample size accounting for around 96% of the total number of participants included in this review. That study provided estimates for anxiety and cognitive impairments and the weighted average for these outcomes falls exactly on the value of the prevalence estimated by Taquet et al. (35) by looking at the forest plots of anxiety and cognitive impairment, it can be easily observed that only three studies for anxiety and two studies for cognitive impairment provided estimates smaller than Taquet et al. (35) supporting its influence on the pooled prevalence. Accordingly, for these two outcomes, the raw mean resulted higher than the weighted mean, because the former is not affected by the differences in the sample size across the studies.

Nevertheless, the relatively high pooled prevalence of psychiatric symptoms among LC patients requires a better understanding. Our analyses did not find a significant association between the severity of COVID-19 infection and psychiatric symptoms, except for a potential inverse

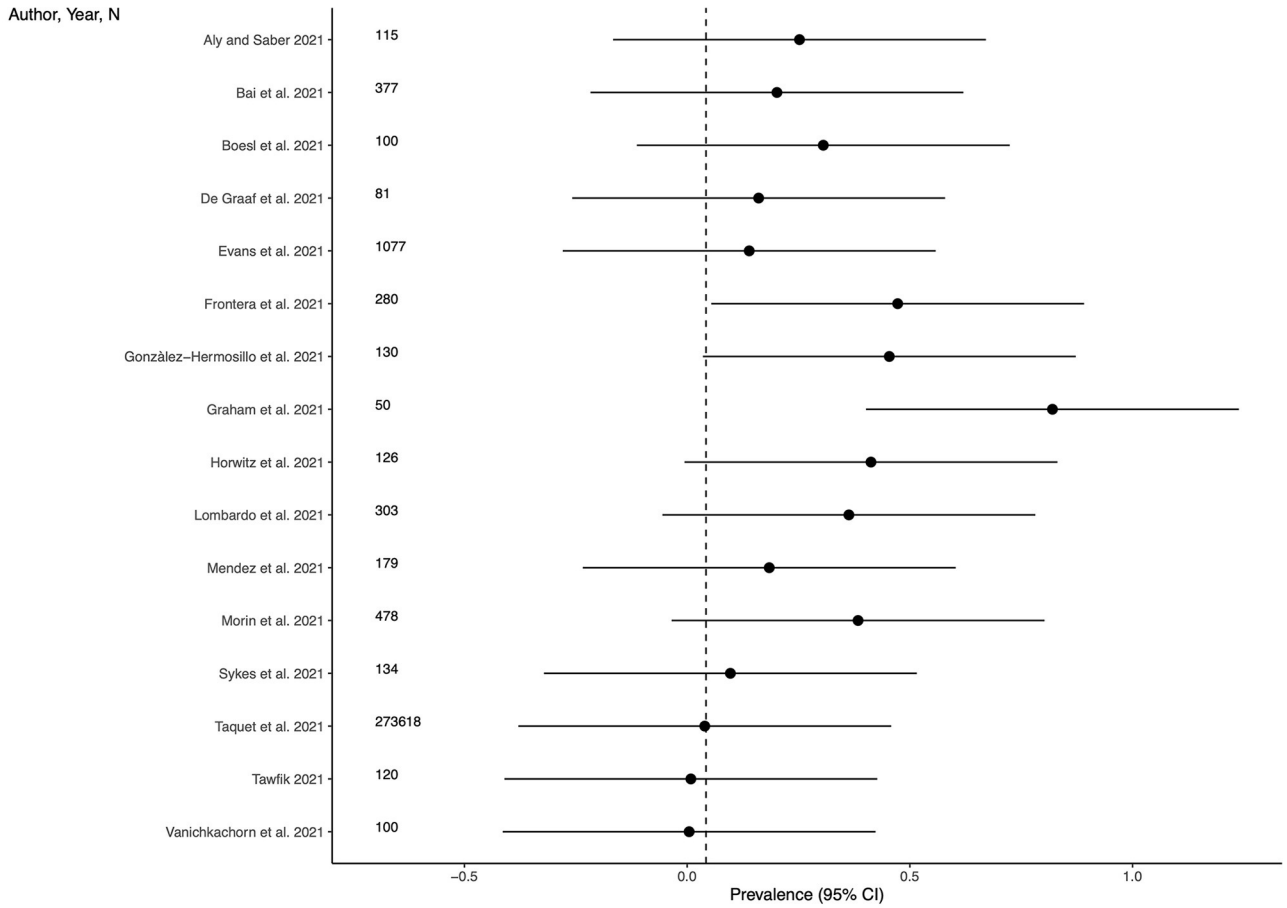

FIGURE 4
Prevalence of cognitive impairment across the studies and weighted mean prevalence. The vertical dotted line represents the weighted mean prevalence.

association with symptoms of cognitive impairment. These findings align with the conclusions drawn from most of the reports included in our systematic review, which examined the relationship between infection severity and psychiatric symptoms (6, 17, 20, 23, 27, 34, 40). Notably, only one study reported an increased risk of depression and anxiety among individuals with the most severe form of infection (8). However, it is important to acknowledge that the confidence in the results is limited by the comparatively small representation of patients with mild infection, leading to low statistical power.

It should be noted that research in the pre-COVID-19 era observed that survivors after intensive care (IC) are at greater risk of developing long-term mental disorders (47). Particularly, anxiety, depression, and PTSD would have occurred in half of this sample of UK patients discharged from IC. Psychiatric symptoms of the post-IC syndrome fall into three broad categories: physical, cognitive, and psychological deterioration. Symptoms of physical deterioration include fatigue and insomnia, while cognitive and psychiatric symptoms include anxiety, depression, memory impairment, and PTSD. Therefore, there seems to be a significant overlap in the experience of some of the LC patients analyzed in this review with post-IC syndrome.

A considerable amount of COVID-related research also focused on the effect on mental health of public health measures (such as quarantine, lock-down, social isolation and other limitations to personal freedom), finding an association with symptoms of depression, anxiety, loneliness, psychosocial distress, and persisting post-traumatic arousal (48, 49). Therefore, another possible explanation for the higher prevalence of psychiatric symptoms among LC patients may be more a consequence of the imposed quarantine and other restrictions in terms of anxiety, fear, anger, and other negative emotions, regardless of specific aspects of the COVID-19 infection such as neuro- or systemic inflammation. Even if the quarantine imposed by a local health authority has not been directly associated with any psychological outcomes (50), it was suggested that belonging to a publicly recognized COVID-19 risk group/community would be associated with increased anxiety, depressive symptoms, self-concern, fear, increased psychosocial distress, and decreased life satisfaction. In addition, loneliness and isolation have been associated with an increased risk for various mental disorders (as well as for various somatic diseases). In the context of the COVID-19 pandemic, loneliness has been found to be predictive of depressive and anxious symptoms during the lockdown measures (51, 52).

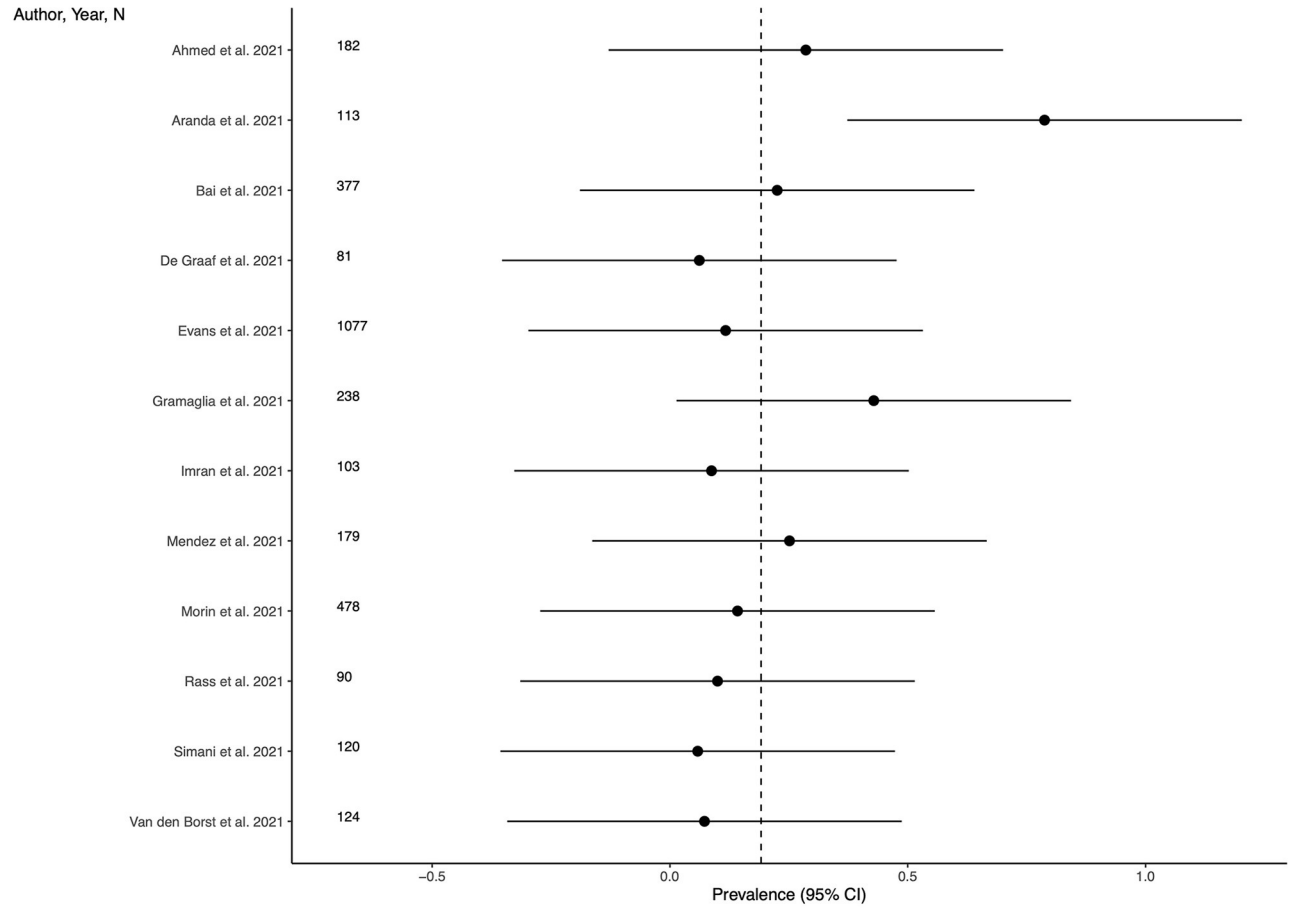

FIGURE 5
Prevalence of post-traumatic symptoms across the studies and weighted mean prevalence. The vertical dotted line represents the weighted mean prevalence.

COVID-19 is in fact only the most recent of many other infectious diseases that have been associated with chronic sequelae after recovering from the acute phase of infection (53): similarly as with LC, the underlying pathophysiological and etiological mechanisms are far from being clearly understood. The review by Choutka et al. (53) investigated the common characteristics between LC and other chronic infectious syndromes, finding higher prevalence of the following symptoms: intolerance to physical effort, neurocognitive and sensory impairment, persistent flu-like symptoms, disturbed sleep, myalgias, and arthralgias. The greatest analogies are with the post-acute effects described in the SARS epidemic in 2002–2004 (54).

All these elements are probably interrelated with each other and influential in the experience of LC patients.

Limitations

The results of this review should be interpreted considering its limitations. First, the lack of a control group made difficult to draw considerations on the risk of psychiatric symptoms among LC patients, reducing considerably generalizability and reliability of our findings. This translated also in the impossibility to meta-analyze the results of the selected studies to detail the risk of psychiatric symptoms in patients who have had COVID-19. Second, most of the included studies reported measures of psychiatric symptoms instead of assessing psychiatric diagnoses, with a risk for diagnostic overestimation: this was partially attenuated by including only studies applying validated psychometric tools or clinical interviews. Third, there were a marked outlier effect played by one study (35), which implemented a sample size accounting for more than 90% of the total sample size. Even though that study resulted at low risk of bias in the assessment, it may have impacted on the pooled prevalence estimate of the outcomes reported in that study. Fourth, the condition of LC has been assessed only through a temporal criterion, that was 4 weeks after recovery from the infection. The lack of a more comprehensive definition of LC may have increase the heterogeneity in the estimates. Finally, the risk of bias was rated high or unclear in many studies, with serious threats related to the inconsistency in the estimates and to the assessment of confounders.

