Community series in
mental illness, culture, and society: Dealing with the COVID-19 pandemic, volume VII

Edited by
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Community series in mental illness, culture, and society: Dealing with the COVID-19 pandemic, volume VII

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Editorial: Community series in mental illness, culture, and society: dealing with the COVID-19 pandemic, volume VII

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Editorial on the Research Topic
Community series in mental illness, culture, and society: dealing with the COVID-19 pandemic, volume VII

The ongoing COVID-19 pandemic has had far-reaching repercussions on society and individuals' lives, significantly impacting their physical and mental health (1–3). These ramifications have been further influenced by a variety of factors, such as personal circumstances, socioeconomic status, and cultural background (4, 5). With a focus on investigating the effects of the pandemic on mental health, this Research Topic aims to shed light on the role played by sociocultural and personal factors on mental wellbeing. Specifically, the Seventh Volume of our Community Series Research Topic "*Mental Illness, Culture, and Society: Dealing with the COVID-19 Pandemic*" expands upon the findings of the preceding six volumes (6–11) and presents nine articles that explore the impact of the pandemic on the mental health of diverse groups.

Two studies evaluated the mental wellbeing of healthcare workers during the pandemic. Nadeem et al. conducted a cross-sectional study in Pakistan to assess the level of depression, anxiety, and stress among frontline doctors ($n = 319$) and validate the Depression, Anxiety, and Stress Scale (DASS-21). A considerable percentage of respondents had high levels of depression (72.7%), anxiety (70.2%), and stress (58.3%). DASS-21 was validated in the cultural context of Pakistani doctors. Results also revealed a positive correlation between depression and anxiety (r = 0.696, $p < 0.001$), depression and stress (r = 0.761, $p < 0.001$), and anxiety and stress (r = 0.720, $p < 0.001$). In a single group study, Gerbarg et al. evaluated the effects of Breath-Centered Virtual Mind-Body Medicine, the Breath-Body-Mind Introductory Course—BBMIC, on COVID-19-related stress among 39 female healthcare workers in Northern Ireland. Participants completed the Perceived Stress Scale (PSS), Stress Overload Scale-Short (SOS-S), Exercise-Induced Feelings Inventory (EFI), and Indicators of Psychophysiological State (IPSS) at baseline and after finishing the course.

Participation in the BBMIC significantly reduced scores on PSS ($p < 0.011$) and EFI subscales for Revitalization ($p < 0.001$), Exhaustion ($p < 0.002$), and Tranquility ($p < 0.001$), but not Engagement. More than 60% reported moderate to very strong improvements in 22 IPSS, including tension, mood, sleep, and mental focus.

Along the same lines, Raeisi et al. assessed the impact of COVID-19 on the children of mothers working as medical staff during the pandemic in Hamadan, Iran. Using a causal-comparative design with a control group, mothers of children aged 6 to 12 years filled information using the Child Behavior Checklist (Achenbach) and the Child Symptom Inventory-4. Compared to controls, children in the staff group scored significantly higher on mean scores of depression, attention problems, and aggression ($p < 0.05$), highlighting the importance of targeted child-parent intervention in this vulnerable group.

Looking at other group populations, Santos et al. assessed the impact of the pandemic on the mental health of Brazilians who reported a positive diagnosis of the disease, with or without symptoms, compared to controls who reported not being diagnosed with COVID-19. Through a cross-sectional design, the authors collected online data from 1,334 people to investigate symptoms of depression, anxiety, post-traumatic stress, and insomnia. The findings highlighted that the pandemic impacted the mental health of individuals regardless of if they were ever diagnosed. Ding et al. investigated the impact of the dynamic zero COVID-19 strategy on pregnant women residing in rural South China. Using a cross-sectional survey, they collected data on anxiety status, sleep quality, physical activity, and diet among 136 pregnant women and 680 controls. Of pregnant women, 25.7, 28.7, and 83.1% had anxiety, sleep problems, and low/medium physical activity, respectively, with no significant difference from the controls. The authors concluded that the strategy had little impact on anxiety, sleep, or physical activity, but affected food intake during pregnancy. Alternatively, in Korea, Lee et al. used an online cross-sectional survey to investigate the association between social determinants of health and perceptions of COVID-19 social distancing, mental health, and quality of life among 1,276 Korean undergraduate students. Compared to those who answered neutrally, students who experienced a negative impact on their social-networking activities due to social distancing were at significantly higher odds to perceive pandemic-related confinement as not being beneficial (OR = 1.948, 95% CI 1.254–3.027) and having elevated stress levels (OR = 1.619, 95% CI 1.051–2.496) and decreased quality of life (OR = 2.230, 95% CI 1.448–3.434). The authors concluded that the social distancing policy may have had a negative impact on the social-networking activities of undergraduate students, emphasizing their need for greater social support and access to resources during periods of confinement.

Using a cross-sectional design, Segura-García et al. also analyzed the impact of social confinement in the first wave of COVID-19 among a group of volunteers in Mexico City. The authors particularly looked at components related to family life, social life, work, mental health, physical activity, and domestic violence. Suffering from domestic violence was significantly associated with having suffered from a symptomatic COVID-19 infection (OR = 4.0099, $p = 0.0009$), being unmarried (OR =

1.4454, $p = 0.0479$), and having poor eating habits (OR = 2.3159, $p = 0.0084$). Despite the policy to assist vulnerable populations during confinement, only a small proportion of the sample reported benefiting from it, emphasizing the importance of improving such policies.

Cohrdes et al. investigated the role of coping factors in maintaining the quality of life among 2,137 German adults during the pandemic, using the Brief COPE and WHOQOL-BREF, respectively. Results of this cross-sectional study showed that participants mostly pursued problem- and meaning-focused coping factors and showed a relatively good quality of life, except for the social domain, with a decreasing trend over time. Escape-avoidance coping was negatively related to all quality-of-life domains, whereas support- and meaning-focused coping showed positive associations ($p < 0.05$). The authors concluded that certain types of coping (support- and meaning-focused) might prevent a decrease in quality of life and should be considered in future health-targeted interventions.

Lastly, in their cross-sectional study, Akingbade et al. looked at the association between electronic health (eHealth) literacy and anxiety and depression during the pandemic in Nigeria. For this purpose, 590 Nigerians filled out the "COVID-19's impAct on feaR and hEalth" (CARE) questionnaire, the eHealth literacy scale, the Patient Health Questionnaire-4, and the COVID-19 fear scale. High eHealth literacy was associated with lower odds of anxiety (aOR = 0.34, 95% CI 0.20–0.54) and depression (aOR = 0.34, 95% CI 0.21–0.56). There were age, sex, and regional differences in the associations between eHealth literacy and psychological outcomes. The authors emphasized the importance of digital health information to improve access and delivery of mental health services.

In conclusion, the papers compiled in the Seventh Volume of this Research Topic offer an insightful outlook on the effects of COVID-19 on mental health, further highlighting the intricate interplay among sociocultural, economic, and individual factors. It is necessary to acknowledge that the impact of the pandemic, whether on mental wellbeing or society, extends beyond a temporary disruption, necessitating continued attention and comprehensive understanding. To address the specific vulnerabilities faced by different groups, there is a crucial need for further clinical and epidemiological research, as well as the provision of appropriately tailored resources and interventions.

Author contributions

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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Breath-centered virtual mind-body medicine reduces COVID-related stress in women healthcare workers of the Regional Integrated Support for Education in Northern Ireland: a single group study

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Background: During the COVID-19 pandemic, healthcare workers endured prolonged stress affecting their psychological well-being. Objectives: (1) Evaluate the effects of the Breath-Body-Mind Introductory Course (BBMIC) on COVID-related stress among employees of the Regional Integrated Support for Education, Northern Ireland, (2) Reduce the risk of adverse effects from COVID-related stress, and (3) Evaluate the effects of BBMIC on indicators of psychophysiological states and the consistency with hypothesized mechanisms of action.

Methods: In this single group study, a convenience sample of 39 female healthcare workers completed informed consent and baseline measures: Perceived Stress Scale (PSS), Stress Overload Scale-Short (SOS-S), and Exercise-Induced Feelings Inventory (EFI). Following the online BBMIC 4h/day for 3 days and the 6 week solo (20 min/day) and group practice (45 min weekly), repeat testing plus the Indicators of Psychophysiological State (IPSS) and Program Evaluation were obtained.

Results: Baseline (T1) mean PSS score was significantly elevated compared to a normative sample: PSS=18.2 vs. 13.7 ($p<0.001$) and improved significantly 11 weeks post-BBMIC (T4). SOS-S mean score declined from 10.7(T1) to 9.7 at 6 week post-test (T3). The SOS-S proportion of High Risk scores found in 22/29 participants (T1), dropped to 7/29 (T3). EFI mean subscale scores improved significantly from T1 to T2 and T3 for Revitalization ($p<0.001$); Exhaustion ($p<0.002$); and Tranquility ($p<0.001$); but not Engagement ($p<0.289$).

Conclusion: Among RISE NI healthcare workers affected by COVID-related stress, participation in the BBMIC significantly reduced scores for Perceived Stress, Stress Overload, and Exhaustion. EFI Revitalization and Tranquility scores significantly improved. More than 60% of participants reported moderate to very strong improvements in 22 indicators of psychophysiological state, e.g., tension, mood, sleep, mental focus, anger, connectedness, awareness, hopefulness, and empathy. These results are consistent with the hypothesized mechanisms of action whereby voluntarily regulated breathing exercises change interoceptive messaging to brain regulatory networks that shift psychophysiological states of distress and defense

to states of calmness and connection. These positive findings warrant validation in larger, controlled studies to extend the understanding of how breath-centered Mind-body Medicine practices could mitigate adverse effects of stress.

Introduction

During mass disasters, such as the COVID-19 pandemic, the number of people needing mental health support far exceeds the capacity of existing conventional healthcare resources using the model of one provider for one patient at a time. Pandemics place heavy burdens on already strained healthcare services (1, 2). Rapidly effective, inexpensive, low-risk, non-stigmatizing group interventions are needed to ameliorate adverse effects of COVID-related stress on the wellbeing and work efficacy of health workers (3–5). When healthcare workers experience prolonged severe stress, reactive changes in their stress response systems can impair their abilities to work effectively and make them vulnerable to cumulative emotional and physical impairments, deterioration of relationships, and professional burnout. In effect, they may become locked into a defensive psychophysiological state of feeling unsafe, anxious, overwhelmed, and exhausted (1, 6).

This study evaluated the effects of Breath-Body-Mind Introductory Course (BBMIC), a breath-centered Mind-body Medicine program, on indicators of stress and psychophysiological state among employees of the Regional Integrated Support for Education in Northern Ireland (RISE NI) during the COVID-19 pandemic, from December 16, 2020 to April 14, 2021. RISE NI is a Health and Social Care Trust (HSCT), funded by the Department of Education through the Department of Health. Approximately 100 RISE staff provide direct support for about 100,000 at-risk and special needs children, mainly ages 3 to 8 years, who are mainstreamed into public primary schools, nurseries, and playgroups. Each HSCT has a RISE Team of speech and language therapists, occupational therapists, physiotherapists, clinical psychologists, social workers, behavior therapists, and therapy assistants. RISE uses a Transdisciplinary model working across professional boundaries. The key aims are: (1) to reduce underachievement by optimizing children's access to learning within the educational environment and (2) to foster health, wellbeing and social inclusion and improve the life chances of children.

The adverse effects of the COVID pandemic on learning, physical health and mental health are most severe in children already at risk

for educational disparities: students of color, English as a second language learners, children from low-income households, and those with disabilities or autism spectrum disorder (7–9). During the pandemic, most services withdrew from face-to-face work with children and families. Nevertheless, many RISE staff were required to continue face-to-face support because virtual support was ineffective or inaccessible. Staff underwent changes in responsibilities due to the Health Care response to COVID. Many were deployed to acute hospital COVID wards covering jobs outside their established remit. The remaining staff had added responsibilities, including support for community services hardest hit by the loss of other healthcare services.

A review of 18 clinical studies of mind-body modalities in health workers affected by the COVID-19 pandemic found that combining mental focus, controlled breathing, and body movements to relax the body and mind had significant positive effects on perceived stress, burnout, insomnia, anxiety, depression, resilience, and well-being (10). Poor methodological quality was noted. A review of guidelines for reducing the mental health burden in healthcare workers found that 33 out of 41 articles recommended self-care: 50% of these suggested training for resilience building and stress management (11). Implementation strategies were lacking.

When BBMIC began at RISE NI, employees had already endured 10 months of severe COVID pandemic-related stress. Many felt overloaded and exhausted from daily job duties, home schooling children, and/or caring for relatives. In mass disasters, health workers carry the cumulative stresses of providing services while coping with the disaster's effects on their own families (12). BBMIC was chosen by RISE because it is an evidence-based program that rapidly relieves symptoms of stress, anxiety, and trauma for health workers, children, families, and groups. With practice BBM can improve emotion self-regulation, social engagement, mental clarity, energy, and physical health (13–15). Management wanted to integrate BBM practices throughout RISE as ongoing institutional support for staff resilience and well-being.

Co-regulation of psychophysiological (mind-body) states by children and their caregivers is essential for healthy autonomic function, stress resilience, emotion self-regulation, relationships, and learning (4, 15–17). When adults interact with children, they communicate their own emotional states nonverbally. Children who have experienced excess stress, trauma, neglect, or disability tend to react more intensely and have more difficulty restoring emotional balance (9, 18). Educational settings provide opportunities for staff to reduce adverse effects of stress, trauma, and disabilities on children through positive co-regulation using simple, breathing exercises that support emotion self-regulation. Evidence supports the following mechanisms hypothesized to underlie the effects of BBM on psychophysiological states:

1. Changing the pattern of breathing changes afferent interoceptive messages from the respiratory system to central regulatory areas, including the limbic system, hypothalamus, thalamus, and insular, prefrontal, and anterior cingulate cortices (14, 16, 17, 19).

2. Slow breathing, particularly Coherent Breathing, balances the autonomic nervous system by reducing overactivity of the sympathetic nervous system (SNS) and boosting underactivity of the parasympathetic nervous system (PNS) (13).

3. Reducing SNS overactivity reduces energy expenditure. Increasing PNS activity restores energy reserves.

4. Breathing entrains the electrical activity of the brain. Voluntarily controlling breathing increases entrainment in critical areas such as insular cortex and amygdala (20, 21).

5. Slow breathing, such as Coherent Breathing, activates the social engagement system and enhances feelings of safety, trust, empathy, and connection (22–24).

6. Activating the vagus nerves by slow breathing may increases oxytocin release (4, 16).

Both RISE NI and the Breath-Body-Mind Foundation, a not-for-profit 501(c)3, evaluate programs and identify ways to improve outcomes. The objectives of this study were to:

1. Evaluate the effects of the Breath-Body-Mind Introductory Course on COVID-related stress among employees of RISE NI;

2. Reduce the risk of adverse effects from COVID-related stress;

3. Evaluate the effects of BBMIC on indicators of psychophysiological states and the consistency with hypothesized underlying mechanisms of action.

Materials and methods

Approval

RISE NI regional management approved the BBM training and service evaluation. Each manager obtained approval from their respective trusts. They determined that BBM Programs and Evaluations were part of service evaluation/service development, i.e., they did not meet criteria for research as defined by the National Health Services (NHS) UK Policy Framework for Health and Social Care Research, based on the Research Ethics Service. Consequently, BBM Programs and Evaluations did not require ethical approval from NHS Health Research Authority or Research Ethics Committee (25). Nevertheless, BBM provided RISE management with their informed consent form (see Supplementary Appendix A) which they approved.

Recruitment

An email about BBMIC was sent to the RISE coordinators who advised their teams of the training. From among staff who volunteered to participate, team managers chose participants representing each discipline and forwarded the names to the BHSCT manager. The intent was for BBMIC training to maintain the transdisciplinary

nature of the service. Initially, 40 places were allocated: 7 for each of 4 HSCTs and 12 for BHSCT. Unfilled places were offered first to the 4 HSCTs and last to BHSCT. The final allocation was: BHSCT 23; South Eastern HSCT 4; Southern HSCT 4; Northern HSCT 3; Western HSCT 5.

Informed consent

Consent to participate in the program, test measures, and for publication, was obtained the week prior to BBMIC (see Supplementary Appendix A Consent Form). Team managers explained to staff the Informed Consent form, risks and benefits, the evaluation, confidentiality, the right to withdraw, and the potential for further BBM Training. Staff had an opportunity to have their questions answered. Staff registration to participate was considered consent.

Participants

The participants, 39 adult women between ages 23 and 55 years, professional staff of the five HSCTs of RISE NI, included: speech and language therapists, occupational therapists, physiotherapists, clinical psychologists, behavior therapists, and therapy assistants. One male registered to participate, but he withdrew before BBMIC leaving an all-women group.

Data collection and analysis

Data was collected between December 16, 2020 and April 14, 2021. Dependent measures were taken at four time points, pre-BBMIC training (T1), post-3 days of BBMIC (T2), post 6 weeks of solo and group practice (T3), and 11 weeks post training (T4). After BBMIC, some graduates ($n = 22$) participated in BBM Teacher Training Level-1, yielding additional data at T4 (see Figure 1).

Test scores were obtained online using questionnaires generated and collected through Surveymonkey.com. To maintain confidentiality and test security, each participant was assigned a unique Identification Code (ID) emailed to them individually by the BBM research team. RISE NI administrators and sponsors were blind to the match between IDs and individual participants and could not access their responses. To protect employee privacy, all tests were coded (no names or other identifying information appeared on test documents). The Master Code List was kept by Dr. Gerbarg, who was not affiliated with RISE, on a separate, secured memory stick. Since the study as a "low stakes" personal employee development opportunity, we did not anticipate any response tampering, multiple submissions or substitutions. The rater and data analyst were blind to participant IDs.

The RISE NI training contract did not allow time or funding to train more than one group, hence, the single group design. Comparison groups and randomized were not possible. Participants were a convenience sample of supervisor-nominated employees who volunteered to participate without additional pay beyond their usual salaries. BBMIC was taught during normal work hours.

The data collection plan was informed by the following assumptions and intentions:
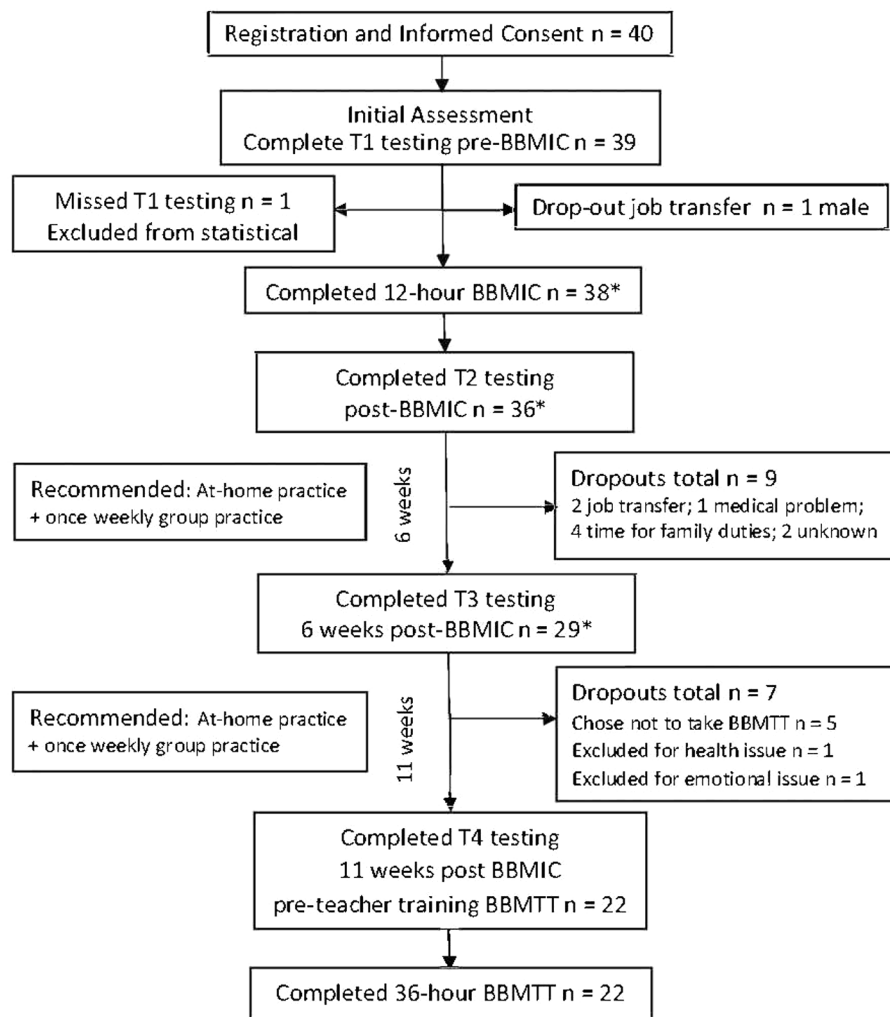
FIGURE 1
Starting with 40 registrants, the study flow diagram tracks participants through BBMIC and 11 weeks of follow-up and test measures while accounting for dropouts. * Indicates that the actual number of participants who completed BBMIC was 38. However, 36 completed T2 testing and 29 completed T3 testing. Because one person missed T1 testing, their scores were not included in the statistical analysis.

1. Given the nature of their work and work-related changes necessitated by the COVID-19 pandemic, this sample of RISE NI staff would have higher-than-normal psychological stress.
2. On average, participation in BBMIC would be associated with measurable, meaningful, statistically significant improvements in perceived stress, engagement, revitalization, tranquility, physical exhaustion, and stress overload.
3. On average, participation in BBMIC would be associated with measurable improvements in indicators of positive change in psychophysiological states, such as tension, calmness, mood, sleep, energy, mental clarity and focus, friendliness, empathy, and body pain.
4. Having experienced personal relief and emotional healing, some participants would volunteer for a train-the-trainer program to learn how to incorporate BBM practices into their work.
5. The data would provide a formative evaluation of BBMIC to use to improve the training.

The data analysis plan was to measure baseline participant stress prior to BBMIC. Using the dependent measures we applied a General Linear Model (GLM) matched-pair, within-subjects, repeated measures design, a standard analytic approach, to test the level of change in each participant (26). Three conditions were set up for the factor "Time": pretest (T1); post-3 days of BBMIC (T2); and after 6 weeks of solo and group practice (T3). SPSS uses Mauchly's test for sphericity. The Bonferroni method was used for *post hoc* analysis.

Practice logs were analyzed to understand the degree to which the amount of group practice and at-home practice might correlate with changes in dependent measures. As in many studies of busy professionals, a drop-off in practice was anticipated. The pattern of those who left the program was analyzed using a *t*-test comparison of leavers vs. stayers to better understand potential biases in the overall result. In addition, we collected a matched set of measurements for those registered for Teacher Training Level 1 (TTL-1). The pre-test for TTL-1 served as an 11 weeks extension of post-time to measure persistence of effects. Effect size of changes were measured in the

means of the key to matched sets of dependent measures calculating Cohen's d.

We summarized the Program Evaluation questionnaire responses which assessed participants' satisfaction with the training and their suggestions for improving BBMIC.

Test measures

The *Perceived Stress Scale (PSS)* is a widely used, validated measure of perceived stress with reduced stress indicated by a lower score (27). Participants rate how often they have experienced stress-related symptoms over a period of at least 1 month on 10 items on a scale from 0 (never) to 4 (very often). Internal reliability has been estimated at $\alpha = 0.78$ (28). In addition, Cohen et al. report evidence of concurrent and predictive validity showing the results of various samples where the PSS correlated significantly with the Number of [stressful] Life Events, Impact of [stressful] Life Events, depressive symptomatology, and Health Center Utilization (27). PSS scores in normative samples have been published (28).

The *Exercise Induced Feeling Inventory* (*EFI*) has been shown to be sensitive to mood changes associated with yoga interventions (29, 30). Participants are asked to describe "how you feel at this moment in time" on a scale from 0 (do not feel) to 4 (feel very strongly). The EFI consists of 12 items grouped into 4 subscales: Positive Engagement, Revitalization, Tranquility, and Physical Exhaustion. Improvement in the first three subscales is indicated by a higher score and for the last subscale by a lower score. Estimates for internal reliability of EFI subscales range from $\alpha = 0.74$ to $\alpha = 0.91$ (29, p. 415). The subscales demonstrate good concurrent and discriminant validity with existing measures of mood and affect (29, p. 417). The data also suggest that EFI is highly sensitive to changes in feeling states that occur with exercise (29, p. 419).

The *Stress Overload Scale-Short (SOS-S)* is comprised of 30 items designed to measure "stress overload," a state described in stress theories as occurring when demands overwhelm resources (31). A 5-point Likert scale (1 = not at all, 5 = a lot) indicates subjective feelings and thoughts experienced over the prior week. Two factors underly stress overload: Personal Vulnerability (PV) and Event Load (EL), measured by two distinct but correlated subscales. Higher total scores indicate higher levels of stress overload. SOS-S internal consistency is excellent (Cronbach's alphas > 0.94 for both subscales and the measure as a whole). Test–retest reliability is good (coefficients averaging 0.75 over 1 week). Significant correlations with other measures of stress and illness demonstrate construct validity. Criterion validity has been shown in prediction of illness and abnormal cortisol responses following a stressful event (32). Amirkhan also suggests a "categorical scoring option" for separating participants into risk categories using norm sample group means as dividing points on the Personal Vulnerability ($\mu PV = 9.15$) and Event Load ($\mu EL = 12.15$) subscales. Those scoring in the High EL-High PV category were found to be at highest risk for developing a stress-related health condition.

Indicators of Psychophysiological State is a subjective non-validated self-assessment of 22 items, created by authors Gerbarg and Brown to document changes in psychophysiological state that reflect stress responses, emotional state, and perceptions of oneself, other people, and the environment, as delineated in the Polyvagal Theory of Stephen Porges and discussed below (15, 16, 33). Items are based on awareness of physical sensations (*interoception*), energy, emotions, cognitive functions, attention, and aspects of social engagement, including awareness of others, attitude towards others, connectedness, and empathy. Some items are similar to those in the Body Perception Questionnaire Short Form, a validate measure develop by Porges (34, 35).

Compliance with the recommended practice time was assessed using home Practice Logs submitted by participants and attendance records kept by BBM teachers during weekly group practice sessions.

Qualitative Data: Following BBMIC, participants were asked three open-ended questions at T2: (1) What did you like the most about BBMIC?, (2) What can be improved in the BBMIC?, and (3) How can BBM practices be helpful to students?

Intervention: Breath-Body-Mind Introductory Course

BBMIC includes a 12 h manualized training provided live online 4 h/day for 3 consecutive days followed by 6 weeks of once-a-week online group practice (45 min per session) and daily home practice (recommended 20 min per day of coherent breathing with some movement practices). This course teaches participants how to become more aware of their own psychophysiological states and how to use BBM techniques to balance their own stress response systems (sympatho-vagal balance). By developing self-awareness and regulation of their own psychophysiological state, participants become better able to co-regulate the emotional states of others. In collaboration with Jyoti Manuel,[1] methods for working with children with special needs were incorporated into the BBMIC.

In BBM programs, Coherent Breathing, the foundational practice, is used alone and with attentional focus, synchronized movements, visualization during Breath Moving, music, and audio track or voice pacing. To optimize relaxation, participants are encouraged to be in a comfortable, supported position and to exert as little effort as possible during Coherent Breathing paced at 5–6 cpm (cycles per minute). This gentle cyclical breathing (without breath pauses or holds) has calming effects, reduces SNS activity, increases PNS activity, lowers blood pressure, and induces synchronized alpha waves across large areas of cerebral cortex (17, 19, 20, 36–39). In the resulting psychophysiological state, the individual feels both calm and alert.

Each day had 3 Rounds that included: activating practices, such as tapping the body to music or "Ha" breath (no more than 1 or 2 min); autonomic balancing practices that coordinate breathing with movement, for example, breathing at 5 cpm while making synchronized arm circles; two deep relaxing sighs, a brief top-down muscle relaxation; Coherent Breathing (or resonant breathing) paced at 5 cpm, starting with 7 min and working up to 20 min; and Breath Moving (imagining the movement of breath inside the body in a sequence of circuits) (See Supplementary Appendix B – Table B1 Schedule and Table B2 Description of Practices). This can be followed by a bottom-up body scan, soft relaxing music, or Open Focus Attention Training (40, 41). The practice finishes with a few minutes of rest, lying down if possible.

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1 https://www.specialyoga.co.uk

Results

Participants

After baseline tests were obtained from 39 RISE NI employees, the only male in the group dropped out. Subsequently, 38 female employees (administrators and front-line workers) from the five district offices of RISE NI participated in BBMIC. Their ages ranged from 23 to 55 years. Among the 38 participants included in the statistical analysis were: 8 behavioral specialists, 8 occupational therapists, 7 speech and language therapists, 5 physiotherapists, 7 therapy assistants, 2 social workers, and 1 clinical psychologist. These included 8 Team Leaders. Figure 1 tracks the number of participants who completed tests at each time point and the reasons for study dropouts.

Assessment measures: results and analysis

Perceived stress scale

Using Welch Modified Two Sample t-Test in R-Studio (Version 1.2.5019 BSDA library), showed that at baseline (T1), PSS mean score of the 38 women participants (PSS = 18.3 ± 6.108 SD) was significantly higher ($p < 0.0001$) than the estimated population mean in a PSS norming sample of 1,406 women (μ = 13.7 ± 6.6 SD) (28). Participants who chose to participate in BBM Teacher Training Level-1 ($n = 21$) completed the PSS 11 weeks post BBMIC during the week before teacher training. A matched pair t-test comparing the PSS BBMIC baseline (T1) mean of 18.19 with the pre-BBMTTL1 (T4) mean of 15.67 was statistically significant ($p < 0.046$) with an effect size estimate using Cohen's $d = 0.46$ in the moderate range.

Impact of the BBMIC training on dependent measures

Stress overload scale-short

The pretest (T1) estimated marginal means of the *Personal Vulnerability* (PV) subscale of the SOS-S was 10.69 ($n = 38$) and decreased significantly to 9.69 after BBMIC. When subjected to a Multivariate Repeated Measures analysis of Covariance, the dependent variables yielded an $F = 8.668$ with df = 12 and $p < 0.001$. Pairwise Comparisons of the marginal means across the 3 time periods for SOS-S Personal Vulnerability ($n = 29$) (see Figure 2A) shows the initial decrease from the T1 mean of 10.69 to the T2 mean of 9.69 in not statistically significant ($p < 0.287$), but the T1 mean compared to the T3 mean of 7.97 is significant ($p < 0.001$). The T1 PSS total score was used as a covariate with a value of 18.138. In a similar analysis of the SOS-S *Event Load* subscale the Pairwise Comparisons of the marginal means ($n = 38$) (see Figure 2B) shows a significant drop from 15.69 (T1) to 13.38 (T2) ($p < 0.028$). The decrease in marginal means from 15.69 (T1) to 10.90 (T3) is also statistically significant ($p < 0.001$).

The SOS-S can be analyzed by placing each participant's scores on a 2 × 2 matrix (Figure 2C) with Event Load as the vertical axis and Personal Vulnerability on the horizontal. The graph divides into 4 categories by a vertical line drawn at the Personal Vulnerability population norm ($μ_{PV} = 9.15$) and a horizontal line drawn at the Event Load population norm ($μ_{EL} = 12.29$). The resulting quadrants sort participants into "Challenged," "High-Stress," "Low- Stress" or "Fragile" categories. The pretest (T1) SOS-S identified 17 of the 38 participants (45%) in the High Stress category (32). In Figure 2C data points for participants who later dropped out of the study "Leavers" are designated by yellow triangles ($n = 9$). Those who stayed appear as blue circles ($n = 29$). A blue circle over a yellow triangle indicates a score (data point) that is the same for one Stayer and one Leaver. Figure 2D shows SOS-S at T3 ($n = 29$) when only 5 of the 29 (17%) were identified as "High Stress." Thus, the percentage of participants at high risk for developing a stress-related disorder at T1 decreased substantially from 45 to 17% at T3.

Exercise induced feelings inventory

Pairwise comparisons of marginal means for the EFI subscales ($n = 29$) are shown in Figure 3:

3A. EFI Positive Engagement means showed statistically significant increases from 6.27 (T1) to 7.98 (T2) ($p < 0.001$), but dropped to to 6.69 (T3) which was still significantly better that at T1 ($p < 0.037$).

3B. EFI Revitalization Scale means showed a statistically significant increase from 2.86 (T1) to 5.62 (T2) ($p < 0.001$), but dropped slightly to 5.31 (T3), which was still significantly better than at T1 ($p < 0.001$). The difference of 0.31 between T2 and T3 is not significant ($p < 1.0$).

3C. EFI Exhaustion Scale means showed statistically significantly decreases from 6.45 (T1) to 4.45 (T2) ($p < 0.018$) and 4.0 (T3) ($p < 0.014$).

3D. EFI Tranquility Scale means showed statistically significant increase from 4.38 (T1) to 7.27 (T2) ($p < 0.001$) and stayed relatively unchanged to 7.03 (T3) ($p_{T2–T3} < 1.0$).

Subjective changes in indicators of psychophysiological state

Participants rated the level of improvement they experienced after the first 3 days of BBMIC (T2) on a 7-point Likert-type scale, which was collapsed into five categories by combining "strong" with "very strong improvement" scores, as well as combining "modest" with "moderate improvement" (see Figure 4). No subjects reported "no improvement." Therefore, that category was dropped, leaving four categories. On average, including all items, approximately 10% of respondents felt that an item was not a problem for them; about 22% reported slight improvement; 41% modest to moderate improvement; and 28% strong to very strong improvement in 22 indicators of psychophysiological states ($n = 36$). For example, calmness and peacefulness are associated with feelings of safety and higher PNS activity versus tension, worry, and anger, which are associated with feeling threatened and defensive states of higher SNS system activity (15, 16, 19).