Implications for research and clinical practice

The overlapping of some clinical features of LC in terms of signs and symptoms with other post-infectious syndromes and

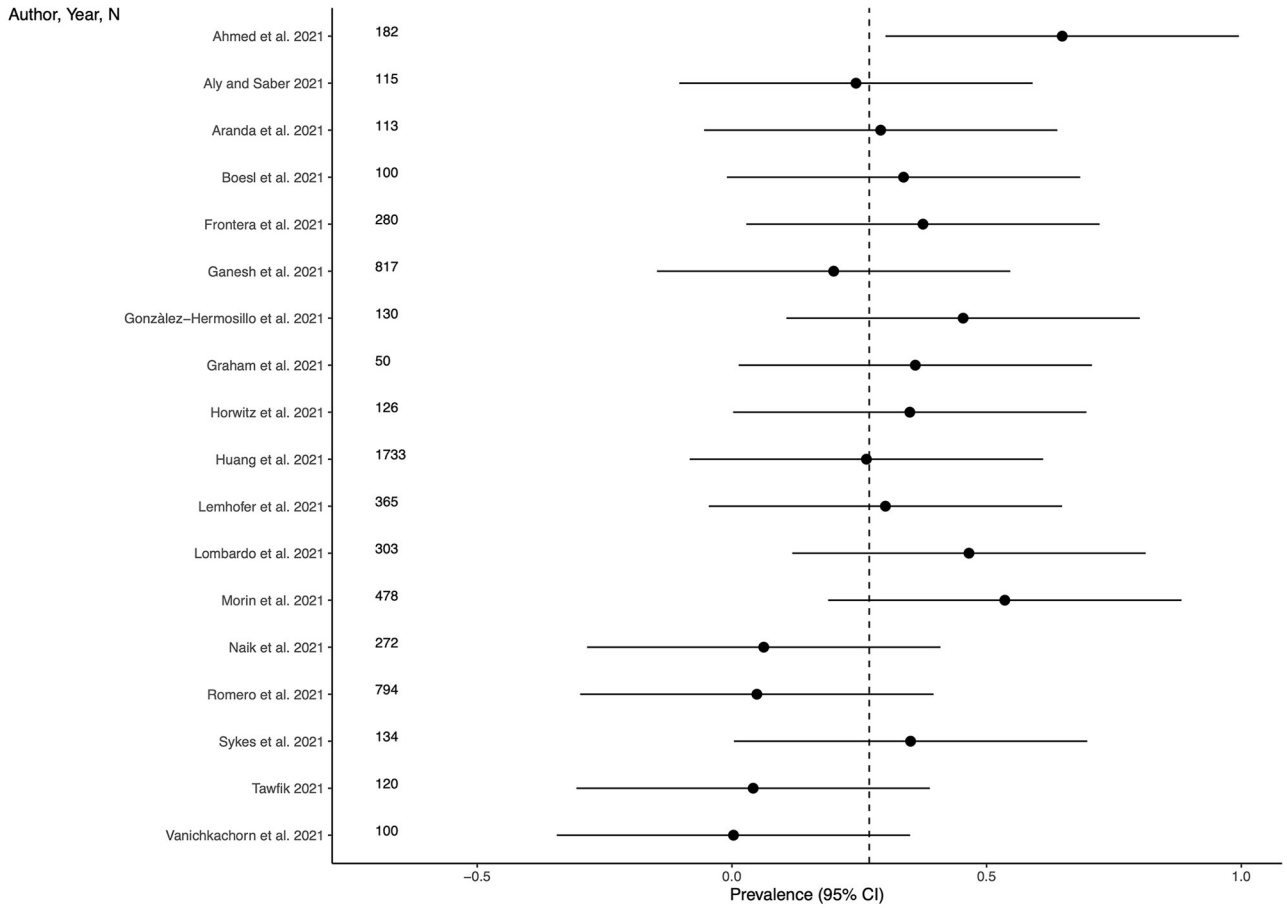

FIGURE 6
Prevalence of sleep disturbances across the studies and weighted mean prevalence. The vertical dotted line represents the weighted mean prevalence.

with the post-IC syndrome would suggest the involvement of shared pathophysiological pathways. The perspective of identifying a unified etiological model would lead the way toward the implementation of diagnostic markers and tailored treatments (53). At present, however, our understanding of the underlying pathophysiological mechanisms and etiological factors is poor, though promising studies are being conducted (55–57). For example, a recent review advanced the hypothesis that perivascular inflammation serves as the critical pathogenetic factor for LC neuropsychiatric manifestations (58). Indeed, SARS-CoV-2 and other viruses (such as retrovirus) showed the ability to activate brain mast cells and microglia resulting in the release of inflammatory, neurotoxic, and vasoactive mediators impacting neuronal connectivity and signal transmission (59–61). Hopefully, that may also converge to a better definition of functional and psycho-somatic syndromes, such as fibromyalgia and chronic fatigue syndrome, for which the association with viral infections has been previously proposed (62–67).

More research is therefore needed, more clearly comparing different patient groups (e.g., LC patients that were admitted to ICU vs. other ICU patients with or without other infectious diseases; LC patients vs. patients remitting from other infectious diseases) and applying prospective designs, allowing causal considerations, and providing more epidemiological details. Also, qualitative studies investigating the subjective experience of people recovered from COVID-19 are being conducted (68): this approach may also contribute to the understanding of the psychological mechanism contributing to the onset of psychological symptoms. Such different research methods could converge on a better conceptualization

TABLE 3 Prevalence of psychiatric symptoms by severity of the COVID-19 infection.

	Mean P (SD) mild	Mean P (SD) severe	Mean P (SD) both	*p*-value
N	5	15	11	
Depression	0.36 (0.36)	0.29 (0.22)	0.16 (0.12)	0.339
Anxiety	0.36 (0.12)	0.37 (0.14)	0.21 (0.19)	0.089
Cognitive impairment	0.56 (0.36)	0.31 (0.16)	0.15 (0.14)	0.061
PTS	NA	0.24 (0.28)	0.20 (0.15)	0.731
Sleeping disturbances	0.33 (0.03)	0.33 (0.14)	0.28 (0.26)	0.879

P, prevalence; SD, standard deviation; N, number; PTS, post-traumatic symptoms; NA, not available.
p-value are based on multiple groups analysis of variance (ANOVA).

and analysis of the symptoms associated with the LC syndrome, as well as supporting the construction of a better defined and unified nomenclature.

A better understanding of the LC psycho-pathophysiology is essential to provide and improve treatment. From a therapeutic point of view, in close relation both to the traumatic component of a part of the symptoms found in LC, and to the inflammatory component (initially exerted by the infection and then self-sustained), interventions aimed at reducing the inflammatory process and reducing the excessive activation of the sympathetic nervous system through a relaxation response may be useful. For example, models of intervention involving reconditioning and mindfulness may help patients suffering from LC (69). Future clinical trials on LC patients may be therefore warranted.

Conclusions

People who have recovered from COVID-19 may experience more and persistent psychiatric symptoms. These include depression, anxiety, post-traumatic distress, cognitive and sleeping disturbances. However, there is marked heterogeneity in the literature about how these symptoms are investigated and differentiated from other post-infectious or post-hospitalization conditions. More research, particularly implementing control groups and prospective follow-up, are needed to better define psychopathology related or included into the LC syndrome.

Data availability statement

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

Author contributions

MM, PG, and VS: conceptualization and planning and interpretation of the results. PG, VS, FC, FR, and PM: acquisition. MM: analysis of the data. MM, PG, VS, FC, FR, and PM: drafting. SF, LP, and GG: critical revision of the manuscript. All authors approved the final submitted 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.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2023.1138389/full#supplementary-material

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Psychometric properties of the Korean version of questionnaires on adherence to physical distancing and health beliefs about COVID-19 in the general population

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Introduction: We aimed to examine the psychometric properties of the Korean version of the questionnaires on adherence to physical distancing and health beliefs about COVID-19 in the general population in South Korea. In addition, we investigated how the various sections interacted with each other and with viral anxiety and depression, and ultimately affected adherence to physical distancing.

Methods: An anonymous online survey was conducted among members of the general population in South Korea between 10 and 18 January 2022. We recruited 400 respondents and measured their demographic information, symptoms, and responses to questions about COVID-19. First, we examined the reliability and validity of the questionnaires, which included questions about people's adherence to physical distancing guidelines and COVID-19-related health beliefs. Second, we examined the relationship between physical distancing and viral anxiety or depression, as assessed using the six-item Stress and Anxiety to Viral Epidemics (SAVE-6) scale and the Patient Health Questionnaire-9 (PHQ-9).

Results: All 400 participants (204 men, age 41.6±10.8) completed the survey. Confirmatory factor analysis revealed a good model fit for adherence to physical distancing (CFI=1.000, TLI=1.019, RMSEA=0.000, and SRMR=0.034) and health beliefs about COVID-19 (CFI=0.993, TLI=0.991, RMSEA=0.030, and SRMR=0.052). It also showed good reliability for Factor I (Cronbach's α=0.826) and Factor II (α=0.740). Four categories of the COVID-19 health beliefs questionnaire also showed good reliability for perceived susceptibility (α=0.870), perceived severity (α=0.901), perceived benefit (α=0.935), and barriers to following physical distancing (α=0.833). Structural equation models showed that the effects of health beliefs and viral anxiety and depression were mediated mostly by personal injunctive norms. Goodness-of-fit measures indicated a good fit. (Chi-square=24.425, df=7, p<0.001; CFI=0.966; RMSEA=0.079).

Conclusion: The Korean version of the COVID-19 adherence to physical distancing and health beliefs questionnaires showed good reliability and validity in the Korean general population. In addition, the effects of health beliefs, along

with viral anxiety and depression, were mainly mediated by personal injunctive norms.

KEYWORDS

physical distancing, health beliefs, COVID-19, anxiety, depression

Introduction

During the COVID-19 pandemic, physical distancing was a key public policy used to prevent the transmission of the virus, along with hand washing and mask use (1). Adopted by many countries around the world, physical distancing was crucial in reducing the spread of the virus. Its implementation has reduced the risk of contracting COVID-19 from 13 to 25%. Higher levels of adherence (for example, by avoiding public places or gatherings of more than 10 people) can further reduce the risk (2, 3).

Due to its effectiveness, physical distancing has been a critical component of the public response. As a result, many factors that increase adherence have been investigated. Individuals who are female, older, more educated, in a higher socioeconomic group, or non-White are more likely to adopt this protective behavior (4, 5). Similarly, those who trust the government or agency responsible for the policy, hold liberal political views or have fewer pseudoscientific beliefs are more likely to adhere more closely to distancing guidelines (6). Adherence can also be influenced by emotional states and socio-demographic factors. Fear or anxiety related to the virus has been found to be associated with higher compliance with public health guidelines (7), and fostering empathy through outreach to individuals at high risk of viral infection has shown to improve adherence to physical distancing measures (8). Depression severity has been linked to the fear of social distancing (9), while people with better adherence have been shown to have fewer symptoms (10). Personality has also been studied in this context: being agreeable, conscientious, and extraverted may improve adherence (11). Furthermore, reduced social support may reduce adherence (12).

Among numerous previous reports, one study focusing on non-adherent behaviors (13) found that the following factors—vulnerability to COVID-19, an inability to maintain physical distance, pressure from (and the perceptions of) friends and neighbors, and support from friends— influenced those types of behaviors. Because these factors include constructs from the Health Beliefs Model and Social Norms Theory, such approaches may offer an effective way to understand how different factors interact to increase or decrease adherence to social-distancing guidelines.

The theoretical Health Beliefs Model (HBM) was developed to understand and predict the success or failure of health-promoting behaviors (14). Fundamentally, it posits that health-related behavior consists of two components: (1) the desire to avoid being ill, and (2) the belief that certain health-related actions will prevent or cure illness. The model consists of six constructs: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. The COVID-19 health-belief questionnaire is an evaluation tool based on the Health Beliefs Model (HBM) and is used to measure COVID-19-related health beliefs. It includes five of the original constructs, excluding "cue to action."

Social norms theory is another promising way to improve our understanding of the factors that influence people to adhere to physical distancing guidelines. This approach analyzes health behavior by focusing on environmental and interpersonal influences, particularly peer perceptions (15). It postulates that peer-influenced perceived norms differ from actual norms. To promote good health behaviors, this gap or misperception must be addressed. The perceived social norms questionnaire used in this study was developed based on the social norms theory (16). It consists of perceived, descriptive, and injunctive social norms. Both injunctive and descriptive social norms both influence the intention to engage in healthy behaviors (17).

During the COVID-19 pandemic, Gouin et al. developed questionnaires on adherence to physical distancing, COVID-19-related health beliefs, and perceived social norms (18). These questionnaires have been used in other studies to predict physical distancing behaviors during the pandemic (19). Although they have been validated by Korean healthcare workers to examine whether viral anxiety mediates the influence of uncertainty intolerance on adherence to physical distancing, no previous study has validated these questionnaires with the general population in South Korea. In this study, we aimed to investigate the psychometric properties of the Korean version of the questionnaires on adherence to physical distancing, health beliefs about COVID-19, and perceived social norms among the general population. Additionally, we examined how the various sections interacted with each other and with viral anxiety and depression, and ultimately affected the adherence to physical distancing.