Compliance

All participants who completed BBMIC were asked to keep a log of the time they spent each day practicing BBM techniques on their own (Solo) and in Group Practice Sessions led by BBM senior instructors throughout the 6 weeks period of practice. The goal for 100% compliance was 20 min/day solo practice (20 min/day × 6 days/wk. × 6 wks = 720 min) plus one 45 min group practice session per week (45 min/wk. × 6 wks = 270 min). Of the 38 participants, 34 submitted practice logs weekly through SurveyMonkey (see Table 1).
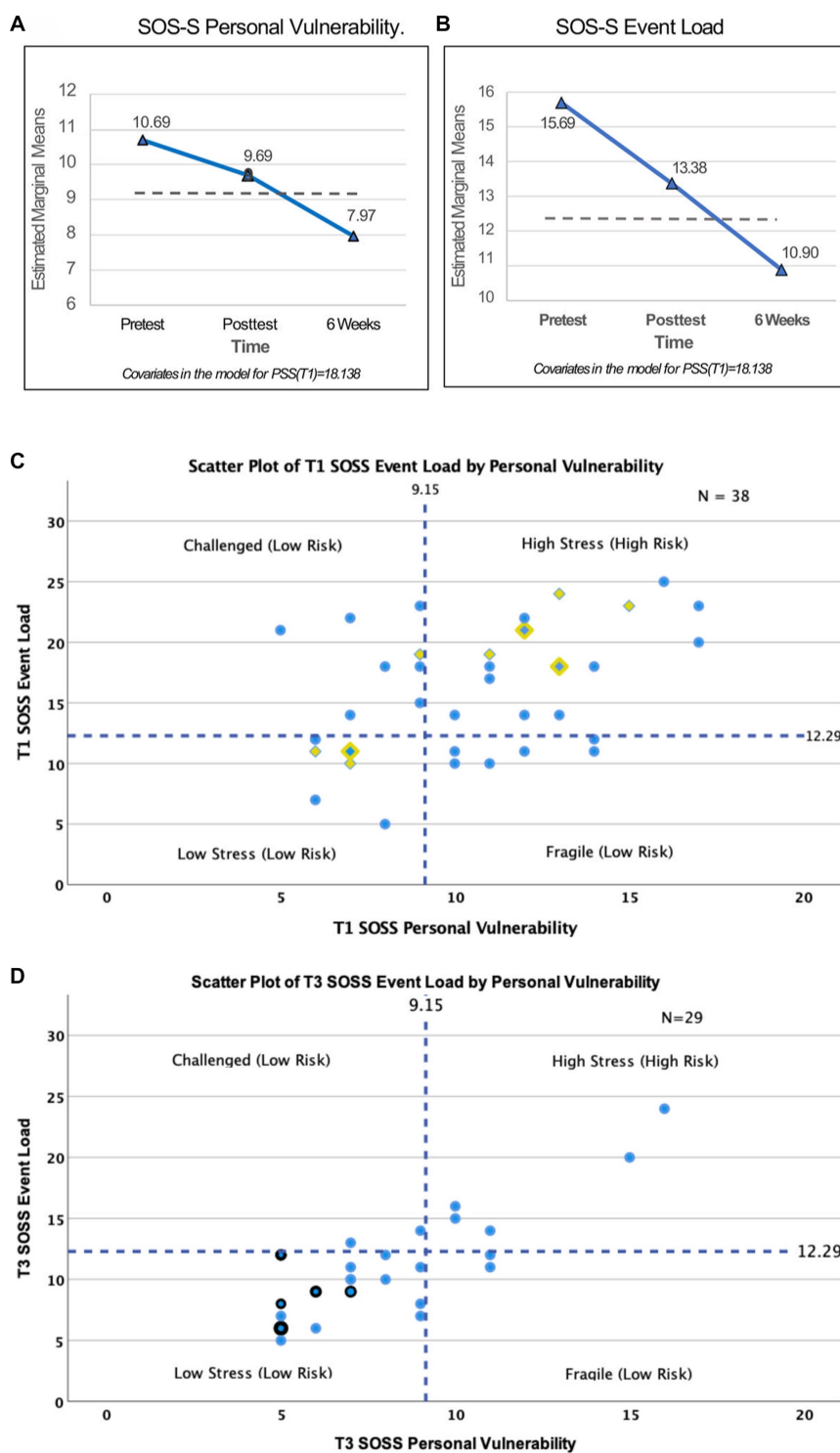
FIGURE 2
Stress Overload Scale-Short (SOS-S). **(A)** Pretest (T1) estimated marginal means of the Personal Vulnerability (PV) subscale was 10.69 and decreased to 9.69 at T2. Six weeks later (T3) PV score decreased significantly to 7.97 ($p<0.001$), below the normative mean score (dashed line). The T1 Perceived Stress Scale (PSS) total score was used as a covariate, value=18.138. **(B)** Pretest (T1) estimated marginal means of the Event Load (EL) subscale was 15.69 and decreased significantly to 13.38 ($p<0.028$) at T2. SOS-S estimated marginal means decreased significantly to 10.90 ($p<0.001$) at T3 and was below the normative mean score (dashed line). The T1 PSS total score was used as a covariate, value=18.138. **(C)** A scatterplot of Baseline (T1) scores shows Event Load on the vertical axis and Personal Vulnerability on the horizonal axis. Dashed lines represent the normative population mean scores (μ_{PV}=9.15) and (μ_{EL}=12.29). The resulting four quadrants indicate characterizations as Challenged (Low Risk), Low Stress (Low Risk), Fragile (Low Risk) and High Stress (High Risk). Blue circle=1 subject who stayed in the study; Yellow diamond=1 subject who dropped out anytime between T1 and T4; Blue dot inside yellow diamond=2 participants with identical scores, one who stayed in the study and one who dropped out. **(D)** 6 weeks post (T3) matrix with Event Load on the vertical axis and Personal Vulnerability on the horizonal axis. Dashed lines are at the normative population mean scores (μ_{PV}=9.15) and (μ_{EL}=12.29). Blue circle=1 subject; Blue circle with black border=2 subjects with the same score.
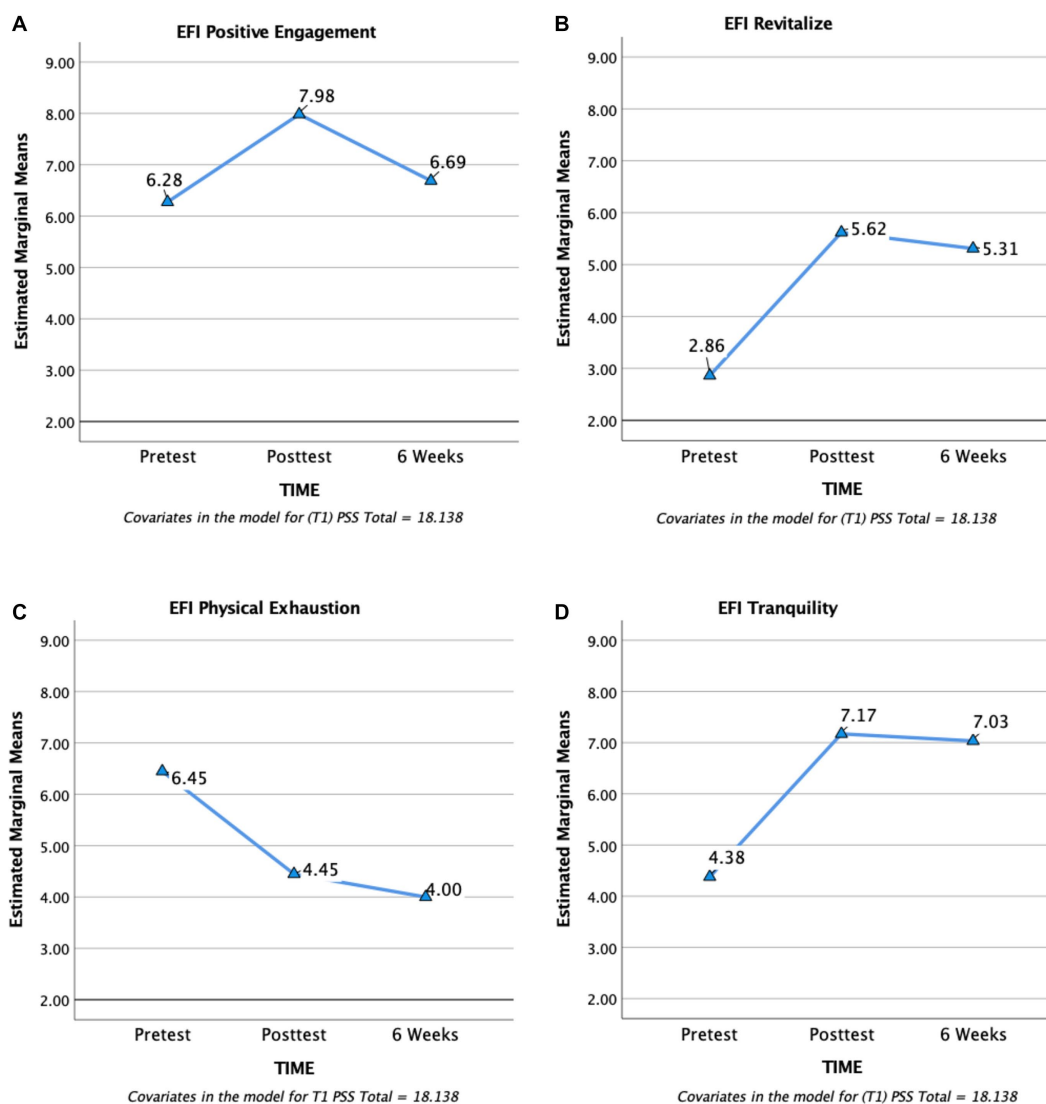
FIGURE 3
EFI Subscales Estimated Marginal Means over time. **(A)** Positive Engagement. **(B)** Revitalization. **(C)** Physical Exhaustion. **(D)** Tranquility. The three time points are pretest baseline (T1), 3 days posttest (T2), and 6week posttest (T3). The initial improvement in engagement from T1 to T2 was not sustained at T3. However, statistically significant improvements from T1 to T2 in revitalization, physical exhaustion, and tranquility were maintained at T3.

Based on the mean practice times reported, participants met 85% of the goal for Group Practice; 44% of the goal for solo practice; and overall 55% of the total practice goal.

Qualitative data

A total of 106 comments submitted by 34 of the participants were organized into eight themes for each question. The most frequent responses were as follow:

1. What did you like the most about BBMIC? Breathing techniques 25%; scientific background and examples 11%; practicality, applicability, and easiness of techniques 11%; environment/organization of the course 9%; time for self- care 7%; tapping 7%; other.
2. What can be improved in the BBMIC? Move lectures to day-1 19%; more breakout rooms 14%; smaller work groups 8%; in-person workshops 8%; other.

3. How can BBM practices be helpful to students (see Figure 5). Better focus 24%; calm and relax 24%; stress/anxiety and anger management 18%; self-regulation 11%; more alert and aware 10%; positivity 5%; other.

Adverse reactions

Participants were encouraged to report any adverse experiences during BBMIC group sessions and home practice. During each session the BBM teachers did "check-ins" by asking the participants how they were feeling and encouraging them to share positive and negative experiences related to the practices. In addition, visually monitoring students enabled teachers to observe how they were doing the breath practices and any signs of tension, distress, or discomfort.
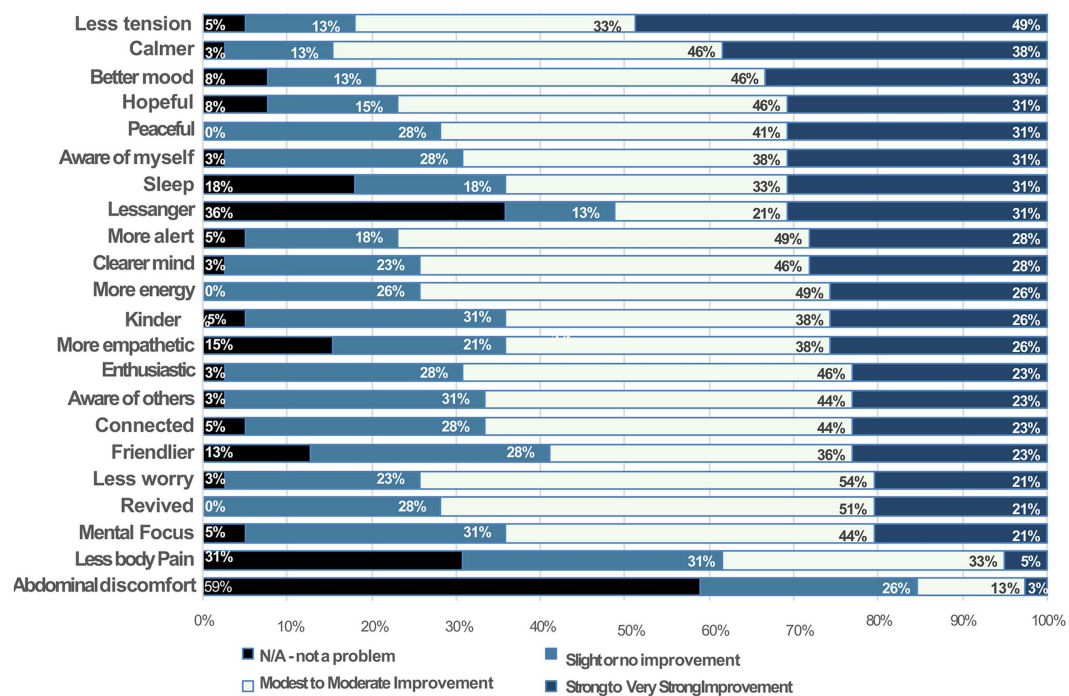
FIGURE 4
Subjective Changes in Indicators of Psychophysiological State from Baseline (T1) to 3days posttest (T2): The vertical axis lists psychological and physical items, including qualities, functions, and states that reflect or are strongly associated with psychophysiological states. Each bar shows the proportion (%) of participants who rated each item on a scale of severity condensed into four categories from left to right: "not a problem," "slight improvement," "modest to moderate improvement," or "strong to very strong improvement."

TABLE 1 Group mean practice times and compliance with practice goals.

	Mean practice time over 6 weeks n =34		
	Mean group Practice minutes	Mean solo Practice minutes	Mean total Practice minutes
Practice goal	270	720	990
Reported practice	230.3	316.4	546.7
Mean % of practice goal completed	85%	44%	55%

During the 6 weeks of practice from T2 to T3, participants reported their group practice time and solo practice time, which were combined for total practice time in minutes. The group mean reported practice time compared to group practice goals yielded the compliance as the percent (%) of practice goal completed.

FIGURE 5
Program Evaluation at week 6 (T3): How Can BBM Practices be Helpful to Students? Each sector of the pie represents a way in which the participants thought that students could benefit from BBM practices. The numbers show how many participants made a comment related to each sector and the percentage (%) of the total comments they represented.

No serious or persistent adverse reactions occurred. On the first day of learning Coherent Breathing, several participants reported that they felt uncomfortable as though they could not prolong their breath enough. However, by the second day, all but a few were breathing more comfortably at 5 cpm. Some experienced sad feelings transiently. Several participants had recently lost close relatives or friends and were in grief. They took time out as needed. One woman could not reduce her respiratory rate below 20 cpm. She was referred for medical evaluation. A few participants noted transient muscle aches as tension was released. Most reported feeling better physically and emotionally by the end of each BBMIC session. One participant with asthma and allergies found it stressful to slow her respiratory rate to 5 cpm. Instead, she was given an audio track to pace her breath at 6 cpm which was more comfortable. Most people find that over time Coherent Breathing improves asthma, but when they are having acute asthma symptoms, they may not be able to breathe at 5 cpm and trying to do so may exacerbate their difficulties. This can
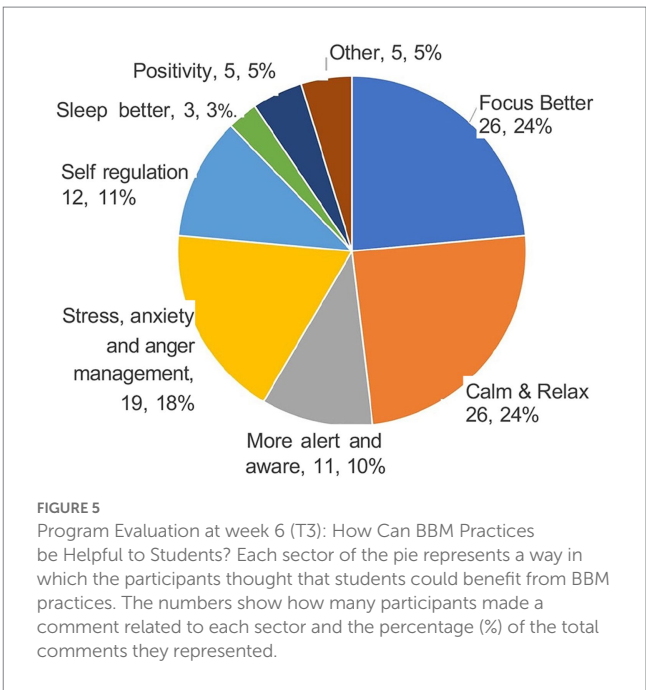
be prevented by instructing them to use Breath Moving during Coherent Breathing and, if necessary, by breathing at a slightly faster rate.

Individuals recovering from COVID are instructed to do coherent breathing lying in prone position and to breathe very gently at a rate that does not cause any strain. They are also taught to do the other breath practices very gently and rest when needed. One pregnant participant was uncomfortable sitting. She was instructed to lie down during Coherent Breathing. She was advised not to do breath holds, forceful breaths, or rapid breathing.

Discussion

Background and context

COVID effects on the regional integrated support for education Northern Ireland

Healthcare agencies, like RISE NI, have been subjected to increased levels of psychological stress since the COVID-19 pandemic began (12, 42). As conscientious caregivers, they felt responsible not only for the wellbeing of the children and families they serve, but also for their own families. Moral distress, a precursor to moral injury, can occur when staff cannot provide the needed services, for example, during the COVID pandemic (43). Evidence suggests that in agencies providing services for children with disability or developmental delay, the four main factors that impact the effectiveness of workers in providing services are: engagement with the workplace, engagement with clients, professional capacity, and staff wellbeing (44).

The effects of COVID on children and families in Northern Ireland

A study led by the National Children's Bureau highlighted the impact of the COVID pandemic on children and youth with Special Educational Needs and Disabilities (SEND), their families, and those who support them (18). The report noted: (1) fear, insecurity, and worry about the health of their children and themselves, (2) social isolation and loneliness, already problematic for children with SEND, was exacerbated by the closing of schools and other activities as well as quarantine requirements, (3) loss of support from caregivers and support workers from other agencies who could no longer do home visits, (4) loss of learning and development during school lockdowns or changes in how schools functioned, and (5) worsening of stress on the already strained services.

Working under such adversity affects stress response systems and leads to psychophysiological states of defense, as evidenced by the baseline data which showed high levels of perceived stress, stress overload, and physical exhaustion, as well as low levels of tranquility, energy, mood, and social engagement. Many of these manifestations of the stress-related psychophysiological states are associated with impaired effectiveness at work and at home, poorer quality of life, ill health and increased vulnerability to stress-related disorders.

Neurophysiological theories: the Polyvagal theory and the Vagal-GABA theory

According to the Polyvagal Theory of Stephen Porges, we can perceive the environment as safe ("green zone"), unsafe ("orange zone"), or life threatening ("red zone"). When we feel safe, the

myelinated fibers of the parasympathetic nervous system (PNS) (within the vagus nerves) are orchestrating an autonomically balanced psychophysiological state of elevated heart rate variability (an indicator of health and longevity), social engagement and non-defensiveness, wherein our emotions are well regulated, and we are able to trust, bond, love, be intimate, self-soothe, heal, feel empathy and compassion, and cooperate with others (15, 16, 45).

When we feel threatened (unsafe), the sympathetic nervous system (SNS) becomes more dominant, inducing a psychophysiological state of defense in which heart rate variability is low, social engagement declines, and we become mobilized for fight or flight. This behavioral activation is necessary for survival, but is accompanied by emotion dysregulation, anger, fear, mistrust, hypervigilance, and overreactivity (4, 16). In a situation perceived as life-threatening, when we can neither fight nor escape, the nervous system may default to the evolutionarily older unmyelinated vagal pathways associated with a state of low heart rate variability wherein the social engagement network cannot function. In addition, this can lead to freeze reactions, disconnection, dissociation, or numbing.

The neurophysiological theory of mechanisms contributing to the effects of voluntarily regulated breathing exercises articulated by Brown and Gerberg (4, 14, 39) hypothesizes that:

1. Changing the pattern of breathing changes afferent interoceptive messages from the respiratory system (mechanoreceptors, chemoreceptors, and baroreceptors) that ascend through the vagus nerves to brainstem nuclei and from there to the main central regulatory areas, including the limbic system, hypothalamus, thalamus, interoceptive (insular) cortex, prefrontal cortex, and anterior cingulate cortex (16, 17, 46–49).

2. Slow breath exercises, particularly Coherent Breathing, balances the autonomic nervous system by reducing the overactivity of the sympathetic branch, as occurs in anxiety disorders and PTSD, and by boosting the underactivity of the parasympathetic branch (13, 38, 50, 51). This is consistent with the changes perceived stress and psychophysiological state.

3. When the sympathetic nervous system is over-active it consumes more energy and generates more free radicals as byproducts. Reducing sympathetic system overactivity reduces this excess energy expenditure. The parasympathetic system is responsible for restoring energy reserves. Increasing parasympathetic system activity restores the depleted energy reserves. The net result is increased energy and decreased exhaustion. Participant reporting of significant improvements in exhaustion at T2 and T3, despite the fact that their workloads and stressors were virtually the same at all test points are consistent with hypothesis #3.

4. The Vagal-GABA Theory of Inhibition hypothesizes that slow coherent breathing increases levels of gamma-aminobutyric acid (GABA), the main inhibitory neurotransmitter in the brain. Furthermore, increased GABA transmission from the prefrontal cortex and insular cortex could inhibit the overactivity that occurs in the amygdala in anxiety disorders and PTSD (52). A Mass Resonance Spectroscopy (MRS) study showed increased levels of GABA in the thalamus of patients with Major Depression who participated in a 12 week program

of yoga and Coherent Breathing at 5 cpm (52). Test results showing improvements in tension, worry, calmness, mood, peacefulness, sleep, and tranquility are consistent with improved emotion regulation and inhibition of amygdalar over-reactivity.

5. Breathing entrains the electrical activity of the brain. Voluntarily controlling the breath pattern further increases the entrainment in critical areas such as the insular cortex and amygdala (20, 21). Slow breathing induces synchronous alpha waves across broad areas of the cerebral cortex, consistent with a state of calm attention and awareness, as indicated on the Subjective Indicators of Psychophysiological States.

6. Slow breathing, such as Coherent Breathing, activates the social engagement system and enhances feelings of safety, trust, friendliness, empathy, connection, and bonding (4, 22–24), as documented by the Subjective Indicators of Psychophysiological States.

7. Slow gentle breath practices may increase levels of oxytocin, enhancing feelings of closeness, trust, safety, bonding, and love (4, 16, 53) that are consistent with items on the Subjective Indicators of Psychophysiological States.

Breath-Body-Mind practices may improve both stress resilience and trauma recovery through: (1) strengthening and activating the myelinated pathways of the PNS such that the individual develops greater ability to sustain the feeling of safety and calmness, even under multiple prolonged stressors and (2) learning to activate the PNS while reducing overactivity of the SNS, providing a means to calm down and shift out of the perceived threat "orange zone" and back into the feeling of safety "green zone" (15, 16, 19).

Breath-Body-Mind affects psychophysiological states during and after mass disasters

In mass disasters and in clinical studies, BBM practices have significantly reduced symptoms of anxiety disorders, stress, depression, and post-traumatic stress disorder, including in populations affected by mass disasters, for example, the 2001 New York World Trade Center attacks; Gulf Horizon oil spill; military service; war and genocide in South Sudan, Rwanda, Myanmar, and Ukraine; kidnapping, and trafficking in Nigeria and South Sudan (54–57). BBM programs are specifically designed for situations in which a small number of caregivers with a limited amount of time must serve a large population of individuals experiencing stress, trauma, disaster, or illness such as COVID-19. Traditional mind-body programs offer hundreds of worthwhile practices, but these may require months or years of training. In contrast BBM has distilled sets of simple, relatively short practices that are safe and effective for most people, can be easily modified for those with physical or mental conditions, are accepted across cultures and ethnicities, require no equipment or supplies, and can be delivered by community extenders.

In 2002, Jyoti Manuel founded Special Yoga, a program for children with special needs, disabilities, developmental disorders, and/or trauma. She has worked for the National Health Service (NHS) and education authorities, providing in-house training and programs in schools, and through clinical teams of occupational therapists, physiotherapists, and other specialists. In 2019, Manuel began BBM training and eventually became a BBM Level-4 teacher.

She found that the breath-centered practices were easily adapted and rapidly effective for the children she treats. Manuel, Gerbarg, and Brown integrated Special Yoga with BBM techniques for children with learning disabilities and other special needs and for the wider population of children and families affected by the COVID pandemic, stress, war, and trauma. Manuel contributed her knowledge and experience to the development of the child curriculum of BBM training and she co-taught RISE NI staff during the BBM courses.

The neurophysiological platforms affected by BBM techniques support restoration of autonomic balance (reduce the overactivity of the SNS and increase the underactivity of the PNS), the sense of safety, and interoception (perceptions of sensations arising from inside the body). Furthermore, evidence suggests that these changes activate the social engagement and Bonding systems and reduce defensive behaviors (15, 16, 45). Also, the breath and movement exercises can improve respiratory function, endurance, blood pressure, and inflammation (58, 59).

Participation in BBMIC was associated with significant improvements on PSS, SOS-S, EFI, and Subjective Indicators of Psychophysiological State. These changes were in the expected direction of positive improvement, based on previous studies. They are also consistent with a shift from a defensive state of increased sympathetic tone and decreased parasympathetic tone, described by Porges as the "Orange Zone" to a state of feeling safe (non-defensive) with increased parasympathetic tone and reduced sympathetic tone, the "Green Zone" (15, 16). Based on their personal experience of the changes that occurred during BBMIC, the RISE staff anticipated that the practices would benefit their students in comparable ways: calm and relax; better focus; stress/ anxiety and anger management; self-regulation; and more alert and aware.

This study met its three objectives:

1. The study evaluated the effects of the BBMIC on COVID-related stress in RISE NI staff.

2. Participation in the BBMIC was associated with significant improvements on standardized measures of stress, PSS and SOS-S. The SOS-S matrix demonstrated substantial reduction in the number of participants who were at high risk for developing a stress-related condition, thereby reducing their risk of adverse effects from COVID-related stress;

3. The study evaluated and quantified the degree of subjective improvement on 22 indicators of psychophysiological states following BBMIC. The PSS, SOS-S, and EFI subscale items are also associated with psychophysiological states, adding evidence of improvement on standardized tests. The positive direction of all of these changes is consistent with the hypothesized underlying mechanisms of action.

Study strengths

Study strengths included the use of manualized, previously tested BBM interventions taught by experienced faculty (Dr.

Brown, Dr. Gerbarg, Jyoti Manuel, and BBM senior teachers). Another strength was the use of codes to preserve participant confidentiality (particularly in their workplace) and blinding of those who collected and analyzed the data. The faculty were trained and led by Dr. Brown and Dr. Gerbarg who created the BBM programs and who have taught BBM for over 15 years to disaster survivors and others with stress, trauma, and stress-related physical conditions. To provide high quality, consistent teaching, all BBM assistant faculty were trained and certified in BBM Levels 3 or 4 by Dr. Brown and Dr. Gerbarg. Additionally, thrice daily meetings enabled the teachers to discuss the participants and receive guidance and supervision from Drs. Brown and Gerbarg. Thus, problems could be addressed quickly. Individual coaching was provided as needed for participants who had difficulty performing the practices.

Study limitations

This study of professional healthcare employees had no control group. A randomized controlled study is needed to compare the impact of BBMIC on employees with a similar group who did not participate in the intervention. One cannot dismiss the possible effects of time away from work duties, interaction with BBM faculty, and group interaction. It is also possible that environmental conditions improved, reducing the load of stressors. This is unlikely because the COVID pandemic did not abate during the study, nor was there relief from the workload or psychosocial pressures.

The selection process may have favored employees who were more motivated to learn mind-body practices. Future studies could explore whether participant motivation correlates with responses to BBMIC.

Because the participant group was small, larger studies are needed to validate and extend the findings; studies in other settings are needed to expand generalizability. The one male who signed up for the study dropped out before the intervention. Inclusion of a larger proportion of males would address the possibility of gender-related differences in response. Studies are also needed for more ethnically diverse populations.

All measures were subjective. The use of biological measures in future studies could provide objective evidence of changes in psychophysiological states, for example, measures of resting pulse, blood pressure, respiratory sinus arrhythmia or heart rate variability, cortisol levels, or inflammatory markers. Brain scan studies, including connectivity, would deepen our understanding of the neural mechanisms involved.

BBM is an interactive multi-component program that includes sequences of breathing, movement, Open Focus attention training, interoceptive awareness (akin to mindfulness), and group processes. Given that each exercise is chosen for its specific effects, one cannot clearly differentiate the relative contribution of the components to the overall effect.

Future directions

This study evaluated the effects of BBMIC on professional staff only. The next step would be to study how the program affects the way staff perform their jobs and the effects on children and families

receiving care. Studying the effects of improvements in staff self-regulation on the children and the role of co-regulation in the children's responses would be worthwhile. The negative impact of COVID-related psycho-social stressors on children's mental health, social–emotional development, and, particularly for those with special needs, those affected by trauma, and marginalized students, cannot be overstated.

Voluntarily controlled breath practices open a portal to interoceptive communication networks which upregulate or downregulate brain functions. Breath practices can be used as non-invasive probes to explore changes in connectivity and neurotransmitter levels, shedding light on neurophysiological events that underly the observed clinical responses (60). It is possible to prescribe specific breath practices that integrate easily into treatments for a wide range of mental and physical disorders, as well as for prevention and performance enhancement. The practices used for everyday stress can be used for mass disasters to support better functioning and recovery.

Conclusion

Breath-Body-Mind programs have been shown to reduce symptoms of anxiety, depression, and PTSD in survivors of mass disasters internationally. The COVID pandemic caused acute and chronic psychological stress for healthcare workers, who experienced increased workloads while they and their families were suffering from COVID-related stressors. The stress was exacerbated by reductions in staff due to illness, family needs during school closures, worsening problems of children with disabilities and other special needs, and loss of other support services.

The staff at RISE NI showed elevated levels of stress on two standardized measures. Baseline data were consistent with states of defensiveness, fear, worry, and exhaustion. Completion of the Breath-Body-Mind Introductory Course (BBMIC) was associated with improvements in measures of stress, personal vulnerability, sense of work overload, revitalization, tranquility, physical exhaustion, mood, sleep, and indicators of positive, emotionally meaningful relatedness, including feelings of connectedness, kindness and empathy. These changes are consistent with the hypothesized psychophysiological shift from feeling unsafe (increased sympathetic activity) to feeling safe (increased parasympathetic activity). In accord with polyvagal theory, the state of feeling safe supports the social engagement system, including the ability to feel trust, close, connected, and empathic. These essential components of stress resilience are also necessary for optimal co-regulation and work performance during interactions with co-workers, children, and families, particularly during times of prolonged, increased stress, such as the COVID pandemic, war, population displacements, and other mass disasters.

Breath-centered mind-body programs, such as Breath-Body-Mind, may support staff recovery from COVID-related and other stressors. In effect, the BBMIC served to counteract adverse effects of COVID-related psychological stress on mental and physical health. Training healthcare employees in BBM may serve a preventive role by enhancing their abilities to tolerate stress and maintain their own wellbeing in a more robust psychophysiological

state. Further research is needed to validate and extend these promising findings towards the development of breath-centered individual and group treatments.

Data availability statement

The original contributions presented in the study are publicly available. This data can be found here: https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/NO0VGP.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

drawing upon her expertise in working with children with special needs. This made the intervention even more relevant to the staff of RISE NI. She emphasized the importance of self-regulation by the caregiver to enable co-regulation in working with children. They also want to thank the BBM teachers who volunteered and worked extra hours to support the participants through the learning process.

Conflict of interest

PG and RB have written books and book chapters about Complementary and Integrative Medicine, including breath-centered mind-body practices. They sometimes receive financial remuneration or honoraria for teaching mind-body practices. They are Co-Founders and members of the Board of Directors of the Breath-Body-Mind Foundation, a not-for-profit 501(c)3 that provides pro bono crisis relief programs for survivors of mass disasters, scholarships for applicants who cannot afford to pay for training, and grants for research projects.

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

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2023.1199819/full#supplementary-material

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Support- and meaning-focused coping as key factors for maintaining adult quality of life during the COVID-19 pandemic in Germany

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Introduction: During the COVID-19 pandemic, questions about both consequences and helpful strategies to maintain quality of life (QoL) have become increasingly important. Thus, the aim of this study was to investigate the distribution of coping factors during the COVID-19 pandemic, their associations with QoL and the moderating role of certain sociodemographic characteristics.

Methods: Analyses were based on cross-sectional self-reports from German adult participants ($N = 2,137$, $18-84$ years, 52.1% female) of the CORONA HEALTH APP Study from July 2020 to July 2021. Multivariate regression analyses were used to predict (a) coping factors assessed with the Brief COPE and (b) QoL assessed with the WHOQOL-BREF while taking measurement time, central sociodemographic, and health characteristics into account.

Results: During the COVID-19 pandemic, German adults mostly pursued problem- and meaning-focused coping factors and showed a relatively good QoL [Mean values (M) from 57.2 to 73.6, standard deviations (SD) = 16.3–22.6], except for the social domain (M = 57.2, SD = 22.6), and with a decreasing trend over time (β from -0.06 to -0.11, $ps < 0.01$). Whereas, escape-avoidance coping was negatively related to all QoL domains ($\beta = -0.35$, $p < 0.001$ for psychological, $\beta = -0.22$, $p < 0.001$ for physical, $\beta = -0.13$, $p = 0.045$ for social, $\beta = -0.49$, $p < 0.001$ for environmental QoL), support- and meaning-focused coping showed positive associations with various QoL domains (β from 0.19 to 0.45, $ps < 0.01$). The results also suggested differences in the pursuit of coping factors as well as in the strength of associations with QoL by sociodemographic characteristics. Escape-avoidance-focused coping was negatively associated with QoL levels in older and less educated adults (simple slopes differed at $ps < 0.001$), in particular.

Conclusions: The results demonstrated what types of coping may be helpful to avoid QoL deterioration (i.e., support- and meaning-focused coping) and provide implications for future universal or targeted health promotion (i.e., older or less educated adults who lack social or instrumental support) and preparedness in the face of unknown challenging societal situations similar to that of the COVID-19 pandemic. Cross-sectional trends of enhanced use of escape-avoidance-focused

coping and QoL deterioration point toward a need for increased attention from public health and policy.

1. Introduction

Based on the initial conceptual work of Lazarus and Folkman (1), individuals pursue distinct types of coping in response to stressful life events, where coping is defined as the (cognitive or behavioral) effort to adapt to adverse situations that are evaluated as personally harmful and exceeding a person's resources. Following this idea, initial coping research has focused on two different types of coping in response to a stressor: *problem-focused* coping, which is the attempt to actively manage or alter the current problem, and *emotion-focused* coping, which is the striving to regulate negative emotions raised by the current problem (1, 2). Later research has extended and complemented the conceptual framework by introducing the so-called *meaning-focused* coping [i.e., positive orientation and effort to find coherence and meaning in the current problem; (3–5)] and *support-focused* coping (i.e., seeking instrumental or emotional support) as a third and fourth type that individuals use to cope with current problems (4, 6). Such kind of four-factor solutions correspond with the original work of Carver (2) and a number of investigations of the Brief Coping Orientation of Problem Experience (Brief COPE) questionnaire (7, 8), as used in the present study.

However, it should be noted that a significant amount of studies found other ways of summarizing the coping factors of the Brief COPE inventory (9–11). In coping research, there are relatively diverse opportunities of summarizing and grouping coping factors of higher order in general, not least because of differing contextual or methodological approaches and measurement instruments (12, 13). Thus, it is questionable if coping efforts in the context of the COVID-19 pandemic are similar to other stressful life events and can be replicated or integrated into existing coping structures.

1.1. Coping during the COVID-19 pandemic

During the COVID-19 pandemic, as in other stressful life situations, adaptive coping ability offers the potential to decrease the risk of long-lasting negative consequences on health and wellbeing (14). Results from recent studies indicate that the general population has already been struggling with their psychological (15), social (16), and environmental wellbeing (17) due to COVID-19-related restrictions and long-term consequences on daily life (18). In Germany, after a temporary decrease during the first lockdown, there was an ongoing increasing trend of certain psychopathological symptoms and poor self-rated mental health over time (19). Information on the pursuit and efficacy of coping factors to reduce and prevent adverse effects on the general population in the long run is thus urgently needed (20–22). This

becomes particularly apparent when considering that programs aiming at the universal promotion of coping skills are still seldom and rather group-specific (23) even though there is promising evidence on its potential efficacy in terms of population mental health (24).

Studies summarizing past evidence from stressful life events suggest that certain types can be more helpful than others and that people may differ in their situational application of such (25, 26). Across various stressors, coping factors reflecting active and focused efforts toward problem solution (problem-focused) and a positive orientation (meaning-focused) were predominantly associated with better health and wellbeing, whereas escape-avoidance-focused coping (emotion-focused) showed the opposite pattern (27–29). However, exceptional situations do not appear to allow the application of certain coping factors, such as when confronted with unfamiliar and overwhelming situations or lack of control, hampering the effort of problem-focused coping factors that aim to actively solve a problem (5, 27). Accordingly, other coping factors, such as acceptance or positive reappraisal (meaning-focused) and seeking instrumental or emotional support (support-focused), may become even more important for positive health and wellbeing outcomes (5, 27).

Accordingly, individuals who reappraised the lockdown situation as a chance to rest or pursue hobbies, promote a healthy lifestyle (meaning focus), or seek social or instrumental support reported high life satisfaction and psychological wellbeing (14, 30). Furthermore, early observations revealed a less pronounced use of problem-focused coping and a relatively high use of emotion-focused coping during the COVID-19 pandemic (31). As in other stressful situations, emotion-focused coping, which is often operationalized as avoidance or denial, showed associations with decreased psychological wellbeing across different countries (20, 32, 33). However, the majority of these studies have focused on symptoms of psychopathology or psychological wellbeing and other wellbeing domains have received less attention. In the face of the COVID-19 pandemic, financial constraints, and work- and family-related challenges have been identified as additional major issues over long periods, underscoring the importance of considering the burden in the environmental and social life domains as well (34, 35).

1.2. Differences in coping based on sociodemographic factors

Regarding age-related differences in general, one pattern that was relatively robust in previous studies constitutes a decline in problem- and support-focused coping with older age (36, 37).

Research on age differences in emotion-focused coping, on the other hand, yielded mixed results (37, 38). The inconclusive findings are likely related to different forms of operationalization of emotion-focused coping (12).

From a theoretical perspective, two main mechanisms are considered to explain age-related differences in coping. The first position assumes that coping varies inherently as a function of age (developmental interpretation), and the second position proposes that coping varies based on the type of situations one must face at different stages of life (contextual interpretation) (38, 39). Both theoretical approaches were complemented by the idea that individuals develop a preference for certain coping factors over time that correspond with personality and have proven to be effective in past situations (40). Against this background, an investigation of coping factors in contexts that are neither age-specific nor comparable to previous experiences appear particularly important to provide more insights into age-related aspects, such as during the current COVID-19 pandemic.

Actual findings of the COVID-19 pandemic suggest a higher risk of burden but also more efficient coping of older adults than younger adults due to less stress reactivity (41). Verhage et al. (42) recently identified acceptance and positive reframing as central coping factors among older adults, emphasizing a meaning focus. However, older adults also reported critically following mitigation measures to avoid an infection, which can be interpreted as higher acceptance of medical appropriateness and a problem-focused coping approach (42).

Besides age, individuals' sex has been discussed as a major source of between-person variation in the pursuit of coping factors across various situations (37, 43). As suggested by the *socialization hypothesis* (44), men are assumed to cope more actively and instrumentally, while women are assumed to cope more passively and emotionally. Men and women are also considered to differ in the respective situations with which they must cope (39) and in the biological basis of hormonal activity that explains sex differences in coping behaviors (summarized as "fight-or-flight" for males and "tend-and-befriend" for females; (6). Consistent with theoretical predictions, women most frequently reported more social support-seeking strategies than men (43, 45), and some evidence also suggests a more frequent use of emotion-focused strategies (45, 46). Evidence on sex differences in problem-focused coping is mixed (43, 45). However, because gender roles are constantly progressing, differences in preferences for coping factors might also change and require ongoing investigation (47).

Furthermore, the educational level is associated with health behaviors (48) and subjective perceptions regarding psychological, physical, social, and environmental wellbeing (49, 50). Individuals with higher levels of education may have more competencies, for instance, in terms of stress regulation (51) or help-seeking behavior (52), and greater access to relevant resources, such as health-related knowledge or well-paid jobs (48, 50). However, the role of educational levels for the use and efficacy of coping factors has not yet attracted sufficient scientific attention, particularly in the general population. Currently, increasing evidence suggests that both the educational level and health knowledge affected people's attitudes and behaviors when handling the COVID-19 pandemic (53, 54). Thus, factors and correlates of coping with the COVID-19

pandemic may also differ as a function of people's educational levels and have implications for public health prevention, but require further investigation.

1.3. The present study

Evidence on the factors individuals used to cope during the COVID-19 pandemic and associated restriction measures are still fragmentary but very important (22). Currently (May 10th, 2023), the COVID-19 pandemic in Germany is in the stage of leveling off after the sixths wave and has been demanding on people for a long time. Accordingly, the present study addressed the following exploratory questions (E) and hypotheses (H) to draw conclusions for future response and preparedness in similar demanding societal situations:

1) To what extent did people use different coping factors over a period of time characterized by different stages of the COVID-19 pandemic? Based on previous knowledge, we expected a generally high prevalent use of meaning-focused coping (H1) and aimed to explore the use of other coping factors (E1).

2) Did the pursuit of diverse coping factors differ among people grouped by relevant sociodemographic characteristics (age, sex, and educational level)? By considering previous indications of differences in coping, we expected that older age is associated with less problem-focused and support-focused coping, but higher meaning-focused coping (H2), whereas age differences in the use of escape-avoidance-focused coping require further exploration (E2a). Based on previous conflicting results, we aimed to gather further insights into possible differences in the frequency of problem-focused coping efforts between women and men (E2b). In addition, we explored whether individuals with low education may have used escape-avoidance-focused coping more often than those with high education (E2c).