Methods

Participants and procedure

This study was part of a research that examined people's behavior and attitudes toward physical distancing during the COVID-19 pandemic and its effects on their psychological factors (20). We conducted an anonymous online survey among the general population in South Korea through the professional survey company, EMBRAIN (www.embrain.com) during the period between 10 and 18 January 2022. A total of 400 respondents were recruited from a pool of 1,650,000 public panels registered with the survey company. No specific exclusion criteria were applied. The estimated sample size was based on 40 samples for 10 cells (biological sex X five age groups) (20, 21). The survey company sent emails for enrollment emails to 2,000 ~ 3,000 panelists, and all 400 panelists' responses were collected from 949 panelists who accessed the survey system.

The survey form reflected the guidelines (22) provided by the Checklist for Reporting the Results of Internet e-Surveys (CHERRIES). It included questions about participants' demographic

characteristics, responses to COVID-19, past psychiatric history, and current level of psychiatric distress as measured by symptom rating scales. Concerning COVID-19, participants were asked: "Did you experience quarantine because you had a COVID-19 infection?," "Have you had a COVID-19 infection?," and "Have you been vaccinated?." Their past psychiatric history and current psychiatric status were assessed using their responses to the following questions: "Have you ever experienced or been treated for depression, anxiety, or insomnia?" and "Do you currently feel depressed, anxious, or in need of help to cope with your emotional state?." The study protocol was approved by the Institutional Review Board (IRB) of the Asan Medical Center (2021–1755), which waived the need for written informed consent.

Measures

Questionnaires on adherence to physical distancing, health beliefs about COVID-19, and perceived social norms

We used Korean versions of the questionnaires translated in a previous study (23), using a translation/back-translation method. For each questionnaire, two bilingual experts separately translated the English version into Korean; these two Korean translations were merged into one, which was then back-translated into English by another bilingual expert. The back-translated and original English versions were compared to check for discrepancies in meaning, and the final Korean version was developed.

Adherence to physical distancing

We applied the physical distancing adherence questionnaire developed by Gouin et al. (18). Each of the seven items in this questionnaire (e.g., "I minimize contact with other people by staying at home") can be rated on a 5-point Likert scale. Higher total scores indicate greater adherence.

Health beliefs about COVID-19 and perceived social norms

The questionnaire on COVID-19-related health beliefs included perceived susceptibility to infection (Three items, e.g., "How susceptible do you think you are to becoming infected or contracting the virus?"), perceived severity of viral infection (Three items, e.g., "If you become infected or contract the virus, how dangerous will COVID-19 be for you?"), the perceived benefits of physical distancing (Three items, e.g., "How effective do you think these social-distancing recommendations will be in protecting you from COVID-19?"), barriers to physical distancing (Four items, e.g., "How costly or expensive will it be for you to implement these recommendations?"), and self-efficacy (One item). To test the psychometric properties of the COVID-19 health beliefs questionnaire, the single self-efficacy item was not included, as it was the sole factor.

The questionnaire on perceived social norms related to physical distancing included one item each on descriptive social norms, personal injunctive norms or moral norms, and social injunctive norms, for a total of three items. Its psychometric properties were not investigated in this study because the three individual items could not be clustered into a single factor.

Stress and anxiety to viral epidemics-6 items

The SAVE-6 is a 6-item scale that was developed to measure an individual's viral anxiety (24); it is one of the subscales of the SAVE-9 scale, a self-report rating scale used to assess work-related stress and anxiety responses, specifically related to viral epidemics (25). Each item (e.g., "Are you afraid that your health will worsen because of the virus?") can be rated using a 5-point Likert scale (0-never to 4-always). We used the Korean version of the SAVE-6 scale in this study. Cronbach's alpha in this sample was 0.789.

Patient health questionnaire-9

The PHQ-9 is a rating scale for assessing the severity of depression (26). It consists of 9 items, each of which (e.g., little interest or pleasure in doing things) can be rated on a 4-point Likert scale (0-not at all to 3-nearly every day). A higher total score corresponds to a higher level of depressive symptoms. We used the Korean version of the PHQ-9 (27), and Cronbach's alpha was 0.890 in this sample.

Statistical analysis

The construct validity and reliability of the Korean versions of the questionnaires on adherence to physical distancing and health beliefs were examined in the general population. The factor structure of both scales was examined through confirmatory factor analysis (CFA). For the CFA, the Kaiser-Meyer-Olkin (KMO) value and Bartlett's sphericity test were used to examine sampling adequacy and data suitability. Next, the two-factor model for the Adherence to the physical distancing scale and the four-factor model for the Health Belief Model Scale were examined using the DWLS estimation. Model fit was assessed through a comparative fit index (CFI), Tucker-Lewis index (TLI), standardized root-mean-square residual (SRMR), and root-mean-square-error of approximation (RMSEA) values (28). Multigroup CFA was run to assess the measurement invariance of these two scales across gender, depression (PHQ-9 $\geq$ 10), and insomnia (ISI $\geq$ 8). The psychometric properties of these two scales were also examined using Rasch analysis. In the Rasch analysis, infit mean square (infit MnSq), outfit mean square (outfit MnSq), and item difficulty were assessed. Infit MnSqs and outfit MnSqs between 0.50 and 1.50 are recommended. In addition, item and person reliability and separation indices were calculated for both scales.

We also examined the interactions between the different assessments and the adherence to physical distancing. First, we performed correlation analysis using Pearson's r. Then, based on the results, we constructed a structural equation model (SEM) in which the variables were arranged in such a way that the effects of each variable would ultimately lead to adherence to physical distancing.

The reliability of internal consistency was tested by Cronbach's alpha and McDonald's omega. Convergent validity was examined based on Pearson's correlation analysis with scores on the SAVE-6 and PHQ-9 scales. We used SPSS version 21.0, AMOS version 27 for Windows (IBM Corp., Armonk, NY, United States), JASP version 0.14.1, jMetrik 4.1.1, and R version 4.1.2 with the lavaan package used to perform the statistical analyses.

TABLE 1 Clinical characteristics of the study subjects (n=400).

Variable	Mean±SD, *N* (%)
Male subjects, *n* (%)	204 (51.0%)
Age (years)	41.6 ± 10.8
18–29	86 (21.5%)
30–39	90 (22.5%)
40–49	108 (27.0%)
50–59	96 (24.0%)
≥ 60	20 (5.0%)
Marital status	
Single	186 (46.5%)
Married, with kids	169 (42.3%)
Married, no kids	35 (8.8%)
Other	10 (2.6%)
Questions about COVID-19	
Did you experience quarantine because you had a COVID-19 infection? (Yes)	52 (13.0%)
Have you had a COVID-19 infection? (Yes)	8 (2.0%)
Have you been vaccinated? (Yes)	368 (92.0%)
Psychiatric history	
Have you ever experienced or been treated for depression, anxiety, or insomnia? (Yes)	51 (12.8%)
Have you ever experienced or been treated for depression, anxiety, or insomnia? (Yes)	36 (9.0%)

Results

Reliability and validity of the questionnaires

Of the 400 participants, 204 (51.0%) were men, 52 (13.0%) had been quarantined, eight (2.0%) had been infected, and 368 (92.0%) had been vaccinated (Table 1). Before conducting the CFA, the suitability of the data and sampling was checked based on KMO measures (0.82 for both scales) and Bartlett's test of sphericity ($p < 0.001$). Table 2 presents the factor loadings of the two-factor model of adherence to physical distancing and the four-factor model of health beliefs. CFA with DWLS estimation showed a good model fit for adherence to physical distancing (CFI = 1.000, TLI = 1.019, RMSEA = 0.000, and SRMR = 0.034) and health beliefs about COVID-19 (CFI = 0.993, TLI = 0.991, RMSEA = 0.030, and SRMR = 0.052, Table 3). The multi-group CFA showed that the Korean versions of the questionnaires on adherence to physical distancing and health beliefs about COVID-19 could be applied without considering gender, depression (PHQ-9 ≥ 10), or insomnia (ISI ≥ 8) (Supplementary Tables 1, 2).

The physical distancing adherence questions showed good reliability for Factor I (Cronbach's alpha = 0.826) and Factor II (Cronbach's alpha = 0.740, Table 3). The four categories in the questionnaire on health beliefs about COVID-19 also showed good reliability (perceived susceptibility, Cronbach's alpha = 0.870; perceived severity, Cronbach's alpha = 0.901; perceived benefits, Cronbach's alpha = 0.935; perceived barriers, Cronbach's alpha = 0.833).

Rasch analysis results (Supplementary Table 3) showed that the infit and outfit MnSqs for both scales were within the recommended range (0.50 to 1.50). The item difficulty results showed that item 3 was the least difficult item and item 5 was the most difficult item in the questionnaire on adherence to physical distancing. For the COVID-19 health beliefs questionnaire, item 3 of the susceptibility to infection subscale was the least difficult item, and item 1 of the perceived severity of viral infection subscale was the most difficult. All subscales in both questionnaires had the acceptable item and person-separation indices and reliability, except for Factor II in the adherence to physical distancing scale. This would be due to fewer items (only two) of the subscale.

The convergent validity of each factor with each other and with rating scales of depression or viral anxiety are shown in Table 4.

Structural equation model

Based on the correlation results, we arranged the variables into three levels. The first level included viral anxiety, depression, perceived benefits, perceived barriers, and self-efficacy. The second level included personal injunctive norms and social injunctive norms. The final level consisted of adherence to physical distancing. The final model (Figure 1) showed that the effects of health beliefs and viral anxiety and depression were mostly mediated by personal injunctive norms. Goodness-of-fit measures indicated a good fit (Chi-square = 24.425, df = 7, $p < 0.001$; CFI = 0.966; RMSEA = 0.079).

Discussion

This study aimed to validate the Korean versions of the questionnaires on physical distancing adherence and COVID-19-related health beliefs in the general population. We found them to be valid and reliable rating scales, which also included good convergent validity with measures of viral anxiety and depression. Through structural equation modeling, we also showed that personal injunctive norms were an important mediator, linking the effects of health beliefs to viral anxiety and depression.

In a previous study, we found that the two questionnaires on physical distancing adherence and COVID-19-related health beliefs could be applied to healthcare workers (23). The present study shows that these questionnaires can also be used in the general population. The results revealed a few differences, reflecting the different impacts of the pandemic. The first item in the perceived barrier subscale highlighted a key difference between these two groups. In response to the question, "How costly or expensive will it be for you to implement these recommendations?," nearly half (48.0%) of healthcare workers responded "Not at all." In contrast, a similar proportion of members of the public (47.5%) said "Moderately," and more than 20% responded "A lot" or "Extremely," despite holding views slightly more on the severe side of the perceived severity subscale. Factor loading was also relatively low (0.390), possibly for economic reasons. In South Korea, although the pandemic was a significant cause of emotional distress among healthcare workers, it rarely led to economic hardship or loss of work. After an initial period of shortages, the supply of personal protective equipment increased enough to keep prices affordable. During the same period, many small businesses saw their income shrink dramatically, possibly because of the social distancing

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TABLE 2 Factor structure of the Korean version of the physical distancing adherence and health beliefs questionnaires on COVID-19 and factor loadings (N=400).

Items	Response scale					Descriptive		CITC	CID	Factor loading
	0	1	2	3	4	M	SD			CFA
(A) Questionnaire on adherence to physical distancing										
Distancing factor I										
Distancing 1	1.5	4.5	11.3	47.3	35.5	4.107	0.879	0.629	0.811	0.753
Distancing 2	0.8	4.0	13.3	41.5	40.5	4.170	0.859	0.664	0.806	0.802
Distancing 3	0.5	3.5	10.8	39.0	46.3	4.270	0.827	0.721	0.799	0.836
Distancing 4	1.5	4.0	11.3	35.8	47.5	4.238	0.910	0.569	0.819	0.650
Distancing 5	3.5	12.5	26.3	41.5	16.3	3.545	1.018	0.431	0.843	0.508
Distancing factor II										
Distancing 6	1.0	1.8	7.0	20.5	69.8	4.562	0.783	0.531	0.824	0.827
Distancing 7	0.3	1.3	6.3	20.3	72.0	4.625	0.682	0.512	0.826	0.717
(B) Questionnaire on health beliefs regarding COVID-19										
Perceived susceptibility										
Susceptibility 1	6.8	19.5	52.8	18.8	2.3	2.903	0.857	0.773	0.797	0.828
Susceptibility 2	4.0	18.5	56.3	19.5	1.8	2.965	0.781	0.809	0.767	0.877
Susceptibility 3	1.0	15.5	47.0	30.8	5.8	3.248	0.820	0.678	0.882	0.789
Perceived severity										
Severity 1	4.5	17.5	42.0	31.0	5.0	3.145	0.920	0.769	0.890	0.843
Severity 2	2.3	14.8	35.5	41.3	6.3	3.345	0.885	0.842	0.825	0.908
Severity 3	2.0	13.0	43.8	34.5	6.8	3.310	0.855	0.804	0.860	0.854
Perceived benefit										
Benefit 1	8.3	11.3	22.8	45.5	12.3	3.423	1.101	0.875	0.898	0.941
Benefit 2	5.8	11.8	21.8	38.3	22.5	3.600	1.128	0.851	0.917	0.869
Benefit 3	8.3	9.0	22.0	42.8	18.0	3.533	1.135	0.871	0.901	0.920
Perceived barrier										
Barrier 1	15.0	16.0	47.5	18.3	3.3	2.787	1.015	0.390	0.895	0.390
Barrier 2	8.8	16.5	30.0	31.5	13.3	3.240	1.143	0.778	0.734	0.894
Barrier 3	10.0	14.8	32.3	29.8	13.3	3.215	1.154	0.794	0.725	0.924
Barrier 4	15.5	22.3	38.0	20.0	4.3	2.752	1.074	0.717	0.765	0.777

CITC, Corrected Item-total Correlation; CID, Cronbach's alpha if item deleted; CFA, Confirmatory Factor Analysis.

measures. Members of the public also had a slightly more favorable view of the distancing measures on the perceived benefits subscale. How effective do you think these social-distancing recommendations will be in protecting you from COVID-19?", 60% of the members of the public responded "A lot" or "extremely", compared with only 40% of health care workers. While these results suggest that the public messaging campaign was successful in promoting social distancing in the general population, healthcare workers may have felt less positive, because many contracted the virus while working (29) despite strict adherence to distancing guidelines (30). These differences suggest that a change in perspective may be needed when addressing issues in these populations in the future.

The Rasch analysis showed that item 5 in the questionnaire on physical distancing, "In public, outside the home, stand at least two meters away from other people," was the most difficult guideline to follow. Factor loading was also relatively low (0.508). This survey was conducted in January 2022. By that time in Korea, a significant number of individuals in the general public had already become accustomed to COVID-19 policies (and had grown less vigilant) after two years of the pandemic. They had received vaccinations (31) and had resumed many of their pre-pandemic activities, such as using public transportation for commuting and shopping at department stores. Government guidelines had also been relaxed. Consequently, during the survey period, it was challenging for participants to consistently adhere to a strict two-meter distance from others in practical life.

The CFA also showed a good fit for the four-factor model of the questionnaire on health beliefs regarding COVID-19, in parallel with our previous study (23). The subscales showed good convergent validity with each other and with other rating scales. However, the perceived barrier subscale score was not significantly correlated with the scores on adherence to physical distancing, a finding that we also observed in healthcare workers

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TABLE 3 Scale-level psychometric properties of the Korean version of the questionnaires on adherence to physical distancing and health beliefs regarding COVID-19.

Psychometric properties	Adherence to physical distancing		Health beliefs regarding COVID-19				Suggested cut-off
	Distancing Factor I	Distancing Factor II	Susceptibility	Severity	Benefit	Barrier	
Cronbach's alpha	0.826	0.740	0.870	0.901	0.935	0.833	≥ 0.7
Standard error of measurement	1.443	0.668	0.790	0.765	0.996	0.914	Smaller than SD/2
KMO measure of sampling adequacy	0.82		0.82				0.5
Bartlett's sphericity test	1052.00 (<0.001)		3660.844 (<0.001)				Significant
Confirmatory factor analysis model fits							
χ^2 (df, p value)	5.456 (13, 0.964)		80.449 (59, 0.033)				Not significant
CFI	1.000		0.993				>0.95
TLI	1.019		0.991				>0.95
RMSEA	0.000		0.030				<0.08
SRMR	0.034		0.052				<0.08

KMO, Kaiser-Meyer-Olkin; CFI, comparative fit index; TLI, Tucker-Lewis index; RMSEA, root-mean-square-error of approximation; SRMR, standardized root-mean-square residual.

TABLE 4 Correlation coefficients of each variable across all participants.

Variables	Age	1	2	3	4	5	6	7	8	9	10	11	12
1. Adherence to physical distancing, Factor I	0.16**												
2. Adherence to physical distancing, Factor II	0.09	0.41**											
3. Adherence to physical distancing, total	0.17**	0.96**	0.82**										
4. Perceived susceptibility	−0.06	0.10*	0.08	0.11*									
5. Perceived severity	0.01	0.12*	0.09	0.13*	0.62**								
6. Perceived benefit	0.26**	0.29**	0.17**	0.30**	0.26**	0.32**							
7. Perceived barrier	−0.10*	−0.07	−0.06	−0.08	0.14**	0.09	−0.28**						
8. Self-efficacy	0.08	0.25**	0.20**	0.27**	0.16**	0.19**	0.32**	−0.02					
9. Descriptive social norms	0.22**	0.14**	0.14**	0.16**	−0.03	−0.01	−0.03	−0.004	0.01				
10. Personal injunctive or moral norms	0.21**	0.33**	0.26**	0.35**	0.14**	0.20**	0.57**	−0.35**	0.32**	0.14**			
11. Social injunctive norms	−0.15**	−0.11**	−0.20*	−0.21**	−0.08	−0.09	−0.35**	0.27**	−0.22**	0.04	−0.36**		
12. SAVE-6	0.06	0.12*	−0.002	0.10*	0.48**	0.44**	0.25**	0.12*	0.13**	0.001	0.16**	−0.15**	
13. PHQ-9	−0.18**	0.05	−0.12*	0.005	0.12*	0.16**	0.02	0.26**	0.04	−0.16**	−0.13**	0.04	0.27**

SAVE-6, Stress and Anxiety to Viral Epidemics-6 items; PHQ-9, Patients Health Questionnaire-9 items *$p < 0.05$, **$p < 0.01$.

(23). Based on the Health Belief Model (HBM), individuals consider the effectiveness of an action or intervention in relation to perceived costs, dangers, unpleasantness, discomfort, time required, and inconvenience (32) Therefore, if people perceive a recommended policy to be more effective and the barriers to compliance to be low, we can expect them to adhere and comply with the policy. In contrast, if individuals perceive an extremely high level of severity or benefit, they may decide to follow the policy despite significant barriers. The pandemic may have had this effect; similar messaging strategies may be effective in future pandemics.

In addition, our structural equation model adds weight to the importance of personal injunctive norms or "moral norms" in a pandemic. Existing literature has already determined that it is independently associated with adherence to physical distancing, along with other measures of health beliefs (18). Our model supports these findings and goes further by showing that the effects of health beliefs on adherence to physical distancing are mediated

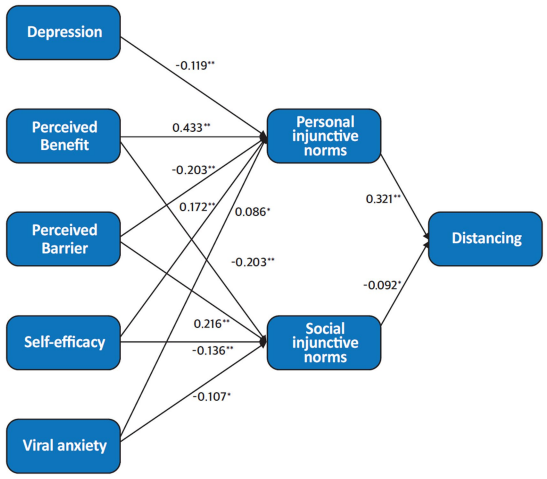

FIGURE 1
Structural equation model of the variables. Numbers next to arrows correspond to standardized estimates. The goodness-of-fit measures indicate a good fit (Chi-square=24.425, df=7, $p<0.001$; CFI=0.966; RMSEA=0.073). †$p<0.1$, *$p<0.05$, **$p<0.01$.

by personal injunctive norms. These findings suggest that authorities should emphasize civic duties when educating the public and formulating public policy. Prior to COVID-19, humanity had already experienced numerous pandemics, which are now becoming more frequent (33). Since the preventive effect of physical distancing has already been proven, the government plays an important role in increasing policy adherence during any pandemic. For instance, depending on the health-belief model applied, public relations can emphasize the effectiveness of physical distancing and the risk posed by infectious diseases, thus encouraging people to participate in the policy. In addition, developing a non-contact social system and compensating for the losses caused by physical distancing will make the practice more accessible and sustainable. According to this study, the health belief model is mediated as a personal injunctive norm. Therefore, a political perspective that embraces different sociocultural classes is essential. This study has several limitations. First, the survey was conducted in January 2022, two years after the onset of the pandemic. Although participants may have adjusted their views on the pandemic during this time, they will also have had a chance to reflect on the effects of social-distancing measures. Second, the sample size was relatively small, limited to 400 individuals. Despite being large enough to meet the primary research objective (validating questionnaires for use with members of the general public), we were unable to compare differences between populations. Future studies with larger samples may be able to achieve this, while also uncovering factors to consider when targeting specific populations.

Conclusion

In conclusion, the Korean version of the questionnaires on adherence to physical distancing and health beliefs with COVID-19 showed good reliability and validity in the general population. We also observed that the effects of health beliefs, along with viral anxiety and depression, were mainly mediated by personal injunctive norms. Health policymakers and healthcare professionals can use these questionnaires to assess adherence to physical distancing and health beliefs among the general population during the current pandemic. Our results also suggest that public-messaging strategies focusing on perceived severity, benefits, and civic duties may help to improve adherence to health interventions during future pandemics.

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 Institutional Review Board (IRB) of the Asan Medical Center (2021–1755), and obtaining the written informed consent was waived by IRB. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

YH, SY, and SC: conceptualization. SC, MA, and EC: data curation. OA, HA, and SC: formal analysis. YH, OA, HA, EC, MA, and SY: methodology. YH, HA, EC, OA, MA, SY, and SC: writing—original draft and writing—review and editing. All authors contributed to the article and approved the submitted version.

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.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2023.1132169/full#supplementary-material

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The mental health of working women after the COVID-19 pandemic: an assessment of the effect of the rise in sexual harassment during the pandemic on the mental health of Pakistani women using DASS-21

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Introduction: The mental health of South Asian women has been observed to be in regression lately, with sexual harassment as one of the major factors accounting for mental health deterioration, especially for women who leave their homes frequently for work and study. The COVID-19 pandemic not only augmented the mental health distress of the general female population but the rise in sexual violence against women is being consistently reported around the globe. Based on this background, we adopted a two-pronged strategy to assess whether working women and students aged 18–55 experienced a rise in sexual harassment in the 18months after lifting the COVID-19 lockdowns. Secondly, using the well-validated psychometric test, DASS-21, we evaluated the psychiatric outcome of this change on the mental health of those women.

Study design: The study was designed as a quantitative, cross-sectional survey-based research.

Methodology: A total of 303 women participated in this study. Personal interviews through a specifically designed questionnaire and psychometric test DASS-21 were administered to assess the mental health state of working women and female students, aged between 18 and 55 years old. The mean age of the participants was 37±2.8. The study population was further categorized into two main groups of limited and frequent interactions based on varying levels of the frequency of leaving home and interacting with male strangers in their daily routine. Data were analyzed and the correlation between limited/frequent interaction and DASS-21 total scores and sub-scores of depression, anxiety and stress, and other sociodemographic variables were investigated using the Chi-square test, whereas psychosocial predictors of mental distress were evaluated using multiple linear regression analysis after matching limited and frequent interaction groups using a 1:1 propensity score-matched pair method for sociodemographic covariates.

Results: Overall, approximately 50% of our study population experienced changes in the behavior of male strangers that could be categorized as harassment in their daily life interactions, whereas 33.66% of participants experienced relatively more sexual harassment post-pandemic than before it. This observation was significantly correlated with the frequency of male interaction ($\chi 2=5.71$, $p<0.01$). Overall, 34% of our study population scored >60 on the DASS21-total score,

whereas 29.04% scored >21 on the depression scale. Alarmingly, >40% of the women in the frequent interaction group scored in the extremely severe range of anxiety and depression. Moreover, in the regression analysis, out of all the factors analyzed, the extent of everyday interaction with male strangers, an increase in fear of sexual crimes, and a self-perceived increase in mental distress during the 18months post-pandemic were found to be highly statistically significant predictors of mental distress not only for total DASS 21 but also for the sub-scales of depression, anxiety, and stress.

Conclusion: In Pakistan, women experienced a rise in sexual harassment cases post–COVID–19. An increase in sexual harassment was found to be a predictor of negative mental health in the form of depression, anxiety, and stress.

KEYWORDS

sexual harassment, working women, DASS-21, COVID-19 pandemic, mental disorders among Pakistani women

Introduction

Sexual harassment is one of the major causes of mental health deterioration among women, specifically among those who leave home every day for work and study and have frequent interactions with male strangers (1, 2). It is a very prevalent crime against women worldwide (3). In Pakistan, sexual harassment is the most prevalent form of gender-based violence (4). The local emergency helpline (Madadgaar) reported that approximately 93% of women in Pakistan have experienced some sort of sexual harassment in their lives (5).