3) What types of coping factors were positively related to wellbeing during the COVID-19 pandemic and may thus offer entry points for the maintenance of wellbeing in the general population? Since research has focused mainly on psychological wellbeing, we have broadened this perspective by adding physical, social and environmental wellbeing as outcomes. After considering findings from studies assessing other critical life events, we expected positive associations between meaning-focused coping and negative associations between escape-avoidance-focused coping and wellbeing (H3), whereas the roles of problem- and support-focused coping are currently unclear and need to be clarified (E3).

4) Did associations between coping factors and wellbeing differ among people stratified by relevant sociodemographic characteristics (age, sex and educational level) during the COVID-19 pandemic? Due to a lack of knowledge, we explored whether certain sociodemographic characteristics are moderators of these associations (E4).

2. Materials and methods

2.1. Sample and procedure

The present research is part of the CORONA HEALTH App study, an observational app-based survey on psychological and physical health outcomes during the COVID-19 pandemic that started in July 2020 (55). The present analyses will use cross-sectional self-report data collected from July 2020 to July 2021, including a phase of relaxation after the second wave during the summer in 2020 (July till October 2020), intensification of restriction measures to combat the spreading of the COVID-19 pandemic in Germany with the beginning of the third wave (November 2020 till January 2021: partial lockdown with restrictions on social contacts and traveling; Home office directive; closing of stores in the service sector and gastronomy; cancellation of all entertainment and leisure events; January till April 2021: lockdown; additional obligation to wear an FFP-2 mask in all public places and on public transport, proof of a negative Corona test upon entry into Germany), followed by stepwise relaxation of restriction measures and infection rates from April until July 2021. Participation was voluntary and without reimbursement but restricted to adults 18 years and older. Each participant provided informed consent. The CORONA HEALTH App study was conducted in accordance with the German medical products law and the data protection officer of the University of Würzburg, Germany. The procedures used in this study were in accordance with the 1964 Helsinki declaration and its later amendments and was approved by the ethics committee of the University of Würzburg, Germany (No. 130/20-me).

2.2. Measures

2.2.1. Coping

Participants answered the German Brief COPE Inventory (2, 56) consisting of two items for each of the fourteen subscales. The instruction was to "please now assess to what extent the following statements apply to your thinking and acting since the beginning of the COVID-19 pandemic." Each statement was rated on a 4-point rating scale from "I have not been doing this at all" to "I have been doing this a lot." Although data-driven approaches reinforce the multidimensional conceptualization of coping, avoiding predetermined higher-order factors and using hierarchical factor analyses in every new investigation is recommended (12). Consequently, categorizations of coping differ somewhat in the coping research field with respect to the particular context and a situational or dispositional focus (56, 57). As recommended by Carver (2), Skinner et al. (12), and as performed by Knoll et al. (56), we therefore summarized the 14 subscales (often referred to as "strategies") to latent factors by performing both exploratory principal component analyses (PCA) with oblique rotation and subsequent confirmatory factor analyses (CFA) with the R package *lavaan* (58) based on random half split samples. A detailed description can be obtained from the Supplementary material 1. The final model with four latent coping factors (i.e., problem-focused, support-focused,

escape-avoidance-focused, and meaning-focused) suggested good fit with $\chi^2_{(45)} = 2,105.86$. $p < 0.001$, CFI = 0.96, TLI = 0.94. RMSEA = 0.05, SRMR = 0.03 and showed great overlap with the original conceptual work of Carver (2) as well as prior studies with German-speaking samples (56, 59). We built coping factors analogous to the method used by Knoll et al. (56) by calculating the mean of subscales, ranging from min = 1 to max = 4. Internal consistencies were $\alpha = 0.76$ for problem-focused coping (Active Coping and Planning subscales), 0.83 for support-focused coping (Emotional Support and Instrumental Support subscales), 0.73 for escape-avoidance-focused coping (Denial, Substance Use and Self-Blame subscales) and 0.73 for meaning-focused coping (Positive Reframing, Humor, and Accepting subscales).

2.2.2. Quality of life (QoL)

We used the German version of the WHOQOL-BREF questionnaire as an indicator for quality of life (60, 61), a standardized well-established 26-item instrument comprising the four subscales of psychological (e.g., "To what extent do you feel your life to be meaningful?") physical (e.g., "How satisfied are you with your capacity for work?"), social (e.g., "How satisfied are you with the support you get from your friends?") and environmental wellbeing (e.g., "Have you enough money to meet your needs?") answered on a 5-point rating scale. Consistent with the scoring, values were transformed into scales ranging from 0 to 100 with a mean of 50, with higher values indicating better QoL. Internal consistencies were $\alpha = 0.85$ for psychological QoL, 0.87 for physical QoL, 0.72 for social QoL, and 0.80 for environmental QoL.

2.2.3. Educational level

Participants were asked to indicate their highest educational degree, and answers were categorized into three levels: low (no school-leaving certificate or graduation after 9 years), moderate (vocational baccalaureate diploma or similar), or high (high school graduation) in accordance with the Comparative Analyses of Social Mobility in Industrial Nations Index [CASMIN; (62)].

2.2.4. Health status

We used three items as indicators of the participant's current health status, the presence of a chronic long-term illness [no = 0, yes = 1, Mini European Health Module; (63)], a (lifetime) medical diagnosis of mental disorder (no = 0, yes = 1), and a current or past COVID-19 infection based on a medically proven positive test (no = 0, yes = 1).

2.2.5. Measurement time

The eligible participation in this study amount to a total of 2,137 over the period of 1 year. To address the time of data collection in our analyses, we have aggregated the cross-sectional points in time on a monthly basis and included them as a metric variable in our analyses. The average number of participants by month was $n = 365$ (SD = 296.85).

2.3. Statistical analyses

Analyses were performed with R statistics (64). First, we performed multivariate regression analyses with robust standard errors to investigate differences in the use of coping factors. The four latent factors were regressed on the participant's age, sex, educational level, health status (chronic condition, mental disorder, and COVID-19 infection), and measurement time (aggregated by month). Next, we performed a second multivariate regression analysis with robust standard errors to investigate differences in associations between coping factors and the four QoL domains in various German adult population groups. The health status indicators and the measurement time were entered as control variables, and the four coping factors, sociodemographic characteristics, and their interactions were entered as predictors of the four QoL domains. Significant interactions were probed with simple slope analyses using the R statistics *interactions* package (65). Finally, we performed *post-hoc* power analyses for both multivariate regression models with the R statistics *pwr* package (66).

3. Results

The present analyses are based on a convenience sample of N = 2,156 participants. Inspection of the plausibility of answers (e.g., correspondence between similar items) careless responding (straight-lining and intraindividual response variability) and extreme outliers (Mahalanobis distance, Cook's distance) led to the exclusion of 19 participants. Thus, the final sample consisted of 2,137 participants (52.1% female, 47.3% male, 0.7% transgender; mean age = 40.98, SD = 13.62). Descriptive statistics as presented in Table 1 include male, female and transgender persons. For robust multivariate regression analyses (Tables 2, 3) including investigations of sex interactions, the 15 transgender participants were excluded due to statistical problems associated with the small group size, resulting in N = 2,122 participants (47.5% female, 52.5% male; mean age = 41.03 years, SD = 13.23 years). No values were missing, except for five not assignable educational degrees (acquired abroad), which were excluded case wise.

3.1. Use of coping factors

On average, participants reported the use of problem- and meaning-focused coping factors most frequently, while escape-avoidance-focused coping was reported least frequently. The results also suggest several differences in the pursuit of coping factors among different German adult population groups (see Table 2). An older age was associated with a less frequent use of coping factors in general, except for meaning-focused coping. Men reported problem- and support-focused coping less frequently than women, and individuals with a low educational level used factors of problem-, support-, and meaning-focused coping less frequently, whereas they reported a more frequent use of escape-avoidance-focused coping than individuals with a moderate or high educational level. In addition, the participant's health status was related to the use of diverse coping factors:

The self-reported diagnosis of a mental disorder was related to less use of meaning-focused coping and a more frequent use of escape-avoidance-focused as well as support-focused coping; individuals with a chronic condition more frequently reported escape-avoidance coping; a current or past COVID-19 infection was associated with more escape-avoidance and support-focused coping. The measurement time was unrelated to coping efforts, except for a positive association with escape-avoidance coping. Supplementary Figure 1 in the SUP shows the use of coping factors averaged across time.

Effect sizes for associations between the considered sociodemographic or health characteristics and coping factors were small to moderate, as was the proportion of explained variance, ranging from 4% (problem-focused coping) to 17% (escape-avoidance-focused coping; see Table 2).

3.2. Associations between coping factors and quality of life domains

Overall, participants' QoL was relatively high, as suggested by mean values considerably exceeding the average norm value of 50 scheme (60, 61), except for the comparatively lowest value of the social domain (Table 1). Controlling for measurement time, relevant general health and sociodemographic characteristics, coping factors substantially contributed to the explanation of variance in participants' QoL levels. In particular, escape-avoidance-focused coping was relatively strongly associated to poor QoL in all four domains (see Tables 3, 4). Additionally, support-focused coping was moderately related to higher psychological and social QoL levels and meaning-focused coping to higher psychological as well as environmental QoL levels. Coping factors, measurement time, general health and sociodemographic factors explained 45% of the variance in psychological QoL, 40% of the variance in physical QoL, 20% of the variance in social QoL, and 32% of the variance in environmental QoL (Tables 3, 4).

Older participants had better psychological and environmental QoL than younger adults, and male participants showed better psychological and physical QoL but worse social QoL than female participants. The educational level was positively associated with physical and environmental QoL, and individuals with high education scored better than those with low education. Moreover, a chronic somatic condition or mental disorder were negatively associated with each of the four QoL domains, whereas a COVID-19 infection was unrelated to QoL. Later measurement time was related to lower QoL levels (Tables 3, 4).

3.3. Moderation effects of age, sex, and educational level on the associations of coping factors with QoL

Participants' age moderated associations between several coping factors and QoL domains (Supplementary Figure 2 of the SUP). In particular, the more older adults used escape-avoidance-focused coping, the lower was their psychological, social and

TABLE 1   Sample characteristics of the 2,137 German adult survey participants (July 2020−July 2021).

		Coping style M (SD)				Quality of life M (SD)			
	N	Prob	Sup	Esc	Mea	Psy	Phy	Soc	Env
Age group									
18–29	494	2.54 (0.62)	2.22 (0.75)	1.61 (0.55)	2.56 (0.62)	56.2 (21.4)	67.5 (18.4)	57.2 (22.5)	70.5 (16.5)
30–44	828	2.49 (0.63)	2.06 (0.79)	1.41 (0.47)	2.44 (0.60)	60.8 (20.1)	69.0 (19.2)	57.2 (22.0)	73.4 (16.5)
45–59	590	2.51 (0.65)	1.90 (0.67)	1.31 (0.39)	2.36 (0.63)	65.2 (23.8)	68.0 (21.8)	56.2 (23.8)	75.2 (16.6)
60+	225	2.34 (0.64)	1.58 (0.56)	1.24 (0.35)	2.22 (0.61)	61.0 (21.1)	68.3 (20.2)	59.2 (22.1)	77.1 (15.7)
Sex									
Female	1,009	2.59 (0.62)	2.17 (0.72)	1.46 (0.48)	2.44 (0.61)	58.2 (20.7)	65.9 (20.2)	58.0 (22.1)	72.8 (16.6)
Male	1,113	2.39 (0.63)	1.81 (0.67)	1.35 (0.47)	2.40 (0.63)	64.3 (21.1)	71.2 (19.7)	56.4 (23.2)	74.6 (15.9)
Transgender	15	2.43 (0.53)	2.20 (0.75)	1.59 (0.57)	2.40 (0.41)	44.7 (16.6)	52.9 (18.8)	48.9 (18.1)	64.0 (13.1)
Educational level									
Low	146	2.34 (0.69)	1.91 (0.78)	1.65 (0.63)	2.14 (0.63)	51.2 (22.2)	56.2 (21.5)	51.3 (23.3)	61.2 (19.1)
Moderate	842	2.42 (0.65)	1.90 (0.72)	1.40 (0.49)	2.37 (0.63)	60.2 (21.5)	66.4 (20.9)	56.1 (23.1)	71.8 (16.7)
High	1,141	2.57 (0.60)	2.09 (0.71)	1.38 (0.43)	2.49 (0.60)	62.8 (20.2)	71.3 (18.7)	58.7 (21.9)	76.6 (14.5)
Chronic condition[a]									
Yes	961	2.48 (0.64)	2.00 (0.73)	1.45 (0.51)	2.37 (0.64)	56.0 (22.4)	59.7 (21.8)	53.0 (23.5)	69.6 (17.6)
No	1,176	2.50 (0.62)	2.00 (0.72)	1.38 (0.44)	2.46 (0.60)	65.0 (19.0)	75.4 (15.6)	60.6 (21.3)	76.9 (14.4)
Mental disorder[a]									
Yes	842	2.50 (0.62)	2.13 (0.74)	1.55 (0.54)	2.35 (0.63)	50.4 (21.2)	57.9 (21.0)	50.7 (23.1)	68.3 (20.2)
No	1,263	2.49 (0.64)	1.91 (0.69)	1.30 (0.39)	2.47 (0.61)	68.4 (17.6)	75.5 (15.8)	61.9 (21.0)	77.7 (13.7)
COVID-19 infection[b]									
Yes	85	2.46 (0.61)	2.37 (0.74)	1.68 (0.63)	2.39 (0.63)	52.0 (22.0)	56.2 (21.4)	54.8 (22.6)	67.4 (17.7)
No	2,052	2.49 (0.63)	1.99 (0.72)	1.40 (0.47)	2.42 (0.62)	61.3 (21.0)	68.8 (20.0)	57.3 (22.6)	73.9 (16.2)
Total	2,137	2.49 (0.63)	2.00 (0.72)	1.41 (0.48)	2.42 (0.62)	61.0 (21.1)	68.3 (20.2)	57.2 (22.6)	73.6 (16.3)

[a] Self-reported lifetime diagnosis.
[b] Medically proven positive COVID-19 test.
Prob, problem-focused; Sup, support-seeking-focused; Esc, escape-avoidance-focused; Mea, meaning-focused; Psy, psychological; Phy, physical; Soc, social; Env, Environmental. Coping scales min = 1 and max = 4; quality of life domains min = 0 and max = 100.

environmental QoL. Further probing of interactions with escape-avoidance-focused coping showed that simple slopes significantly differed from zero for young, middle and older age (psychological QoL: intercept = 67.88; slopes for 1 SD below the mean B = −10.24, SE = 0.49, $p < 0.001$; at mean age B = −11.52, SE = 0.45, $p < 0.001$; 1 SD above the mean B = −12.80, SE = 0.63, $p < 0.001$; social QoL: intercept = 63.24; slopes for 1 SD below the mean B = −5.42, SE = 0.65, $p < 0.001$; at the mean age B = −7.56, SE = 0.56, $p < 0.001$; 1 SD above the mean B = −9.69, SE = 0.88, $p < 0.001$; environmental QoL: intercept = 76.21; slopes for 1 SD below the mean B = −5.51, SE = 0.47, $p < 0.001$; at the mean age B = −6.53, SE = 0.40, $p < 0.001$; 1 SD above the mean B = −7.56, SE = 0.60, $p < 0.001$). Similarly, associations between meaning-focused coping and physical QoL were significantly stronger with older age. Simple slopes differed significantly from zero for younger (1 SD below the mean B = 4.67, SE = 0.64, $p < 0.001$), middle-aged (at the mean B = 4.91, SE = 0.45, $p < 0.001$) and older adults (1 SD above the mean B = 5.15, SE = 0.67, $p < 0.001$; intercept physical QoL: 74.40). Moreover, the results suggested an

interaction of age with support-focused coping. Although support-focused coping was related to better social QoL in younger and middle-aged adults (intercept = 63.24; slopes for 1 SD below the mean B = 4.82, SE = 0.68, $p < 0.001$; at the mean age B = 2.97, SE = 0.52, $p < 0.001$) it was unrelated for older adults (1 SD above the mean B = 1.12, SE = 0.75, $p = 0.14$).

The sex of participants moderated associations between problem-focused coping and psychological QoL (Supplementary Figure 3 of the SUP). The association between problem-focused coping and psychological QoL was stronger for female as compared to male participants (intercept = 67.88, female B = 6.73, SE = 0.64, $p < 0.001$, male B = 1.98, SE = 0.68, $p < 0.001$).

Furthermore, the educational level of participants moderated associations between support-focused coping as well as escape-avoidance coping and QoL (Supplementary Figure 4 of the SUP). Simple slope analyses revealed that support-focused coping was positively related to psychological (B = 3.90, SE = 0.89, $p < 0.001$), and social QoL (B = 7.35, SE = 1.90, $p < 0.001$) for individuals with

TABLE 2 Differences in coping by age, sex, educational level, health status, and measurement time ($N = 2,122$) determined using multivariate regression analysis.

	Problem-focused coping				Support-focused coping			
	B	SE	β	p	B	SE	β	p
Intercept	**2.48**	**0.09**		**<0.001**	**2.39**	**0.07**		**<0.001**
Female vs. male	**−0.20**	**0.03**	**−0.21**	**<0.001**	**−0.28**	**0.03**	**−0.22**	**<0.001**
Age	**−0.15**	**0.05**	**−0.16**	**0.001**	**−0.15**	**0.01**	**−0.33**	**<0.001**
Low vs. moderate education	0.08	0.06	0.05	0.226	−0.01	0.07	−0.01	0.925
Low vs. high education	**0.20**	**0.06**	**0.17**	**0.001**	**0.17**	**0.07**	**0.12**	**0.011**
No vs. yes chronic condition[a]	−0.01	0.03	−0.01	0.944	0.02	0.03	0.01	0.452
No vs. yes mental disorder[a]	0.01	0.03	0.01	0.892	**0.16**	**0.03**	**0.20**	**<0.001**
No vs. yes COVID-19[b] infection	−0.06	0.07	−0.02	0.372	**0.25**	**0.08**	**0.08**	**0.002**
Time	−0.01	0.01	−0.02	0.252	0.01	0.01	0.03	0.074
	Escape-avoidance-focused coping				Meaning-focused coping			
Intercept	**1.78**	**0.07**		**<0.001**	**2.55**	**0.06**		**<0.001**
Female vs. male	−0.02	0.02	−0.01	0.366	−0.03	0.03	−0.02	0.268
Age	**−0.12**	**0.01**	**−0.16**	**<0.001**	−0.03	0.01	−0.05	0.061
Low vs. moderate education	**−0.20**	**0.05**	**−0.14**	**<0.001**	**0.22**	**0.06**	**0.24**	**0.017**
Low vs. high education	**−0.21**	**0.05**	**−0.21**	**<0.001**	**0.30**	**0.05**	**0.25**	**<0.001**
No vs. yes chronic condition[a]	**0.05**	**0.02**	**0.04**	**0.014**	−0.01	0.03	−0.01	0.659
No vs. yes mental disorder[a]	**0.22**	**0.02**	**0.16**	**<0.001**	**−0.09**	**0.03**	**−0.07**	**<0.001**
No vs. yes COVID-19 infection	**0.17**	**0.06**	**0.05**	**0.009**	−0.02	0.07	−0.01	0.752
Time	**0.02**	**0.01**	**0.09**	**<0.001**	−0.01	0.01	−0.03	0.094

[a]Self-reported lifetime diagnosis.
[b]Medically proven positive COVID-19 test.
B, unstandardized coefficients; SE, robust standard errors; β, standardized coefficient.
R^2 for problem-focused coping was 0.04, for support-focused coping 0.14, for escape-avoidance-focused coping 0.17, and for meaning-focused coping 0.06. Coding of sex: male = 0, female = 1; educational level: low = 0, moderate = 1, high = 2; self-reported chronic condition: no = 0, yes = 1; self-reported diagnosis of a mental disorder: no = 0, yes = 1; COVID-19 infection; no = 0, yes = 1. Significant results at $p < 0.05$ are highlighted in boldface.

a low educational level. In contrast, for individuals with moderate and high educational levels, support-focused coping was unrelated to the respective QoL domains (psychological QoL: intercept = 67.88; slopes for moderate educational level B = −1.28, SE = 1.01, $p = 0.20$; high educational level B = 0.65, SE = 0.60, $p = 0.28$; social QoL: intercept = 63.24; slope for a moderate educational level B = 1.09, SE = 0.83, $p = 0.19$). One exception was a positive association between support-focused coping and social QoL for individuals with a high educational level (B = 3.22, SE = 0.66, $p < 0.001$). In addition, the probing of interactions revealed a stronger relation of problem-focused coping and environmental QoL with lower as compared to moderate and high educational levels (intercept = 76.21; slopes for low educational level B = 3.53, SE = 1.37, $p < 0.001$, moderate educational level B = 1.22, SE = 0.51, $p < 0.001$; high educational level B = 1.55, SE = 0.40, $p < 0.001$).

3.4. Power analyses

Post-hoc power analyses suggested a power of 1.0 at an alpha = 0.05 for both multivariate regression analyses, as reported in

Table 2 (eight numerators and 2,124 denominators of freedom, with f^2 ranging from 0.04 for problem-focused coping to 0.20 for escape-avoidance-focused coping) and Tables 3, 4 (28 numerators and 2,004 denominators of freedom, with f^2 ranging from 0.25 for social QoL to 0.81 for psychological QoL).

4. Discussion

The present research aimed to add knowledge on the use and potential benefits of diverse coping factors in German adults facing the COVID-19 pandemic, as well as possible preventive measures and long-term consequences. We extended previous studies by including the general population and potential moderators such as the age, sex and educational level of participants, and thus our study allowed an in-depth investigation into the pursuit of four different coping factors (problem-, support-, meaning-, and escape-avoidance-focused), their associations with four quality of life domains (psychological, physiological, social, and environmental wellbeing) and interactive effects over a considerable period of time from July 2020 to July 2021.

TABLE 3 Differences in associations between coping and psychological as well as physical QoL among participants of various age, sex and educational level ($N = 2,122$) and while controlling for health status and measurement time, as calculated using multivariate regression analyses.

	Psychological QoL				Physical QoL			
	B	SE	β	p	B	SE	β	p
Intercept	67.88	1.85		<0.001	74.40	2.06		<0.001
Female vs. male	2.18	0.39	0.05	0.003	1.77	0.74	0.06	0.017
Age	2.46	0.39	0.12	<0.001	0.01	0.40	<0.01	0.992
Low vs. moderate education	1.64	1.70	0.03	0.332	4.93	1.91	0.13	0.010
Low vs. high education	1.38	1.69	0.04	0.413	6.34	1.88	0.18	<0.001
No vs. yes chronic condition[a]	−5.17	0.71	−0.12	<0.001	−11.59	0.74	−0.29	<0.001
No vs. yes mental disorder[a]	−10.82	0.79	−0.25	<0.001	−9.81	0.81	−0.24	<0.001
No vs. yes COVID-19 infection[b]	0.53	0.57	0.01	0.353	0.02	0.62	0.02	0.971
Time	−0.55	0.12	−0.08	<0.001	−0.64	0.12	−0.10	<0.001
Problem-focused coping	0.57	1.96	0.03	0.770	1.84	2.15	0.16	0.055
Support-focused coping	3.32	1.57	0.19	0.004	−0.29	1.66	−0.02	0.860
Escape-avoidance-focused coping	−7.47	1.14	−0.35	<0.001	−5.21	1.23	−0.22	<0.001
Meaning-focused coping	5.04	1.90	0.24	0.008	2.09	1.97	0.01	0.290
Problem-focused coping × age	−0.71	0.43	−0.03	0.100	−1.17	0.47	−0.11	0.006
Support-focused coping × age	−0.63	0.40	−0.03	0.109	0.04	0.41	<0.01	0.920
Escape-avoidance-focused coping × age	−0.83	0.41	−0.04	0.033	−0.47	0.43	−0.03	0.303
Meaning-focused coping × age	0.70	0.44	0.03	0.111	1.26	0.47	0.12	0.004
Problem-focused coping × male	−1.84	0.95	−0.06	0.036	−1.46	0.46	−0.06	0.087
Support-focused coping × male	0.49	0.85	0.02	0.563	1.59	0.84	0.04	0.167
Escape-avoidance-focused coping × male	−1.00	0.81	−0.03	0.218	−1.19	0.79	−0.04	0.131
Meaning-focused coping × male	−0.36	0.90	−0.01	0.685	−0.83	0.91	−0.02	0.361
Problem-focused coping × moderate education	1.58	2.06	0.05	0.446	0.57	2.21	0.03	0.797
Problem-focused coping × high education	2.61	2.04	0.09	0.302	0.26	2.17	0.03	0.904
Support-focused coping × moderate education	−3.22	1.68	−0.11	0.046	−0.57	1.72	−0.02	0.743
Support-focused coping × high education	−3.07	1.64	−0.19	0.038	−0.50	1.68	−0.01	0.764
Escape-avoidance-focused coping × moderate education	−0.21	1.28	−0.01	0.873	<0.01	1.36	0.01	0.998
Escape-avoidance-focused coping × high education	−0.84	1.24	−0.03	0.498	<0.01	1.30	0.02	0.233
Meaning-focused coping × moderate education	−1.23	2.01	−0.04	0.539	−2.05	2.67	−0.02	0.443
Meaning-focused coping × high education	−0.89	1.98	−0.03	0.655	−0.94	2.43	−0.03	0.700
R^2	0.45				0.40			

[a] Self-reported lifetime diagnosis.
[b] Medically proven positive COVID-19 test.
QoL, quality of life; B, unstandardized coefficients; SE, robust standard errors; β, standardized coefficient.
Coding of sex: male = 0, female = 1; educational level: low = 0, moderate = 1, high = 2; self-reported chronic condition: no = 0, yes = 1; self-reported diagnosis of a mental disorder: no = 0, yes = 1; COVID-19 infection; no = 0, yes = 1. Significant results at $p < 0.05$ are highlighted in boldface.

4.1. Use of coping factors

During the COVID-19 pandemic, German adults mainly used coping factors characterized by actively addressing the current problem (problem-focus) and by focusing on positive aspects (meaning-focus). This finding is partially consistent with H1 and previous assumptions of a frequent use of meaning-focused coping in general and in situations with low predictability and controllability in particular (5, 27, 67). As addressed by E1, we found that individuals of the present study used problem- and meaning-focused coping to a similar extent, in accord with other studies (18, 68). Considering that problem-focused coping efforts during the COVID-19 pandemic may manifest in following hygiene and contact restriction measures (18, 42), the present

TABLE 4 Differences in associations between coping and social as well as environmental QoL among participants of various age, sex, and educational level (N = 2,122) and while controlling for health status and measurement time, as calculated using multivariate regression analyses.

	Social QoL				Environmental QoL			
	B	SE	β	p	B	SE	β	p
Intercept	**63.24**	**2.38**		**<0.001**	**76.21**	**1.59**		**<0.001**
Female vs. male	**−2.80**	**0.96**	**−0.06**	**0.004**	−0.53	0.65	−0.02	0.410
Age	0.59	0.49	0.03	0.232	**1.89**	**0.32**	**0.12**	**<0.001**
Low vs. moderate education	2.15	2.12	0.05	0.311	**2.97**	**1.47**	**0.09**	**0.043**
Low vs. high education	1.53	2.09	0.03	0.467	**6.08**	**1.42**	**0.19**	**<0.001**
No vs. yes chronic condition[a]	**−4.85**	**0.94**	**−0.11**	**<0.001**	**−4.76**	**0.62**	**−0.15**	**<0.001**
No vs. yes mental disorder[a]	**−7.82**	**1.01**	**−0.17**	**<0.001**	**−5.01**	**0.68**	**−0.15**	**<0.001**
No vs. yes COVID-19 infection[b]	0.74	0.79	0.02	0.348	0.10	0.52	0.01	0.846
Time	**−0.44**	**0.15**	**−0.06**	**0.003**	**−0.55**	**0.10**	**−0.11**	**<0.001**
Problem-focused coping	−0.28	2.53	−0.01	0.912	**3.32**	**1.49**	**0.20**	**0.026**
Support-focused coping	**10.18**	**2.80**	**0.45**	**<0.001**	1.31	1.49	0.08	0.329
Escape-avoidance-focused coping	**−3.84**	**2.29**	**−0.13**	**0.045**	**−7.97**	**1.02**	**−0.49**	**<0.001**
Meaning-focused coping	−0.67	2.46	−0.03	0.784	**4.40**	**1.54**	**0.27**	**0.004**
Problem-focused coping × age	−0.38	0.63	−0.02	0.546	−0.49	0.38	−0.03	0.195
Support-focused coping × age	**−1.10**	**0.53**	**−0.06**	**0.038**	−0.40	0.35	−0.02	0.249
Escape-avoidance-focused coping × age	**−1.98**	**0.51**	**−0.09**	**<0.001**	**−0.86**	**0.37**	**−0.05**	**0.017**
Meaning-focused coping × age	0.78	0.56	0.04	0.164	0.43	0.38	0.03	0.265
Problem-focused coping × male	−1.26	1.31	−0.04	0.334	−1.18	0.83	−0.05	0.154
Support-focused coping × male	0.21	1.18	0.01	0.856	0.50	0.74	0.02	0.500
Escape-avoidance-focused coping × male	−1.28	1.04	−0.04	0.219	−0.20	0.77	−0.01	0.795
Meaning-focused coping × male	0.23	1.16	0.01	0.844	−0.10	0.81	−0.01	0.902
Problem-focused coping × moderate education	−0.97	2.61	−0.03	0.709	−2.68	1.59	−0.11	0.093
Problem-focused coping × high education	0.01	2.60	<0.01	0.997	**−2.98**	**1.54**	**−0.13**	**0.045**
Support-focused coping × moderate education	**−6.09**	**2.39**	**−0.17**	**0.003**	−0.63	1.58	−0.03	0.689
Support-focused coping × high education	**−5.69**	**2.32**	**−0.18**	**0.006**	−0.17	1.58	−0.01	0.913
Escape-avoidance-focused coping × moderate education	**−3.34**	**2.28**	**−0.10**	**0.034**	**3.15**	**1.19**	**0.13**	**0.008**
Escape-avoidance-focused coping × high education	−2.81	2.26	−0.08	0.074	**3.53**	**1.26**	**0.14**	**0.001**
Meaning-focused coping × moderate education	3.52	2.49	0.10	0.137	−2.10	1.66	−0.08	0.205
Meaning-focused coping × high education	4.24	2.48	0.13	0.069	−1.64	1.58	−0.07	0.298
R^2	0.20				0.32			

[a] Self-reported lifetime diagnosis.
[b] Medically proven positive COVID-19 test.
QoL, quality of life; B, unstandardized coefficients; SE, robust standard errors; β, standardized coefficient.
Coding of sex: male = 0, female = 1; educational level: low = 0, moderate = 1, high = 2; self-reported chronic condition: no = 0, yes = 1; self-reported diagnosis of a mental disorder: no = 0, yes = 1; COVID-19 infection; no = 0, yes = 1. Significant results at $p < 0.05$ are highlighted in boldface.

findings can be interpreted as corroborating these earlier findings. Similar to the results of other recent studies (18, 68), the pursuit of escape-avoidance-focused coping was comparatively low. Though the use of such strategies turned out to be particularly detrimental to QoL, especially for certain population groups, as described below.

Individuals from various age groups differed in the pursuit of coping factors. As suggested by H2, an older age was associated with a less frequent use of problem- and support-focused coping. Furthermore, with older age, the use of escape-avoidance-focused coping decreased (E2a). This pattern of results has already been observed in other studies (36, 37, 69) and corresponds with

socioemotional selectivity theory [SST; (70)]. SST and subsequent work from the emotion regulation research field proposes that whenever people's sense of remaining time is limited, such as in older aged individuals, they increasingly value meaningful social relationships, which are often associated with smaller but closer social networks (71), and prioritize hedonic motivations to maintain or enhance positive affect and wellbeing (72). In contrast, younger adults tend to have open-ended time horizons that are frequently associated with larger social networks and seeking to establish new social ties that serve as important future resources (71), and contra-hedonic motivations to maintain or enhance negative affect that is occasionally beneficial, socially appropriate or instrumental in the long term (72), which in turn may lead to a greater pursuit of support-focused coping or escape-avoidance-focused coping, respectively. The negative associations between age and problem-focused coping corresponds with the idea that with older age, the application of coping factors aiming to actively solve critical events is limited due to incremental loss and reduced controllability [e.g., deterioration of the physical health status, death of close others; (73)]. Consequently, increasing age has been related to changes from an *assimilative* to an *accommodative* mode of coping, i.e., a decrease in coping factors characterized by a modification of a particular situation (e.g., active planning as in problem-oriented coping) and an increase in personal adjustment to situational constraints (e.g., acceptance and positive reframing as in meaning-focused coping) (74). In contrast to these prior findings, we did not observe age-related differences in meaning-focused coping. This finding may be an expression of equalization of coping possibilities in the face of pandemic conditions across diverse age groups, but requires further investigation. Since the findings are consistent with already observed general decreases in the number or intensity of coping factors with older age (75), the fact that only meaning-focused coping did not differ by age may also be a sign of a relatively strong pursuit of this coping style among older adults. However, the reduced pursuit of coping is not to be equated with a loss of skills. In contrast, the majority of research indicates improved coping efficiency with older age (76, 77) and can also be seen as an expression of serenity due to greater life experience and overcoming of challenges (75).

We found that female participants used support- and problem-focused factors more often than men when dealing with the COVID-19 pandemic (E2b). Thus, the results partially refute the theoretical considerations [e.g., socialization hypothesis; (44)] but substantiate other prior empirical findings (43), such as that women cope more actively within the limits of the given pandemic by engaging more frequently in protective behaviors to mitigate the spread of the SARS-CoV-2 virus than men (18, 53, 78). A potential next step for future studies is to include specific protective behaviors in the investigation of sex differences in coping with the COVID-19 pandemic or with other naturalistic critical events. Since the COVID-19 pandemic affects both women and men, explanations based on differences in the experience of events (39) can be excluded. Other explanatory approaches suggesting a rather biological (6) or social (44) basis for sex differences cannot be answered by this study and should be addressed in the future, for example, by including questions on gender role or biophysiological parameters.

Our results moreover support prior observations of educational differences in coping with the COVID-19 pandemic (53, 54). As addressed in E2c, individuals with lower educational levels were more likely to use escape-avoidance-focused coping and less likely to use meaning-, problem-, and support-focused coping. Possible explanations are related to insufficient knowledge, competency and (financial as well as social) resources among less educated individuals (53, 54, 79), and that may become particularly evident during the COVID-19 pandemic. Thus, health-related attitudes and knowledge (i.e., literacy) should be considered in future studies in addition to education.

4.2. Associations between coping factors and quality of life domains

The findings showed that the more individuals pursued escape-avoidance-focused coping, the lower was their QoL across all four domains, as expected in H3, and as indicated by previous evidence on maladaptive associations of escape-avoidant-focused coping with several health outcomes in general (20, 27, 33) as well as during the COVID-19 pandemic (21, 32, 80). The finding of positive associations between meaning-focused coping and QoL, substantiates its adaptive potential for wellbeing in general (5) and in the face of the current pandemic situation, in particular (21, 30, 68, 81).

In addition, support- and meaning-focused coping were positively related to psychological and social, respectively environmental QoL (E3). As already observed in adolescents and emerging adults (82), connecting with others appears to be of great importance for people's quality of life. At an early stage of COVID-19 pandemic, older adults also emphasized seeking social support as adaptive coping (81) and social capital has been identified as a central factor for stress experience irrespective of age (14, 34).

Regarding the included covariates of health status, results replicated general findings of lower QoL in individuals with somatic or mental disorders (83). A decreasing trend of all QoL domains with later measurement time found in the present study corresponds with other population-based evidence on trends of German (19) as well as other European adult mental health [e.g., Poland; (84)] and, pending further investigation, might be interpreted as long-lasting effects of the challenges associated with the COVID-19 pandemic.

4.3. Moderation effects of age, sex, and educational level on the associations between coping factors and QoL

The present findings also showed that the associations between coping factors and QoL domains were moderated by the participant's age, sex and educational level, as addressed in E4. Although support-focused coping was positively related to social QoL in younger and middle-aged adults, this association was not significant for older adults. This indicates how support seeking can be of particular benefit for young to middle-aged adults' social QoL

whereas older adults with lower social QoL may either be less in need of support-focused coping or may require other strategies to enhance their social QoL. Older age is generally indicative of less pronounced seeking of social or emotional support due to motivations to maintain a relatively small selection of close social contacts (71) and to coping efficacy (73, 75). In the figurative sense, those younger and middle-aged adults who were seeking social support may have been unable to rely on close others or less efficient in their coping efforts as compared to older adults. Lack of social support has been identified as one major public health concern affecting health and wellbeing in diverse domains (85) and may have become particularly evident in the current pandemic.

In older-aged participants, associations of escape-avoidance-focused coping with psychological, social, and environmental QoL were more negative than in younger-aged participants. Thus, escape-avoidance-focused coping may have either exerted particularly negative effects on older adults or older-aged participants with low psychological, social, and environmental QoL levels may have tended to pursue maladaptive coping. Similar to support-focused coping, the use of escape-avoidance-focused coping usually tends to decrease as the age of people increases due to efficient emotion regulation skills (77). Thus, older adults who do not fit into the regularly observed pattern of enhanced emotion regulation skills may require specific public health attention.

Another finding was that physical QoL levels were most strongly related to meaning-focused coping with older age. With regard to middle-aged adults, this finding may be a sign of positive adaption to the pandemic in terms of a forced pause in a stage of life usually characterized by career and child care (86). COVID-19-related mitigation measures have been related to reduced stress levels, more family time, opportunities to rediscover hobbies, and promote a healthy lifestyle (30) that might be of great benefit for middle-aged adults. For older adults, who commonly have to deal with physical limitations to an increasing extent, it appears more likely that increased physical QoL is related to meaning-focused coping irrespective of the COVID-19 pandemic. Positive health behaviors and attitudes should be considered in future investigations to draw further conclusions.

The found interaction with the sex of participants suggests that the psychological QoL level of women was better when they used problem-focused coping more frequently. This speaks against the assumption of socialization hypothesis (44) and in favor of the current pandemic encouraging women to pursue problem-focused coping more than in other contexts (18, 53, 78). Moreover, it highlights the positive potential of problem-focused coping for achieving good QoL levels in females. Since the direction of association might also be reversed, female adults with good QoL levels might also have pursued more problem-focused coping.