An excessive prevalence of sexual harassment in the country brings about a state of regressive mental health conditions among its victims. Continuous exposure to the same stressor and underreporting because of social stigma and possibly due to the fear of restriction placements on mobility for education or work often lead to the incubation of these symptoms over time, which causes the development of mania, psychosis, aggressive behavior, and ultimately suicidal thoughts (6). Unfortunately, Pakistan is one of those South Asian countries where women experience a two-to three-fold increased incidence of psychiatric disorders, compared to men (7). Moreover, they also form a major group in the country who attempt non-suicidal self-injurious behavior (NSSIB) (8). The Baluchistan-based study showed that 69.3% of victims of sexual harassment reported extremely severe depression, 97.1% reported extremely severe anxiety, and 79% reported severe and extremely severe stress levels (9).

Other than Pakistan, Bhutan, Bangladesh, India, Nepal, Srilanka, and Maldives are a few other South Asian countries where sexual harassment in public spaces has been normalized and is termed indirectly as "eve-teasing." Women have learned to live with the "normality of unsafety" (10, 11). In Bangladesh, sexual harassment in public transport is rampant to the extent that according to many women, traveling in public transport is like "going to war"; women are compelled to weigh their economic prosperity against the actual risk to their security. Consequently, increased incidences of sexual harassment are limiting women's participation in the labor force which in turn directly impacts the economic growth of the country (12). In India alone, sexual harassment has become extremely pervasive during the last 20 years, with rape being reported as the fourth most common crime in India (13). Alarmingly, despite an exponential rise in crime rates, only a very slight percentage of the victims (fewer than 1.5%) will ever report to the police (14). Although, in recent years, a slight improvement in reporting has been observed following a very high-profile fatal gang rape and murder in Delhi in a moving public bus which sent shock waves across the region (15). Ironically, all the countries of the South Asian region have enacted laws against sexual harassment; nevertheless, their enforcement remains a far bigger challenge. It is a grim reality that victims of sexual assault, usually women or children, often choose not to register a complaint out of fear of intense victimization and the biased attitudes of service providers. Therefore, very few women are courageous enough to report incidents of sexual violence to the police; most endure these unscrupulous acts silently (16). In Pakistan, in light of the recent rise in harassment incidents and underreporting, the government has sought help from digital media to increase reporting. Now, victims can report cases of assaults *via* a "police web portal" but can also track progress on their cases online (17). The e-portal can be quite helpful for city dwellers and tech-savvy individuals, but still, reporting such crimes in rural areas and slums poses a challenge to the government. Despite the overall improvement in the reporting of sexual assaults, conviction rates are quite low across the region, ranging from 2 to 3% in Bangladesh to 4% in India which reflects the level of impunity the perpetrators enjoy in the South Asian region despite strong projections of such cases in electronic and print media. The existing justice system in these countries is heavily plagued by corruption at all hierarchical levels. Consequently, this acts as a major impediment to accessing justice for the survivors. Across all six South Asian countries, pressure is put on the survivor or her family to withdraw the complaint and enter into an extra-legal settlement with the perpetrator. In Bangladesh, India, and Nepal, over 60% of the survivors interviewed reported facing pressure to settle/compromise the case. Lack of protection from retaliation or further threats coupled with weak judicial procedures opens the door to out-of-court settlements that force victims to drop charges, reinforcing a climate of impunity for perpetrators (18). In Pakistan, according to law, rape is a non-compoundable offense; nevertheless, the conviction rates are quite low (2–3%) which have been slightly improved to 16% with the establishment of special courts for gender-based violence working

under the recent anti-rape act 2021 (19). Still, protection gaps in the law, biased attitudes of the service providers, delays in medical examinations, and prosecution and trials by the police are major barriers to accessing justice coupled with the risk of ostracization of the victim by society.

It is a grim reality that pandemics tend to intensify the persecution of women which often leads to a rise in domestic and sexual violence. Rates of sexual violence increase during states of emergency, including natural disasters, wars, and health crises. This could possibly be because of an increase in enabling environments for gender violence to occur or due to an exacerbation of underlying drivers of violence against women and girls such as a failure of law enforcement and an increase in gender inequalities and unequal social norms (20).

The COVID-19 pandemic not only intensified the mental health distress of the general female population by widening the social and economic disparities but consistent reports of a rise in sexual violence against women also augmented the mental health burden further. In Pakistan, the health impact of COVID-19 has not been as devastating as feared, possibly due to the younger demographics of the country. Nevertheless, the pandemic exposed and exacerbated some of the country's major weaknesses such as poverty, gender inequality, and persecution. During the pandemic (since January 2020), a rise in gender-based violence was expected. The United Nations predicted a 20% increase in both physical and sexual violence during the COVID-19 pandemic (21) with 15 million more cases for every 3 months of lockdowns (22). The reality perfectly aligned with the expectations, especially in South Asia; multiple reports of increased gender-based violence in the region were made (23–26). Specifically, in Pakistan, during the first to the third month of 2020, violence against women increased by 200% and rape, specifically, by 300% although it is believed that many more cases exist but have not been reported (27). However, despite an apparent increase in the number of cases of sexual harassment, no such studies have been reported so far on the subject from Pakistan.

Therefore, in this first-of-its-kind study, we sought to assess: 1) if working women and female students of various socioeconomic backgrounds and professions had experienced increased sexual harassment during the past 18 months after lifting the COVID-19 lockdowns, 2) observed changes in the behavior of male strangers that can fall under the definition of sexual harassment, 3) the resulting impact on the mental health of these women based on the findings of a recent empirical study that observed that men are usually the main perpetrators of sexual harassment crimes for both men and women (28), 4) We also tried to analyze if having more male interactions in daily life meant more frequent experiences of sexual harassment, and 5) We also investigated whether the frequency of leaving home and the extent of interaction with male strangers could be a predictor of mental distress in our study population.

In our study, we adopted the tripartite model of sexual harassment proposed by Gelfand et al. (29). According to this model, sexual harassment can be grouped into three types of actions: gender harassment, unwanted sexual attention, and sexual coercion or *quid pro quo* sexual harassment. Gender harassment refers to all forms and extents of demeaning and intimidating verbal and non-verbal acts and behaviors toward women; these can range from taunts to flashing genitalia or sexual images. Unwanted sexual attention includes verbal and non-verbal acts of a sexual nature that invade someone's personal space such as making sexual remarks aimed at someone, touching them, or attempting a sexual assault. Sexual coercion means threatening or demanding sexual favors in response to benefits - specifically job-related benefits. Overall, sexual harassment covers a wide range of behaviors and actions ranging from staring, catcalling, groping, and gesturing inappropriately, to sending inappropriate sexual text messages, assaults, attempted rapes and rapes (29, 30).

Methodology

Study population

This multi-site, cross-sectional study was conducted among 303 women aged between 18 and 55 years who belonged to different socio-economic classes. The study was conducted for 3 months from September 2021 to November 2021 in many different cities all over Pakistan. In these cities, personal visits were made to sites such as banks, salons, hospitals, shopping malls, cash-and-carry stores, pharmacies, clinics, private and government schools, colleges, and other educational institutions like academies, universities, and vocational training centers (see Figure 1). This ensured a broad range of professional backgrounds of the study population ranging from students and teachers to nurses and sanitation workers and even women security guards with varying levels of frequency of leaving home and interaction with male strangers in their daily life routine. The participants were individually approached and asked for their consent to participate in the research survey. The participants were briefed about the objectives of the study and the tripartite model of sexual harassment was explained to them. The option to leave the survey anytime during the data collection was given to all the respondents. The inclusion criteria of the study comprised working women and students aged 18 to 55 years old, with or without a past diagnosis of depression, stress, and/or anxiety, with varying degrees of frequency of leaving home for work or study; they were defined as the study population. The study excluded women below 18 or older than 55 years of age. Patients with a medical history of mental diseases such as dementia, Alzheimer's, Schizophrenia, and psychosis were also excluded from the present study to minimize confounding due to neuropsychiatric disorders, and the study of the effects of sexual harassment on patients of the aforementioned disorders was out of scope of the present study.

The study was carried out in adherence to the Helsinki Declaration of 1975 as revised in 2000, and the research study was accepted and

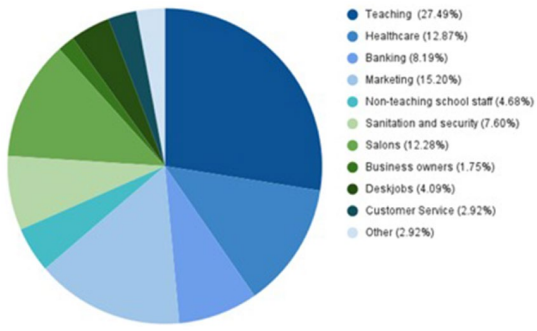

FIGURE 1
Occupational industries of working women.

approved by the Ethics Review Board of the Department of Biosciences, COMSATS University, Islamabad, and informed consent was obtained from all the participants.

Study instruments

This was a multi-site, multi-city study in which personal visits were made to various locations and cities to ensure participation by a wide range of professions and sociodemographic backgrounds (see Figure 1). The two-part survey was conducted by a team of trained female interviewers (psychologists), who approached women in different settings and comprehensively explained the purpose of the survey and the tripartite model of sexual harassment. The context period in which information was sought, i.e., 18 months after the COVID-19 pandemic lockdowns were lifted, was clearly mentioned and then the willingness to participate was sought. All the participants who showed a willingness to participate were requested to provide written informed consent for recruitment. The interviewers conducted the first part of the survey, whereas since DASS-21 is a self-reported questionnaire, it was filled out by the participants. The interviews were conducted in a comfortable setting at the participant's workplace, hostel, or university in case of students.

The questionnaire consisted of three parts. The first part of the questionnaire included questions related to demographics: participants' age, level of education, nativity, household income, and relationship status. In addition to this, specific questions were asked about participants' commute and work routines and levels of male interaction. The second part comprised questions specifically related to sexual harassment experiences in the past 18 months after the lifting of the COVID-19 lockdown in Pakistan. Participants were asked if they perceived any changes in behavior or interactions (which can be categorized as sexual/verbal/physical harassment) with male strangers in their routine encounters before and after the pandemic/COVID-19, e.g., the interviewers explained the behaviors to them and asked if they had observed an increase in the occurrence of more men catcalling, making lewd gestures, touching inappropriately, or women experiencing increased incidences of rape in accordance with the definition of sexual harassment. They were also asked if they have experienced more sexual harassment after the COVID-19 pandemic than before it. In addition to this, participants were asked whether their fear of sexual harassment-related crimes has increased in the past 18 months/ after the COVID-19 pandemic and in what ways this has affected their lifestyle or everyday routine. The third part of the questionnaire was related to their mental health status. Participants were asked if they felt increasingly stressed /anxious or depressed in recent times. Additionally, they were asked about the reasons that greatly contributed to their increase in anxiety/stress and depression or worsened already existing depression symptoms. The frequency or the exact number of times a participant experienced sexual harassment was not included in a deliberate attempt to increase study participation and maintain confidentiality.

In addition, the current mental health status of all the participants was assessed using the established psychometric test, DASS-21. The participants filled out the questionnaire themselves. Additional information regarding opinions and experiences of sexual harassment and mental health, as well as past diagnoses of mental health, was also obtained from the participants through the interviews.

DASS-21

The Depression, Anxiety, and Stress Scale (DASS– 21) has 21 questions that cover a wide range of symptoms of depression, anxiety, and stress (see DASS -21 questionnaire in Supplementary files). Each of the questions was stated in the first person, assertive tone, and required the participants to grade on a 4-point scale their experiences with a score of 0 (did not apply to me at all), 1 (applied to me to some degree or some of the time), 2 (applied to me to a considerable degree or a good part of the time), and 3 (applied to me very much or most of the time).

In recent years, accumulating data suggest good reliability, construct, and structure validity of DASS -21 in the Pakistani Population (31–33). Therefore, we found this test suitable for the assessment of psychometric measures in Pakistani working women. In our study population, we assessed the construct reliability using Cronbach's alpha. Overall, for our study population, DASS 21 had αn alpha value of 0.939 for 21 items which showed good reliability. High construct reliability was also obtained for clinical sub-categories. Depression had an alpha value of 0.846, anxiety had an alpha value of 0.828, and stress had an alpha value of 0.843. Concerning validity, in Pearson's correlation test, all study questions were significantly correlated at 0.01 level (two-tailed).

After the DASS-21 data collection, for analysis, the scores for depression, anxiety, and stress were separated, added, and each subcategory was multiplied by two. The score range for each of the three categories was 0 to 42. The scores were then measured against the scales provided for each of the sub-categories, categorizing participants into groups of normal, mild, moderate, severe, and extremely severe. Total DASS-21 scores were also calculated (see Supplementary information). The total scores were the cumulative addition of all sub-category scores. Cut-off scores of 60 and 21 were used, respectively, for the total DASS score and the depression subscale. These cut-off scores were derived from a set of severity ratings proposed by Lovibond and Lovibond (34). Scores ≥60 (for DASS-total) and ≥ 21 (for the depression subscale) are labeled as "high" or "severe." For those with total scores of 60 or over, professional psychiatric consultation was advised.

We defined the participants as Normal, Mild, Moderate, Severe, and Extremely Severe for each of the three sub-categories of DASS-21, i.e., Depression, Anxiety, and Stress using the scale originally defined by Lovibond and Lovibond (34). The DASS-21 test is based on the assumption that the differences between depression, anxiety, and stress experienced by normal individuals and clinical populations are different in degree. In this study, the scores, therefore, do not point toward objective disorders but rather provide insights into the overall population severity levels. For depression, 0–9 scores formulated the range for normal levels of depression in the population, 10–13 referred to mild rates of depression, 14–20 pointed toward moderate levels of depression severity, 21–27 represented severe levels, and scores over 28 pointed toward extremely severe depression rates. For the DASS-21 subscale of anxiety, 0–7 scores referred to normal population levels. Having a score of 8 or 9 for anxiety questions translated to mild anxiety, 10–14 were scores for moderate levels, and 15–19 were for severe levels of anxiety. A score of 20 was defined as the highest cut-off score and all individuals with 20+ scores showed strong anxiety levels in the population. For the DASS-21 subsection of stress, 0–14

were only for individuals with normal levels, 15–18 were mild levels, and 26–33 were for severe levels of stress. For stress, the highest cut-off score was 34, and scores above that referred to extremely severe levels of stress.

Statistical tests

Quantitative values were described using their numbers, mean, frequency, percentage, and standard deviation. For categorical variables, we performed a Chi-square test of independence to analyze the association of the extent of male interaction (limited and frequent) being taken as the dependent factor with all the categorical variables. For continuous variables and assessment of predictors of psychological conditions, a linear regression test was applied with DASS-21 total score and individual scores of depression, stress, and anxiety taken as dependent variables after matching with propensity score analysis. We used a 1:1 propensity score-matched pair method combined with covariate adjustment to analyze both limited and frequent interaction groups. The unbalanced conditions at baseline between the two groups were controlled by using PS matching with covariate adjustment. The 1:1 PS matching yielded 95 pairs of matched subjects between limited and frequent interaction groups, resulting in no differences in age, education, income, profession, locality, or relationship status. Data sets were analyzed using the statistical software SPSS version 25.

Results

General characteristics of the study population

Demographic groups

Our study population comprised of 303 participants who originated from various socioeconomic backgrounds and professions (see Figure 1). All the participants were women; the majority of them were young (67.66%) in the 18 to 35 years age group, whereas 32.34% were middle-aged between 36 to 55 years. The mean age of the participants was 37 ± 2.8. The majority (55.78%) were students, whereas 19.47% had post-graduate level education. Concerning nativity, 16.5% of women belonged to rural regions and 83.5% were from urban areas. In terms of socio-economic background, the majority of the study population (59.08%) belonged to the middle-class economic background with a monthly household income of 50,000 to 200,000 PKR. In our study population, 49.5% of the women were single and 50.49% were in committed relationships. By profession, the two major groups of participants were either students who formed 43.56% of the study population, or working women who formed 56.44% of the total population. For the commute, the majority of the participants (50.17%) walked to and from their educational institutions/workplaces; 41.58% were frequent users of busses; 28.71% used taxis, and 25.74% used ride-hailing services. A good majority of the total study population (49.17%) used other modes of commute as well; these modes of commute included self-driving, passage with family, or company-provided commute (see Table 1).

Frequency of leaving home and sexual harassment

One of the important variables for this study was to assess whether the probability of sexual harassment has any association with the frequency of leaving home (every day vs. often) and the extent of interaction with male strangers (limited vs. frequent). Our data showed that 77.56% of the total study population was comprised of individuals who leave their homes every day. Out of these, 73.53% of participants had frequent interactions with male strangers. Meanwhile, in the limited interaction group, this proportion was lower (44.88%). Of the remaining participants, a smaller proportion of 17.16% leaves often or weekly, whereas a small group of 5.28% leaves their homes only occasionally.

Sexual harassment experiences post-COVID-19 pandemic

Overall, 49.17% of our population affirmed that they had perceived changes in the behavior of male strangers that could be categorized as harassment in their daily life interactions, after the lifting of lockdowns, post-COVID-19 pandemic. This observation was highly significantly related to the frequency of interaction with male strangers ($\chi^2 = 7.53$, $p < 0.006$); of the participants with frequent interactions, 56.29% noticed violating male behavior. Whereas, intriguingly, a good majority (59.56%) in the limited interaction group did not perceive such changes. Of note, overall, 33.66% of our study population reported experiencing relatively more sexual harassment, post-COVID-19 pandemic than before it. An increased occurrence of incidents of sexual harassment during COVID-19 was significantly correlated with the frequency of male interaction ($\chi^2 = 5.71$, $p < 0.01$). Looking at population data, we see that a larger proportion of participants (39.52%) with frequent male interaction experienced increased sexual harassment in the post-pandemic period, whereas comparatively much less (26.47%) reported such negative behavior within the limited male interaction group. In our study population, the extent of male interaction was more frequent in women below the age of 35, effectively increasing their chances of sexual harassment; therefore, 18–35 years old participants reported almost a two-to-three-fold increase in experiences of sexual harassment both generally and specifically during the COVID-19 period in comparison to participants aged 36–55 years. Similar trends were observed for single women, as well as for students at the undergraduate level of education having the highest fear of sexual crime, followed by those with 12 or fewer years of education, which was followed by participants at the postgraduate level. Concerning economic classes, the middle class was found to have the maximum male interaction. In our study, we observed those with incomes below 50,000 had limited male interactions. We assume that this might be because these participants were in jobs that had gender-segregated workplaces, for example, female-only salons and sanitation workers often working in the all-female set-up such as girls' schools and colleges.

Frequency of interaction with male strangers and fear of sexual harassment

Women interacting frequently with men were found to harbor an increased fear of sexual harassment in comparison to those with lesser male interactions ($\chi^2 = 11.82$, $p < 0.0005$). Overall, 70.3% reported an increased fear of the crime of sexual harassment during COVID-19. Among women with frequent male interactions, 78.44% reported an increase in fear of crime. Whereas, this proportion was less (60.29%)

TABLE 1 Extent of male interaction in participants' daily lives and its association with various categorical study variables.

		Total (n =303)	Limited interaction N =136	Frequent interaction N =167	χ^2	p-value
Age	18–35	205 (67.66%)	73 (53.68%)	132 (79.04%)	22.04	0.00001
	36–55	98 (32.34%)	63 (46.32%)	35 (20.96%)		
Level of education	≤12 years	75 (24.75%)	42 (30.88%)	33 (19.76%)	6.98	0.03
	Bachelors	169 (55.78%)	65 (47.79%)	104 (62.28%)		
	Post-graduate	59 (19.47%)	29 (21.32%)	30 (17.96%)		
Nativity	Rural	50 (16.5%)	23 (16.91%)	27 (16.17%)	0.03	>0.05
	Urban	253 (83.5%)	113 (83.09%)	140 (83.83%)		
Household income range	Less than 50 k	73 (24.09%)	35 (25.74%)	38 (22.75%)	7.54	0.02
	50 k – 200 k	179 (59.08%)	87 (63.97%)	92 (55.09%)		
	More than 200 k	51 (16.83%)	14 (10.3%)	37 (22.16%)		
Relationship status	Single	150 (49.51%)	53 (38.97%)	97 (58.08%)	10.95	0.0009
	Committed	153 (50.49%)	83 (61.03%)	70 (41.92%)		
Profession	Student	132 (43.56%)	47 (34.56%)	85 (50.9%)	8.14	0.0043
	Working woman	171 (56.44%)	89 (65.44%)	82 (49.10%)		
Frequency of leaving home	Everyday	235 (77.56%)	100 (73.53%)	135 (80.84%)	2.39	>0.05
	Often, on a weekly basis	52 (17.16%)	27 (19.85%)	25 (14.97%)		
	Occasionally	16 (5.28%)	09 (6.62%)	07 (4.19%)		
Mode of commute	Walk	152 (50.17%)	62 (45.59%)	90 (53.89%)	10.441	0.034
	Bus	126 (41.58%)	39 (28.68%)	87 (52.1%)		
	Taxi	87 (28.71%)	30 (22.06%)	57 (34.13%)		
	Ride hailing services	78 (25.74%)	22 (16.18%)	56 (33.53%)		
	Others[1]	149 (49.17%)	68 (50%)	81 (48.50%)		
Perceived changes in behavior 18 months post-COVID-19	Yes	149 (49.17%)	55 (40.44%)	94 (56.29%)	7.53	0.006
	No	154 (50.83%)	81 (59.56%)	73 (43.71%)		
Experienced more SH 18 months post-COVID-19?	Yes	102 (33.66%)	36 (26.47%)	66 (39.52%)	5.71	0.01
	No	201 (66.34%)	100 (73.53%)	101 (60.48%)		
Increased fear of crime during pandemic period	Yes	213 (70.3%)	82 (60.29%)	131 (78.44%)	11.82	0.0005
	No	90 (29.70%)	54 (39.71%)	36 (21.56%)		
Effect of increased fear of crime 18 months post-COVID-19	Protective attitudes[2]	203 (67%)	80 (58.82%)	123 (73.65%)	53.95	0.00001
	Defensive attitudes[3]	119 (39.27%)	18 (13.24%)	101 (60.48%)		
	Vigilant attitudes[4]	120 (39.60%)	29 (21.32%)	91 (54.49%)		
	Others[5]	07 (2.31%)	03 (2.21%)	04 (2.4%)		
	Fear of crime did not increase	90 (29.70%)	54 (39.71%)	36 (21.56%)		
Feel increasingly stressed, anxious, depressed in recent times	Yes	242 (79.87%)	100 (73.53%)	142 (85.03%)	6.17	0.01
	No	61 (20.13%)	36 (26.47%)	25 (14.97%)		
Reasons behind feeling more stressed, anxious, depressed in recent times	Increased fear of incidence of SH during the COVID-19 pandemic	142 (46.86%)	43 (31.62%)	99 (59.28%)	15.43	0.001
	pandemic related work/study stress	170 (56.11%)	69 (50.74%)	101 (60.48%)		
	Domestic violence	41 (13.53%)	19 (13.97%)	22 (13.17%)		
	Do not feel more depressed, stress, or anxious	61 (20.13%)	36 (26.47%)	25 (14.97%)		

χ^2 values show relationship between limited and frequent male interaction groups, SH, sexual harassment. 1 = Includes self-driving, traveling with family, using booked vans or company provided commute. 2 = Includes sharing tracking link/car number with friends or family during commute, avoiding going out alone, avoiding going out at night. 3 = Includes carrying weapons or pepper sprays, wearing more culturally accepted clothing. 4 = Includes checking for secret cameras in public try-rooms, and restrooms, avoiding sharing contact information (phone number, address) with a strangers, avoiding interacting with men that women expresses their distrust in 5 = For example excessive worry for related younger women as their reaction to increase in fear of crime during the COVID-19 period, frequent change of cell numbers to avoid identification.

in the limited interaction group. An escalation of the fear of becoming a victim of sexual harassment during COVID-19 heightened the sense of insecurity among women and brought about behavioral changes of a protective and defensive nature (see Table 1). Among those in the frequent interaction group, 73.65% became more protective, 54.49% more vigilant, 60.48% more defensive, and 2.4% took up other behaviors such as having different contact numbers for work and personal communication. Intriguingly, the magnitude of this behavioral change was not lesser in the limited interaction group; 58.82% reported taking up protective behaviors, 13.24% adopted defensive attitudes, 21.32% started being more vigilant, and 2.21% took up other preventive measures by staying in continuous contact whenever traveling alone or feeling unsafe. This adoption of preventive attitudes in response to increased fear of crime was found to be significantly associated with the frequency of interaction with male strangers ($\chi^2 = 53.95$, $p < 0.00001$).

Overall, a large majority of study participants (79.87%) reported being increasingly mentally distressed during the COVID-19 pandemic, which, in line with the earlier observed trend, the frequent interaction group formed a relatively larger proportion (85.03%) than the limited interaction group (73.53%). This overall increase in stress, anxiety, and/or depression post-COVID-19 period was significantly related to the extent of male interaction in daily life ($\chi^2 = 6.17$, $p < 0.01$).

The reasons behind increased self-perceived stress, anxiety, and/or depression were highly significantly related to everyday male interaction ($\chi^2 = 15.43$, $p < 0.001$). The stark difference between the limited and frequent male interaction groups for reasons for being depressed, anxious, or stressed was "increased fear of the incidence of sexual harassment during the COVID-19 pandemic," with 59.28% from the frequent male interaction group feeling increasingly distressed because of this reason, whereas only 31.62% of those with limited male interaction opted for this reason for their mental distress. Work and study burden due to pandemic-related factors were the second most frequent response, with 60.48% belonging to the frequent male interaction group vs. 50.74% prevalence in the limited interaction group. The option of domestic violence was opted for by almost an equal number of respondents in the limited (13.97%) and frequent (13.17%) male interaction groups.