Positive associations between support-focused coping and social QoL were stronger for individuals with a low educational level than for those with a high or moderate educational level. However, the active request for utilization of emotional and instrumental support in the social and societal environment implies its presence, availability, and knowledge as well as awareness of actual needs. Based on previous evidence on associations between low education and a lack of (emotion) regulation competencies, social or instrumental resources, and health literacy (48, 51, 54, 87),

one may conclude that support-focused coping can serve as a buffer for such gaps and thereby may counteract QoL losses. It needs to be further evaluated if relevant information on support offers can be advertised more effectively. Moreover, associations between escape-avoidance-focused coping and psychological, social, and environmental QoL were the most negative for individuals with a low educational level. These findings are in line with other reports on risk behaviors among individuals of lower socio-economic status (48, 51) as well as other results on maladaptive coping factors during the COVID-19 pandemic (79). However, the underlying mechanisms of these associations are not yet fully understood and require more information, such as on personality and resilience, certain knowledge or competencies (e.g., health literacy). Relatively low levels of explained variance, particularly for social QoL and problem-focused coping, may also point to so far unconsidered predictors or moderators.

4.4. Limitations

Apart from the aforementioned insights, the present study has limitations that should be acknowledged. First, it employs a cross-sectional design that does not allow to draw conclusions on the direction of the identified associations. Although we tested and reported results on the direction of associations from coping factors to QoL, we cannot rule out bidirectional relationships. Second, generalized and retrospective self-reports yield only a salient snapshot of coping effort and should be supplemented in the future by repeated situational interviews in concrete daily life situations. Another aspect that calls for an intraindividual longitudinal perspective on coping in the long term is that the intensity of used strategies may change in the course of the pandemic due to adaption processes (42). Based on theoretical assumptions (1), individuals may also use coping factors in sequence, for example, by initially regulating emotions and then engaging in solving the problem thereafter. Consequently, coping flexibility (26) may play a crucial role in the face of such a dynamic situation as the COVID-19 pandemic (32).

Third, there is no universal gold standard for summarizing hierarchical coping factors and theoretical as well as methodological approaches to coping are still in constant flux (12). The found four-factor structure largely corresponds with other European research using the Brief COPE inventory from before (7, 56, 88) and partly during the COVID-19 pandemic (59). However, the brief COPE is not all-embracing so that other potentially relevant coping strategies or factors were not considered in this study. Moreover, it is questionable to what extent situational adaption of the instruction ("thinking and acting since the beginning of the COVID-19 pandemic") can be interpreted as either state or trait coping. Additionally, three subscales had to be excluded due to ambiguity (Venting, Behavioral Disengagement, and Self-Distraction) and one subscale (Positive Reframing) was allowed to load on two factors to achieve the best fit for the present factorial structure, which can be interpreted in line with prior findings and criticism on conceptual overlap or exclusive categorization (12, 59, 80). By synthesizing existing evidence on coping structures, Skinner et al. (12) concluded that it may be

beneficial to build rather action-oriented categorizations of coping (e.g., proximity seeking) than functional (e.g., problem-focused coping) or topological (e.g., approach coping).

Last, results were based on a convenience sample and the proportions of people with low educational levels, as well as adults aged 60 years or older, were comparatively low. Although smartphones were already used comprehensively at the time, a small number of people might not have had smartphones available, possibly leading to sampling bias. Thus, the generalizability of this work is limited, as the CORONA HEALTH APP study is not representative for the German population structure, and future studies should endeavor to increase the proportion of people with a lower level of education and older age in particular.

5. Conclusions

The present findings are in accord with prior observations on coping efforts and associations with QoL during adverse life events to a relatively large extent. Thus, already identified mechanisms seem to hold true also during the COVID-19 pandemic. For instance, escape-avoidance-focused coping was associated with a reduced QoL in various domains, as observed in other challenging situations of life. Apart from that, this study extended other investigations during the COVID-19 pandemic by considering a comprehensive selection of coping, QoL, sociodemographic and health characteristics, and time of data collection. Thereby, the results yielded additional insights into population groups with enhanced risk of reduced QoL and the potentially beneficial role of certain coping factors for these groups with relevant implications for public health promotion and preparedness.

In sum, support- and meaning-focused coping factors seemed to be important in coping with the actual pandemic and maintaining QoL. Hence, in future pandemics or other naturalistic societal crises, efforts should prioritize on ensuring sufficient offers, information, and low-threshold access to social and instrumental support, such as comprehensive and easily understandable informational campaigns, increasing support hotlines, or initiating voluntary neighborhood organizations. Moreover, public health educational campaigns may help avoid maladaptation (i.e., enhanced substance abuse or denial) and promote adaptive coping factors (e.g., positive reframing or acceptance) by, for example, providing specific recommendations and examples on daily mental hygiene and emotion regulation, in terms of universal health promotion. Pending replication and further investigation, these suggestions may be particularly helpful for individuals with low educational levels, older-aged individuals at risk of lack of adaptive emotion regulation skills, or younger individuals at risk of a lack of emotional or instrumental support. In the present sample, these groups showed the greatest potential of benefit from making use of support-focused coping as well as from reducing escape-avoidance focused coping. Overall, an increasing trend of escape-avoidance-focused coping as well as reduced QoL over time point toward long-term developments in the general population that require particular attention.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by University of Würzburg, Germany. The patients/participants provided their written informed consent to participate in this study.

Author contributions

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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.2023.1196404/full#supplementary-material

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The assessment and validation of the depression, anxiety, and stress scale (DASS-21) among frontline doctors in Pakistan during fifth wave of COVID-19

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Objective: The study aims to document sociodemographic features, address the symptoms and levels of depression, anxiety, and stress among frontline doctors in Pakistan, and validate the depression, anxiety, stress scale (DASS-21) on the context of Pakistan.

Method: A cross-sectional survey was conducted throughout the regions of Pakistan on frontline doctors to document their sociodemographic patterns and the levels of depression, anxiety, and stress while dealing with the fifth wave (Omicron-variant) of the coronavirus (SARS-CoV-2) pandemic in Pakistan (December 2021−April 2022). Respondents ($N = 319$) were recruited through a snowball sampling process.

Results: Though previous literature reported declines in psychological symptoms after earlier waves of COVID-19, these DASS-21 findings show that as the pandemic has worn on, frontline doctors in Pakistan are having considerable personal symptoms of depression (72.7%), anxiety (70.2%), and stress (58.3%). Though specifically related to the COVID-19 pandemic, they rated only moderate levels of depression and stress, however they reported severe levels of anxiety. The results also revealed a positive correlation between depression and anxiety ($r = 0.696$, $p < 0.001$), depression and stress ($r = 0.761$, $p < 0.001$), and anxiety and stress ($r = 0.720$, $p < 0.001$).

Conclusion: Through the application of all required statistical procedures, DASS-21 is validated in the cultural context of Pakistan among this group of frontline doctors. The findings of this study can provide new directions for the policy makers (government and hospitals' administration) of Pakistan to focus on the mental wellbeing of the doctors under similar enduring public health crises and to protect them from short- or long-term disorders.

1. Introduction

The coronavirus (SARS-CoV-2) was reported to have emerged from the city of Wuhan in Hubei province in China and later reported to spread rapidly in different parts of the world within the following months. Its most common symptoms have been equated with flu, high fever, dry cough, sore throat, loss of taste, with frequent impact on the lungs and respiratory system creating breathing difficulties, and with some cases leading to death (1, 2). The speedy transmission, heavy upsurge of infections, and associated deaths have created a sense of panic across the world (3). As the pandemic wave(s) spread, most countries declared the novel corona virus to be a public health emergency and took precautionary measures such as social distancing, isolation, quarantines, and wearing masks (4) to reduce its dispersion (5) aiming to protect their citizens.

Other than physical health, implementation of lockdowns (restricting populations to stay in and work from home) along with inadequate information or uncertain measures to protect themselves or vulnerable loved ones have created varying types of psychological distress among people worldwide (6). Fears of being infected or isolated in quarantines have adversely affected many as they felt compelled to distance themselves from their peers, colleagues, families, and other social contacts (7). Seeking to deal with the uncertainties and possible implications of COVID-19 has impacted human psychology at many levels, including increasing fear, stress, anger (8), depression, anxiety, and in worst case scenarios, suicidal tendencies (9). It has also been reported that pandemic distress coupled with certain extreme preventive measures could trigger other pre-existing mental health diseases and even induce novel symptoms in those who previously did not have any mental health issues (10).

COVID-19 pandemic related studies across various regions have documented different psychological factors that directly and indirectly affect the mental health of almost every segment of the population (11). Special attention has been given to the impacts on medical workers around the world (12–15) as they were both directly exposed to COVID-19 patients and psychologically faced with additional self- and other-care challenges. Studies conducted in diverse cultural contexts such as, Israel, Turkey, Egypt, India, the United States, Saudi Arabia, China, Kuwait, Iran, Poland, and Bangladesh (16–26) have noted and examined the unique issues and implications facing medical staff during the COVID-19 pandemic. However, neither the context nor challenges facing doctors in Pakistan have been widely reported in recent literature especially during the fifth wave of COVID-19.

Pakistan presents an interesting and important case for a national context as a highly populated (220 million) under-developed country and one already facing the multiple challenges of an energy crisis, weak economy, and political instability. A health emergency was declared in Pakistan right after the initial infected COVID-19 cases gained momentum. Partial and smart lockdowns, vaccinations, and improved treatment policies have helped Pakistan to control the transmission of the virus to protect the general citizens of the country (27).

An earlier investigation about the COVID-19 pandemic on seven different Asian countries (including Pakistan) found that the people of Thailand and Pakistan scored very high on the depression anxiety stress scale (DASS-21) as compared to the other countries (28). A study on the Punjab province of Pakistan reported that 21.9% of depression and 21.4% of anxiety symptoms were witnessed among the health care workers (HCW) and that the most affected population was medical doctors (29). It is also found that 79.7% of the HCW in Pakistan were having very high levels of and severe anxiety issues concerning COVID-19 (7). Researchers interviewed thirteen young doctors and found that they were experiencing psychological distress in the form of increased stress, fear, and anxiety after the emergence of the COVID-19 pandemic in Pakistan (30). Another sample reported that 43% of anxiety/depression prevailed among the frontline doctors of Pakistan in 2020 (31). Clearly, HCW in Pakistan have been more exposed to COVID-19 as elsewhere, and as an important health service sector that every country looks to in such distressing pandemic situations, their responses, wellbeing, and mental health cannot be overlooked.

The abovementioned studies provide evidence that HCW and frontline doctors are among the most vulnerable populations at a higher risk who are also more exposed to COVID-19 cases on a frequent and long-term basis as compared to ordinary people (in Pakistan as in other nations). Unfortunately, most of previous studies were completed during the initial waves of COVID-19 and did not adopt a well-established scale (like the DASS-21) to document the levels of depression, anxiety, and stress specifically of doctors. DASS-21 is widely considered to effectively address the symptoms of depression, anxiety, and stress (32) which indicate the mental health of the general populace rather than a clinical population. Research gaps exist in not examining the fifth wave of COVID-19, application of DASS-21, and specifically not yet targeting the frontline doctors in Pakistan. Therefore, the current study aims to address and consider the connections between these previously unexplored areas by incorporating the DASS-21 to apply this instrument to the frontline doctors of Pakistan during fifth wave of COVID-19.

2. Methods

2.1. Respondent and procedures

An online survey (through Google Forms) was created to capture the responses of frontline doctors who were directly dealing with the COVID-19 patients during the fifth wave in Pakistan. In the scenario of this emergency, limited access due to pandemic measures, and seeking broader reach, we resorted to utilizing a snowball sampling technique and approached a couple of doctors that could be accessed to participate in this study and help recruit others. The survey form was shared with them through different social networking platforms. The consent form clearly stated at the top of the survey that their responses and identities would be kept confidential, and if they feel uncomfortable while filling in the survey that they can leave it at any stage. The overall process of data collection took 3 months: starting from February 2022 and ending in April 2022 (at the time that the fifth was considered over).

Considerations regarding the selected sample size include: First, the recommended, calculated minimum sample size was

10 participants for each scale item. Regardless of the number of items on a scale, at least 210–310 participants are recommended for factor analysis (33). The sample size ($N = 319$) in our study was sufficient according to the ideal ratio of items (10:1). Second, the former relevant studies have considered healthcare workers or professionals (including doctors) as their samples (29–31). Representative size may be questioned, yet the current study has only focused on the frontline doctors compared to the entire medical staff (representation is intentionally limed to this select and important group). Third is the size needed for analysis, whereby structural equation modeling (SEM) requires a minimum of 200 and a maximum of 500 samples for the data analysis regarding the estimation of good results (34). Therefore, the samples ($N = 319$) of this current research were in between these two thresholds and considered adequately suited for final analysis.

2.2. Survey instrument

The survey form was entirely designed in English with two major sections. The first section elicited standard sociodemographic features such as area, gender, age, etc. and for section two, the DASS-21 instrument (35) was adopted to measure the levels of depression, anxiety, and stress of the doctors. Section one was further classified into ten major sociodemographic questions including area, gender, age, marital status, workplace, job title, current area of practice and work. In addition, two questions about the media preference and the consumption of COVID-19 related news on that specific media channel/portal were also included in this section. To assess psychological states, the DASS-21 instrument contains a total of 21 items with 7 items for each of the three dimensions (depression, anxiety, and stress) respectively. Participating medical doctors were encouraged to rate their responses about the current situation which they were facing in the midst of the fifth wave of COVID-19. A four-point Likert type scale was incorporated to capture their responses ranging from 0 (did not apply to me at all) to 3 (applied to me very much) to avoid mid-point non-meaningful responses. The lower scores represent a normal range; however, the higher scores indicate a more severe emotional situation affecting the doctors. This instrument has previously been shown to exhibit very high reliability and validity and used in a very recent study (32). Furthermore, the validity and reliability of DASS-21 during the COVID-19 period have also been confirmed (36). It has robust validity and reliability values. We therefore employed the original and still widely used version of the scale for the current study.

2.3. Statistical analysis

All statistical procedures were first evaluated using the Statistical Package for Social Sciences (SPSS) version 23.0 and later the reliability and validity of DASS-21 were processed by the Analysis of a Moment Structures (AMOS) version 23.0. In SPSS, the descriptive statistics and one-way ANOVA were performed to report the frequency and percentages of all sociodemographic features of the participants and to document the significant

differences among each demographic sub-section. In addition, the individual scores for depression, anxiety, and stress as well as the overall scores of DASS-21 were also evaluated. All essential aspects for testing the reliability and validity of DASS-21 were examined in AMOS.

3. Results

3.1. Respondents' features

In this study, a total of 319 frontline doctors completed the survey form. The sociodemographic details of the respondents are presented in Table 1 (through SPSS). Many frontline doctors belonged to the Pakistan region of Punjab ($N = 155$, 48.6%) and 87.8% of the respondents were young with an age range between 20 and 30. Female doctors heavily dominated the sample set with 73%. Regarding marital status, those separated/divorced participants were minimal (only 1.2% of the sample) and most were single ($N = 227$, 71.2%). In terms of their workplace and job title, 87.8% of the doctors were directly associated with the hospitals and 60.5% were titled as the house officers. Most of them were working in the private sector ($N = 176$, 55.2%) and performing their duties in wards ($N = 143$, 44.8%). Regarding media use, a large majority of doctors ($N = 280$) preferred digital media over newspapers and television. 63% of the frontline doctors reported they consume any form of media for less than an hour daily, mainly to update themselves on news regarding COVID-19, thus can be considered minimal and functional or information-oriented media consumers.

3.2. Levels of depression, anxiety, and stress of frontline doctors

The significant differences regarding the three facets (depression, anxiety, and stress) of DASS-21 among each demographic feature were evaluated based on the one-way ANOVA results. The findings revealed that there were significant differences between the sub-categories of gender ($F = 12.542$, $p < 0.05$; $F = 5.505$, $p < 0.05$; $F = 6.470$, $p < 0.05$), marital status ($F = 3.571$, $p < 0.05$; $F = 6.283$, $p < 0.05$; $F = 4.375$, $p < 0.05$), and job title ($F = 5.069$, $p < 0.05$; $F = 7.110$ $p < 0.05$; $F = 6.390$, $p < 0.05$) of the frontline doctors in reporting depression, anxiety, and stress. In addition, significant differences were also witnessed among the age ($F = 3.368$, $p < 0.05$; $F = 2.825$, $p < 0.05$) and daily media coverage consumption ($F = 8.058$, $p < 0.05$; $F = 3.185$, $p < 0.05$) between the doctors concerning the levels of anxiety and stress. However, the other sub-categories of respondents' profile (i.e., area, workplace, area of practice and others) did not have any statistically significant differences regarding the levels of depression, anxiety, and stress. To highlight these findings, the significant values obtained from one-way ANOVA for depression, anxiety, and stress against every sociodemographic feature are stated in Table 1.

The overall trend (Table 2) of the scores revealed that the frontline doctors were having noticeable symptoms of all three: depression ($N = 232$, 72.7%), anxiety ($N = 224$, 70.2%), and

TABLE 1 Features of respondents and one-way ANOVA results.

Variables		N (%)	Depression		Anxiety		Stress	
			F	p	F	p	F	p
Area	Punjab	155 (48.6)	0.513	0.798	0.286	0.943	0.333	0.919
	Sindh	25 (7.8)						
	KPK	24 (7.5)						
	Baluchistan	9 (2.8)						
	AJK	13 (4.1)						
	Gilgit-Baltistan	2 (0.6)						
	Islamabad (ICT)	91 (28.5)						
Gender	Male	86 (27.0)	12.542	<0.001	5.505	0.020	6.470	0.011
	Female	233 (73.0)						
Age	20–30	280 (87.8)	2.488	0.061	3.368	0.019	2.825	0.039
	31–41	18 (5.6)						
	42–52	13 (4.1)						
	53–63	8 (2.5)						
Marital Status	Single	227 (71.2)	3.571	0.014	6.283	<0.001	4.375	0.005
	Married	88 (27.6)						
	Separated	1 (0.3)						
	Divorced	3 (0.9)						
Workplace	Hospital	280 (87.8)	0.139	0.936	2.205	0.087	2.639	0.050
	Health clinic	28 (8.8)						
	District health office	8 (2.5)						
	State health office	3 (0.9)						
Job Title	House officer	193 (60.5)	5.069	0.007	7.110	0.001	6.390	0.002
	Medical officer	84 (26.3)						
	Specialist	42 (13.2)						
Current area of practice	Public sector	132 (41.4)	1.255	0.263	1.200	0.274	2.299	0.130
	Private sector	187 (58.6)						
Current area of work	Emergency	55 (17.2)	0.520	0.595	0.087	0.917	0.798	0.451
	OPD	121 (37.9)						
	Ward	143 (44.8)						
What is your media preference?	Digital media	280 (87.8)	0.090	0.914	0.831	0.437	0.170	0.844
	Television	35 (11.0)						
	Newspaper	4 (1.3)						
News about COVID-19 (per day)?	<1 h	201 (63.0)	2.588	0.053	8.058	<0.001	3.185	0.024
	1–2 h	76 (23.8)						
	3–4 h	24 (7.5)						
	More than 4 h	18 (5.6)						

stress ($N = 186$, 58.3%). The depression symptoms range among respondents were extremely severe (22.9%), severe (10.7%), moderate (23.8%), and mild (15.4%) respectively. Less intense, the symptoms of anxiety ranged from 8.5% as mild, 14.4% as moderate, 11.6% as severe, and 35.7% as extremely severe in frontline doctors. The participants' reported stress symptoms ranging from 16.3% extremely severe, 17.6% severe, 14.7% moderate, and 9.7% mild. Furthermore, the mean scores for DASS-21 ($M = 51.69$) and its subscales were also calculated to evaluate the exact level of depression ($M = 17.31$), anxiety ($M = 15.24$), and stress ($M = 19.14$) among the frontline doctors. The mean scores highlighted that the frontline doctors of Pakistan were having severe levels of anxiety and moderate levels of depression and stress.

TABLE 2 Levels of depression, anxiety, and stress.

	Depression			Anxiety			Stress		
	Limit	N	%	Limit	N	%	Limit	N	%
Normal	0–9	87	27.3	0-7	95	29.8	0–14	133	41.7
Mild	10–13	49	15.4	8-9	27	8.5	15–18	31	9.7
Moderate	14–20	76	23.8	10-14	46	14.4	19–25	47	14.7
Severe	21–27	34	10.7	15-19	37	11.6	26–33	56	17.6
Extremely severe	28+	73	22.9	20+	114	35.7	34+	52	16.3

TABLE 3 DASS-21 items and loading.

DASS-21 items	Depression	Anxiety	Stress
DN1-I could not seem to experience any positive feeling at all	0.730		
DN2-I found it difficult to work up the initiative to do things	0.716		
DN3-I felt that I had nothing to look forward to	0.789		
DN4-I felt downhearted and blue	0.865		
DN5-I was unable to become enthusiastic about anything	0.850		
DN6-I felt I was not worth much as a person	0.751		
DN7-I felt that life was meaningless	0.743		
AT1-I was aware of dryness of my mouth		0.510	
AT2-I experienced breathing difficulty		0.621	
AT3-I experienced trembling		0.713	
AT4-I was worried about situations in which I might panic and make a fool of myself		0.746	
AT5-I felt I was close to panic		0.800	
AT6-I was aware of the action of my heart in the absence of physical exertion		0.772	
AT7-I felt scared without any good reason		0.827	
ST1-I found it hard to wind down			0.762
ST2-I tended to over-react to situations			0.808
ST3-I felt that I was using a lot of nervous energy			0.853
ST4-I found myself getting agitated			0.835
ST5-I found it difficult to relax			0.801
ST6-I was intolerant of anything that kept me from getting on with what I was doing			0.811
ST7-I felt that I was rather touchy			0.757

3.3. Reliability and validity of the DASS-21

An assessment of DASS-21 was carried out in AMOS, to reconfirm its reliability and validity among the frontline doctors in the context of Pakistan. The process of evaluation was done by considering different approaches such as alpha values, composite reliability (C.R.), confirmatory factor analysis (CFA), construct and convergent validity, and fitness indices in AMOS. The model has fulfilled the minimum required values suggested by the literature (34) regarding CFA (>0.50) and reliability (Table 3). The DASS-21 showed an overall excellent internal consistency reliability (Cronbach's $\alpha = 0.953$, McDonald's $\omega = 0.954$) as well as for its sub-scales such as, Depression (Cronbach's $\alpha = 0.913$, McDonald's $\omega = 0.917$), Anxiety (Cronbach's $\alpha = 0.883$, McDonald's $\omega =$

0.884), and Stress (Cronbach's $\alpha = 0.928$, McDonald's $\omega = 0.928$). Furthermore, for each factor, all the square roots of average variance extracted (AVE) are highlighted in bold and shown (Table 4) to be greater than the coefficients or off-diagonal elements in the corresponding rows and columns, thus establishing evidence of discriminant validity (>0.70).

Table 4 also indicates that the C.R. values for depression (0.915), anxiety (0.881), and stress (0.926) were relatively higher than the minimum limit of acceptance (>0.70). In addition, the values of AVE for depression, anxiety, and stress were 0.608, 0.519, and 0.617 respectively. It reconfirms that the values have crossed the required minimum threshold (>0.50). Lastly, the fitness indices confirmed that the data were well fitted with the measurement model of DASS-21 which indicates the attainment of construct

TABLE 4 Results of validity and reliability.

	α	C.R.	AVE	Depression	Anxiety	Stress
Depression	0.913	0.915	0.608	**0.780**		
Anxiety	0.883	0.881	0.519	0.696***	**0.825**	
Stress	0.928	0.929	0.647	0.761***	0.720***	**0.805**

*** $\rho < 0.001$. Bold values represent the establishing evidence of discriminant validity (>0.70).
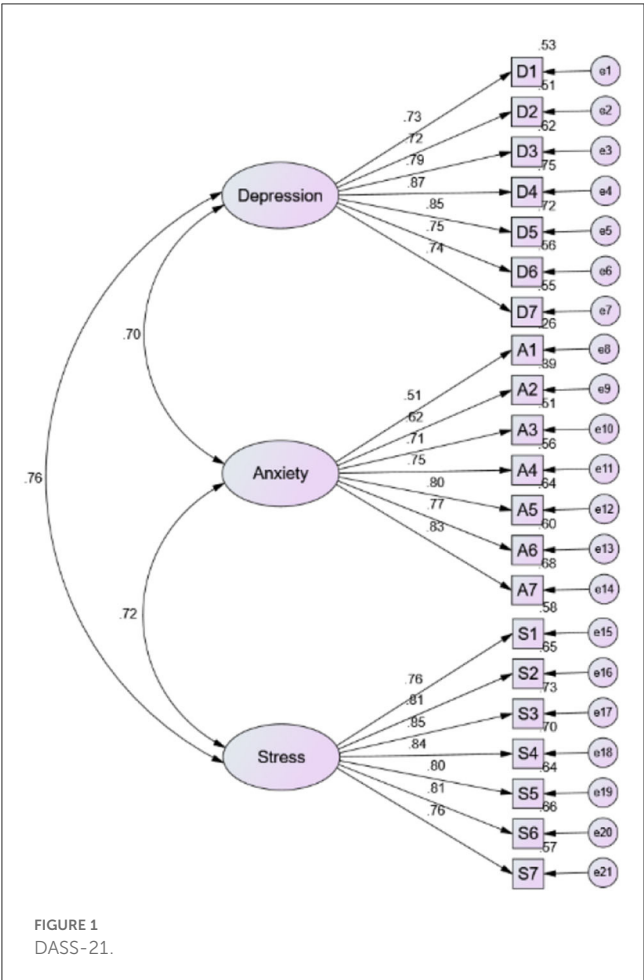
FIGURE 1
DASS-21.

validity: $\chi^2 = 302.015$, $\chi^2/dF = 1.67$, SRMR = 0.040, GFI = 0.920, NFI = 0.937, IFI = 0.973, TLI 0.969, CFI = 0.973, PNFI 0.803, and RMSEA = 0.046 (37, 38). The measurement model of DASS-21 is presented in Figure 1. Therefore, these procedures of instrument testing confirmed that the use of DASS-21 is validated among the frontline doctors in the cultural context of Pakistan.

3.4. Correlations

The correlations between depression, anxiety, and stress were also examined in the current study (Table 4). The findings revealed that depression was positively and significantly correlated with anxiety ($r = 0.696$, $p < 0.001$) and stress ($r = 0.761$, $p < 0.001$). Furthermore, a positive and significant association between anxiety

and stress ($r = 0.720$, $p < 0.001$) was also witnessed from the findings of this present study.

4. Discussion

The study aimed to fill noted gaps to extend pandemic research to document the symptoms and levels of depression, anxiety, and stress among the frontline doctors in Pakistan during the fifth wave of COVID-19, and to validate DASS-21 in the context of Pakistan. Past research in Pakistan tended to focus mainly on HCW but could not be extrapolated to project the special case situation or psychological orientations faced by frontline doctors who had to actively deal with a pandemic that lasted several years and face the unabating needs of COVID-19 patients. Most of the previous research had been carried out during the initial waves of COVID-19 and though contributing much toward general understandings of the psychological effects of a pandemic, had not yet found ways to study the ongoing mental health of frontline doctors, especially during this late stage, in the fifth wave of COVID-19. Most importantly, a well-established scale (DASS-21) had not been previously considered or validated, either in Pakistan or tested for its effectiveness in determining which psychological symptoms arise more prominently in medical or para-medical staff. Therefore, connecting all the above-mentioned limitations, the current study is designed to fill the gaps in the existing literature.

It is evident in this study that 72.7% of doctors were having the symptoms of depression, 70.2% were having anxiety, and 58.3% were dealing with stress arising from the COVID-19 pandemic. The findings revealed that the psychological symptoms reported during the fifth wave of COVID-19 are much higher than the previously documented symptoms had been during the start of pandemic (29). This may be a logical finding from an ongoing pandemic, but has not been studied or confirmed previously, nor the impact expected to this hight degree. In addition, doctors rated moderate levels of depression and stress, but severe levels of anxiety specifically related to COVID-19 issues. The levels are in line with the findings of previous research which reported the severity of anxiety among the HCW in Pakistan (7). It has been reported that the symptoms and levels of depression, anxiety, and stress are more intense over time as compared to the earlier studies (30, 31). In comparison to the normal populace, it seems that mental health of the frontline doctors is seriously affected and considerably worse since the emergence of COVID-19 pandemic, suggesting that their needs may need to be recognized and better dealt with. Even though the treatment system has been improved and multiple vaccines are available and have been administered broadly, medical doctors are still facing psychological challenges.

In terms of the validation of DASS-21, the results of multiple statistical procedures essential for the attainment of reliability and validity of any measurement tool were fulfilled in the current study. There is abundant evidence available in the literature that has confirmed that DASS-21 is a reliable and valid scale for the assessment of depression, anxiety, and stress symptoms among various cultural contexts (32, 35). However, very few studies are available that confirm DASS-21 as a valid measurement tool in the cultural context of Pakistan, and if so, most have been applied to the general public (28) not specifically to the frontline doctors of Pakistan. The findings of this investigation revealed that DASS-21 is a valid and reliable measurement tool to document the depression, anxiety, and stress symptoms of frontline doctors during the fifth wave of COVID-19 on the cultural setting of Pakistan.

Though it has been established that mental health challenges are not limited to ordinary citizens or persons that have already been diagnosed as having mental health diseases, this study shows that those professionals that society relies on most during times of international health crises suffer at higher rates than might be expected. COVID-19 studies have already warned the world that the pandemic will likely have lasting impacts on the masses. The findings of the existing study have reconfirmed their predictions. Continuing in the line of studies that have examined HCW and the medical profession, this study shows even more clearly that even doctors, who are trained to deal with crises and have many such experiences, are not unaffected by its impacts, and in fact, perhaps suffer far more than expected. Pakistan has excellent medical doctor training, and its physicians are expected to perform an important role in the stability of society. Therefore, findings like these on the existence of serious levels of depression, anxiety, and stress among them even (or especially after dealing with several years of this pandemic) cannot be neglected due to the potential adverse effects on the society.

The pandemic may now have subsided, but more research is needed to determine if there are any long-term psychological syndromes that linger among medical professionals. Facing such facts, both policy makers and administrators need to ensure more support and assistance focused on frontline doctors. Their mental health can be improved or maintained primarily through two main bodies: the government and hospitals. The government should focus on providing certain seminars or training sessions for the counseling of their frontline doctors to secure and ensure their mental health. The hospitals and doctors' associations could regularly monitor their mental wellbeing and provide treatments to their HCW. Though effective strategies based on such research findings, Pakistan or other countries with similar conditions might be able to provide better medical conditions and staff support to effectively serve public health needs.

4.1. Limitations

Potential limitations associated with this study include its snowball, cross-sectional design, and inability to explore further effects. The cross-sectional research technique was incorporated as the only viable option under the pandemic conditions and constraints at that time, and the design proved unable to effectively examine the direct cause and effects among different factors. In this study, it was also a limitation that the samples gathered were mostly females (with no clear reasons why fewer male doctors responded), thus gender responses can be explored further, as well as what long-term effects might be noted regarding the mental health of either gender group. The responses are also noted to be time- and situation-sensitive and might change under future conditions, representing a common limitation of survey research. Fourth, the reliability of the participants' answers may be problematic because our study was conducted online. However, online data collection was not just preferable but the only viable option, as the survey was conducted during COVID-19 pandemic measures. Thus, conclusions drawn can only be tentative and generalized to situations like those examined. Future researchers could identify personality and situational factors that might directly be influencing the depression, anxiety, and stress symptoms of the doctors or compare the scores of DASS-21 with other developing or developed countries.

5. Conclusion

The mental wellbeing of the frontline doctors is a necessity for any country or nation during both normal and emergency situations like the COVID-19 pandemic. The current study has shed light on the alarming symptoms and higher-than-expected levels of depression, anxiety, and stress among the frontline doctors who have had to cope with the fifth wave of COVID-19 in Pakistan. Highlighting this issue warrants serious consideration from the government and both public and private hospitals' management. The policy makers in Pakistan or similar countries need to frame new polices to ensure their doctor's wellbeing which can ultimately influence the betterment of health in the society. The present study also validated the established DASS-21 instrument in the cultural context of Pakistan. Future research could seek to identify personality and situational factors that are directly influencing the depression, anxiety, and stress of doctors to consider correlations between factors or moderating variables. More studies targeting the long-term impacts of COVID-19 and the post-pandemic situation on the mental health of doctors or other health care populations will be beneficial for a greater understanding concerning the nature and influences of these past and 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 studies involving human participants were reviewed and approved by the Institutional Ethics Review Committee of the SISU Intercultural Institute (SII), Shanghai International Studies University (SISU), China (2022-SII/IRB-0103). The patients/participants provided their written informed consent to participate in this study.

Author contributions

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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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Effects of dynamic zero COVID-19 policy on anxiety status and lifestyle changes of pregnant women in rural South China: a survey-based analysis by propensity score matching method

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Introduction: The coronavirus disease 2019 (COVID-19) pandemic triggered a global public health crisis and has brought an unprecedented impact on pregnant women. The problems faced by pregnant women in the rural areas of China during the epidemic are different from those in urban areas. Although the epidemic situation in China has gradually improved, studying the impact of the previous dynamic zero COVID-19 policy on the anxiety status and lifestyle of pregnant women in rural areas of China, is still necessary.

Methods: A cross-sectional survey of pregnant women in rural South China was conducted from September 2021 to June 2022.Using questionnaires, sociodemographic characteristics, anxiety status, physical activity, sleep quality, and dietary status of the population were collected. Using the propensity score matching method, the effect of the dynamic zero COVID-19 strategy on the anxiety status and lifestyle of pregnant women was analyzed.

Results: Among the pregnant women in the policy group (*n*=136) and the control group (*n*=680), 25.7 and 22.4% had anxiety disorders, 83.1 and 84.7% had low or medium levels of physical activity, and 28.7 and 29.1% had sleep disorders, respectively. However, no significant difference (*p* >0.05) was observed between the two groups. Compared with control group, the intake of fruit in the policy group increased significantly (*p* =0.019), whereas that of aquatic products and eggs decreased significantly (*p* =0.027). Both groups exhibited an unreasonable dietary structure and poor compliance with the Chinese dietary guidelines for pregnant women (*p* >0.05). The proportion of pregnant women in the policy group, whose intake of stable food (*p* = 0.002), soybean, and nuts (*p* =0.004) was less than the recommended amount, was significantly higher than that in the control group.

Discussion: The dynamic zero COVID-19 strategy had little impact on the anxiety status, physical activity, and sleep disorders of pregnant women in the rural areas of South China. However, it affected their intake of certain food groups. Improving corresponding food supply and organized nutritional support should be addressed as a strategic approach to improve the health of pregnant women in rural South China during the pandemic.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic triggered a global public health crisis and has brought an unprecedented impact on the health, economy, and society on the entire human population (1). According to the statistics published on the WHO website, as of December 2022, the number of patients with COVID-19 worldwide reached 730 million, with a mortality rate of over 0.92% (2). With the global spread of the epidemic, its harm to people was no longer limited to the direct impact of the virus itself, but also included the health impacts of psychological changes, medical delays, reduced exercise, and other changes caused by the epidemic. Pregnancy is a special stage in a woman's life. Studies showed that, compared with non-pregnant women, pregnant women infected with COVID-19 had a higher risk of entering the ICU and receiving mechanical ventilation (3, 4) and were associated with an increased risk of maternal and neonatal complications, such as preeclampsia, miscarriage, preterm birth, intrauterine growth restriction, and fetal distress (5, 6). So far, the direct threat of COVID-19 to pregnant women's health has been widely concerned, but its indirect threat to pregnant women still needs further evaluation. Due to changes in hormones, concerns about fetal growth, and fear of pain caused by childbirth, the emotional sensitivity of pregnant women (especially primiparous women) fluctuates greatly. Studies have found that problems such as the risk of COVID-19 infection, inconvenience of medical services, and irritability induced by access being limited to the home aggravated the anxiety of pregnant women and even increased mental illness prevalence (7, 8). This epidemic also significantly affected their physical activity, sleep, and diet, which further affected maternal and infant health (9). For example, studies in Japan and Poland have found that the pandemic may have affected the physical activity level or even accelerated physical inactivity (9, 10). Because of the decrease in activity time, sleep rhythm disorders occurred, and the risk of sleep disorders increased (11). Some studies comparing the dietary consumption of pregnant women before and during the COVID-19 pandemic have shown that the intake of vegetables, fruits, dairy products, fish, and legumes decreased (1, 9).

The rural population of China is huge (approximately 500 million) (12). Compared with cities with large population mobility, rural areas have a relatively fixed population, which is advantageous for epidemic prevention and control. In the early stage, average COVID-19 infection rates were lower in rural areas than in urban areas. However, with the spread of the epidemic, COVID-19 had hit rural residents considerably harder than urban residents (13). In rural areas, information is not available in time, medical resources are scarce, and medical conditions are worse compared with those in cities (14, 15). Houses in rural areas are scattered and the roads extend in all directions. Therefore, implementing blockade and quarantine measures in rural areas is not as convenient as in urban areas. Because of the low health literacy level and weak awareness of prevention, rural people wear masks considerably less frequently than urban residents (16). In addition, the shops in rural areas are relatively limited. Many shops are closed during the epidemic, and people have no suitable goods to choose from (9). Based on these particularities, studying the changes in the psychology, physical activity, sleep, and diet of pregnant women in rural China during the epidemic is necessary. However, the relevant research is relatively limited.

With an increase in vaccine coverage and the availability of specific drugs, the epidemic prevention and control measures in China have been adjusted. From August 2021, the dynamic zero COVID-19 policy of full-chain precise prevention and control has been adopted. When COVID-19 cases occur, effective and comprehensive prevention and control measures will be taken to quickly cut off the transmission chain of the epidemic, so that each epidemic can end in time, the number of infected people will be "zero ", and the maximum effect will be achieved at the lowest cost (17, 18). The specific measures include three aspects: first, timely and active detection of the infection source, mainly by mon-itoring the early warning of fever clinics and by using some rapid detection and screening methods, such as antigen and nucleic acid detection, after the collection of nasal and throat swabs. Second, when cases are found, public health and social intervention measures need to be taken quickly, including control of the outbreak point, management of close contacts, epidemiological investigation, and reduction of crowd gathering. Third, patients must be effectively treated, mainly by combining traditional Chinese and western medicine therapies, thus aiming to immediately stop the progress of the epidemic, prevent the disease from worsening, and reduce the occurrence of severe cases and death (19).