Overall, in the DASS-21 questionnaire, on average, our study population scored below the 60-cut-off range for total DASS-21 scores (48.97 ± 1.69), whereas a good proportion (34%) of the study population scored >60, and the rest of the participants (66.01%) scored <60. Student's t-test showed a statistically significant difference in the total DASS- 21 scores of those who scored ≤60 vs. those who scored ≥60 [t (1,301) =23.29, $p < 0.0001$], which highlights the fact that in our study population, there were at least 103 (34%) participants who scored ≥60; hence, psychiatric/clinical consultation was advised for these participants (35). The majority of the participants scored in the normal range of the three sub-categories of DASS-21; however, for anxiety, the population mean was 15.66 ± 0.59, which fell in the severe range. Notably, in relation to this, a greater majority (36.63%) had scores in the extremely severe range for anxiety (Table 2).

The extent of male interaction and DASS-21 results

The study population mean scores for total DASS-21 and sub-categories were found to vary greatly with the extent of interaction with male strangers; as a result, stark differences in mean DASS-21scores for total and clinical sub-categories (depression, anxiety, and stress) were observed between the limited and frequent interaction groups. Participants in the frequent interaction group had a mean total score of 60 ± 2.28, which is an alarming observation and reflective of the distressed psychological state of women who had relatively increased encounters with male strangers in daily routines; in contrast, this score was found to be many folds less and was in the normal range (below 60) for participants in the limited interaction group (39.26 ± 2.24). Significantly, more numbers of participants in the frequent group had scores in the >60 range (45.5% vs.19.8%). The chi-square test revealed a highly significant inter-group association [$\chi^2 = 21.98$, $p < 0.0001$] (see Table 2).

The DASS-21 subscale scores for depression, stress, and anxiety showed linear trends of increase with the frequency of male interaction in everyday life. The extent of male interaction showed the strongest trends for anxiety, implying that women with increased everyday interactions with men had higher levels of anxiety. Anxiety levels were found to be highly significantly different between our two variable groups and among those with frequent daily life interaction with men; 48.50% fell into the extremely severe range of anxiety, whereas in the contrasting group with reduced male interaction, approximately half (22.06%) had a score in that range [$\chi 2 = 195.2$, $p < 0.0001$]. Similarly, a significantly greater number of participants had scores in the severe (17.37%) and extremely severe range (22.16%) of depression in the frequent interaction group [$\chi^2 = 22.01$, $p < 0.05$]. Of note, twice the number 39.52% of the women in the frequent interaction group had ≥21 depression scores, a cutoff value for identifying extremely severe depression (35) [$\chi^2 = 19.82$, $p < 0.0001$]. For DASS-21 stress subscales, in the frequent interaction group, 19.76% were in severe and 11.38% were in the extremely severe stress group, whereas among those with limited interaction with men, only 9.56% of participants had scores in the severe subscale and only 4.41% participants had scores in the extremely severe stress sub-scale. The two groups had an overall highly significant intergroup association [$\chi^2 = 16.429$, $p < 0.002$] (see Table 2).

Overall, the level of mental distress was found to be much higher in women who had frequent interaction with male strangers every day versus those who had limited interactions.

The psychological impact of the increase in sexual harassment crimes during COVID-19 and its association with the two clinical cut-offs (>60 and <60) for total DASS-21 scores were evaluated to understand the mental health conditions of women who leave home every day for study or work (see Table 3 for details). Overall, in all perceived behaviors, a greater percentage of participants who responded in the affirmative had scores in the above-normal range, i.e., >60 than those who did not. This observation was statistically significant and the chi-square test showed a strong association with the response variable and the DASS-21 clinical cut-off ranges of the total DASS-21 scale (see Table 3). From the analysis, it was evident that a significantly greater percentage (40%) of those participants who responded in the affirmative were likely to score in the severe range ≥60 in total DASS-21 than those who did not. Of participants with total DASS-21 scores of 60 or above, 49% responded in the affirmative of experiencing increased changes in violating male behavior in their routine interactions post-COVID-19 pandemic. Of this proportion, 46.31% scored above 60 while 53.69% scored below 60. A relatively small proportion (22.08%) did not report any such observations or experiences. Whereas 33.66% responded in the affirmative for experiencing more sexual harassment after the

TABLE 2 Chi-square analysis of the relationship between extent of male interaction and DASS-21 scores.

DASS-21 classification	Total participants N =303	Limited interaction group	Mean DASS-21 scores	Frequent interaction group	Mean DASS-21 scores	χ^2	p-value
Depression Mean ± SD	15.47 ± 0.62	N = 136 (44.8%)	12.24 ± 0.79	N = 167 (55.11%)	18.12 ± 0.87	22.01	<0.05
Normal (0–9)	96 (31.68%)	55 (40.44%)	3.49 ± 0.40	41 (24.55%)	4.2 ± 0.48		
Mild (10–13)	38 (12.54%)	21 (15.44%)	11.14 ± 0.22	17 (10.18%)	10.94 ± 0.25		
Moderate (14–20)	81 (26.73%)	38 (27.94%)	16.3 ± 0.29	43 (25.75%)	17 ± 0.34		
Severe (21–27)	40 (13.20%)	11 (8.09%)	23.63 ± 1.28	29 (17.37%)	23.7 ± 0.28		
Extreme severe 28+	48 (15.84%)	11 (8.09%)	32.3 ± 1.07	37 (22.16%)	34 ± 0.93		
DASS score (<21)	215 (70.96%)	114 (83.82%)	9.92 ± 0.43	101 (60.48%)	10.73 ± 0.63	19.82	<0.0001
DASS score (>21)	88 (29.04%)	22 (16.18%)	28 ± 1.10	66 (39.52%)	29.4 ± 0.82		
Anxiety Mean ± SD	15.66 ± 0.59	N = 136 (44.8%)	12.29 ± 0.80	N = 167(55.11%)	18.41 ± 0.79	28.68	<0.0001
Normal (0–7)	71 (23.43%)	45 (33.09%)	3 ± 0.35	26 (15.57%)	3.23 ± 0.49		
Mild (8–9)	23 (7.59%)	14 (10.3%)	8 ± 0	9 (5.39%)	8 ± 0		
Moderate (10–14)	60 (19.80%)	32 (23.53%)	12.75 ± 0.26	28 (16.77%)	12.35 ± 0.27		
Severe (15–19)	38 (12.54%)	15 (11.03%)	16.93 ± 0.26	23 (13.77%)	16.60 ± 0.20		
Extreme severe (20+)	111 (36.63%)	30 (22.06%)	26.2 ± 1.06	81 (48.50%)	27.03 ± 0.68		
Stress Mean ± SD	17.84 ± 0.60	N = 136(44.8%)	14.74 ± 0.82	N = 167 (55.11%)	20.44 ± 0.81	16.429	<0.002
Normal (0–14)	132 (43.56%)	74 (54.41%)	7.7 ± 1.31	58(34.73%)	9.97 ± 0.94		
Mild (15–18)	38 (12.54%)	17 (12.5%)	16.35 ± 0.19	21 (12.57%)	17.23 ± 0.21		
Moderate (19–25)	62 (20.46%)	26 (19.12%)	21.46 ± 0.34	36 (21.56%)	22 ± 0.28		
Severe (26–33)	46 (15.18%)	13 (9.56%)	27.69 ± 0.54	33 (19.76%)	28.06 ± 0.38		
Extreme severe (34+)	25 (8.25%)	6 (4.41%)	37.33 ± 1.11	19 (11.38%)	38.3 ± 0.74		
Total DASS-21scores Mean ± SD	48.97 ± 1.69	N = 136 (44.8%)	39.26 ± 2.24	N = 167(55.11%)	59.96 ± 2.28	21.98	<0.0001
≥ 60	103 (33.99%)	27 (19.85%)	80.46 ± 2.78	76 (45.51%)	83.8 ± 2.13		
< 60	200 (66.01%)	109 (80.15%)	29.52 ± 1.64	91 (54.49%)	36.54 ± 1.8		

Data represents mean (±SD) scores and % of participants in each subcategory. Chi-square analysis was performed on the % of participants in the respective sub-categories ($p < 0.05$).

pandemic than before it; out of this, 49.02% scored >60 whereas 51% scored <60. Intriguingly, 73% of the participants who responded negatively to this question scored <60 in total DASS 21 scores. A large majority of our study population (70.3%) reported an increase in fear of sexual harassment crimes in the past 18 months after the lifting of COVID-19 lockdowns; of these, 42.25% scored >60 on the total DASS 21 score. Whereas out of 29.07% who did not perceive any increase in the fear of the crime, 85.56% scored <60 of the total DASS-21 scores. Approximately 79.87% of our study population reported feeling increasingly stressed, anxious, or depressed in recent times after the COVID-19 pandemic. Of these, 39.97% scored above 60 in total DASS21 scores, whereas only 20.13% of participants did not agree with the statement and scored <60 in total DASS21 scores.

Factors acting as predictors of mental distress

To identify psychosocial factors which could act as predictors of mental distress, we used multiple regression models with a total DASS 21 score and the clinical sub-categories as dependent variables. To control for confounding by demographic variables (age, education, profession, income, locality, and relationship status), we performed a 1:1 propensity score matching between the limited and frequent interaction groups which yielded 190 matched subjects. The demographic variables were not found to be significantly different after matching. Whereas out of all the psychosocial factors analyzed, the extent of everyday interaction with male strangers, the effects of an increase in fear of sexual crimes, and self-perceived increase in mental distress during the 18 months post-pandemic were found to be highly statistically significant predictors of mental distress not only for total DASS-21 (see Table 4) but also for all the clinical sub-categories. Intriguingly, for the subcategory of anxiety, the frequency of leaving home was also found to be significant. We observed that an increase or decrease in everyday life male interaction was significantly related to an increase in DASS-21 total score, depression scores, anxiety scores, and stress scores. The predictor variable "effects of an increase in the fear of the crime of sexual harassment" was strong enough to induce behavioral and decisional changes in the study participants and was found to be highly significantly associated with an increase in DASS-21 total

TABLE 3 Chi-Square table for analysis of association of DASS-21 total scores cutoff values >60 and <60 with sexual harassment and related behavioral changes before and after COVID-19.

Variable questions	DASS-21 total scores	Number of participants with positive response to questions *N* (%) (mean DASS-21 scores)	Number of participants with negative response to questions *N* (%) (meanDASS-21 scores)	χ^2	*p*-value
Do you perceive any changes, in behaviors (which can be categorized as sexual / verbal /physical harassment), with male strangers in your routine encounters, before and after the pandemic/COVID-19?		*N* = 149 (49.17%)	*N* = 154(50.83%)	19.81	<0.00001
	≥ 60	69 (46.31%)	34 (22.08%)		
	≤ 60	80 (53.69%)	120 (77.92%)		
Do you think you have experienced more sexual harassment after the COVID-19 pandemic, than before it?		*N* = 102 (33.66%)	*N* = 201 (66.34%)	15.47	<0.00008
	≥ 60	50 (49.02%)	53 (26.37%)		
	≤ 60	52 (50.98%)	148 (73.63%)		
Has your fear of crime increased in the past 18th months/ after Covid – 19 pandemic?		*N* = 213 (70.3%)	*N* = 90 (29.70%)	21.8	<0.00001
	≥ 60	90 (42.25%)	13 (14.44%)		
	≤ 60	123 (57.75%)	77 (85.56%)		
Do you feel increasingly stressed /anxious or depressed, in recent times		*N* = 242 (79.87%)	*N* = 61 (20.13%)	29.5	<0.00001
	≥ 60	96 (39.97%)	2 (3.28%)		
	≤ 60	146 (60.33%)	59 (96.72%)		

SH, sexual harassment.

scores and all sub-categories. Our study participants reported an increase in mental distress due to three main reasons: an increase in work/study stress, domestic violence, or an increase in fear of crime or sexual harassment in the first 18 months of the pandemic period. Of these, fear of sexual harassment was highly significantly associated with an increase in psychometric levels of depression, anxiety, and stress and was reported by 46.86% of the participants.

Discussion

Pandemics usually have inequitable effects on the most vulnerable groups of society. The COVID-19 pandemic was no exception. Although the causality rate was twice higher for men than women, the pandemic has affected women more not only socially and economically by increasing the load of unpaid care work and precarious employment situations but also, foremost, by intensifying gender-based violence against women and girls exponentially (36). The statistical data released by the United Nations (37) for gender-based violence around the world is alarming and shows an unprecedented increase in domestic and sexual violence, unequivocally, in both third-world developing countries as well as in developed nations, e.g., domestic violence in France increased by 30 percent following the country's lockdown on March 17, whereas during the first 2 weeks of lockdown in Spain, the emergency number for domestic violence received 18 percent more calls, and the helplines in Singapore have received 30 percent more calls. However, research on the impact of gender-based violence on the mental health of its victims is still scarce, especially among women.