Although Chinese people have gradually returned to normal life, whether the dynamic zero COVID-19 policy has affected the psychological, physical activity, sleep, and diet of pregnant women in the rural areas of China remains to be explored. Because the pandemic is not over yet, people may still follow certain behaviors to deal with COVID-19. We here conducted a cross-sectional survey on some pregnant women in rural South China and analyzed the effect of the dynamic zero COVID-19 strategy on the anxiety status and lifestyle of pregnant women based on the propensity score matching (PSM) method.

2. Methods

2.1. Study design and participants

This cross-sectional survey was conducted from September 2021 to June 2022 (the stage of the dynamic zero COVID-19 policy). The South China region is one of the seven major geographical regions in China, including Guangdong Province, Guangxi Zhuang Autonomous Region, Hainan Province, Hong Kong Special Administrative Region, and Macau Special Administrative Region. A multi-stage sampling method was employed to enroll the study participants. In the first stage, Guangdong Province and Guangxi Zhuang Autonomous Region were selected as representatives according to the geographical location and convenience of implementation. In the second stage, each province (or autonomous region) was divided into urban and rural areas. Finally, two maternal and child health care institutions were randomly selected from the rural areas of each province (or autonomous region). Pregnant women aged 18–49 who had resided locally for more than 12 months were recruited at these hospitals. Women with speech communication difficulties or mental disorders were excluded. All women provided their signed informed consent. The study was approved by the Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology (No. 2021-S092).

2.2. Data collection and measures

In order to study the impact of the previous dynamic zero COVID-19 policy on the anxiety status and lifestyle of rural pregnant women, they were divided into policy group and control group. According to the government risk area demarcation, pregnant women with overlapping home addresses and risk areas were in the policy group and the remaining were in the control group. Pregnant women in the policy group obeyed the rules of the dynamic zero COVID-19 policy. None of the two groups were infected with COVID-19. The data on demographic characteristics, anxiety, physical activity, and sleep quality were collected through a face-to-face questionnaire survey, and the dietary status of pregnant women were evaluated using a semi-quantitative food frequency questionnaire (FFQ). Of the original sample, 1,386 pregnant women were included. In order to eliminate the influence of confounding factors on the study results, we employed the nearest neighbor matching of the PSM method (20) based on the caliper value <0.02. The covariate factors used for matching included the pregnancy stage, age, ethnicity, education, income, and parity. Owing to the difficulties in the survey of pregnant women in the risk area and to improve the statistical power, a 1: 5 matching method was adopted. Finally, 136 women (16.7%) in the policy group and 680 women (83.3%) in the control group were enrolled. The covariates were balanced after matching, and the differences in the sociodemographic characteristics between the two groups before and after matching are presented in Table 1.

2.2.1. Questionnaires used to collect anxiety status, physical activity, and sleep quality

The Self-rating Anxiety Scale (SAS) used in this study was developed by Zung in 1971 (21) to assess the anxiety status of pregnant women in the past week. The correlation coefficient between this scale and the Hamilton Self-Rating Anxiety Scale was 0.37 (22). SAS consisted of 20 items. According to the frequency of symptoms, each item was categorized into 4 grades. Among them, 15 were positive scores and 5 were negative scores. The sum of the scores of 20 items was the total rough score, and the latter was multiplied by 1.25, which was the total standard score. In this study, a total standard score < 50 was considered to indicate a normal condition, and a total standard score ≥ 50 was considered to indicate anxiety disorder, among which the score of 50–62 was considered to indicate mild anxiety disorder, while a score > 62 was considered to indicate a severe anxiety disorder (23).

The short version of the International Physical Activity Questionnaire (IPAQ) was applied to measure the physical activity level of pregnant women in the past week. The questionnaire consisted of 7 items related to the frequency and duration of weekly walking, moderate-intensity, and vigorous-intensity physical activities. The reliability and validity of the Chinese version of IPAQ were tested. The reliability coefficient was found to be 0.66–0.89, and the validity coefficient was 0.60–0.78 (24). In this study, ac-cording to the energy requirements defined in metabolic equivalent (MET), these ac-tivities were weighted to generate a MET-minute score, which was then computed by multiplying the MET score with the minutes performed (walking = 3.3 METs, moderate activity = 4.0 METs, and vigorous activity = 8.0 METs). The total physical activity level (MET-min/week) of pregnant women was calculated and then divided into low, medium, and high intensities (25).

The Pittsburgh Sleep Quality Index (PSQI) proposed by Buysse (26) in 1989 was referred to evaluate the sleep quality of pregnant women in the past month. The reliability and validity of the Chinese version of PSQI were tested in Chinese adults, and the results indicated that the split-half reliability coefficient was 0.82 and the overall Cronbach's α-coefficient was 0.85 (27). In this study, PSQI consisted of 18 self-reported items, which were divided into 7 subcategories, as given below: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each subcategory was scored 0–3. The total PSQI score ranged from 0 to 21, with higher scores indicating poorer sleep quality. PSQI ≤4 (good sleep), 4< PSQI <8 (general sleep), and PSQI ≥8 (sleep disorders) served as the criteria for judging sleep quality (28).

2.2.2. Food intake questionnaire and dietary data analysis

A semi-quantitative FFQ was used to investigate the dietary status of pregnant women in the past month. This FFQ includes the following 3 portions: the food list, the frequency of eating a certain food, and the amount of each consumption. There were 61 items on the food list, which were then divided into the following 13 categories: staple food (cereals and their products, potatoes, and beans other than soybeans); vegetables; fruits; livestock meat and poultry; aquatic products (fish, shrimp, and shellfish); eggs; milk and its products; soybean and its products; nuts; cooking oil; processed food; flavorings; beverages. It was specially designed for pregnant women and was validated against three 24-h dietary recalls. For foods, the intraclass correlation coefficients of two administrations of FFQ ranged from 0.23 (nuts) to 0.49 (fruits), and the energy-adjusted and de-attenuated correlation coefficients between the 2 methods ranged from 0.35 (beans) to 0.56 (fruits) (29). To improve the accuracy of food-weight estimation, tableware and the food atlas developed by our research team were integrated into the dietary intake recall (30).

The raw data on the amount of food was input into EpiData software for verification. The daily food intake of each group was then calculated. The food intakes of the 9 main food groups (i.e., staple food; vegetables; fruits; livestock meat and poultry; aquatic products; eggs; milk and its products; soybean and its products; nuts) were compared with the recommended intakes of the Chinese balanced dietary pagoda for pregnant women (31). The number of pregnant women within and out of the recommended intake ranges was recorded. The Chinese Dietary Guidelines Compliance Index for Pregnant Women (CDGCI-PW) was further used to assess the overall dietary status of pregnant women. This index was developed by our research group (32) and included 13 components, with a total score of 100 points. The CDGCI-PW score reflected the compliance of the pregnant women with the Chinese dietary guidelines for pregnant women. The higher the CDGCI-PW score, the better the dietary quality.

2.3. Statistical analysis

SPSS V.24 was used for statistical analysis. Normally distributed continuous variables were expressed as the mean ± standard deviation (SD) and compared via Student's *t*-test. Non-normally distributed continuous variables were ex-pressed as median (interquartile range)

TABLE 1 Sociodemographic characteristics of pregnant women before and after propensity score matching.

Characteristics	Before matching			After matching		
	Policy (n=136)	Control (n=1,250)	p	Policy (n=136)	Control (n=680)	p
Pregnancy stage			0.873			0.750
First trimester, n (%)	42 (30.9)	407 (32.6)		42 (30.9)	227 (33.4)	
Second trimester, n (%)	51 (37.5)	442 (35.4)		51 (37.5)	233 (34.3)	
Third trimester, n (%)	43 (31.6)	401 (32.0)		43 (31.6)	220 (32.3)	
Age (years), mean ± SD	29.7 ± 5.9	28.8 ± 5.1	0.088	29.7 ± 5.9	29.4 ± 5.2	0.631
Height (cm), mean ± SD	156.3 ± 4.6	156.5 ± 5.0	0.696	156.3 ± 4.6	156.6 ± 4.9	0.572
Pre-pregnancy BMI (kg/m²), mean ± SD	20.9 ± 2.9	21.0 ± 3.4	0.511	20.9 ± 2.9	21.0 ± 3.3	0.685
Current BMI (kg/m²), mean ± SD	23.5 ± 3.3	23.4 ± 3.7	0.576	24.8 ± 3.6	23.0 ± 3.5	0.140
Ethnicity			<0.001			0.628
Han, n (%)	82 (60.3)	933 (74.6)		82 (60.3)	425 (62.5)	
Minority, n (%)	54 (39.7)	317 (25.4)		54 (39.7)	255 (37.5)	
Educational level			0.068			0.898
Junior high school and below, n (%)	54 (39.7)	599 (47.9)		54 (39.7)	274 (40.3)	
Junior high school above, n (%)	82 (60.3)	651 (52.1)		82 (60.3)	406 (59.7)	
Occupation			0.911			0.798
Housewife, n (%)	83 (61.0)	769 (61.5)		83 (61.0)	407 (59.9)	
Working, n (%)	53 (39.0)	481 (38.5)		53 (39.0)	273 (40.1)	
Monthly income (RMB)			0.129			0.282
<3,000, n (%)	64 (47.1)	504 (40.3)		64 (47.1)	286 (42.1)	
≥3,000, n (%)	72 (52.9)	746 (59.7)		72 (52.9)	394 (57.9)	
Parity			0.622			0.612
Primiparous, n (%)	55 (40.4)	533 (42.6)		55 (40.4)	291 (42.8)	
Multiparous, n (%)	81 (59.6)	717 (57.4)		81 (59.6)	389 (57.2)	

SD, standard deviation; BMI, body mass index.

and analyzed by the Mann–Whitney U-test. Categorical variables were expressed as frequency (n) and percentage (%) and analyzed using the Chi-square test or Mann–Whitney U-test. $p < 0.05$ was considered to indicate a statistically significant difference.

3. Results

3.1. Sociodemographic characteristics of pregnant women

As shown in Table 1, before PSM, a significant difference in ethnic distribution was observed between the policy and control groups. After PSM, no statistically significant difference in baseline characteristics was observed between the two groups, indicating that the propensity scores were well-matched. In total, 816 pregnant women (mean age: 29.5 ± 5.5 years, mean height: 156.4 ± 5.1 cm, mean current body mass index (BMI): 23.3 ± 3.6 kg/m²) were included in the analysis. Among them, 34.8 and 32.2% of pregnant women were in the second and third trimesters, respectively. Of the pregnant women, 62.1% were Han nationality, 59.8% had an education level above junior high school, 60.0% were housewives, 46.3% had a *per capita* income of 3,000 yuan/month or more, and 57.6% were multiparous.

3.2. Anxiety status, physical activity, and sleep quality of pregnant women

The SAS scores of the policy and control groups were 46.3 ± 6.0 and 45.6 ± 5.4, respectively. In the two groups, 34 (25.0%) and 150 (22.1%) pregnant women had mild anxiety disorder, while 1 (0.7%) and 2 (0.3%) pregnant women had severe anxiety disorder (Table 2). Further statistical analysis revealed no significant difference in anxiety status between the two groups ($p = 0.771$ and $p = 0.380$).

The physical activity scores of the policy and control groups were 1942.8 ± 1521.4 MET-min/week and 1952.3 ± 1563.2 MET-min/week, respectively, and there was no statistically significant difference between the two groups ($p = 0.213$). After being divided into different intensities based on scores, there were 40 (29.4%) and 156 (22.9%) pregnant women with low levels of physical activity, and 73 (53.7%) and 420 (61.8%) pregnant women with medium levels of physical activity in the policy group and control groups, respectively, with no statistically significant difference ($p = 0.371$).

The PSQI scores of the policy and control groups were 6.0 ± 3.1 and 6.1 ± 3.4, respectively, and 39 (28.7%) and 198 (29.1%) pregnant women in the two groups had sleep disorders, respectively. Statistical analysis showed that there was no significant difference in the PSQI

score and prevalence of sleep disorders between the two groups ($p = 0.948$ and $p = 0.897$).

3.3. Food intake of pregnant women

As shown in Table 3, compared with the control group, fruit intake in the policy group was significantly increased (300.0 > 260.0 g/day, $p = 0.019$), whereas the intake of aquatic products (30.6 < 41.6 g/day, $p = 0.027$) and eggs (28.6 < 34.3 g/day, $p = 0.034$) decreased significantly. The intake of other food groups, namely staple foods, vegetables, livestock meat and poultry, milk and its products, soybean and its products, and nuts, was not statistically significant between the two groups ($p > 0.05$).

In comparison with the corresponding recommended intake in the Chinese balanced dietary pagoda for pregnant women, the dietary structure of both groups was found to be unreasonable. As shown in Table 4, the main problems were concentrated in the large proportion of pregnant women with insufficient intake of milk and its products, soybean, and nuts. Moreover, statistical analysis revealed that the proportion of pregnant women in the policy group who consumed less than the recommended amounts of stable food ($p = 0.002$), soybean, and nuts ($p = 0.004$) was statistically higher than that in the control group. The intakes of other food groups, namely vegetables, fruits, livestock meat and poultry, aquatic products and eggs, and milk and its products, were not statistically significant between the two groups ($p > 0.05$).

The CDGCI-PW score represented the overall dietary status of pregnant women. The mean CDGCI-PW scores of the policy and control groups were 54.9 and 55.9, respectively, both lower than 60. This indicated poor compliance of pregnant women with the Chinese dietary guidelines for these women. Furthermore, statistical analysis exhibited no significant difference between the two groups ($p = 0.392$).

4. Discussion

This study provides snapshots of the anxiety status, physical activity, sleep quality, and dietary status of pregnant women in the rural areas of Guangdong Province and Guangxi Zhuang Autonomous Region from September 2021 to June 2022 (the stage of the dynamic zero COVID-19 policy). As per our understanding, this study is the first to investigate the direct impact of the dynamic zero COVID-19 policy on the anxiety status and lifestyle of pregnant women in rural South China.

The COVID-19 pandemic has undoubtedly resulted in many changes in the life of pregnant women. Paying attention to the impact of prevention and control measures on their life status is also necessary (33). After confounding factors such as maternal age, pre-pregnancy BMI, and chronic history were adjusted, Giesbrecht et al. found that the epidemic increased the incidence of anxiety and depression among Canadian pregnant women (OR = 2.04, $p < 0.001$) (34). In our study of rural South China, 25.7 and 22.4% of pregnant women in the two groups had anxiety disorders, respectively. This proportion was significantly lower than that of fear, anxiety, and depression related to COVID-19 in the Chinese population at the beginning of 2020 (29.6%) (35), which is also lower than that of studies in Canada (56.6%) and Ethiopia (42.1%) (36, 37). The main reason for this phenomenon mainly because infection and mortality rates were significantly reduced towing to the prevention and control measures, such as lockdown and vaccination. You Chuan et al. found that 53.6% of pregnant women in Beijing did not exercise during the epidemic, and only one-fifth of them exercised for 20–60 min every day (38). Unlike pregnant women in urban areas, such as in Beijing, in our study, 29.4 and 22.9% of the pregnant women in the policy and control groups in the studied rural areas had a lower physical activity level, which was close to the physical activity level of rural residents in China (39). A study in Debre Berhan Town, Ethiopia, found that 63% of pregnant women had poor sleep quality during the epidemic, which

TABLE 2 Comparison of the anxiety status, physical activity, and sleep quality of pregnant women between the two study groups.

Lifestyles	Item	Policy ($n=136$)	Control ($n=680$)	p
Anxiety status	SAS score, mean ± SD	46.3 ± 6.0	45.6 ± 5.4	0.771
	Anxiety levels, n (%)			0.380
	Normal	101 (74.3)	528 (77.6)	
	Mild	34 (25.0)	150 (22.1)	
	Severe	1 (0.7)	2 (0.3)	
Physical activity	Physical activity score, MET-min/week, mean ± SD	1942.8 ± 1521.4	1952.3 ± 1563.2	0.213
	Physical activity levels, n(%)			0.371
	Low	40 (29.4)	156 (22.9)	
	Medium	73 (53.7)	420 (61.8)	
	High	23 (16.9)	104 (15.3)	
Sleep quality	PSQI score, mean ± SD	6.0 ± 3.1	6.1 ± 3.4	0.948
	Sleep Quality, n (%)			0.897
	Good	48 (35.3)	249 (36.6)	
	General	49 (36.0)	233 (34.3)	
	Sleep disorders	39 (28.7)	198 (29.1)	

SAS, Self-rating Anxiety Scale; SD, standard deviation; MET: Metabolic Equivalent Task; PSQI, Pittsburgh Sleep Quality Index.

was mainly a result of sleep rhythm disorder and psychological problems (40). In our study, the proportion of sleep disorders among pregnant women was considerably lower, accounting for only approximately 29% in both the policy and control groups. The study results showed that the dynamic zero COVID-19 policy led to no

TABLE 3 Comparison of food intake (g/day) of the pregnant women between the two study groups.

Food groups	Policy (n=136)	Control (n=680)	p
Staple food	258.3 (223.6, 280.5)	268.9.0 (216.4, 336.2)	0.152
Vegetables	408.1 (284.8, 527.1)	373.3 (250.0, 500.0)	0.057
Fruits	300.0 (200.0, 450.0)	260.0 (180.0, 385.7)	0.019
Livestock and poultry	88.9 (50.7, 137.0)	85.8 (57.1, 154.3)	0.345
Aquatic products	30.6 (7.1, 71.4)	41.6 (16.0, 71.4)	0.027
Eggs	28.6 (14.3, 50.0)	34.3 (16.7, 50.0)	0.034
Milk and its products	114.0 (17.0, 250.0)	142.9 (8.6, 250.0)	0.379
Soybean and its products	10.0 (2.3, 16.1)	10.0 (4.3, 17.6)	0.097
Nuts	2.6 (0.0, 10.0)	4.0 (0.0, 17.1)	0.106
CDGCI-PW	54.9 ± 12.5	55.9 ± 13.2	0.392

CDGCI-PW, Chinese Dietary Guidelines Compliance Index for Pregnant Women. Data are presented as median (P25; P75).

significant increase in the incidence of anxiety disorders, low physical activity, and poor sleep quality in pregnant women. The implementation of this policy in rural South China was relatively optimistic. A previous study conducted in the urban areas of Greece revealed that pregnant women were most worried about the lack of stability in their living conditions, the economic pressure of the epidemic on their families, and missed social activities because of the imposed restrictions (5). The living conditions of pregnant women in rural South China were relatively stable (41, 42). Under the dynamic zero COVID-19 policy, their economic income and social activities were not particularly affected. In addition, some pregnant women received remote guidance from obstetricians through the network, which also ensured access to maternal health care with the lowest exposure risk (43).

The current impact of the COVID-19 itself and its prevention and control measures on the diet (food type and quantity) of pregnant women is inconsistent. For example, a longitudinal cohort study indicated that the more severe the epidemic, the less the average daily intake of vegetables, fruits, livestock meat, dairy products and nuts by pregnant women (44). However, a few studies have found that the consumption of grains, fruits, vegetables, and dairy products by pregnant women during the epidemic increased significantly compared with that before the epidemic (45). Meanwhile, some researchers have found that changes in the food intake of pregnant women were not associated with the epidemic lockdown (46). In our study, the fruit in-take of the policy group significantly increased, whereas the intake of aquatic products decreased significantly. This was possible because the landform of the rural South China involved in this study was

TABLE 4 Comparison of the recommended values and the actual food intake by pregnant women from the policy and control groups, n (%).

Food groups	Policy (n=136)			Control (n=680)			p	Rec, g/d
	Below rec[a]	Rec[b]	Above rec[c]	Below rec[a]	Rec[b]	Above rec[c]		
Staple food	60 (44.1)	57 (41.9)	19 (14.0)	258 (37.9)	198 (29.1)	224 (33.0)	0.002	Frist trimester 250 ~ 300 Second trimester 275 ~ 325 Third trimester 300 ~ 350
Vegetables	38 (27.9)	57 (41.9)	41 (30.2)	234 (34.4)	290 (42.6)	156 (23.0)	0.055	Frist trimester 300 ~ 500 Second trimester 300 ~ 500 Third trimester 300 ~ 500
Fruits	58 (42.6)	52 (38.2)	26 (19.2)	300 (44.1)	257 (37.8)	123 (18.1)	0.723	Frist trimester 200 ~ 350 Second trimester 200 ~ 400 Third trimester 200 ~ 400
Livestock, poultry, aquatic products and eggs	62 (45.6)	32 (23.5)	42 (30.9)	274 (40.3)	159 (23.4)	247 (36.3)	0.192	Frist trimester 130 ~ 180 Second trimester 150 ~ 200 Third trimester 200 ~ 250
Milk and its products	118 (86.8)	18 (13.2)	0	560 (82.4)	103 (15.1)	17 (2.5)	0.179	Frist trimester 300 Second trimester 300 ~ 500 Third trimester 300 ~ 500
Soybean and nuts	108 (79.4)	1 (0.7)	27 (19.9)	462 (67.9)	10 (1.5)	218 (30.6)	0.004	Frist trimester 25 Second trimester 30 Third trimester 30

Rec: recommended value.
[a]Below rec: the number and percentage of pregnant women whose food intakes were lower than the recommended value.
[b]Rec: the number and percentage of pregnant women whose food intakes were within the recommended value.
[c]Above rec: the number and percentage of pregnant women whose food intakes were higher than the recommended value.

mainly mountainous and hilly, which are rich in fruits. Therefore, these pregnant women could conveniently access fruits. Moreover, the time of our survey did not include summer. The weather was suitable and it was easy to store fruits. However, the local supply of fish, shrimp, shellfish, and other aquatic products was not sufficient. Under the dynamic zero COVID-19 policy, their supply was affected by the logistics blockage. Furthermore, the COVID-19 virus is often detected in aquatic products requiring cold-chain transportation (47). Therefore, pregnant women may also worry about the risk of infection, which thus reduces the intake of aquatic products. Therefore, providing corresponding food supply and organized nutritional support in these rural areas during the future epidemic can be advocated. Different from previous studies (34, 48, 49), our study further evaluated the impact of COVID-19 itself and its prevention and control measures on the dietary quality of pregnant women. The results revealed that the dietary structure of pregnant women in rural South China was unreasonable, and their compliance with the Chinese dietary guidelines for pregnant women was also poor. The epidemic control policy in this study, the dynamic zero COVID-19 policy, had little impact on the overall diet structure of pregnant women. There is an urgent need to provide education on scientific diet and moderate physical activity for pregnant women in these areas of South China to ensure reasonable nutrition intake and weight gain during pregnancy.

This study also had some limitations. First, this study was a cross-sectional survey, so all inferences about causality need to be made cautiously and only associations can be recognized. Second, retrospective questionnaires were used to obtain the data regarding the anxiety status, physical activity, sleep quality, and food intake of pregnant women, which had a certain recall bias. Third, the difficulty of conducting a survey in risk areas had resulted in a relatively small sample size of this study, which may affect the statistical power and precision of the results. Fourth, due to the wide differences in the geographical environment, climate, customs, and medical service levels in different regions of China, our study only investigated pregnant women in the rural areas of Guangdong Province and Guangxi Zhuang Autonomous Region, which do not rep-resent the whole of China. Large sample size studies in additional areas are required to provide more powerful evidence for the impact of COVID-19 on the physical and mental health and lifestyle of pregnant women in China.

5. Conclusion

In conclusion, the current epidemic situation in China has greatly improved, but we, especially pregnant women, should not relax our vigilance because they are in a very important physiological stage, and more attention should be paid to the health status and behavior of pregnant women. According to our study, the dynamic zero COVID-19 strategy had little impact on the anxiety status, physical activity, and sleep disorders of pregnant women in the rural areas of South China, but it affected their intake of some food groups. Our results may help provide information for targeted public health strategies to support pregnant women in rural South China during the current epidemic and other similar future public health crises.

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 Tongji Medical College, Huazhong University of Science and Technology (No. 2021-S092). The patients/participants provided their written informed consent to participate in this study.

Author contributions

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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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eHealth literacy was associated with anxiety and depression during the COVID-19 pandemic in Nigeria: a cross-sectional study

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Background: Electronic health (eHealth) literacy may play an important role in individuals' engagement with online mental health-related information.

Aim: To examine associations between eHealth literacy and psychological outcomes among Nigerians during the Coronavirus disease-2019 (COVID-19) pandemic.

Methods: This was a cross-sectional study among Nigerians conducted using the 'COVID-19's impAct on feaR and hEalth (CARE) questionnaire. The exposure: eHealth literacy, was assessed using the eHealth literacy scale, and psychological outcomes were assessed using the PHQ-4 scale, which measured anxiety and depression; and the fear scale to measure fear of COVID-19. We fitted logistic regression models to assess the association of eHealth literacy with anxiety, depression, and fear, adjusting for covariates. We included interaction terms to assess for age, gender, and regional differences. We also assessed participants' endorsement of strategies for future pandemic preparedness.

Results: This study involved 590 participants, of which 56% were female, and 38% were 30 years or older. About 83% reported high eHealth literacy, and 55% reported anxiety or depression. High eHealth literacy was associated with a 66% lower likelihood of anxiety (adjusted odds ratio aOR, 0·34; 95% confidence interval, 0·20−0·54) and depression (aOR: 0·34; 95% CI, 0·21−0·56). There were age, gender, and regional differences in the associations between eHealth literacy and psychological outcomes. eHealth-related strategies such as medicine delivery, receiving health information through text messaging, and online courses were highlighted as important for future pandemic preparedness.

Conclusion: Considering that mental health and psychological care services are severely lacking in Nigeria, digital health information sources present an opportunity to improve access and delivery of mental health services. The different associations of e-health literacy with psychological well-being between age, gender, and geographic region highlight the urgent need for targeted interventions for vulnerable populations. Policymakers must prioritize digitally backed interventions, such as medicine delivery and health information

dissemination through text messaging, to address these disparities and promote equitable mental well-being.

1. Introduction

Coronavirus Disease 2019 (COVID-19) pandemic has had a considerable impact on physical and psychosocial health (1). and is an emerging risk factor for chronic diseases such as hypertension, diabetes mellitus, cardiovascular disease, and chronic kidney disease (2), including debilitating post-acute sequelae of COVID-19 (3, 4). While COVID-19 adversely impacts physical health, a range of psychological issues has been linked to the pandemic as both direct and indirect impacts. The prevalence of psychological stress, insomnia, and psychological distress following COVID-19 has been reported to be between 20% and 30% globally (5). Similarly, in Nigeria, various studies have reported a range of psychological issues among Nigerians during the pandemic, including anxiety, depression, insomnia and inadequate social support (6–9). Risk factors associated with increased psychological distress during the pandemic include younger age group (≤40 years), female gender, previous mental health problems, unemployment, student status, and frequent exposure to social media or news related to COVID-19 (10).

Electronic health (eHealth) includes health-related services and information delivered or enhanced through the internet or related health technologies (11), including the capacity to evaluate health information obtained from electronic sources and use what is learned to address or resolve a health issue (12). The COVID-19 pandemic has increased global eHealth and mobile health (mHealth) usage alongside substantial increases in screen time (13). In Nigeria, the use of digital devices significantly increased during the COVID-19 pandemic (14). Nigeria has the largest mobile market in Africa, with 199.6 million mobile connections as of March 2022 (15); hence, mobile phones have been a resource for seeking health information in Nigeria as well as in many low and middle-income countries (16).

COVID-19 poses critical challenges to the utility of eHealth literacy, for which the World Health Organization and other agencies warned strongly against infodemics; "an overabundance of information and rapid spread of misleading and fabricated news, images, and videos, which, like the virus, is highly contagious, grows exponentially, and undermines public health measures and leads to unnecessary loss of life" (17). The exceptionally high volume and rapid evolution of COVID-19 pandemic-related information, with a proliferation of misinformation and disinformation, contributed to widespread public confusion and can have severe and lethal health and social consequences, further eroding trust in science (18). There have been speculations that these could contribute to increased anxiety, psychological stress, suicidal ideation, and worsened mental health (19). However, high eHealth literacy also offers opportunities for rapid dissemination of information and may contribute to assured safety and help people make better health-related decisions (20).

Healthy eHealth literacy and internet use may be linked to better psychological wellbeing. Previous reports have shown reports of a negative correlation between eHealth literacy and depression, insomnia, and post-traumatic disorder (21). Improving eHealth literacy has been recommended to address psychological distress (22). The mental health of Nigerians was adversely affected during the pandemic (9, 23). With the high internet and social media use in Nigeria, examining eHealth literacy during the COVID-19 pandemic and its contribution to psychological outcomes is important. This is vital to planning and preparedness for communication and mitigation strategies in future pandemics or crises. Hence, this study aimed to: assess the associations between eHealth literacy and psychological outcomes among Nigerians during the COVID-19 pandemic; examine the effect modification of age, gender, and geographic differences on these associations; and investigate residents' preferences for future preparations.

We hypothesized that there would be no significant association between eHealth literacy and anxiety, depression, and fear of COVID-19, after adjusting for age, gender, education and employment.

2. Methods

2.1. Study design and population

This cross-sectional study was conducted in Nigeria as part of a larger international cross-sectional study on societal perceptions of COVID-19's impact and preferences for future preparations. As cross-sectional designs help gain insight into population characteristics and behaviors at a given time (24), it was deemed fit for this study as the researchers were interested in investigating eHealth usage among Nigerians during the pandemic. The STROBE cross-sectional reporting guidelines were followed in reporting this study. The study was approved by the Institutional Review Board of the University of Hong Kong/ Hospital Authority Hong Kong West Cluster (UW 20-272). Additional details of the study have been reported in the published protocol (25). Participants were recruited from the six geopolitical zones in Nigeria: North Central, North East, North West, South East, South South, and South West through an online survey using both convenience and snowball sampling methods.

2.2. Sampling, recruitment and data collection

The inclusion criteria for the study include Nigerians who could understand English. Although Nigeria has over 250 ethnic groups, with each ethnic group having indigenous languages, English is the

national language of communication (26). Similarly, participants with access to the internet and who use social media platforms were included. This is because evidence suggests increased internet and social media usage during the COVID-19 pandemic (14). Persons less than 18 years, non-Nigerians, Nigerians who were not residing in the country at the time of data collection, and those who were cognitively impaired were excluded from the study. The sample size was calculated based on the estimation of the prevalence of a health-related issue. A conservative scenario of 50%, with a 5% margin of error in a 95% CI, required 385 subjects (25). However, data collection continued until 590 respondents were recruited to provide a broader representation.

Social media platforms were the preferred recruitment methods to reach participants across the six geopolitical zones, specifically WhatsApp, Facebook, Twitter, LinkedIn, and Instagram. Participants were recruited from various tertiary institutions and National Youth Service Corp (NYSC) camps across various regions in Nigeria to facilitate representation (27). Initially, we conveniently sampled participants and then snowballed by encouraging participants to share the survey with their friends and family. This sampling and recruitment strategy was adopted due to the COVID-19 pandemic that restricted access to participants in person. This strategy also improved access to a large population of participants as people could participate in the survey within the comfort of their geographical location. The tertiary institutions and National Youth Service Corp (NYSC) camps comprise Nigerians from different geographical regions, age groups, gender, ethnic and cultural groups. Participants were encouraged to share the survey with their friends and family. Participants who agreed to participate were required to consent before they were given access to complete the survey. For every survey participant, HK$1 (about US$0.13) was donated to the Red Cross for each completed questionnaire in the respondent's area. The data collection period spanned 3 months.

Data collection was conducted using the 'COVID-19's impAct on feaR and hEalth (CARE) questionnaire (28), launched on the Qualtrics platform. The instrument has been validated, and the psychometric properties have been presented in the study protocol (25). For the Nigerian survey, a contextually relevant validation question was added: "What is the capital of Lagos?" to enhance internal validity; the survey was also pilot tested to ensure consistency and understanding of survey items. The online survey included a captcha to ensure that the respondents were actual participants, not automated users or bots. Data collection was conducted between January and March 2021. The questionnaire sections included sociodemographic characteristics with eight items age, gender, marital status, occupational status, perceived social status, pregnancy status (if applicable), and household size. The fear scale had eight items on a 5-point Likert scale; higher total scores indicate a higher fear level. This scale was adapted from a previous study conducted in Nigeria with a Cronbach's alpha of 0.90 (29). The e-health literacy scale (eHEALS) had eight items that assessed electronic sources and channels of information-seeking behavior concerning the COVID-19 outbreak on a 5-point Likert scale, exposure to and pursuit of various types of health-related information, perception of the credibility, accuracy, and usefulness of the information, and confidence in locating the accurate information. The reliability of the eHEALS has been confirmed in a previous study conducted in Nigeria, with a Cronbach's alpha of 0.92 (30). The PHQ-4 scale had two items that measured anxiety, and the other two measured depression on a 4-point Likert scale. Higher scores indicate a higher level of anxiety and depression. The reliability of the PHQ-4

scale has been confirmed in a previous study among Nigerian University students with a good test–retest reliability score (r = 0.894, p < 0.001) (31). Participants were also asked to rank the most important preparation for future pandemics; these were; online consultation with doctors (e.g., Zoom, Skype), instant personalized health advice by online chatbot, telephone health advice, online courses, instant streaming courses (e.g., Zoom, Skype), receiving health information through email, receiving health information through text messaging (e.g., SMS, WhatsApp), receiving health information from social media (e.g., Facebook, Instagram, Twitter), receiving health information from mobile app, get medicine prescribed in a hospital visit/follow-up in a community pharmacy, medicine delivery, online shopping, food delivery. Other sections of the questionnaire included lifestyle and health-related impact of COVID-19. The development and validation of the instrument have been published (25).

2.3. Statistical analysis

Data were analyzed using Stata Statistical package and R Programming. Data were meticulously organized and underwent thorough quality control procedures to ensure its accuracy and integrity, including checks for missing responses, duplicates, and inconsistencies. Missing data was determined to be missing at random (MAR) and were excluded from the final analyses. A sum score of the eHEALS scale was obtained and dichotomized into "low" and "high" using a ≥ 26 cut point (32). Psychological outcomes, anxiety, and depression were derived from the PHQ-4 scale; for anxiety—a sum score of the first two items of the PHQ-4 scale was obtained and dichotomized into "no anxiety" and "anxiety" using a cut point of ≥3. Similarly, for depression, a sum score of the last two items on the PHQ-4 scale was obtained and dichotomized into "no depression" and "depression" using a cut point of ≥3 (33). A sum score of the fear of COVID scale was also derived and dichotomized using a ≥ 16.5 cut point (34). Descriptive statistics were summarized using frequencies and percentages or means and standard deviations as applicable. We described participants' characteristics stratifying by eHealth Literacy levels, gender, age, and region. We fitted logistic regression analyses to assess the association between eHealth literacy (predictor) and psychological outcomes, specifically depression, anxiety, and fear of COVID-19, adjusting for age, gender, education, and employment as covariates. We conducted subgroup analyses using logistic regression with interaction terms to assess the differences in the association between eHealth literacy and psychological outcomes by age, gender, geographical region, and healthcare worker status. A *post hoc* Bonferroni correction was used to adjust for multiple comparisons; Bonferroni thresholds for each subgroup analysis was set by dividing the alpha level (0.05) by the number of pairwise tests. Descriptive statistics were also used for participants' responses to the most important preparations for future pandemics, displaying this in a Likert chart.

2.4. Ethical considerations

Ethical approval was sought and obtained for the study, which has been reported in the study protocol (20). The authors respected all ethical obligations by providing online information about the research as well

as consent forms. Participants were asked to ascertain if they understood the content of the informed consent by indicating the same online. Prior to accessing the online questionnaire, participants were asked to indicate whether they were willing to proceed or not proceed with the survey. Participants were clearly reminded of their rights to voluntary participation. On no account was a participant forced to participate in the study. Also, data privacy and confidentiality were ensured per IRB regulations and national ethical guidelines. All data were stored on password-protected servers compliant with national privacy laws.

3. Results

3.1. Sample characteristics

Participant characteristics stratified by eHealth literacy level are shown in Table 1. This study involved 590 participants, of which 56% were female, 38% were 30 years or older, 63% had at least a bachelor's degree, 53% were employed, and 54% lived in the Southwest region. For outcomes of depression and anxiety, 55% reported depression, and 55% reported anxiety. Participants with high health literacy were more likely to be female, have at least a bachelor's degree, be employed, and live in the country's Southwestern region. There were gender, age, and regional differences in the sample (Supplementary Tables S1, S2).

3.2. eHealth literacy and psychological outcomes

About 83% of the sample had high eHealth literacy. Higher eHealth literacy was associated with 66% lower odds of both depression (adjusted odds ratio aOR: 0·34; 95% confidence interval, 0.21–0.56) and anxiety (aOR, 0.34; 95%CI, 0.20–0.54), after accounting for age, gender, education, and employment. There were no observed statistical associations between eHealth literacy and fear of COVID-19 (Table 2).

We observed differences in the associations between eHealth literacy and psychological outcomes by age, gender, and geographical region (Supplementary Tables S4–S6). After accounting for covariates, among men, high eHealth literacy was associated with 56% lower odds of depression (aOR, 0.44; 95%CI, 0.22–0.88) and 68% lower odds of anxiety (aOR, 0.32; 95%CI, 0.16–0.65), while for women, high eHealth literacy was linked to 87% lower odds of depression (aOR, 0.27; 95%CI, 0.13–0.55) and 67% lower odds of anxiety (aOR, 0.33; 95%CI, 0.11–0.24; Figure 1A; Supplementary Table S4). The Bonferroni corrected margins plot demonstrates the probability of anxiety and depression by eHealth literacy by gender (Figure 2).

High eHealth literacy was not associated with depression, anxiety, or fear of COVID-19 among persons aged 18–24 years; however, among those aged 25–29 years, there was 82% (aOR, 0.18; 95%CI, 0.07–0.42) and 76% (aOR, 0.24; 95%CI, 0.11–0.53) lower likelihood of depression and anxiety, respectively. Among persons older than 30 years, the odds of anxiety were 62% (aOR, 0.38; 95%CI, 0.16–0.91) lower for those with high eHealth literacy compared to those with low eHealth literacy (Figures 1B; Supplementary Table S5). The Bonferroni corrected margins plot demonstrates the probability of anxiety and depression by eHealth literacy by age category (Figure 3).

Among participants living in the Northcentral region of the country, high eHealth literacy was associated with 22% (aOR, 0.78;

TABLE 1 Participant characteristics, stratified by eHealth literacy level.

Characteristics	Total	eHealth literacy		p-value
		Low	High	
	N =590	N =103	N =487	
BMI, M(±SD)	19·0 (3·4)	18·9 (2·5)	19·1 (3·6)	0.710
Gender, n (%)				**0.014**
Male	255 (43·2)	56 (54·4)	199 (40·9)	
Female	331 (56·1)	47 (45·6)	284 (58·3)	
Missing	4 (0·7)	0 (0·0)	4 (0·8)	
Age category, n (%)				0.470
18–24 years	171 (29·0)	25 (24·3)	146 (30·0)	
25–29 years	255 (43·2)	49 (47·6)	206 (42·3)	
≥30 years	164 (27·8)	29 (28·2)	135 (27·7)	
Education category, n (%)				**0.002**
<Bachelors	219 (37·1)	52 (50·5)	167 (34·3)	
≥Bachelors	371 (62·9)	51 (49·5)	320 (65·7)	
Employment category, n (%)				**<0.001**
Not employed	277 (46·9)	64 (62·1)	213 (43·7)	
Employed	313 (53·1)	39 (37·9)	274 (56·3)	
Marital, n (%)				0.200
Married/cohabitation/common-law	156 (26·4)	27 (26·2)	129 (26·5)	
Separated/divorced/widowed	7 (1·2)	3 (2·9)	4 (0·8)	
Single	427 (72·4)	73 (70·9)	354 (72·7)	
Region, n (%)				**0.004**
North Central	78 (13·2)	19 (18·4)	59 (12·1)	
North East	20 (3·4)	6 (5·8)	14 (2·9)	
North West	37 (6·3)	12 (11·7)	25 (5·1)	
South East	22 (3·7)	6 (5·8)	16 (3·3)	
South South	45 (7·6)	11 (10·7)	34 (7·0)	
South West	317 (53·7)	41 (39·8)	276 (56·7)	
Missing	71 (12·0)	8 (7·8)	63 (12·9)	
Depression, n (%)				**<0.001**
No	266 (45·1)	24 (23·3)	242 (49·7)	
Yes	266 (45·1)	79 (76·7)	245 (50·3)	
Anxiety, n (%)				**<0.001**
No	265 (44·9)	24 (23·3)	241 (49·5)	
Yes	325 (55·1)	79 (76·7)	246 (50·5)	
Health care professional, n (%)				**<0.001**
No	276 (46·8)	80 (77·7)	196 (40·2)	
Yes	314 (53·2)	23 (22·3)	291 (59·8)	

Bold p < 0.05.

95%CI, 0.58–0.99) lower odds of depression and 28% (aOR, 0.72; 95%CI, 0.56–0.92) lower odds of fear of COVID-19. For those living in the Northwest, high eHealth literacy was linked to 43% (aOR, 0.57;

TABLE 2 Associations between eHealth literacy and psychological outcomes.

Psychological outcomes	Prevalence, n (%)	Odds ratio (95% confidence interval)	
		Unadjusted	Adjusted[†]
Depression	266 (45·1)	**0·31 (0·19–0·50)**	**0·34 (0·21–0·56)**
Anxiety	325 (55·1)	**0·31 (0·19–0·51)**	**0·34 (0·20–0·54)**
Fear of COVID-19	499 (84·58)	0·68 (0·36–1·30)	0·68 (0·35–1·33)

Bold: P < 0.05.
[†]Adjusted for age, gender, education, employment.

FIGURE 1
(A–D) Age, gender and geographical region and healthcare worker status differences in the association between eHealth Literacy and Psychological outcomes.
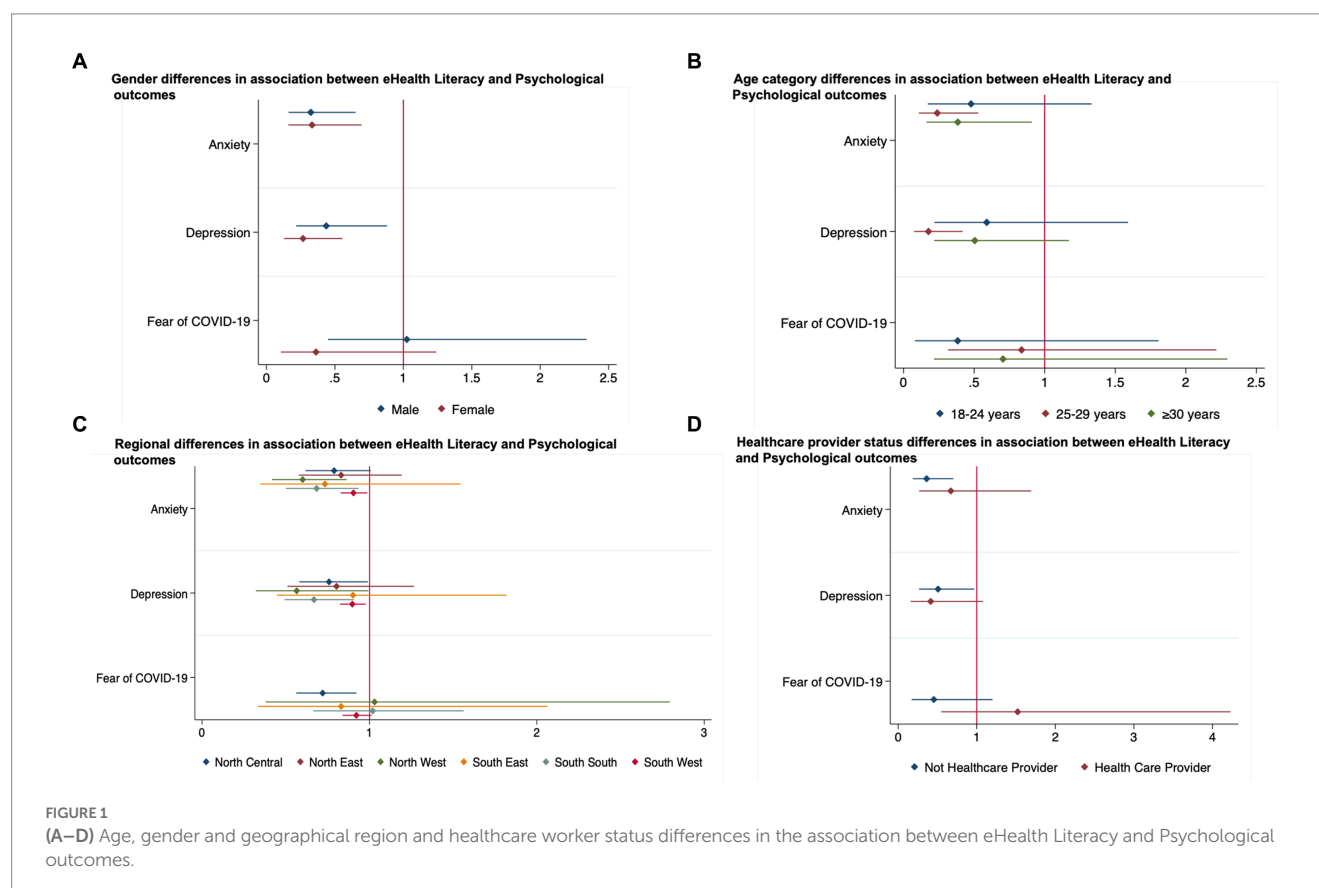
95%CI, 0.32–0.99) and 40% (aOR, 0.60; 95%CI, 0.42–0.86) lower odds of depression and anxiety, respectively. Persons living in the South region with high eHealth literacy were 33% (aOR, 0.67; 95%CI, 0.49–0.91) and 32% (aOR, 0.68; 95%CI, 0.51–0.93) less likely to report depression and anxiety respectively; while the odds of depression (aOR, 0.90; 95%CI, 0.82–0.99) and anxiety (aOR, 0.90; 95%CI, 0.83–0.99) was 10% lower for persons living in the Southwest with high eHealth literacy (Figure 1C; Supplementary Table S6). There were no differences in the associations between eHealth literacy and psychological outcomes by healthcare worker status (Figure 1D). The Bonferroni corrected margins plot demonstrates the probability of anxiety and depression by eHealth literacy by region (Figure 4).

3.3. eHealth-related strategies for future pandemic preparedness

Many of the strategies were rated important (Figure 5). The pandemic preparedness strategies rated to be most important by the participants were medicine delivery (extremely/very important, 60%;

important, 30%), receiving health information through text messaging (extremely/very important, 58%; important, 31%), online courses (extremely/very important,58%; important, 30%), food delivery (extremely/very important, 55%; important, 30%), and receiving health information from social media (extremely/very important, 54%; important, 32%; Figure 2).

4. Discussion

We examined the association between eHealth literacy and psychological outcomes during the COVID-19 pandemic in Nigeria. Our study showed five key findings; first, majority of our participants have high eHealth literacy levels. Second, the prevalence of self-reported anxiety and depression is also substantial. Third, high eHealth literacy was associated with a lower likelihood of anxiety and depression, and fourth, there are age, gender, and geographical differences in the association between eHealth literacy and psychological outcomes. Finally, eHealth-related strategies such as medicine delivery, receiving health information through text
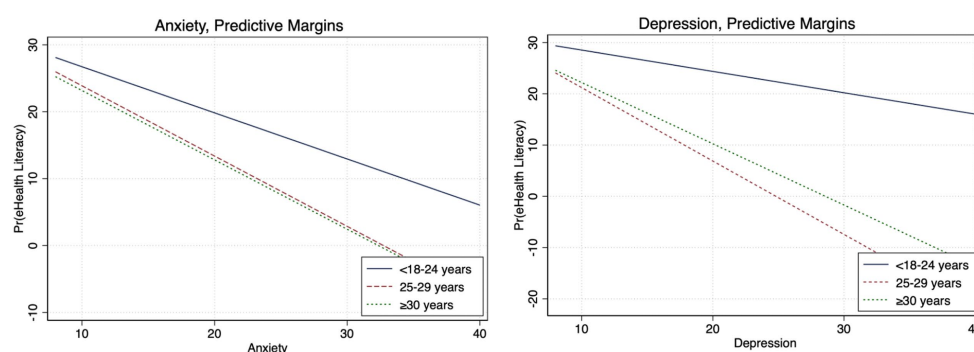
FIGURE 2
Adjusted gender differences between eHealth literacy and anxiety and depression (Bonferroni adjusted).
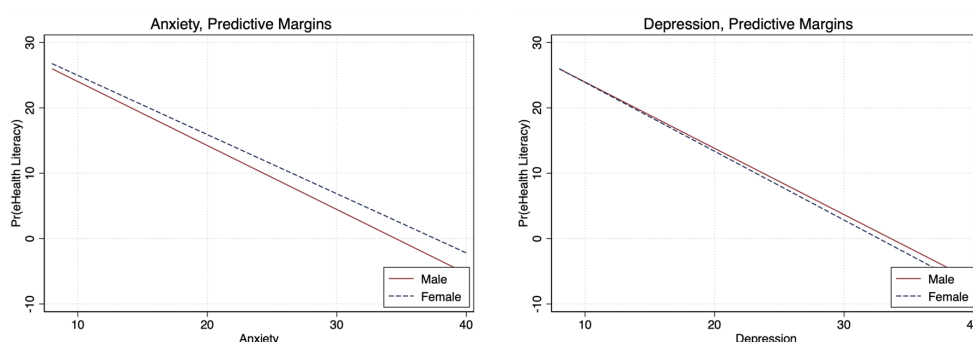

FIGURE 3
Adjusted age differences between eHealth literacy and anxiety and depression (Bonferroni adjusted).

messaging, and online courses were highlighted as important strategies for future pandemic preparedness (Figure 5). These findings have important implications for improving mental health services through digital technologies in Nigeria.

Our findings on high eHealth literacy can be explained by the increased mobile phone usage in Nigeria reported during the pandemic (14, 35). This is similar to the results from various countries that reported increased usage of mobile phones during the pandemic (36–38). Our results also show that participants with high eHealth literacy were more likely to be female, have at least a bachelor's degree, be employed and live in the Southwestern region of the country. This is congruent with previous results conducted in Southwest, Nigeria, where women were shown to have a higher literacy level compared to men (39). This is similar to the results of a study conducted in Turkey which found that women had higher levels of eHealth literacy than men because they felt confident and more competent while searching for online information (40). This study found regional differences in eHealth literacy in Nigeria, where Southwest has higher eHealth literacy than other regions (39). This has also been reported in other studies and may reflect English educational attainment, English language proficiency, higher access to the internet and increased exposure to credible medical information that persons in this region have access to Kuyinu et al. (39).

The prevalence of self-reported anxiety and depression in this study aligns with previous studies that reported a range of psychological issues among Nigerians during the pandemic (6–9). This indicate the need for interventions to address psychological issues among this population. Similarly, as a high e-Health literacy was reported among participants in this study, mobile phones can be considered a platform to deliver such interventions, as evidence has revealed that psychological interventions delivered through mobile phones have beneficial psychological effects (41).

We found an association between higher eHealth literacy and lower odds of both depression and anxiety. Previous studies reported an inverse correlation between eHealth literacy and depression and that improving eHealth literacy may contribute to maintaining good psychological well-being (21, 22). Mental health services are severely sparse in Nigeria, and related stigma persists (42). Hence, it is likely that individuals are accessing online sources of mental well-being information, and this could be harnessed to help manage their anxiety and depression. There were no observed statistical associations between eHealth literacy and fear of COVID-19 in our study; this could be attributed to the country's heightened public awareness of COVID-19 prevention (43). Additionally, persons with high eHealth literacy levels may be better equipped to access credible health information on COVID-19 and less susceptible to misinformation that may fuel fear and anxiety (44). The high mobile usage in Nigeria
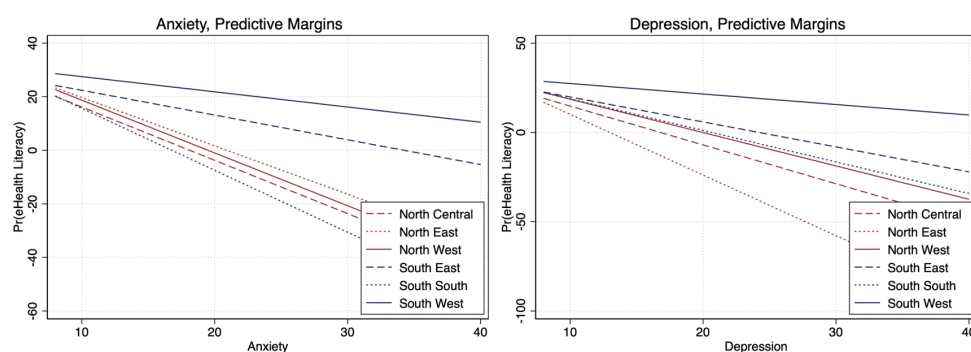
FIGURE 4
Adjusted regional differences between eHealth literacy and anxiety and depression (Bonferroni adjusted).
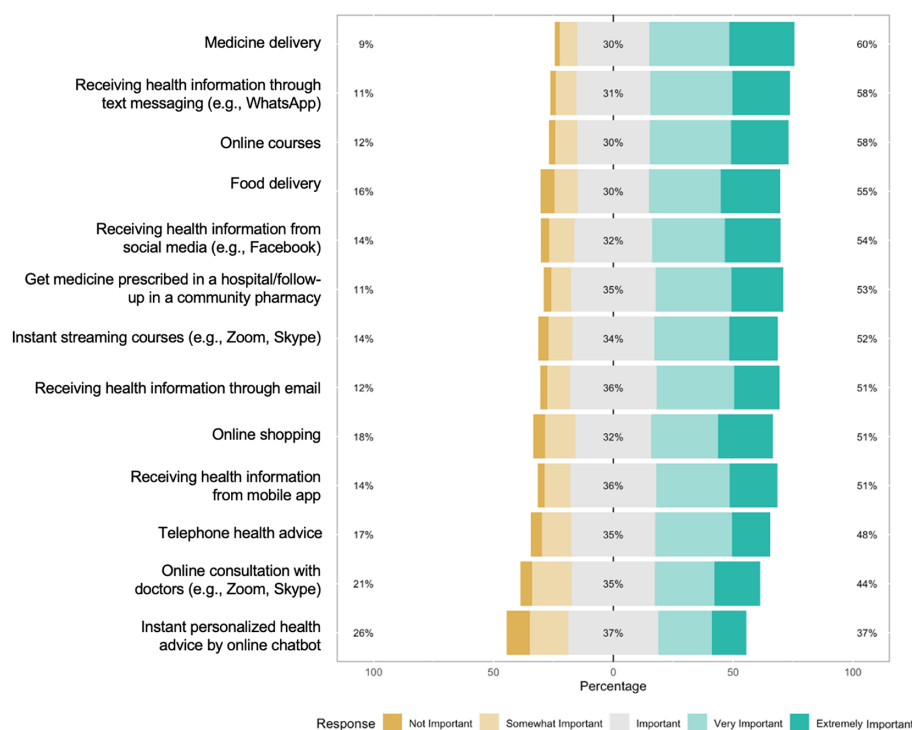
FIGURE 5
Participants' endorsement of eHealth-related strategies for future pandemic preparedness.

and eHealth literacy levels present a critical opportunity to advance mental health awareness and encourage mental health services in Nigeria (45). eHealth literacy-informed interventions may also be harnessed to address other health issues in Nigeria; these include verified information about infectious diseases; self-management of chronic disease through digital means (e.g., hypertension diagnosis and management training through an app). Leveraging high eHealth literacy for improving psychological outcomes in Nigeria could prove an important intervention opportunity.

There were age, gender and geographical differences in the association between eHealth literacy. Among women with high eHealth literacy, the likelihood of anxiety and depression was lower compared to men. This corroborated with other studies that have shown that being female, less than 75 years old and having a higher

education are associated with eHealth literacy (22). Reasons for this disparity are unclear and could be explored in future studies. The regional differences observed in our results highlight the need for improving internet access for increased educational attainment and eHealth literacy interventions in other regions of the country outside of the Southwestern region. There was a high proportion of healthcare workers in our sample, and the high eHealth literacy in this group may be leveraged for advanced training of health workers, especially during crises and humanitarian situations.

Results from future pandemic strategies endorsed by participants further support the need for health technology-backed interventions in Nigeria. Medicine delivery, receiving health information through text messaging, online courses, food delivery, and receiving health information through social media were endorsed as strategies

important to prepare for future pandemics and crises. These are mostly digital interventions that may significantly contribute to improving the health of Nigerians; partnerships between context experts like healthcare workers and digital content experts may further advance such interventions (45). It is important for these interventions to also cater to persons with lower educational attainment and low eHealth literacy. This may include providing health information through platforms like WhatsApp, which is more prevalent among persons with limited digital literacy in Nigeria. Rapid innovations in digital health technologies that improve healthcare access have shown high efficacy in high-income countries. However, access to these health technologies is not equitable globally, with LMICs like Nigeria experiencing global health disparities at a larger scale. Consequently, there is a need for reciprocal innovation, i.e., bidirectional, and iterative exchange of ideas, resources, and innovations to address shared health challenges across diverse global settings (46).

Our study should be interpreted in the context of these limitations. First, this was a cross-sectional design; hence, there was no temporality. Second, the survey was originally designed in Hong Kong and may not have initially included Nigeria in the original context; however, modifications were made to adapt certain survey items to the Nigerian context. Third, our study's participants were mostly young adults from the Southwestern region, which may have contributed to the high level of eHealth literacy observed; hence, findings from this study might not be generalizable to Nigerians with low literacy, non-social media users and older adults. Fourth, the survey was administered digitally and may have excluded persons with limited digital literacy. Nevertheless, this study has some strengths. First, to our knowledge, this is one of the first studies to examine the associations between eHealth literacy and anxiety and depression in a Nigerian sample. In addition, we employed various recruitment strategies to ensure that participants from different regions of the country were represented in the sample.

Our findings have important implications for the development of interventions to address the scarcity of mental health services in Nigeria. The high eHealth literacy in Nigeria and high use of smartphones and mobile application makes the Nigerian environment suitable for digital health interventions. Participants-endorsed strategies for preparation for future pandemics are critical policy options that may inform healthcare policies. Strategies such as receiving credible health information through social media platforms. Future intervention strategies could leverage digital tools and platforms to provide remote mental health services and incorporate other chronic conditions. Given the critically low performance and ranking of the Nigeria health system (47, 48), these interventions have a high potential to strengthen the primary health care system, and guarantee access to care. An example could include implementing remote counseling and psychiatry services platforms using mobile apps, and telemedicine platforms, to improve access, availability, and utilization of healthcare services. Such strategies could be multi-pronged to address several conditions at once; for instance, such remote platforms could also include remote monitoring of cardiometabolic conditions (e.g., remote blood pressure monitoring), bi-directional messaging between providers and patients, etc. These digital tools should be co-designed and co-developed with patients, health care providers, health system leaders, policymakers and other

stakeholders, and should prioritize simplicity in the design with considerations for persons experiencing barriers such as low eHealth literacy, limited broadband access or smartphones, etc. It is critical that digital interventions address health equity and not contribute to widening the digital divide. Importantly, there is a need for health policies that advance the implementation of telemedicine and digital health interventions in Nigeria and ensure equitable funding of health systems in the different regions of the country to improve access to health services.

5. Conclusion

In conclusion, our study showed high eHealth literacy among our sample of Nigerian adults. Self-reported prevalence of anxiety and depression is also considerably high in the face of prevalent economic and structural hardship and limited access to mental health services. High eHealth literacy was associated with psychological outcomes of anxiety and depression. eHealth literacy-informed interventions can be invested in to address several pressing health issues in Nigeria and prepare for future pandemics and health-related crises. The age, gender and regional differences observed present important intervention opportunities for interventions. Additionally, digital solutions focused on medicine delivery, receiving health information through text messaging, online courses, etc., are important health technology-backed intervention opportunities in Nigeria. The Nigerian environment may be suitable for digital health interventions to increase access to mental healthcare services due to the country's high smartphone usage and eHealth literacy, as shown in this study's result. Importantly, there is a need for health policies that promote the implementation of telemedicine and digital health interventions in Nigeria and guarantee equitable funding of health systems in the various regions of the country in order to enhance access to health services.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by University of Hong Kong/Hospital Authority Hong Kong West Cluster (UW 20-272). The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors contributed to the article and approved the submitted version.

Acknowledgments

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.2023.1194908/full#supplementary-material

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Effects of social confinement during the first wave of COVID-19 in Mexico City

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Background: The COVID-19 pandemic led to global social confinement that had a significant impact on people's lives. This includes changes such as increased loneliness and isolation, changes in sleep patterns and social habits, increased substance use and domestic violence, and decreased physical activities. In some cases, it has increased mental health problems, such as anxiety, depression, and post-traumatic stress disorder.

Objective: The objective of this study is to analyze the living conditions that arose during social confinement in the first wave of COVID-19 within a group of volunteers in Mexico City.

Methods: This is a descriptive and cross-sectional analysis of the experiences of volunteers during social confinement from 20 March 2020 to 20 December 2020. The study analyzes the impact of confinement on family life, work, mental health, physical activity, social life, and domestic violence. A maximum likelihood generalized linear model is used to determine the association between domestic violence and demographic and health-related factors.

Results: The findings indicate that social confinement had a significant impact on the participants, resulting in difficulties within families and vulnerable conditions for individuals. Gender and social level differences were observed in work and mental health. Physical activity and social life were also modified. We found that suffering from domestic violence was significantly associated with being unmarried (*OR = 1.4454, p-value = 0.0479*), lack of self-care in feeding habits (*OR = 2.3159, p-value = 0.0084*), and most notably, having suffered from a symptomatic COVID-19 infection (*OR = 4.0099, p-value = 0.0009*). Despite public policy to support vulnerable populations during confinement, only a small proportion of the studied population reported benefiting from it, suggesting areas for improvement in policy.

Conclusion: The findings of this study suggest that social confinement during the COVID-19 pandemic had a significant impact on the living conditions of people in Mexico City. Modified circumstances on families and individuals, included increased domestic violence. The results can inform policy decisions to improve the living conditions of vulnerable populations during times of social confinement.

1. Introduction

At the end of 2019, the SARS-CoV-2 virus, which causes the coronavirus disease 2019 (COVID-19), was identified, which since then has rapidly spread throughout the world. Social confinement or isolation was the most important public health measure adopted by most countries to mitigate, attend to, and control the spread, as well as the effects of the pandemic during the first wave of COVID-19 (1). Mexico was no exception, with ∼126 million inhabitants, and social confinement was based on the suspension of non-essential activities or those that would not affect the substantive activities of a public, social, or private organization such as activities in schools, offices, public works, factories, and/or some services (2). This measure was part of the so-called *National Season of Healthy Distance* (Jornada Nacional de Sana Distancia, in Spanish), a mandatory-yet-not legally reinforced social confinement strategy that started on 23 March 2020, postponed until 30 May 2020, and was accompanied by a *modulated reopening strategy* by an epidemiological traffic light starting 1 June 2020, which established the measures of social de-confinement depending on the spread of the virus in different regions of the country (3, 4). At the end of December 2020, the official data for Mexico City (CDMX), the national epicenter of the pandemic, reported around 264,000 confirmed cases of infected people (5).

More than 3 years after the start of the pandemic, we know that social confinement resulted in the partial or total cancellation of many formal or informal work activities, with strong impacts on the economy and severe consequences for the daily life routine of many families (6–10). Around the world, unemployment figures rose rapidly to double digits, with millions of people signing up for welfare payments, being women more affected than men by the economic instability (11, 12). The highest unemployment rates reported in Mexico in 2020 were located in the months of June, July, and August with an average of 2.8 million unemployed, while informal employment went from 20.7 million in April to 28.1 million in September, with a continuous increase during the following months (13). A study reported that during the same period, Mexican women were the ones most affected by unemployment and most of them have not yet recovered from it (14).

To date, various studies have explored living conditions in the context of lockdown and social distancing from an academic perspective in order to understand the aftermath that isolation has left on society (15–19). In general, we know that changes in the routine of lifestyle and the lack of physical contact with friends and family negatively affect the mental health of people of all ages (20). During the first months of the COVID-19 pandemic, stress, frustration, depression, anxiety, and panic disorder became integral parts of adult life. The presence of chronic illnesses, fear of acquiring the infection, the angst of infecting or losing a loved one, or the uncertainty of not having enough resources to survive have disrupted the dynamics of many families (21).

The social isolation and stay-at-home policies also contributed to increased vulnerabilities related to mental health, including domestic violence, which may manifest in physical, psychological, or economic forms (7, 22). In Mexico City, as in many regions of Latin America, confinement exacerbated this social phenomenon

that has plagued society for decades, the domestic violence and the deterioration in mental health conditions, often related to economic recession, poverty, unemployment, school dropout, addiction, housing crisis, and reduced options for support, among other factors (23–25). The purpose of this article is to analyze the living conditions that occurred or were modified during the first wave of COVID-19 social confinement in a cohort from a metropolitan population in Mexico City. Our focus was set on exploring the presence of particular diseases, the modification of daily-life habits, the experiencing of episodes of violence, and the social support received as part of the follow-up of a group of volunteers participating in a cohort of CDMX.

2. Methods

2.1. Information retrieval

This research was conducted during the COVID-19 health emergency, thus all *fieldworks* were conducted online. The design chosen was an online self-report questionnaire with 24 questions applied to follow-up volunteer adults from Mexico City. Based on online platforms and/or email, the data collection approach has not only proven to be a cost-effective survey alternative for collecting large amount of data in a short period of time but it also appears to be an effective strategy for collecting data on sensitive topics among vulnerable populations (26). The questionnaire was sent via email and WhatsApp messages. The invitation to participate in the study was sent up to three times in some cases as a reminder and/or to give the volunteers more time to send their responses. The initial message explained the objective of the study, the confidentiality of the replies, and stated that the information would be used only for research purposes. At the end of the study, an acknowledgment letter was sent to the volunteers to thank them for their participation. One of the major goals of the survey was to evaluate the social vulnerability of some CDMX families during the COVID-19 pandemic.

For the purposes of this research, 12 of the 24 questions were selected. The form included questions to know the general health conditions, violet situations, and the individual perspective on the impact of the COVID-19 pandemic (see Tables 1, 2). The answer options could be multiple choice or open-ended. Some answers were classified for their systematization and subsequent analysis from pre-established codes. In the case of the variable *type of violence*, the answers were coded as: economic, psychological, verbal, emotional, symbolic, physical, or unspecified, according to the literature reviewed (27). The health conditions were classified according to the International Classification of Diseases, 10th Revision (ICD-10) (28). Demographic information such as sex, age, marital status, and level of social development were also recorded. The Mexican Social Development Index (SDI) classifies population development from worse (less development) to best (more social development) into four levels as follows: (1) very low, (2) low, (3) medium, and (4) high (29).

TABLE 1 Self-report formulaire (sociodemographic, comorbidities, and habits modified).

Features	Abbreviation	Possible answers
Sex	Sex	Man
		Woman
What is your current marital status?	Marital status	Married
		Unmarried
What has been your main workplace during the pandemic?	Work	Business office
		Health services
		Merchant
		Home
		Outdoor work
		Unemployed
Have you been diagnosed with COVID-19?	COVID-19 diagnose	Yes, with lab tests
		Yes, with symptoms
		No
In case your previous response was affirmative, you were at:	Place of treatment	Hospital
		Home
Do you have any of the following diseases?	Ailments	Cardiovascular disease
		Respiratory disease
		Diabetes
		Arterial hypertension
		Obesity
		Metabolic syndrome
		Alcoholism
		Smoking
		None
During the lockdown, What habits have you changed?	Modified habits	Feeding
		Sleeping
		Physical activity
		Social life
		None

TABLE 2 Self-report formulaire (lifestyle characteristics, violence episodes, and support received).

Features	Abbreviation	Possible answers
Do you exercise at home		Yes
		No
How often did you exercise at home?	Low-impact	Yes, at least every third day, for half an hour
	Moderate	Yes, every third day, for more than an hour or
		Yes, more than three times a week at least half an hour
	High-impact	Yes, more than three times a week for more than an hour
Have you taken care of your feeding habits	Feeding	Yes
		Sometimes
		A few times
		No
Do you consider that since lockdown for COVID-19, you have experienced situations of family violence in your home?	Violence	Yes
		No
How often have been this violence situations?	Frequency of violence	Sometimes
		Several times
		Many times
In the affirmative case, could you briefly describe what kind of violent situations have you experienced at home?	Type of violence	Description
Do you receive some kind of support?	Support received	Financial
		Social
		Food
		Psychological
		Medical
		None

2.2. Statistical analysis

The data analysis was carried out with R/Rstudio version 4.0.2. A descriptive analysis of the general characteristics of the studied population was carried out. The chi-square test was used to check for differences between men and women. Statistical significance was determined at $p_{value} < 0.05$. A multivariate logistic regression model was fitted to estimate the association between *Violence* and independent variables (age, sex, marital status, social stratum, COVID-19 diagnosis, work during the pandemic, and some habits such as feeding, sleeping, or physical activity) in the form of a generalized linear model with a binomial link function. Model optimization (stepwise regression) was performed using maximum likelihood calculations to choose the best model compatible with the data. The maximum likelihood criterion in the likelihood ratio test was Wilk's test. Variance inflation factor

(VIF) determination was calculated for each regression model to assess for multi-collinearity. *VIF* $<<$ 10 for all retained variables. Odds ratios (ORs) and 95% confidence intervals (2.5–97.5%C.I.) were calculated to estimate the strength of the association. All tests were performed at a confidence level of $\alpha = 0.05$. The balance between sensitivity and specificity was evaluated using ROC curves and calculation of the area under the ROC curve (AUROC).

3. Results

3.1. General features

Out of the 2,440 forms sent, 1,629 responses were obtained and included in the analysis after meeting the predefined selection criteria (consent to participate in the study, non-duplicate records and complete data, responses received within the period of the first wave of COVID-19 infections). In total, 34% of the volunteers were men, with a median age of 41 years (IQR 33–48) and 66% were women, with a median age of 42 years (IQR 33–49). The percentage of respondents who were married was higher among men than women (55.76 vs. 48.64%, respectively, < 0.0001).

During the first wave of infections, 3.31% of participants had a laboratory-confirmed COVID-19 diagnosis, and 2.15% had the suspicion of having suffered from it based on the presented symptoms. Home was the main place of care and/or treatment (95.51%). Of the cases diagnosed via a laboratory test, men reported slightly more infections than women, 3.24 and 3.36%, respectively (see Table 3). Regarding the employment situation during confinement, the condition of unemployment was reported more by women (15.94%) than by men (8.81%); for those who kept their jobs, it was mainly carried out from home office (55.58 and 59.18%, respectively, $p_{value} = 0.0011$), followed by business office (15.11 and 9.69%, respectively, $p_{value} = 0.0087$) and outdoor work (7.73 and 1.68%, respectively, $p_{value} = 0.0056$).

3.2. Presence of some diseases

The *main diseases*, as reported by the participants, broadly belong to the following classes: (1) *Endocrine, Nutritional, and Metabolic Diseases (22.59%)*, e.g., those related to diabetes mellitus, obesity, and metabolic syndrome (ICD-10: E00-E90); (2) *Mental, Behavioral, and Neurodevelopmental Disorders (10.13%)*, which include alcoholism, smoking, and anxiety and depression (ICD-10: F00-F99), among others; (3) *Diseases of the Circulatory System (4.41%)*, including hypertension, cardiovascular disease, venous insufficiency, and also some arrhythmias (ICD-10: I00-I99); and (4) *Diseases of the Respiratory System (3.68%)*, such as infectious and chronic respiratory diseases, allergic rhinitis, asthma, sinusitis, and chronic bronchitis (ICD-10: J00–J99).

We can observe that men are more frequently affected by endocrine, nutritional, and metabolic diseases than women (22.84 and 22.46%, respectively). Similarly, mental and behavioral disorders were more prevalent among women (12.77%) than men (10.13%), while the opposite trend was found in the case of circulatory diseases (5.03% in women and 3.24% in men) and respiratory system-related diseases (3.82% in women and 3.42%

in men). Statistically significant differences were found between men and women in the categories of endocrine, nutritional, and metabolic diseases ($p_{value} = 0.0288$), as well as mental and behavioral disorders ($p_{value} = 0.0243$; see Table 3). Furthermore, it is worth noting that only women reported suffering from neoplasms such as cervical, colon, and breast cancer (0.47%; ICD-10, C00–D48), albeit in smaller proportions.

3.3. Modified habits

Among the *self-reported habits that were modified* during social confinement between men and women, substantive changes in social life were indicated (38.13 and 34.11%, respectively, $p_{value} = 0.0009$), as was to be expected due to confinement, followed by physical activity (26.98% in men and 27.03% in women, $p_{value} = 0.0189$). We could notice that habits related to feeding and sleeping changed to a lesser extent in men than in women, without being statistically significant (see Table 3).

Regarding exercise at home, a higher percentage was reported in men than in women in low impact—*at least every third day for half an hour* (25 and 24.88%, respectively, $p_{value} = 0.0234$), for moderate impact (*every third day, for more than an hour or more than three times a week at least half an hour*) 25.18% in men and 19.66% in women ($p_{value} = 0.0028$), and for high impact—*more than three times a week for more than 1 h*, 6.53 and 4.55% were reported between men and women, respectively ($p_{value} = 0.2335$). Regarding nutrition care, the majority of the participants reported taking care of it, both men and women (45.50 and 44.64%, respectively); among them, also a statistically significant difference was found ($p_{value} = 0.0012$; see Table 4).

3.4. Violence episodes

During the first period of confinement, ∼9% of the volunteers self-reported having experienced *some forms of violence* within their home. Episodes of violence were registered less often in men than in women (8.27 and 9.51%, respectively, $p_{value} = 0.3922$). The main types of violence were related to the partner, parents, children, or other relatives and were coded as psychological violence (50.68%), emotionals (28.38%), and verbal (33.78%). The frequency with which violence occurred in the home between men and women was described as follows: sometimes (6.29 and 7.18%, respectively, $p_{value} = 0.2412$), several times (1.62 and 1.96%, respectively, $p_{value} = 0.9288$) and in smaller proportions, and many times (0.36 and 0.37%, respectively). Statistically significant differences were found between men and women in the types of violence: psychological (41.30 and 54.90%, respectively, < 0.0001), verbal (28.26 and 36.27%, respectively, $p_{value} = 0.0009$), and economic (13.04 and 5.88%, respectively, $p_{value} = 0.0001$; see Table 4).

Some open-ended responses from participants who experienced violence described the type of violence. Examples include: "*My partner used to mock my crying (my mother died of COVID on May 2020) and he was not patient with my 3-year-old son*

TABLE 3 Distribution of sociodemographic, comorbidities, and habits modified during the first wave of COVID-19 social confinement.

Features	Total 1,629	Man 556 (34%)	Woman 1,073 (66%)	p-value
Marital status*				
Married	51.07	55.76	48.65	**< 0.0001**
Unmarried	48.93	44.24	51.35	**0.0135**
Social stratum*				
1) Very low	11.48	11.69	11.37	0.1420
2) Low	36.89	36.15	37.28	**0.0077**
3) Medium	25.48	25.72	25.35	**0.0195**
4) High	26.15	26.44	26.00	**0.0173**
Work*				
Business office	11.54	15.11	9.69	**0.0087**
Health services	9.15	7.91	9.79	0.4903
Merchant	4.11	4.86	3.73	0.3028
Home office	57.95	55.58	59.18	**0.0011**
Outdoor work	3.74	7.73	1.68	**0.0056**
Unemployed	13.51	8.81	15.94	0.9805
COVID-19*				
With laboratory tests	3.31	3.24	3.36	0.6885
With symptoms	2.15	2.70	1.86	0.5244
No	94.54	94.06	94.78	**< 0.0001**
COVID-19 place of treatment*,**				
Home	95.51	94.87	96.00	**< 0.0001**
Hospital	4.49	5.13	4.00	0.2893
Presence of some diseases*				
Certain infectious and parasitic diseases	0.37	0.18	0.47	0.9999
Diseases of the circulatory system	4.41	3.24	5.03	0.9999
Diseases of the digestive system	2.02	1.26	2.42	0.9999
Diseases of the genitourinary system	0.74	0.36	0.93	0.9999
Diseases of the respiratory system	3.68	3.42	3.82	0.7244
Diseases of the nervous system	0.37	0.54	0.28	0.9999
Diseases of the musculoskeletal system	1.17	0.90	1.30	0.9999
Endocrine, nutritional, and metabolic diseases	22.59	22.84	22.46	**0.0288**
Neoplasms	0.31	0.00	0.47	0.9999
Mental and behavioral disorders	10.13	12.77	8.76	**0.0243**
Modified*				
Feeding	15.22	13.49	16.12	0.2593
Sleeping	17.19	16.19	17.71	0.1316
Physical activity	27.01	26.98	27.03	**0.0189**
Social life	35.48	38.13	34.11	**0.0009**
None	5.10	5.22	5.03	0.4195

*Values expressed in percentage.
**Values calculated only for cases of self-reported COVID-19 (54 men and 35 women).
The bold values indicate the statistically significant results.