In the aftermath of the COVID-19 pandemic and an associated rise in gender-based violence, the UN (38) specifically recommended making endeavors to collect more sex-disaggregated data to analyze the impact of pandemics on women and address the increased demands.

To the best of our knowledge, this is the first study from Pakistan that quantitatively investigated the psychometric effects of the rise in sexual harassment, specifically during the COVID-19 pandemic in a cohort of working women and the resulting change in their mental health and behavior. In this study, we made efforts to collect sex-disaggregated data on the increase in sexual violence among Pakistani women who leave home every day for work or study. We specifically tried to target those women who are hard to reach and were not vocal about their rights such as sanitation workers, female security guards, nurses, and office receptionists. Such data is central to the much-needed policy change, specifically in a developing country like Pakistan where sexual and domestic violence is a prevalent crime (4); COVID-19 further intensified the problem. According to the policy brief released by the Ministry of Human right on the "gendered impact of COVID-19 in Pakistan," 28% of women aged between 15 and 49 years old have experienced physical violence whereas 6% have experienced sexual violence, and nearly 7% of the women who have ever been pregnant have experienced violence during their pregnancy and 34% of ever-married women have experienced spousal physical, sexual, or emotional violence during the pandemic period (39). Corroborating these reports, our study explicitly showed that during the COVID-19 pandemic, working women and students experienced a rise in sexual harassment, which was found to be affecting their mental health not only in their perception but also in psychometric measures, as was reflected by the DASS-21 results. Of our study population, 34% scored >60 in total DASS -21 scores and 29% scored >21 in the depression subscale, a cutoff value at which clinical intervention is suggested to be sought according to Beaufort et al. (35). Another important observation of the study within the span of the last 2 years of the COVID-19 pandemic was that while half of our study population (49.17%) reported increased sexual harassment and men's inappropriate behaviors, alarmingly, a greater proportion (70.3%) reported

TABLE 4 Multiple linear regression model for DASS-21 total scores, depression, anxiety, and stress and independent variables on, 190 matched subjects with 1:1 propensity score matching between limited and frequent male interaction groups, for covariates (age, education, income, profession, locality, relationship status).

Variables	DASS-Total				DASS-Depression				DASS-Anxiety				DASS-Stress			
	B-value	*p*-value	Lower bound (95%)	Upper bound (95%)	B-value	*p*-value	Lower bound (95%)	Upper bound (95%)	B-value	*p*-value	Lower bound (95%)	Upper bound (95%)	B-value	*p*-value	Lower bound (95%)	Upper bound (95%)
Male Interaction	10.309	**0.004**	17.332	3.286	3.904	**0.005**	6.597	1.211	3.179	**0.015**	5.728	0.630	3.226	**0.017**	5.862	0.590
Age	3.813	0.466	14.125	6.500	1.000	0.618	4.954	2.954	1.373	0.470	5.116	2.369	1.429	0.467	5.301	2.442
Education	9.493	0.107	2.079	21.065	3.959	0.081	0.489	8.408	3.579	0.094	0.621	7.778	2.070	0.348	2.274	6.414
Locality	5.102	0.267	3.948	14.151	1.332	0.450	2.141	4.804	2.183	0.191	1.101	5.467	1.536	0.373	1.861	4.933
Income	0.583	0.929	13.422	12.256	1.140	0.649	6.076	3.796	0.568	0.810	4.092	5.227	0.140	0.954	4.960	4.680
Relationship status	0.911	0.834	7.653	9.475	0.806	0.629	2.479	4.090	0.592	0.708	3.700	2.517	0.728	0.655	2.487	3.943
Profession	9.011	0.083	1.188	19.209	3.947	0.48	0.035	7.859	3.442	0.068	0.259	7.144	1.660	0.393	2.169	5.489
F of Leaving Home	11.703	0.132	3.578	26.984	2.235	0.454	3.641	8.111	7.810	**0.006**	2.265	13.356	1.816	0.533	3.920	7.553
Behavior post-	1.708	0.714	10.903	7.488	1.284	0.473	2.242	4.809	0.649	0.702	3.986	2.688	2.346	0.181	5.798	1.105
↑ SH after COVID	5.446	0.272	15.192	4.301	3.104	0.104	6.848	0.639	0.720	0.688	4.257	2.818	1.541	0.407	5.200	2.118
Fear of crime	23.095	0.326	23.225	69.415	7.893	0.382	9.869	25.656	10.975	0.199	5.836	27.785	4.344	0.623	13.045	21.732
Effects of ↑ FoC	16.260	**0.001**	25.343	7.177	4.266	**0.017**	7.749	0.783	5.051	**0.003**	8.347	1.754	6.928	**<0.0001**	10.338	3.518
Increase in DAS	25.924	**<0.0001**	34.390	17.458	9.159	**<0.0001**	12.405	5.912	8.082	**<0.0001**	11.155	5.010	8.705	**<0.0001**	11.883	5.527

F of leaving home; Frequency of leaving home; FoC, fear of crime; SH, Sexual Harassment. Bold values meaning $p < 0.05$.

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heightened worry and fear of becoming the victim of sexual harassment. The majority in our study were frequent users of public transport and reported a rise in experiences of sexual harassment in public spaces as well as sexual abuse inside homes.

We also discovered that the increase in sexual harassment during COVID-19 was highly significantly related to depression, anxiety, and stress. Experiencing traumatic events can understandably cause mental distress; however, an important finding was that the heightened fear of sexual harassment among women was strong enough to influence their mental state and predispose them to the development of depression, stress, and anxiety.

Of note, an increased frequency of interaction with male strangers in daily life was one of the stronger predictors of depression, anxiety, and stress in women, together with the effects of fear of becoming a victim of sexual harassment and self-perceptions of increased mental distress. Interestingly, in our study, these factors continued to be significant predictors irrespective of age, locality, education level, socio-economic, and marital status, which reflects the degree of pervasiveness of sexual harassment in our society. During lockdowns, even though male interaction was likely to be reduced, many women were still working online as well as in-person in industries like healthcare. Moreover, the complete lockdown in Pakistan lasted only for a few months and was lifted in May 2020 (40), and many industries started to get back to normal routines. This meant increased male interaction for most working women. These can be the reason that led to an increased fear of crime and escalated mental distress to the extent that the majority of our study population demonstrated behaviors that limited their personal and social life. The more frequently women interacted with men, the more they tend to adopt defensive behaviors. To avoid sexual harassment, the most prevalent behavior was to avoid going out alone and at night. Many started to wear more culturally acceptable clothing, which would range from simple *shalwar kameez* (a type of suit worn especially by Asian women, with long shirts and loose trousers worn together with long scarfs) (dupatta /chaddars) and *abayas* (full-length gowns) for different people. Usually, non-traditional or provocative clothing is believed to lead to sexual objectification and, hence, biases the perception of sexual violence. It is common for people to increase the extent of victim blaming and letting go of the abusers' crimes after judging the victims' attire (41). This is precisely what explains donning more clothing as an act of defense as after incidents of harassment, clothes are often a major part of the discussion, and a woman in non-traditional attire might be blamed for luring the harasser. On the contrary, studies have shown that convicted harassers and rapists do not remember the attire of their victims (42); therefore, the main reason sexual assaults take place is because a perpetrator committed that offense, irrespective of the victims' attire. In fact, culture is central to the theory of sexual objectification, an observation first made by Fredrickson and Roberts in 1997 (43). According to this theory, bodies exist within social and cultural contexts and are viewed in light of the prevalent socio-cultural practices in that society.

In Pakistan, women are judged by their physical appearance and are considered the source of physical attraction, which prevents many women from comfortably leaving their homes; ironically, in the view of their male counterparts, it's the responsibility of "women to cover themselves and stay inside their homes."

Sexual objectification has more adverse consequences for women than men (44–46), affecting mental health, and intellectual performance, and increasing the risk of depression (47, 48). Objectification also tends to make women behave as lesser beings in social interactions (45) which in turn produces profound effects on the victim's mental health (49).

Studies have shown that sexual harassment and the fear of becoming a victim are chronic stressors that may put victimized workers under severe mental and physical stress and compromise their mental health to a large extent, which if left undiagnosed and untreated, might gradually lead to the development of post-traumatic stress disorders, suicidal ideations, eating disorders, or phobic or somatoform disorders (50, 51). Unfortunately, in South Asia, due to strong patriarchal mindsets, women from puberty have learned to endure their mental distress as part of life and pretend to act normal than to seek help. Moreover, across the South Asian region and particularly in Pakistan, the subject of mental health treatment is associated with stigma, far greater for women than men, which prevents individuals from seeking help, in turn raising the toll of undiagnosed cases. Our study underscores the ever-increasing demand for setting up psychosocial support for working women because a lack of adequate domestic and emotional support can compromise mental health further. Moreover, across the South Asian region, governments need to comprehensively reform the justice system by addressing protection gaps in the sexual harassment laws, improving service providers' response in cases of sexual violence, and overall improvement of prosecution procedures and trials of sexual offenses to effectively combat the enormity of sexual harassment.

Study limitations

Our study hosts a few limitations that can be addressed in future research. Foremost, sexual harassment is a taboo issue in Pakistan and women are often reticent about narrating their experiences; some participants might have underreported their experiences, specifically the number of times they had been a victim of sexual harassment. For this reason, we could not investigate the numerical frequency of sexual harassment before and during COVID-19. During interviews, some participants' hesitation was evident showing that they did not feel comfortable sharing their experiences explicitly. However, we covered it to a greater extent by the breadth of qualitative questions on the topic. This study was also limited by time constraints and, hence, only 303 participants could be recruited. A larger sampling size could provide better insight into the state of women's mental health. Another limitation was that social desirability bias may affect participants' responses to the scale of anxiety, and they might have exaggerated in expressing their level of anxiety due to the overall COVID-19 scenario. Therefore, to minimize this kind of bias, participants were requested to state their actual feelings and perceptions due to which we included close-ended questions together with open-ended ones. However, this might have led to response bias and participants might have felt constrained in their answers. Additionally, collecting data through a self-administered questionnaire carries risks for selection bias although we tried to reduce the selection bias by recruiting participants from a vast number of professions and socio-demographic backgrounds. Nevertheless, the cross-sectional design obscured the

true mental state of our participants since we had to rely on subjective reports rather than screening the respondents for psychopathologies according to a known disease classification system.

Conclusion

Research studies highlighting the impact of COVID-19 on mental health issues are scarce, especially in South Asian women. This research study has opened avenues for understanding the mental health consequences of increasing levels of sexual harassment during and after pandemics. Our study also supports the feasibility and ease of use of DASS-21 as a simple tool to identify individuals who might be prone to develop psychopathologies and are suffering from mental distress. Now, the far bigger challenge for the present governments and organizations is to recognize that the COVID-19 pandemic is affecting the psychosocial well-being of men and women differently; therefore, there is a dire need of creating gender-sensitive intervention programs and policies following effective responses to mental health challenges in the wake of pandemics like COVID-19. To achieve this goal, the UN recommends allocating additional resources to protect women, putting women at the center of policy changes, and making endeavors to collect more sex-disaggregated data to analyze the impact of pandemics on women (38).

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 Ethics Review Board, Department of Biosciences, COMSATS University Islamabad. The patients/participants provided their written informed consent to participate in this study.

Author contributions

SA performed data curation and helped in manuscript writing. PG designed and supervised the study, performed the statistical analysis, and wrote the manuscript. 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.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2023.1119932/full#supplementary-material

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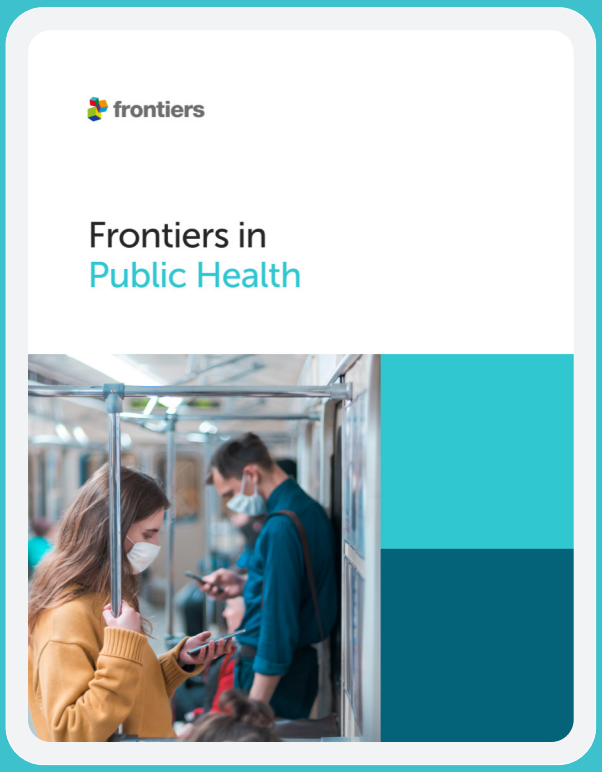

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