TABLE 4   Distribution of lifestyle characteristics, violence episodes, and support received during the first wave of COVID-19 social confinement.

Features	Total (1,629)	Man (556)	Woman (1,073)	p-value
Exercise at home*				
Low-impact	24.92	25.00	24.88	**0.0234**
Moderate-impact	21.55	25.18	19.66	**0.0028**
High-impact	12.28	11.51	12.67	0.2335
No	41.25	38.31	42.78	**0.0149**
Feeding habits care*				
Yes	44.94	45.50	44.64	**0.0012**
Sometimes	38.06	35.97	39.14	**0.0143**
A few times	11.97	13.67	11.09	**0.0439**
No	5.08	4.86	5.13	0.5247
Violence*				
Yes	9.09	8.27	9.51	0.3922
Frequency of violence*,**				
Sometimes	6.88	6.29	7.18	0.2412
Many times	0.37	0.36	0.37	0.9999
Several times	1.84	1.62	1.96	0.9288
Type of violence*,**				
Economic	8.11	13.04	5.88	**0.0001**
Emotional	28.38	21.74	31.37	**< 0.0001**
Physical	8.78	6.52	9.80	0.4662
Not specified	4.73	8.69	2.94	**0.0012**
Psychological	50.68	41.30	54.90	**< 0.0001**
Symbolic	4.05	0.00	5.88	0.2603
Verbal	33.78	28.26	36.27	**0.0009**
Support received*				
Financial	9.76	10.61	9.31	0.1154
Social	5.65	5.03	5.96	0.6190
Food	2.58	1.61	3.07	0.9999
Psychological	6.14	4.86	6.80	0.8136
Medical	8.83	7.91	9.31	0.4336

*Values expressed in percentage.
**Values calculated only for cases of self-reported violence (46 men and 102 women).
The bold values indicate the statistically significant results.

who had many tantrums, often he kicked us out of his mother's house where I was spending my isolation, ... he told me many times that I shouldn't continue traumatized..."; "My sister-in-law threatened to hit me with the aid of her whole family"; "Death threats, insults, and hits." In the same way, indirect or systemic types of violence were identified, such as: "Emotional violence by my brother-in-law, since my sister lives in my parents' house and he hits her and my nephew and that affects me in some way, because I see it almost every day. The man is an alcoholic."; "We are three people living together, we have economic and social problems, we have a small business that is in danger of disappearing due to the contingency, and also

it is a little difficult not to argue while being inside the house."; "I have suffered from Machismo related to domestic tasks from my partner."

3.5. Support received

As for "support received", the majority of the participants (69%) indicated that they did not receive any. However, of those who had some support, women reported receiving more medical (9.31 vs. 7.91%), psychological (6.80 vs. 4.86%), social (5.96 vs. 5.03%),

TABLE 5 Logistic regression model, considering *Violence* as the outcome variable.

Variables	Estimate	[2.5% C.I.]	[97.5% C.I.]	OR	*p*-value
Intercept	−3.81763	−5.252191533	−2.47659362	0.0220	**< 0.0001**
Age	0.02880	0.008393227	0.04952561	1.0292	**0.0060**
Unmarried	0.36835	0.003894635	0.73486521	1.4454	**0.0479**
Work[§] (Home office)	0.05688	−0.740232917	0.99661633	1.0585	0.8965
Work[§] (Merchant)	−0.92503	−2.517180094	0.43539035	0.3965	0.2038
Work[§] (Unemployed)	0.56231	−0.298563685	1.54541383	1.7547	0.2262
Work[§] (Health services)	−0.12805	−1.128519539	0.94089512	0.8798	0.8058
Work[§] (Business office)	−0.34765	−1.343003376	0.71690218	0.7063	0.5024
Exercise at home[†] (Low-impact)	0.40091	−0.232001948	1.09509525	1.4932	0.2328
Exercise at home[†] (Moderate-impact)	−0.34016	−1.080813020	0.42538605	0.7117	0.3716
Exercise at home[†] (Without exercising)	0.21804	−0.396473331	0.89933723	1.2436	0.5063
Feeding habits care[‡] (No)	0.83978	0.193515638	1.44912535	2.3159	**0.0084**
Feeding habits care[‡] (A few times)	0.12702	−0.409418777	0.63382853	1.1354	0.6318
Feeding habits care[‡] (Yes)	−0.55852	−0.978639935	−0.14639141	0.5721	**0.0084**
COVID-19 diagnose (Yes, with laboratory tests)	0.52695	−0.475042890	1.36225307	1.6938	0.2529
COVID-19 diagnose (Yes, with symptoms)	1.38877	0.522492996	2.17601285	4.0099	**0.0009**

[§]Outdoor work was the reference category.
[†]High-impact was the reference category.
[‡]Sometimes was the reference category.
The bold values indicate the statistically significant results.

and food support than men (3.07 vs. 1.61%, respectively), while men indicated receiving only economic support more than women (10.61 and 9.31%, respectively; see Table 4).

3.6. Multivariate logistic regression model

Regarding the logistic regression model, the occurrence of violence (as the dependent variable) was mainly associated with age ($p_{value} = 0.0060$), being unmarried ($p_{value} = 0.0479$), not having taken care of their feeding habits ($p_{value} = 0.0084$) and with the self-reported variable of having presented symptoms of COVID-19 ($p_{value} = 0.0009$). Older participants had a slightly

yet significantly higher risk of experiencing episodes of violence than younger ones (OR = 1.02). Similarly, those participants who worked at home during confinement or who did not have a job and remained in a shelter had higher risks (OR = 1.05 and OR = 1.75, respectively) of suffering a violent event, in contrast to those whose work was carried out outside the home, such as in sectors such as commerce, health services, or in an office (OR = 0.39, OR = 0.87, OR = 0.70) who experienced a lower probability of experiencing violence at home.

The participants who did not perform any exercise at home (OR = 1.24) or who exercised with low-impact activity (OR = 1.49) were found also to have more probability of experiencing episodes of violence than those who performed moderate-impact exercise

(OR = 0.71). A similar pattern was observed for participants who did not take care of their diet or did not take enough care of it (OR = 2.31 and OR = 1.13). Moreover, those volunteers who reported having COVID-19 either with symptoms or with a laboratory test were also at greater risk of suffering episodes of violence at home, unlike those who had not experienced this condition. The AUROC for our overall model was 0.6698405, a value indicating a relatively good model performance for this type of study (30). The full maximum likelihood, adjusted odds ratios (95% CI), and *p*-values of the final (maximum likelihood) model are presented in Table 5.

4. Discussion

This study aimed to investigate the effects of social confinement during the first wave of COVID-19 on certain living conditions of a group of volunteers participating in a cohort study of CDMX [previously described by Martínez-García et al. (29)]. Our results showed that during the first wave of COVID-19, the majority of the population that responded to our questionnaire belonged to low and medium social development strata, and the highest percentage of self-reported unemployment was among women. Men reported a higher prevalence of metabolic diseases and behavioral disorders than women. Social life and physical activity were the factors most affected during confinement, with a higher percentage of women reporting that they did not do any type of exercise at home and did not take adequate care of their diet.

Another finding of our study was that women reported a higher percentage of episodes of psychological (54.90%), verbal (36.27%), and emotional (31.37%) violence. Our results also identified different factors associated with violence, including age, unmarried status, neglect of feeding, and having presented symptoms related to COVID-19 without having undergone conclusive testing.

The COVID-19 pandemic has highlighted the need to promote self-care and healthy lifestyle habits to prevent chronic degenerative and metabolic comorbidities such as hypertension, diabetes mellitus, obesity, metabolic syndrome, and kidney disease (2). These comorbidities have been associated with the severity and worse prognosis of SARS-CoV-2 infection (31–33). In Mexico, as of March of 2022, Loza et al. reported the most prevalent comorbidities of near of six million COVID-19 confirmed cases related to hypertension (12.7%), obesity (10.5%), and diabetes (9.5%). In addition, the percentage of COVID-19-related deaths among people with diabetes and hypertension was 21.9 and 19.8%, respectively (2). Other studies have also reported that those who had died had presented with one or multiple comorbidities, nutritional deficiencies, and often had a history of smoking and a sedentary lifestyle, which could have made them more prone to serious complications (34, 35). Although the participants in our study came from a seemingly healthy population recruited well before the start of the pandemic, and at the time of applying the questionnaire, the majority neither had become ill with COVID-19 nor had their condition worsened. Our findings show that the participants already had a number of nutritional and metabolic comorbidities, as well as some mental and behavioral disorders, some of which were more prevalent in men than in women.

Exploring the effects of confinement on health habits such as eating disorders or physical activity is quite relevant in the context of a population such as the inhabitants of Mexico City, and given that in much of the Mexican population, there is a high level of food insecurity, a large problem of overweight and obesity, sedentary lifestyle, and high rates of the population with metabolic comorbidities (36–38). The preliminary reports of the study "PSY-COVID-19" (39), with more than 7,000 responses from Mexicans surveyed through a Google form, revealed that around half of the participants reduced their physical activity (more often men than women) and neglect their nutrition (more often women than men) during the first months of confinement (39). In our case, 38.31% of men and 42.78% of women did not perform any physical activity; however, 45.50% of men and 44.64% of women did take care of their nutrition. Derived from the experiences in terms of habit modification, the aforementioned study pointed out the importance of working on interventions to address situations such as appetite disorders or lack of motivation for physical activity related to adaptation to confinement and the ways of life of people (39).

On the other hand, although confinement helped to a great extent to contain the spread of COVID-19, the economic and social repercussions and the stress coping mechanisms that impacted health (e.g., excessive alcohol consumption and the use of cannabis, nicotine, and other drugs) are still being explored (40–42). In addition to impacting socioeconomic conditions, physical health, and mental health; social confinement also did so on family life and working conditions, with a greater effect on women (43). For instance, social confinement exposed gender inequalities related to the lack of employment and economic uncertainty (44). These vulnerable situations were perpetuated beyond the period of confinement and may have effects on the development of episodes of violence as those reported by the participants in this study (9.51% of prevalence of violence self-reported by women, see Table 4).

Consistent with these findings, in a recent Mexican study, based on data collected during 2020 through a remote survey of 47,819 women aged 15 years and older, Rivera et al. (25) reported an 11.5% of prevalence of violence against women, and the most reported acts were shouting, insults, or threats (4.3%) between 2020 and 2021 during the pandemic confinement. These authors also identified different factors associated with the episodes of violence, such as unemployment, being partially, and/or totally quarantined, being a family caregiver, binge drinking, and losing a family member to COVID-19 (25). The results from other studies regarding domestic violence during the same period of confinement in Mexico reported a 5.8% prevalence of episodes of violence against adult women, most of whom had already suffered some types of violence prior to the pandemic. This study revealed that the most reported acts of violence were emotional (4.3%), economical (2.1%), and physical (1.9%) (45). Unfortunately, our results also reflect this situation in some Mexican families, manifested mainly as psychological, verbal, and emotional violence, and their impact on socioeconomic vulnerabilities and mental health context has been little explored (44).

As already well-known, in situations of violence within homes, social isolation represents an opportunity to generate or maintain conditions of control and oppression, favored by the increase in contact time between the victim and the perpetrator, who is often the partner (27). Financial strain and isolation are also well-known

domestic abuse risk factors, and both of these situations reduce the opportunities for people who are victims to ask for help (11). It is worth mentioning that the government of Mexico City made specific telephone lines available to the citizens for reporting gender violence and provided mental health support to those affected by the effects of confinement (23). According to Casas and Maldonado (14), there was a 45% increase in telephone complaints of domestic violence in Mexico during the second and third quarters of 2020. However, as Manrique de Lara and De Jesús Medina Arellano (44) pointed out, structural violence against women is often normalized in the Mexican context and has been exacerbated during the pandemic, affecting every sphere of society. Although health policies are being developed to provide life support services for victims of violence, the structural violence derived from the roles associated with care and domestic work that women face every day remains a neglected public health crisis in itself (44).

As we discussed, we found that suffering episodes of violence were significantly associated with being unmarried, as well as age, neglected feeding habits, or physical activity, and having had symptomatic COVID-19 infections. In connection to these issues, some studies have explored the effect of marital status (specifically, being unmarried) in relation to mental health during the lockdown from the beginning of the pandemic, but reports on the relationship with violence are somewhat limited. Ahmed et al. (46) found that women, students, unmarried individuals, and younger people were in more vulnerable positions in terms of demographics related to mental health during the pandemic in Bangladesh. Elhadi et al. (47) in turn, showed through multivariate analysis that being younger, women, unmarried, educated, or victims of domestic violence or abuse, having work suspension or increased workload, financial issues, suicidal thoughts, or a family member hospitalized due to COVID-19 were significantly associated with a high likelihood of mental disorders during the first months of the pandemic among the Libyan population. Additionally, Lee et al. (48) reported that higher levels of adverse mental health symptoms were associated with people who were single, reported a lower household income, had decreased support from friends or family, and increased stress at work or home during the COVID-19 pandemic in South Korea. Further studies may reveal how marital status may influence the observed effects of social confinement, particularly in the context of mental health. In fact, the medium- to long-term effects of social confinement on mental health are suspected to be substantial and remain far from being resolved (49).

The results of the present study further confirm some of these known trends and help contextualize them to highlight the interrelationship between biological, social, and emotional health conditions. In brief, this study has exposed some of the effects that social confinement during the COVID-19 pandemic had on certain living conditions, habits related to food, sleep, and physical activity, as well as people's daily lives and family relationships. This highlights the importance of interdisciplinary analysis, whose sole objective is to highlight the dimension of social vulnerabilities and their articulation with biological and mental factors for the generation of comprehensive health interventions.

The main living conditions modified among the volunteers were related to work, exercise, and food. With respect to violence and support networks, we consider them as a result of higher

or structural categories. For example, different forms of violence can be related to historical–social processes that our society shares with the rest of Latin America, as well as being closely related to inequalities based on age, gender, and social capital (50, 51). Although some public policies have been implemented in Mexico to support victims of violence, it is largely unknown what effect they have had on the population during the pandemic (25). Within this study, we found that emotional and psychological conditions related to in-house violence were particularly salient. This highlights the importance of addressing mental health through public policies in our country in the post-pandemic era (52).

5. Conclusion

The findings of the present study revealed gender and socioeconomic differences in relation to the COVID-19 lockdown established in Mexico. These differences were observed in terms of places of work, the prevalence of metabolic diseases, mental, behavioral, and developmental disorders, as well as modified patterns of physical activity and social life.

The results of multivariate logistic models used to analyze the association between at-home violence episodes and various factors showed that such episodes were associated with *age*, *being unmarried*, *neglecting self-care (including eating habits)*, and *having suffered from COVID-19 infection with symptoms*. All of these factors suggest potential vulnerability. Although the prevalence of violence, in general, was similar between men and women, certain types of violence were significantly more prevalent among women, including economic, emotional, psychological, and verbal violence.

We have also noticed that although some public policy measures were implemented to support both the general and vulnerable populations during the lockdown, <10% of the participants (with no statistically significant gender differences) reported receiving any support. This fact underscores the need to evaluate and redesign such support policies to maximize their social impact. Studies like this one can continue to provide evidence for the ongoing monitoring and improvement of social support policies and raise awareness of the often-overlooked living conditions of vulnerable populations.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by IRB of the National Institute of Cardiology Ignacio Chavez (protocol code 13-802). The patients/participants

provided their written informed consent to participate in this study.

Author contributions

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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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Early impact of COVID-19 social distancing on social determinants of health and their effects on mental health and quality of life of Korean undergraduate students

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Introduction: This study aimed to investigate the association between social determinants of health and perception of COVID-19 social distancing/mental health/quality of life during COVID-19 social distancing in Korean undergraduate students using online survey data augmented with natural language processing.

Methods: An online cross-sectional survey including sociodemographic characteristics, students' perceptions of COVID-19 social distancing, and social determinants of health was conducted between July and November in 2020. We conducted logistic regression analysis to investigate the relationship between social determinants of health (independent variables) and perceptions of COVID-19 social distancing, mental health, and quality of life (dependent variables). This association was augmented using sentiment analysis and word clouds by visualizing open-ended comments on COVID-19 social-distancing policies.

Results: Data were collected from 1,276 undergraduate students. Participants who experienced negative impacts on their social-networking activities due to COVID-19 social distancing were at significantly higher odds to perceive COVID-19 social distancing as not being beneficial [odds ratio (OR) = 1.948, 95% confidence interval (CI) 1.254−3.027], to have increased stress levels (OR = 1.619, 95% CI 1.051−2.496), and to experience decreased quality of life over 5 weeks (OR = 2.230, 95% CI 1.448−3.434) against those who answered neutrally. In contrast, Participants who reported positive perceptions of social-networking activities during the COVID-19 pandemic had lower odds of feeling depressed or anxious (OR = 0.498, 95% CI 0.278−0.894) and reporting a low quality of life over 5 weeks (OR = 0.461, 95% CI 0.252−0.842) compared to those who reported neutral perceptions. Furthermore, the results of the word cloud and sentiment analyses showed that most students perceived social distancing negatively.

Conclusions: The government's social-distancing policy to prevent the spread of COVID-19 may have had a negative impact, particularly on undergraduate students' social-networking activities. This highlights the need for greater social support for this population, including access to psychotherapeutic resources, and improvements in policies to prevent infectious diseases while still maintaining social connections.

1. Introduction

The World Health Organization (WHO) declared the novel coronavirus disease (COVID-19) a pandemic on March 11, 2020 (1). The WHO strongly recommended quarantine as one of the most effective measures against the contagious outbreak of the disease worldwide (2). Quarantine has been defined by the Centers for Disease Control and Prevention (CDC) as the segregation and restraint of individual movement to prevent people potentially at high risk of exposure to infectious diseases from transmitting the disease (3). Furthermore, the CDC recommended a physical distance of at least six feet to minimize physical interactions between people who are carriers but have not yet been identified or quarantined, which is also interchangeably defined as social distancing (4).

A previous observational study indicated that quarantine, social distancing, and isolation cause anxiety, anger, and depression (5). Brooks et al. reported that quarantine and social distancing psychologically affect people, resulting in stress symptoms, confusion, anger, and fear (2). Researchers have also demonstrated an association between younger age and negative psychological impacts (2). Exposure to negative psychological stress for a long time could be associated with changes in social determinants of health, defined as "conditions in the places where people live, learn, work, and play" by the CDC (6). Social determinants of health are essential to public health outcomes, particularly focusing on mental health (7). This is because various changes in individual conditions of daily life can affect individual psychosocial factors (7).

In the case of South Korea, the Korean government raised the alert level from orange to red on February 23, 2020. This resulted in a ban on gatherings of five or more people, the closure of all schools, and recommendations for telecommuting and social distancing (8). South Korea continued to implement social distancing policies, including restrictions on private gathering sizes, until April 18th, 2022 (9). One study, which used the 2020 Health Survey of Korean adults, found that social determinants of health (e.g., socioeconomic statuses such as age and income, education level, marital status, hypertension, eating habits, and social support) were associated with COVID-19 infection (10). Since Korea implemented strong social distancing policies to prevent the spread of COVID-19, it would be meaningful in the global context to understand the impact of the social determinants of health on undergraduate students' perception of COVID-19 social distancing, mental health, and quality of life.

Korean undergraduate students have undergone significant social and educational changes. They undertook online classes and were unable to meet their professors and classmates in the places where they had learned. Owing to the changes in the Korean government's social-distancing policy, university students experienced confusion due to the inconsistent policies of educational institutions regarding schedules for examinations or school closures. In the context of the pandemic, uncertain and anxious circumstances may have negatively affected the psychological health of undergraduate students (11). In fact, another study examining nurse interns found that the COVID-19 pandemic, which was an unprecedented crisis of such magnitude that has not occurred in a century, caused them to experience stress, trauma, and mental health issues, resulting in a negative impact on their quality of life (12). In addition, a longitudinal study showed that undergraduate students without preexisting mental health problems experienced mental health deterioration during social isolation due to COVID-19 (13). Few studies have analyzed the psychological impact of social distancing and COVID-19 on adults in Korea (14–16).

However, it has rarely been reported among undergraduate students which social determinants of health have been affected by COVID-19 social distancing and their impact on mental health. The present study aimed to evaluate the association between the social determinants of health affected by the COVID-19 social distancing among undergraduate students and their perceptions of COVID-19 social distancing, mental health, and quality of life. We also visualized open-ended comments on COVID-19 social-distancing policies using natural language processing to augment the association.

2. Materials and methods

2.1. Study design and participants

To assess the perceptions of COVID-19 social distancing among undergraduate students in Korea, a cross-sectional, anonymous online survey was conducted between July and November 2020. The survey was distributed via the online platform (healthbit.com) by the Pusan National University Students' Association, using a convenient non-probability sampling method.

The survey questionnaire was originally developed by Leeza Osipenko as part of a LockDown Project and subsequently piloted with 20 students and staff members from both national and international locations (17). All respondents voluntarily participated in a 15 minutes online survey and were allowed to submit the survey only once. The inclusion criteria for this study were individuals who met the following three conditions: (a) aged 18 years or above, (b) undergraduate students, and (c) willing to participate voluntarily. Exclusion criteria comprised (a) individuals who did not agree to participate ($n = 6$), and (b) those who were not undergraduate students or did not provide their student status ($n = 288$).

We used a sample size calculator to calculate the necessary representative target sample size for achieving the study objectives with sufficient statistical power (18). The calculator determined that a sample size of 601 participants would be needed, considering a margin of error of ±4%, a confidence level of 95%, a response distribution of 50%, and a total population size of 2,633,787 people, which was the total number of university students in Korea in 2020 (19).

This study was approved by the Institutional Review Board of Pusan National University (PNU IRB/2020_62_HR).

2.2. Study instruments

The questionnaire consisted of three parts: sociodemographic characteristics, undergraduate students' perception of the

COVID-19 social distancing, and social determinants of health impacted by the social-distancing policy during the COVID-19 pandemic. The self-report survey included dichotomous or Likert scale questions. Sociodemographic characteristics including age, residential area type, accommodation type, sex, household income, and comorbidities were recorded. Undergraduate students' perceptions of the COVID-19 social distancing covered questions about their mental health and quality of life. The social determinants of health included (a) social-networking activities, (b) physical exercise, (c) access to health services, and (d) education. Additionally, open-ended questions were asked on undergraduate students' perceptions of the COVID-19 social distancing.

2.3. Social-networking activities

Social-networking activities were assessed with a single question: "Due to the COVID-19 social distancing: (a) My social life was impacted, but, overall, I am/was able to cope owing to other support; (b) My social life has been great, and I managed to stay positive; or (c) My social life was negatively impacted." Assuming that social distancing to avoid the spread of infection may negatively affect university students in terms of social networking, the answers were matched from (a) to (c) on a Likert scale and coded from 0 to 2. For response (b), as the respondent reported that their social life was great and they managed to stay positive, the overall impact was coded as positive perception as 1 = positive perception. For response (c), as the respondent reported a negative impact on their social life, the overall impact was coded as 2 = negative perception. For response (a), as there was no positive or negative direction in the answer, the overall impact was coded as 0 = neutral perception.

2.4. Physical exercise

It was assessed whether the physical exercise pattern was changed due to COVID-19 social distancing and how participants feel about this change through the following six items: "Exercise during COVID-19 social distancing: (a) I do not exercise; no change for me; (b) I cannot exercise, but it does not bother me; (c) I started to exercise more; (d) I get sufficient exercise, and I am satisfied; (e) I can exercise, but it is not how I want it; and (f) I cannot exercise, and it decreases my quality of life." If respondents answered (c) to (e), their response was coded as 1, indicating a positive perception. Option (c) was considered positive because the respondent started to exercise more, which is a positive impact on their exercise routine. Option (d) was also considered positive because the respondent is satisfied with their current exercise routine. Option (e) was also considered positive because even though it is not their preferred way of exercising, they can still exercise. However, if (f) was selected, it was coded as 2, indicating a negative perception. This is because the respondent cannot exercise and it has decreased their quality of life, which is a negative impact on their physical activity. If respondents selected (a) or (b), the score was coded as 0, indicating a neutral perception. For option (a),

it was considered neutral because the respondent did not exercise before, so the pandemic did not impact their exercise routine. Option (b) was also considered neutral because the respondent cannot exercise but is not bothered by it.

2.5. Access to health services

This dimension was assessed using a single item: "I was effectively able to access health services": (a) yes or (b) no. If the respondents selected (a), it was graded 1 as a positive perception. If the respondents answered (b), it was graded 2 as a negative perception.

2.6. Education

Five questions related to the "Education" dimension were combined to form a single question on whether undergraduate students were affected by the COVID-19 social distancing. The following questions were asked as yes or no: "I was unable to continue my university work partially or fully (e.g., lab shut down or international station required)," "Exams were postponed/canceled," "Because of the COVID-19 social distancing, I was not able to continue my education in the near term (after life goes back to normal)," "My university did not progress with the exams/assessments and made a relevant arrangement," "My university was not supportive in offering services, which enabled me to continue my work/education." It was operationally defined that participants might have been influenced by the COVID-19 social distancing and its related social phenomenon if they answered "yes" to any of the five questions.

2.7. Perception of the COVID-19 social distancing, mental health, and quality of life

Four questions were designed to assess participants' perceptions of the COVID-19 social distancing. Two questions were answered using a dichotomous format as follows: "Social distancing is beneficial for me" and "During the pandemic over five weeks, I felt depressed/anxious." The others examined the participants' level of stress and quality of life during the pandemic over 5 weeks, through the following statements: "During the pandemic over five weeks, my level of stress" (a) decreased or stayed the same or (b) increased; and "During the pandemic over five weeks, my quality of life:" (a) decreased or (b) increased or stayed the same. The response options for the question "Social distancing is beneficial for me" were coded as 0 for "yes" and 1 for "no". The response options for the question "During the pandemic over 5 weeks, I felt depressed/anxious" were coded as 0 for "no" and 1 for "yes". For the stress question, a response of (a) was coded as 0, and (b) was coded as 1. For the quality of life question, option (a) was coded as 1, and option (b) was coded as 0. To assess internal consistency, Cronbach's α was used to evaluate the items. A value >0.6 is generally considered acceptable for internal consistency reliability [20].

2.8. Statistical analyses

All variables, except for age, were categorical. Descriptive analyses were used to summarize categorical variables as the number of respondents and percentages, and continuous variables as the mean and standard deviation. Chi-square analysis was conducted to examine the relationship between social determinants of health and participants' perception of the COVID-19 social distancing, mental health, and quality of life variables. Missing values were excluded from the analysis for each survey item.

Logistic regression was used to assess the relationship between the impact of COVID-19 social distancing on social determinants of health (social-networking activities, physical exercise, access to health services, and education) and their influence on undergraduate students' perceptions of COVID-19 social distancing, mental health, and quality of life. The responses to survey questions related to the social determinants of health were used as independent variables, while perceptions of COVID-19 social distancing, mental health, and quality of life were used as dependent variables.

To supplement the results of the multivariate logistic regression, open-ended questions were investigated using word cloud and sentiment analysis with text-mining techniques in addition to natural language processing. The word cloud package was used to analyze frequent words from the open-ended questions. Finally, sentiment analysis was implemented to analyze the sentiments of undergraduate students by linking the KNU Korean Sentiment Lexicon (21). The KNU Korean Sentiment Lexicon, created by Kunsan University in Korea, is an emotional dictionary. It comprises positive, neutral, and negative sentiments used to express emotions. The consensus of three evaluators determined the emotion of each word in this dictionary using a 5-point Likert scale, "very negative," "negative," "neutral," "positive," and "very positive," ranging from 2 (very positive) to−2 (very negative). All sentimental expressions were classified as positive, negative, or neutral, depending on the sentiment scores.

Statistical analyses, including descriptive and logistic regressions, were performed using SAS version 9.4 (Cary, NC. SAS Institute Inc.) and R version 4.0.2 (R Foundation for Statistical Computing) for word cloud and sentiment analyses. A P-value <0.05 was considered statistically significant.

3. Results

3.1. Sociodemographic characteristics

A total of 1,570 individuals were invited to participate in the survey, of which 1,276 ultimately met our inclusion criteria. Among the 1,276 participants, 572 (44.8%) were women, and 384 (30.1%) were men, with an average age of 22.4 years. Most participants (62.1%) lived in a large city, and the accommodation type was apartments. Regarding family income, 47.2% ($n = 602$) of the respondents belonged to the lower class. Most participants (71.6%) had no underlying diseases. The sociodemographic characteristics of the participants are presented in Table 1.

TABLE 1 Sociodemographic characteristics.

Attribute	n	Percentage (%)
Demographics [Student at a university (n) = 1,276]		
Age	974	22.40 ± 3.74[a]
Live in (Residential area)		
Countryside/sub	21	1.65%
Large city	792	62.07%
Small city/town	210	16.46%
Missing	253	19.83%
Accommodation		
Flat	660	51.72%
House	89	6.97%
Rented room	274	21.47%
Missing	253	19.83%
Sex		
Female	572	44.83%
Male	384	30.09%
Others	19	1.49%
Missing	301	23.59%
Household income		
High income	158	12.38%
Middle income	139	10.89%
Low income	602	47.18%
Prefer not to say	75	5.88%
Missing	302	23.67%
Comorbidities		
Yes	60	4.70%
No	914	71.63%
Missing	302	23.67%

[a]Mean ± standard deviation.

3.2. Perceived impact of the COVID-19 social distancing on social determinants of health

Table 2 shows the social determinants of health affected by the COVID-19 social distancing. The chi-square analysis revealed significant correlations between social-networking activities, physical exercise, and participants' perception of these variables. Regarding social-networking activities, 29.1% of participants who answered that COVID-19 social distancing was beneficial also reported a negative impact on their social lives. Of the participants who reported an increase level of stress during pandemic over 5 weeks, 30.0% answered that their social lives were negatively impacted, while 6.3% answered that they managed to stay positive. Among those who reported feeling depressed/anxious during the pandemic over 5 weeks in terms of social-networking activities,

26.7% reported a negative impact. In regards to the decreased level of quality of life during the pandemic over 5 weeks, 29.8% reported a negative impact on their social-network activities, while 5.1% felt positive, and the remaining respondents felt neutral. The internal consistency of the perception of COVID-19 social distancing/mental health/quality of life was found to be acceptable with a Cronbach's α coefficient of 0.62.

3.3. Association between social determinants of health impacted by COVID-19 social distancing and negative perceptions of the COVID-19 social distancing, mental health, and quality of life

Associations between the social determinants of health impacted by COVID-19 social distancing and how these affected undergraduate students' perceptions, mental health, and quality of life were assessed using logistic regression. Table 3 presents the results of these relationships. Participants negatively influenced by social-networking activities during the COVID-19 crisis were significantly associated with the response that the COVID-19 social distancing was not beneficial (OR = 1.948, 95% CI 1.254–3.027) than those who answered neutrally. In contrast, participants who answered positively on social-networking activities were significantly associated with lower odds of feeling depressed or anxious during the COVID-19 pandemic (OR = 0.498, 95% CI 0.278–0.894) compared with those who answered neutrally.

Participants who responded negatively to physical exercise had significantly higher odds of feeling depressed or anxious during the COVID-19 pandemic over 5 weeks (OR = 2.433, 95% CI 1.254–4.718) against those who answered neutrally.

Regarding the high level of stress during the pandemic over 5 weeks, participants who responded negatively to social-networking activities had higher (OR = 1.619, 95% CI 1.051–2.496) than those who responded neutrally. In contrast, participants who felt positive about social-networking activities had significantly lower odds of reporting high levels of stress during the pandemic over 5 weeks (OR = 0.555, 95% CI 0.313–0.982). This tendency was also observed in low quality of life during the pandemic over 5 weeks. Participants who responded negatively to social-networking activities had a significant association with the response to a low level of quality of life during the pandemic over 5 weeks (OR = 2.230, 95% CI 1.448–3.434) than those who responded neutrally. In contrast, participants with positive perceptions of social-networking activities during the COVID-19 pandemic were significantly correlated with lower odds of reporting a low quality of life over 5 weeks (OR = 0.461, 95% CI 0.252–0.842).

3.4. Visualization of social distancing-related discussions

A total of 212 replies and 743 words remained after removing the background noise and performing lemmatization. Refined words were used to visualize the most frequent and sentiment

words for word clouds and sentiment analysis. Figure 1 shows the results of the word cloud visualization based on the open-ended questions related to the COVID-19 social distancing. The highly frequent words are "class," "human," and "crisis." School-related words such as "university," "online," and "education" are ranked high, as well as social distance-related words such as "distancing" and "isolation." Sentiment analysis identified seven words as positive, 12 as negative, and only one as neutral. The most positive sentiment words consisted of "benefit" and "prevention," whereas "disease," "stress," and "depression" occurred in negative sentiment words. The results of the sentiment analysis are shown in Figure 2.

4. Discussion

To the best of our knowledge, this study is the first to examine how COVID-19 social distancing affects social determinants of health among Korean undergraduate students, using survey data enhanced by natural language processing. This study contributes to the existing literature in several ways. Most studies have emphasized the psychological impact of online learning on university students (22, 23) or their satisfaction with it (24, 25). The present study found that COVID-19 social-distancing policies had an impact on the social determinants of health among Korean undergraduate students, and this impact was significantly associated with individual perceptions of COVID-19 social distancing, mental health, and quality of life.

In this study, the social determinants of health that were affected by COVID-19 social distancing included social-networking activities, physical exercise, access to health services, and education. Among them, social-networking activities strongly correlated with undergraduate students' perceptions of social distancing during the COVID-19 pandemic. Those negatively influenced by social-networking activities had significant correlations with thoughts that social distancing was not beneficial, increased stress, and resulted in a low quality of life during the pandemic. These results are consistent with the finding of a previous study that longer periods of isolation and inadequate physical space were associated with worse mental health outcomes, including depression (26). In addition, it aligns with the studies that showed younger age groups, in particular, experienced a higher prevalence of loneliness during COVID-19 lockdowns (27, 28). These findings are noteworthy, considering that social isolation as results of social distancing during pandemics might trigger mental health concerns (29, 30), including general psychological distress (31), decreased well-being (32), and lower life satisfaction (32). In contrast, those positively affected by social-networking activities were significantly less likely to feel depressed or anxious, maintain or decrease stress, and increase or maintain their quality of life. It is consistent with the result that Filipino nurses' strong resilience could aid them in dealing with the impact of situational fatigue on their mental health (33). This positive perception can be explained by the following two hypotheses: this may be because greater psychological flexibility and acceptance of difficult thoughts and emotions appear to act as buffers against the negative effects of increased social isolation during the current pandemic (34). In other words, the results support the notion that their high level of

TABLE 2 Descriptive analysis on questionnaire of the perceived impact of COVID-19 social distancing on social determinants of health.

Social determinants of health	COVID-19 social distancing was not beneficial[a]			Feeling depressed/anxious during pandemic over 5 weeks[a]			Level of stress during pandemic over 5 weeks[a]			Level of quality of life during pandemic over 5 weeks[a]		
	Yes [n (%)]	No [n (%)]	χ^2, p	Yes [n (%)]	No [n (%)]	χ^2, p	Decreased/ stayed the same [n (%)]	Increased [n (%)]	χ^2, p	Increased/ stayed the same [n (%)]	Decreased [n (%)]	χ^2, p
Social-networking activities[b]												
Neutral	147 (19.8%)	106 (14.3%)	**43.8, <0.0001**	97 (12.9%)	165 (22.0%)	**57.4, <0.0001**	147 (19.3%)	115 (15.1%)	**41.7, <0.0001**	158 (20.2%)	111 (14.2%)	**67.8, <0.0001**
Positive	96 (12.9%)	54 (7.3%)		32 (4.3%)	109 (14.5%)		90 (11.8%)	48 (6.3%)		108 (13.8%)	40 (5.1%)	
Negative	123 (16.6%)	216 (29.1%)		200 (26.7%)	147 (19.6%)		132 (17.4%)	228 (30.0%)		131 (16.8%)	233 (29.8%)	
Physical exercise[b]												
Neutral	149(20.1%)	148 (20.0%)	**20.1, <0.0001**	112(14.9%)	189 (25.2%)	**21.7. <0.0001**	166 (21.8%)	140 (18.4%)	**14.4, 0.0007**	164 (21.0%)	149 (19.1%)	**20.4, <0.0001**
Positive	182 (24.5%)	149 (20.1%)		143(19.1%)	187 (24.9%)		162 (21.3%)	171 (22.5%)		193 (24.7%)	152 (19.5%)	
Negative	35 (4.7%)	79 (10.7%)		74 (9.9%)	45 (6.0%)		41 (5.4%)	80 (10.5%)		40 (5.1%)	83 (10.6%)	
Access to health services[b]												
Positive	276 (43.1%)	266 (41.6%)	0.53, 0.47	240 (36.8%)	314 (48.2%)	1.1, 0.30	268 (40.8%)	287 (437%)	0.60, 0.44	297 (44.1%)	275 (40.8%)	0.82, 0.37
Negative	46 (7.2%)	52 (8.1%)		48 (7.4%)	50 (7.7%)		45 (6.9%)	8.7% (15.5%)		48 (7.1%)	54 (8.0%)	
Education[c]												
Yes	43 (6.1%)	33 (4.7%)	1.60, 0.21	33 (4.6%)	45 (6.3%)	0.09, 0.77	44 (6.1%)	32 (4.4%)	2.88, 0.09	43 (5.8%)	35 (4.7%)	0.87, 0.35
No	308 (43.6%)	322 (45.6%)		282 (39.3%)	358 (50.0%)		309 (42.6%)	340 (46.9%)		330 (44.4%)	336 (45.2%)	

The bold indicates the significance of the result.

[a]The sample sizes for the survey questions on "COVID-19 social distancing not being beneficial", "feeling depressed/anxious during the pandemic over 5 weeks", "level of stress during the pandemic over 5 weeks", and "level of quality of life during the pandemic over 5 weeks" were 742, 750, 760, and 781, respectively, with missing value percentages of 42, 41, 40, and 39%. Due to the presence of missing data, the summation of values may not always correspond to the sample size across all variables.

[b]"Neutral" indicated participants were not affected by COVID-19 social distancing. "Positive" indicated participants were positively affected by COVID-19 social distancing. "Negative" indicated participants were negatively affected by COVID-19 social distancing.

[c]"Yes" indicated participants were affected by COVID-19 social distancing.

TABLE 3 Association between social determinants of health and negative perceptions of the COVID-19 social distancing, mental health, and quality of life.
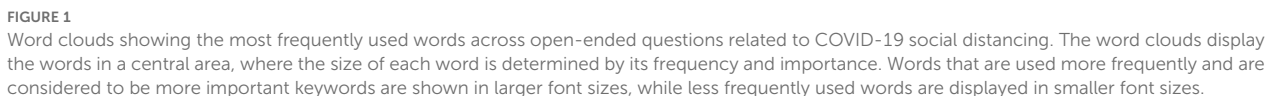
Social-networking activities, ref. neutral[a]													
Positive	20.2%	0.672	0.382–1.183	0.1687	**0.498**	**0.278–0.894**	**0.0195**	**0.555**	**0.313–0.982**	**0.0433**	**0.461**	**0.252–0.842**	**0.0117**
Negative	45.7%	**1.948**	**1.254–3.027**	**0.0030**	1.478	0.955–2.286	0.0797	**1.619**	**1.051–2.496**	**0.0290**	**2.230**	**1.448–3.434**	**0.0003**
Physical Exercise, ref. neutral[a]													
Positive	63.9%	0.640	0.358–1.142	0.1310	1.128	0.637–1.998	0.6802	0.964	0.545–1.706	0.9004	0.837	0.476–1.473	0.5366
Negative	22.0%	1.733	0.872–3.444	0.1167	**2.433**	**1.254–4.718**	**0.0085**	1.369	0.706–2.657	0.3524	1.846	0.952–3.581	0.0697
Access to health services, ref. positive[a]													
Negative	15.3%	1.130	0.657–1.945	0.6584	1.141	0.672–1.936	0.6260	1.066	0.635–1.790	0.8084	0.913	0.539–1.546	0.7352
Education, ref. yes[b]													
No	89.2%	0.953	0.476–1.909	0.8916	0.591	0.301–1.158	0.1254	1.037	0.534–2.016	0.9139	1.090	0.541–2.195	0.8090

CI, Confidence Intervals; OR, Odds Ratios.

The bold indicates the significance of the result.

[a]"Neutral" indicated participants were not affected by COVID-19 social distancing. "Positive" indicated participants were positively affected by COVID-19 social distancing. "Negative" indicated participants were negatively affected by COVID-19 social distancing.

[b]"Yes" indicated participants were affected by COVID-19 social distancing.

FIGURE 1
Word clouds showing the most frequently used words across open-ended questions related to COVID-19 social distancing. The word clouds display the words in a central area, where the size of each word is determined by its frequency and importance. Words that are used more frequently and are considered to be more important keywords are shown in larger font sizes, while less frequently used words are displayed in smaller font sizes.

resilience can be a valuable asset in mitigating the negative effects of situational fatigue on individual mental health. It may also be explained that a greater amount of time for leisure may allow for better recovery with respect to the university context and the rebuilding of personal resources (13, 35). A recent study reports that people who engage in leisure activities can benefit physical health and well-being and alleviate negative emotions such as sadness, anxiety, and stress (36). Negative changes in physical exercise patterns during the pandemic were also associated with feelings of depression and anxiety. This result is in line with a study that reported a higher likelihood of experiencing anxiety

symptoms, depressive symptoms, and high-stress levels among individuals who did not engage in physical exercise during the COVID-19 pandemic (37, 38). It can be explained based on the previous study that physical exercise has various positive effects on the brain, including modulation of neurotransmitter release, enhancement of neurogenesis, anti-neuroinflammatory actions, triggering of neurotrophic factor release, as well as modulation of intracellular signaling to inhibit neuronal dysfunction and promote synaptic plasticity (39). Due to these effects, a negative change in physical exercise patterns may contribute to the development of mental disorders such as depression and anxiety. Based on the
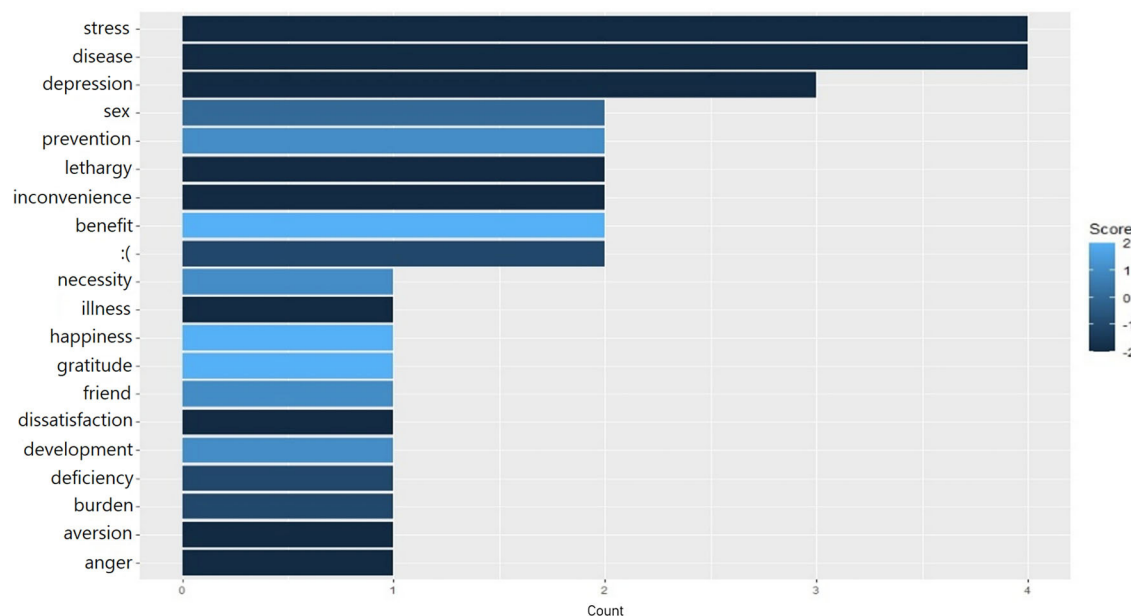
FIGURE 2
Frequent words across sentiment type toward COVID-19 social-distancing policy among undergraduates. Sentiments were based on the frequency of undergraduates' opinions with respect to the scoring from −2 (very negative) to 2 (very positive).

open-ended question about individual opinion on COVID-19 social distancing, the frequent words "class," "human," and "crisis" are not only shown, but also "distancing" and "isolation" are identified as high ranking. This finding can be linked to the results of the logistic regression in that social isolation as a result of social distancing impacted the perception of undergraduate students about preventing the spread of COVID-19. In addition, regarding COVID-19-related words, "infection," "mask," and "spread" were frequently observed. The reason that "mask" was one of the frequent words might be related to the Korean government's policy during the pandemic, which made the public purchase only two masks per week at a uniformly applied price of 1,500 KRW (1.25 USD) in this study period (40).

Sentiments about COVID-19 social distancing had a high proportion of negative responses, suggesting that undergraduate students were unable to face the uncertain and unprecedented public health crises. Negative sentiment words indicated students' negative perceptions of social distancing against COVID-19. The negative emotion-related words such as "stress," "depression," and "lethargy" were highly ranked. This result is consistent with this study's finding that undergraduate students are highly likely to feel depressed/anxious, have high levels of stress, and have a low quality of life.

This study had several limitations. First, real-time data were not captured because of its cross-sectional design. Social media data (e.g., Instagram, Twitter, and Facebook) enabled us to analyze public opinion about current topics of interest in real-time; however, it could not provide detailed sociodemographic information and social determinants of health affected by social distancing against COVID-19. Second, the results may not

be generalizable to other countries. The Korean government implemented a non-lockdown policy, although governments worldwide have implemented numerous anti-contagion policies to control the COVID-19 pandemic (41). Third, the original survey was developed to quickly investigate a broad range of variables related to the impact of the lockdown on participants. However, the study is limited by the lack of validity tests, such as factor analysis. To address this limitation, we collaborated with at least four native speakers and experts to eliminate any ambiguities in the survey questions and improve its quality. Based on the limitations of this study, future studies could consider using longitudinal designs to capture real-time data and identify changes in perceptions and experiences over time. Additionally, studies could explore the generalizability of findings across different countries and cultures, particularly those with different anti-contagion policies. Future studies could also employ more rigorous validity tests, such as factor analysis, to ensure the quality of survey questions and the accuracy of results. Finally, studies could consider utilizing both social media data and survey data to gain a more comprehensive understanding of public opinion and experiences related to social distancing and COVID-19.

Despite these limitations, the present study has several strengths. A large sample was collected, and an investigation of various dimensions allowed for a detailed analysis. Although previous articles focusing on the psychological impacts of pandemic circumstances have been published (34, 42–44), this study is meaningful because it is the first to observe the influence and importance of social-networking activities in undergraduate students, one of the groups in which social-networking activities are important during the pandemic.

5. Conclusions

This study contributes to our collective understanding of the social determinants of health affected by COVID-19 social distancing among undergraduate students, as well as their perceptions of COVID-19 social distancing, mental health, and quality of life.

The impact of COVID-19 social distancing on the social determinants of health can make undergraduates vulnerable to thinking that COVID-19 social-distancing policies are not beneficial to mental health or quality of life. Owing to the government's social-distancing policies to prevent the spread of COVID-19, university students are affected by social determinants of health, such as social-networking activities, resulting in stress, depression, anxiety, and decreased well-being. This highlights the need for greater social support to improve psychotherapeutic settings to help undergraduate students cope with their stress, anxiety, and depression, and to maintain their quality of life. Therefore, it is necessary to evaluate which actions and measures have been taken correctly to prevent infection during this pandemic and what may have a negative impact, to prepare undergraduates to be less psychologically affected in the event of a future pandemic more effectively.

Data availability statement

Data cannot be shared publicly due to the protection of participants' personal information. Inquiries can be directed to the corresponding author (haesun.suh@khu.ac.k) or Pusan National University Institutional Review Board (irb@pusan.ac.kr).

Ethics statement

The studies involving human participants were reviewed and approved by Institutional Review Board of Pusan National University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

KL, SH, and HSS conceptualized this study, interpreted the data, wrote the first draft, and finalized the manuscript. KL and SH performed statistical analyses. HSS collected the primary data and supervised this study. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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

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The impacts of the coronavirus pandemic on the mental health of Brazilian diagnosed with COVID-19 and comparison of symptoms of depression, anxiety, insomnia, and post-traumatic stress with undiagnosed subjects

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Background: The impacts of the COVID-19 pandemic on the mental health of survivors are little known, especially regarding the occurrence of psychological disorders such as anxiety and depression. In this study, we evaluated the impacts on the mental health of Brazilian survivors who were not infected or asymptomatic with COVID-19.

Methods: A cross-sectional study was conducted collecting information through an electronic form from January to May 2021. The sample consisted of 1,334 people and were divided into two groups: case, with individuals who reported a positive diagnosis of the disease, with or without symptoms, and control, who reported not being diagnosed with COVID-19 and did not present any symptoms during the collection period. Validated instruments were used to investigate symptoms of depression (Patient Health Questionnaire), anxiety (Generalized Anxiety Disorder-7), post-traumatic stress disorder (Post Traumatic Stress Disorder Checklist) and insomnia (Insomnia Severity Index). The data were presented as standard deviation or median and interquartile ranges. The chi-square test was applied for statistical significance between categorical variables, considering a $p < 0.05$.

Results: Regarding post-traumatic stress levels, the case and control groups showed no differences ($p = 0.82$). The results of the research indicated that was no statistical correlation between the group that was affected by the virus infection and the group that was not affected in terms of depression ($p = 0.9$) and anxiety ($p = 0.7$). At the same time, the levels of insomnia ($p = 0.02$) demonstrated a statistical correlation between the groups. The prevalence of the analyzed mental health disorders was similar among both groups.

Conclusion: In conclusion, the population of survivors of COVID-19 infection tends to show little difference in terms of developing post-traumatic stress disorder, anxiety, and depression when compared to uninfected individuals. On the other hand, disorders such as insomnia are more prevalent and show a significant difference between groups, appearing more in infected individuals.

1. Introduction

In December 2019, a new betacoronavirus, SARS-CoV-2 was discovered in Wuhan, China (1). The clinical manifestations are pneumonia, symptoms of fever, cough, pulmonary infiltration, dyspnea with the occurrence of myalgias, and taste and smell disorders (1).

In Brazil, the challenges brought by COVID-19 are associated with the high incidence of cases, the wide geographic distribution of the virus, and the consequent circulation of variants. The general picture of the disease showed high mortality, resulting in efforts to access services and specialized health centers with quality of care, efficient epidemiological surveillance, and tactics to control viral spread (2).

Since the beginning of the pandemic caused by SARS-CoV-2, some studies have already shown that the social context—of mental health problems—has undergone a major change. Many self-reported cases have demonstrated a significant increase in illnesses such as depression and anxiety (3).

The perceptions of stress are individual and subjective, which means that they affect a certain group of people in different ways, even if united by a similar situation. In the case of epidemic survivors, one of the most recurrent comorbidities is related to psychiatric disorders, with an emphasis on mood disorders such as depression, anxiety, and Post Traumatic Stress Disorder (PTSD) (4).

In a study carried out by Wang et al. (5) in China with 1,200 participants, the psychological impact of COVID-19 during the first weeks in the country was analyzed. In this research, the DASS 21 scale was used to measure the levels of depression, stress, and anxiety in the volunteers. The results showed that 651 research volunteers (53.8%) reported moderate or severe psychological impact, compared to 24.5% who reported minimal psychological impact. Still, 16.5% were considered, through the score, with moderate, severe, or extremely severe depression. Furthermore, 28.8% attested to moderate or severe anxiety and 32.2% to some level of stress.

Moreover, regarding changes in sleep quality during the COVID-19 pandemic, Barros et al. (6) in their study with data from "ConVid—Research of Behaviors," which was developed by Fundação Oswaldo Cruz, analyzed that 37.1% of male volunteers started to have sleep problems during the pandemic, while this number was of 49.8% in women. In addition, a greater number of women showed worsening previous sleep problems during the pandemic.

The direct—or indirect—relationship between COVID-19 infection, during the pandemic, and psychiatric disorders is a link that demonstrates the varied consequences that such periods can cause in individuals of a population. A pandemic not only brings effects related to physical health or related to the pathophysiology of a particular virus or bacteria, but also a chain of social, cultural, and economic repercussions that significantly interfere with the increase in the occurrence of disorders such as depression, anxiety, post-traumatic stress, and insomnia (4). The increase in these disorders, nowadays, also means an increase in medication dependence, stigmatization, and a decrease in the quality of life of these individuals in various social spheres such as family, friends, and work, which harm—individually or collectively—an entire feedback system that generates more psychic suffering and non-psychiatric illness, as well as the modification of the socio-environmental context and its health determinants. In addition, the COVID-19 pandemic and all its consequences showed a complete picture of how institutions and public policies can act in the event of pandemics and epidemics in the future, given the possibility of new episodes occurring in this century (1).

Although many studies have investigated the impact of the COVID-19 pandemic on the mental health of different social groups around the world, few studies have demonstrated the impacts on the mental health of patients who survived the pandemic. For this reason, it is still urgent that more work be carried out to analyze the previous impacts, from short to long term, on the total panorama of the Brazilian population, which was—and continues—extremely affected by the biological, social, and economic pandemic's consequences. Brazil is a large country with a vast diversity of regions that differ in culture, socioeconomic conditions, and healthcare resources (7). Hence, this study aims to assess the association between the coronavirus infection experience the mental health among people who survived COVID-19 infection in different regions of Brazil in terms of depression, anxiety, insomnia, and post-traumatic stress disorder.

2. Methods

This is a cross-sectional study conducted following the guidelines of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE). The study was carried out by collecting information through an electronic form from January to May 2021.

2.1. Sample

The sample consisted of 1,334 people over 18 years old (67.2 ± 6.7) residing in Brazilian territory. For the sample size calculation, the software G * Power 3.0.10 was used to simulate all the analyzes performed in the present study. Thus, the sample size was determined by the analysis that estimated the largest number of participants, being a chi-square test with up to 6 degrees of freedom, assuming an intermediate effect size, a significance of $p < 0.05$, and statistical power of 95%. The estimated minimum sample size was $n = 232$. However, this minimum estimated sample size was increased by 90% to ensure a better representation of the Brazilian population. Thus, based on cultural plurality in the set of 27 Brazilian states, the estimated minimum sample size increased by 186 (~80%) with an additional 22 (~10%) for possible sample loss. The inclusion criteria for this study were: currently residing in Brazilian territory; being 18 years of age or older; having or not having been diagnosed with COVID-19; and being able to answer all questions in the questionnaire coherently. The exclusion criteria included: residing outside the national territory;

being under 18 years old; not answering all the questions in the questionnaire; or answering incoherently to the questions prepared. The sample consisted of individuals with specific characteristics for each group. In the case group, individuals who reported a positive diagnosis of COVID-19, with or without the manifestation of symptoms, were grouped. In the control group, individuals who reported not having been diagnosed with COVID-19 and did not present any symptoms during the collection period were grouped.

2.2. Procedures

To carry out this study, a structured questionnaire was used. To enhance the quality of the selected questions, the quality of the sample, the participant's understanding of the selected questions, and the feasibility of the questionnaire conducted a pilot questionnaire. This questionnaire was administered to a small group of participants ($n = 62$) randomly selected from the study's target population and sent via email. Based on the results obtained, the questions and instructions were adjusted to make clearer, more precise, and more appropriate for the sample and the study's objective. The 62 participants of the pilot sample were not included in the final data-analysis. The final questionnaire was then administered to all study participants. It was disseminated via email and social networks. To ensure the randomization of the sample was employed a recruitment strategy that involved disseminating the study invitation through social media and targeted emails sent to professors at public and private universities. Participants were encouraged to forward the invitation to other potential participants, such as students, family, and friends (Figure 1). However, we emphasized that participation was entirely voluntary and that forwarding the invitation was not mandatory. We provided participants with feedback on the components evaluated in the questionnaire after they completed it.

The impacts of the new coronavirus pandemic on mental health were evaluated using multiple-choice questions. In addition to general demographics, the questionnaire included questions about COVID-19 treatment management, depressive symptoms, levels of anxiety and post-traumatic stress disorder (PTSD), insomnia symptoms, access to health services, previous exposure to traumatic events, stigmatization by family members, friends and/or society and coping strategies.

To accompany the research participants were offered follow-up, counseling, guidance, and specialized assistance provided by psychiatrists and medical students from the Federal University of Pará—Campus Altamira, following World Health Organization recommendations.

2.3. Instruments

2.3.1. Assessment of depressive symptoms

Depressive symptoms were assessed using the Patient Health Questionnaire (PHQ-9) in the Portuguese language. The instrument comprises nine items, arranged on a four-point scale: 0 (not at all) to 3 (almost every day), with scores ranging from 0 to 27 to assess the frequency of signs and symptoms of depression in the last 2 weeks. A score higher than or equal to 10 is estimated as a positive indicator of major depression (8). Its original version is presented by Spitzer et al. (9) and Kroenke et al. (10), and its validation and translation in Brazil were given by Osorio et al. (11).

2.3.2. Assessment of anxiety levels

The presence of anxiety symptoms was assessed using the Generalized Anxiety Disorder-7 (GAD-7) elaborated by Spitzer et al. (12) and validated by Maley (13). The translation into Portuguese was made by Pfizer (Copyright© 2005 Pfizer Inc., New York, NY). It consists of seven items, arranged on a four-point scale: 0 (never) to 3 (almost every day), with a score ranging from 0 to 21 when measuring the frequency of signs and symptoms of anxiety in the last 2 weeks.

2.3.3. Assessment of post-traumatic stress levels

To assess PTSD, the Post Traumatic Stress Disorder Checklist (PCL-5) was used, which applies the criteria of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). The Brazilian version was translated by Spitzer et al. (12). It consists of 20 items arranged on a five-point scale: 0 (not at all) to 4 (extremely) to evaluate the severity of the symptoms related to traumatic experiences.

2.3.4. Assessment of insomnia symptoms

The Insomnia Severity Index (ISI) was validated by Bastien et al. (14) and its validation was revised by Buysse et al. (15). The ISI was used in Portuguese language and consists of five items, ranging from 0 to 7 for no clinically significant insomnia to 22–28 for severe insomnia.

2.3.5. Assessment of clinical progression scale of COVID-19

The WHO Clinical Progression Scale of COVID-19 was used as a method to divide the groups diagnosed (case) and undiagnosed (control) with COVID-19. This scale ranges from 0 to 10, with 0 representing uninfected individuals with no viral RNA detected, therefore, for undiagnosed individuals, the range from 1 to 9 represents the subjects who received a diagnosis of COVID-19. The
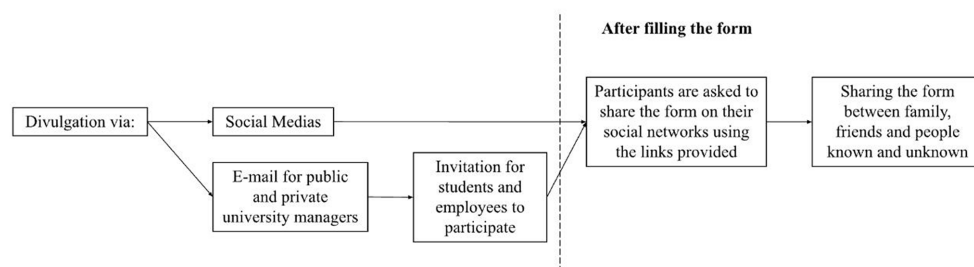

FIGURE 1
Questionnaire disclosure method.

higher the score on this scale, the greater the severity of the symptoms presented by the participants, and 10 represents those who have died from the disease ([16]).

2.4. Data analysis

Continuous data were presented as standard deviation or median and interquartile ranges, depending on distributions, and categorical as percentages. The Pearson or Spearman correlation test was used (in the case of asymmetric distribution). For the test on categorical variables, Pearson's chi-square test was applied with the correction of Fisher's exact test when there were <6 participants in a category. In case of statistical significance, the adjusted residual values >2 were analyzed to identify which categories are influencing p-values.

To analyze the magnitude of the differences between the groups, the effect sizes were observed using Phi (Φ), in 2×2 tables and Cramer's V, in tables above 2×2, assuming values of "Null or Very Weak" for ranges between 0 and 0.05, "Weak" for ranges between 0.05 and 0.10, "Moderate" if between 0.10 and 0.15, "Strong" for values above 0.15–0.25 and "Very Strong" for values above 0.25 ([17]).

For all tests, a value of $p < 0.05$ was adopted as an indication of significance. All statistical analyses were processed in SPSS software (Statistical Package for Social Sciences), version 23.0.

2.5. Ethical-legal aspects

The research project was submitted to the Human Research Ethics Committee for approval through registration on Plataforma Brazil. Participants were informed about the objectives of the study, the voluntary nature of participating, and the need to sign the Free and Informed Consent Term as recommended by Resolutions 466/2012 and 510/2016 of the National Health Council. Data collection was performed after approval by the Ethics Committee of the Institute of Health Sciences of the Federal University of Pará with the following CAAE number: 36046620.0.0000.0018. All subjects provided electronically informed consent before enrollment. The informed consent page presented two options (I accept/I do not accept). Only subjects who chose the "accepted" option advanced to the electronic questionnaire, and subjects could interrupt the process at any time.

3. Results

The research participants totaled 1,334 people, with 668 individuals from the case group, corresponding to those who were diagnosed with the coronavirus, and 666 from the control group. There were participants from all 27 Brazilian states with distribution ranging from $n = 15$ in Amapá and Acre to $n = 165$ in Rio de Janeiro (Figure 1). Additionally, 62 people participated in the pilot study. In the study, 70.6% of respondents were female and 28.4% were male ($n = 1,334$) (Table 1 and Figure 2).

The median (50th quartile) of participants' age was 34 years for the case group and 36 years for the control group. As for marital status, 615 (46.1%) of respondents declared themselves to be married and 628 (47.1%) were single. Widowed and divorced totaled 91 (6.7%). Regarding the level of education, 4 (0.3%) declared having completed

TABLE 1 Sociodemographic characteristics of the research participants.

	Case ($n=668$)	Control ($n=666$)	Effect size	P	Power ($1-\beta$)
	$F = 71.7\%$	$F = 69.7\%$			
Gender			$\Phi = 0.02$	0.43	0.142
	$M = 28.3\%$	$M = 30.3\%$			
Age	34 (18–72)	36 (18–75)	$\Phi = 0.08^\dagger$	<0.001	0.49
Marital status					
Married	45.2%	47.0%			
Divorced	5.5%	6.3%	$\Phi = 0.05^\dagger$	0.3	0.71
Single	47.9%	46.2%			
Widower	1.3%	0.5%			
Education					
Elementary school	0.6%	0.0%			
High school	9.9%	6.6%			
University education	29.3%	24.6%	$\Phi = 0.106^{\dagger\dagger}$	0.004	0.63
Technical education	2.4%	2.9%			
Postgraduate studies	57.8%	65.5%			
Religion					
Atheist or agnostic	13.5%	25.1%			
Buddhist	0.3%	0.6%			
Catholic or protestant	64.7%	49.5%	$\Phi = 0.176^{\dagger\dagger}$	0.176	0.98
Spiritist	10.5%	10.5%			
Jewish	0.3%	0.3%			
African origin	1.2%	2.4%			
Others	9.6%	11.6%			

F, female; M, male. †Small effect size; ††moderate effect size. Researchers' collection.

or incomplete elementary education; 110 (8.2%) said they had completed or incomplete high school; 360 (27%) said they had university education; 35 (2.6%) confirmed having completed technical education and 825 (61.8%) reported being or having completed postgraduate studies.

As for the religion surveyed among respondents, 257 (19.3%) said they were atheists or agnostics, 6 (0.4%) Buddhists, 762 (57.1%) Catholics or protestants, 140 (10.5%) spiritualists, 4 (0.3%) Jewish, 24 (1.8%) were of African origin and 141 (10.6%) claimed to have other religions.

It was also found that of the total sample of participants ($n = 1,334$), 559 (44.9%) reported having experienced a potentially traumatic event, where there was fear or risk of dying and that was not related to COVID-19. When asked about having witnessed traumatizing events during the new coronavirus pandemic, 378 (28.3%) answered yes, 210 (31.4%) from the case group, and 168 (25.2%) from the control group (Table 2).

When analyzing the depression rates, through the responses received by the participants in the questionnaire (PHQ-9), it was observed that 616 (46.2%) patients showed signs of depression, with 310
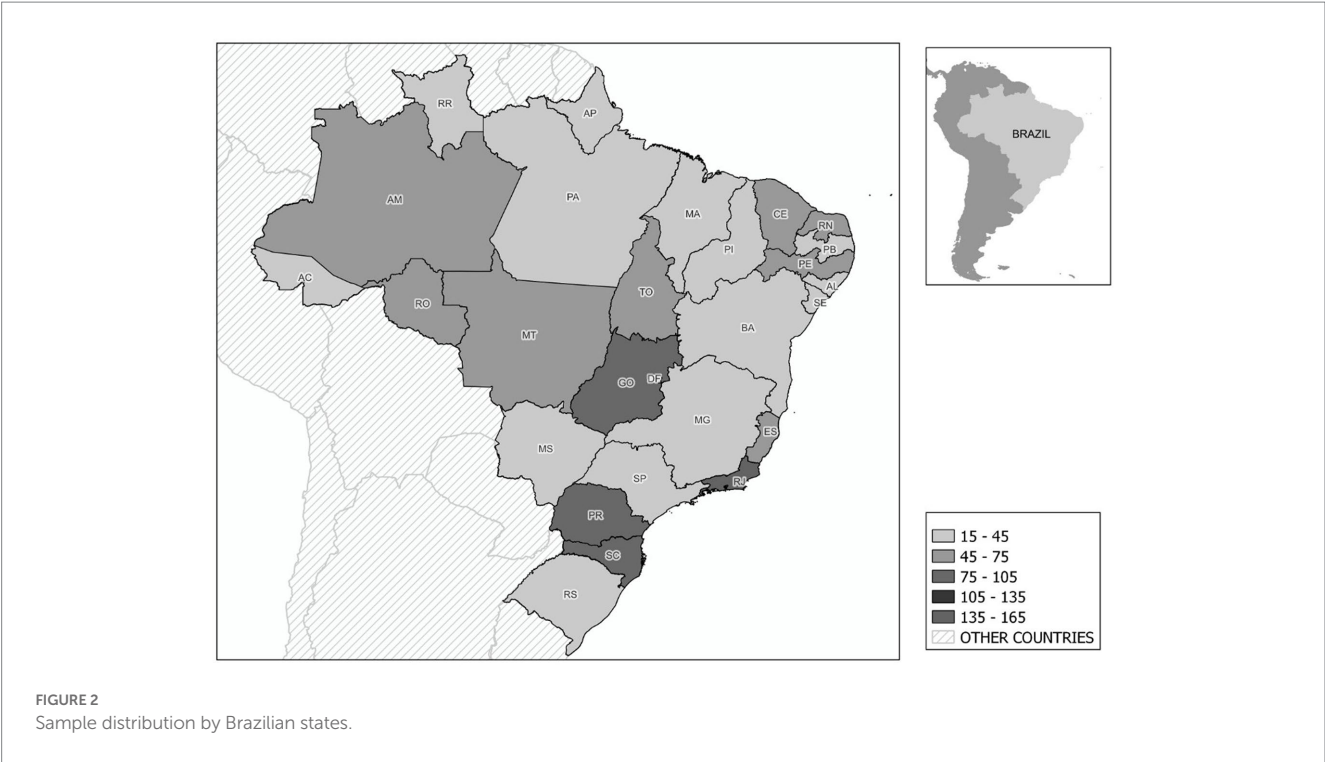
FIGURE 2
Sample distribution by Brazilian states.

TABLE 2 Participants who experienced a potentially traumatic event.

	Case (n=668)	Control (n=666)	Effect size	P	Power (1 − β)
Experienced traumatic pre-pandemic event	42.8%	47%	Φ = 0.04	0.137	0.5
Experienced traumatic events during the pandemic	31.4%	25.2%	Φ = 0.069†	0.01	0.5

†Small effect size. Researchers' collection.

(46.4%) from the group of individuals diagnosed with COVID-19 and 306 (45.9%) of the control group. Those who showed signs of anxiety totaled 390 individuals (29.2%) of the total sample, 199 (29.8%) of the SARS-CoV-2 diagnosed group, and 191 (28.7%) of the undiagnosed group. The PCL-5 checklist for analyzing Post Traumatic Stress Disorder (PTSD) showed in the study that 324 people (24.3%) of the total sample of respondents had signs of PTSD. Of these, 164 (24.6%) were in the case group and 160 (24%) were in the control group. When analyzing the signs of insomnia, it was attested that 766 people (57.4%) of the total met the criteria for the disorder, with 404 (60.5%) corresponding to the group that was diagnosed with COVID-19 and 362 (54.4%) of the group that was not diagnosed with the disease (Table 3).

4. Discussion

In this study, we assessed levels of depression, anxiety, post-traumatic stress disorder, and insomnia in Brazilian survivors of COVID-19. While the impacts of COVID-19 on mental health have been widely described in various populations, survivors of COVID-19 may be more susceptible to psychological and psychiatric issues due to the impact of contracting the virus and experiencing disease symptoms (4).

When comparing the levels of depression and anxiety between subjects affected by COVID-19 (case group) and unaffected subjects

(control group), we did not find a statistically significant correlation between the groups. These findings partially corroborate the results presented by Zhang et al. (18), who demonstrated an increased prevalence of anxiety in both patients infected with COVID-19 and individuals under quarantine and the general public. However, they found an increased prevalence of depression predominantly in patients who had been infected with COVID-19. Similarly, Ryal et al. (19) also demonstrated a high prevalence of psychiatric disorders in surviving patients diagnosed with COVID-19, with depression and anxiety being among the highest. Reagu et al. (20), in their study on a population in isolation and institutional quarantine in Qatar, used the same instruments as this study in similar sample size and reported that participants with positive COVID-19 PCR tests had significantly higher levels of depressive and anxiety symptoms than participants with negative tests. Other studies have linked the clinical severity of the disease to greater severity of psychiatric disorders. For example, in a study conducted in China on a general population of 432 survivors, it was found that the prevalence of anxiety disorder was 29%. However, for survivors with more severe COVID-19, the prevalence of anxiety disorder was up to four times higher than in the general population of the study (21).

Indeed, subsequent experiences from other outbreaks and epidemics have shown an increase in comorbidities among individuals who survived the diseases during the viral spread, regardless of the severity of the condition (18). The COVID-19 pandemic was no

TABLE 3 Depression, anxiety, PTSD, and insomnia in the sample of individuals in the case and control groups.

	Case (n=668)	Control (n=666)	Effect size	P	Power ($1 - \beta$)
Shows signs of depression	46.4%	45.9%	$\Phi = 0.005$	0.9	0.87
Shows signs of anxiety	29.8%	28.7%	$\Phi = 0.01$	0.7	0.68
Shows signs of post-traumatic stress disorder	24.6%	24%	$\Phi = 0.006$	0.8	0.83
Shows signs of insomnia	60.5%	54.4%	$\Phi = 0.062^{\dagger}$	0.03	0.5

[†]Small effect size. Researchers' collection.

exception. It introduced a new social dynamic never before experienced by society, capable of generating emotional impacts on various segments of the population. In a recent meta-analysis focusing solely on the prevalence of psychological distress during the COVID-19 pandemic, it was found that one in three adults in the predominantly general population has anxiety or depression. Women, younger adults, individuals from lower socioeconomic backgrounds, residents in rural areas, and people with or at high risk of COVID-19 infection (suspected/confirmed cases, residents in heavily affected areas, having a history of chronic or mental conditions) were associated with higher chances of psychological distress [22]. Several studies have also assessed the prevalence of mental health symptoms and disorders among healthcare professionals. Almalki et al. [23] demonstrated that over a year into the COVID-19 pandemic, the prevalence of depression, anxiety, and stress remains substantial among healthcare professionals in Saudi Arabia. Hajebi et al. [24] examined the mental health of healthcare professionals in Iran using the same instruments used in our study (PHQ-9 and GAD-7). They found that half of the participants had either generalized anxiety disorder, major depressive disorder, or both. According to Dubey and Tripathi [25], social withdrawal, isolation itself, and excessive information disseminated through social media are sufficient to increase psychological symptoms, potentially leading to anxiety, panic, and depression. Therefore, the pandemic event affects both infected and non-infected individuals in terms of psychological problems, which may justify our findings.

In addition to depression and anxiety, the prevalence of insomnia and post-traumatic stress disorder (PTSD) symptoms has been widely described in a significant proportion of COVID-19 patients [26]. In our study, we found a higher prevalence of insomnia in individuals infected with COVID-19 compared to non-infected individuals. A recent meta-analysis focusing on the prevalence of depression, anxiety, and insomnia symptoms among SARS-CoV-2 infected patients revealed that sleep disorders were present in 48% of coronavirus-infected patients [26]. Lin et al. [27], investigating the immediate impact of the coronavirus on subjective sleep status, evaluated over 5,000 individuals in China divided into groups ranging from those who had direct contact with the virus, such as healthcare professionals, to individuals related to the group with direct contact, such as friends and family of frontline workers. Clinical insomnia was detected in 20.05% of the subjects studied. This clearly demonstrates the correlation, as evidenced in other studies, between coronavirus infection and its impacts on sleep quality, both among individuals who had direct contact with the disease and those who, even without contracting the infection, were involved in the global social context of the pandemic.

Regarding PTSD, although the case group showed higher exposure to potentially traumatic events unrelated to COVID-19, there was no statistically significant difference in post-traumatic stress levels between the groups. In a study conducted with adults in China, the epicenter of the coronavirus pandemic, PTSD was identified as the most concerning disorder during and after the pandemic, with a prevalence of 30%. Both diagnosed and undiagnosed individuals with COVID-19 reported a higher fear of infection risk and a negative perception of the situation, leading to greater PTSD symptoms [28]. These findings differ from the results of the present study, which did not find significant associations between the case and control groups for PTSD symptoms. In some other studies involving hospitalized patients diagnosed with COVID-19, the prevalence of PTSD was as high as 96.2% [29]. According to certain studies, PTSD appears as a provisional diagnosis primarily in patients who were hospitalized during the COVID-19 pandemic [30]. This suggests a relationship with the severity of the illness, as asymptomatic individuals who were not hospitalized did not report significant levels of PTSD.

A study conducted during the second wave of the pandemic in Iran, involving nearly 1,800 participants, showed that the prevalence of PTSD was significantly higher in hospitalized individuals and in outpatient groups receiving treatment for COVID-19 compared to the general population [31]. Furthermore, a study in the United Kingdom with over 13,000 participants who were suspected or confirmed COVID-19 cases found that PTSD symptoms were disproportionately higher in patients who required hospital treatment [32]. Another study by Guo et al. [33] in Mainland China observed higher levels of PTSD, with or without comorbid depression and anxiety, in COVID-19 survivor patients compared to non-infected individuals. Therefore, it is evident that several studies indicate a correlation between post-traumatic stress disorder and potentially destabilizing events on mental health, such as a pandemic.

Due to the analyses of the results of this research, the importance of studies covering this area is understood. Correlations of the disease with possible psychiatric disorders are dangerous because they make this group a risk factor for suicide and other disorders such as self-injury. Thus, individuals who contract the virus and develop the disease should be supported not only in the systemic aspects involving the primarily affected organs (such as lungs, heart, and kidneys) but also concerning their mental health regarding their internal and external suffering and the stigma created against such individuals.

However, the fact that the study design is cross-sectional does not allow for long-term follow-up of the patient to verify if there would be any changes in the profile of the patient's involvement, mainly due to the physiological, social, and psychological sequelae resulting from the disease [34].

The results of this study are very important, as they bring to light psychological and psychiatric symptoms in their most pathological manifestations in a group of survivors of patients of COVID-19 during the pandemic period caused by this virus. This study reveals a series of precautions and alarms that the health system and health professionals must have after such a period of the COVID-19 pandemic, with the diagnosis, treatment, and life quality of the experienced population showing that the consequences of COVID were not only related to the restricted aspects of the comorbidity but also the emotional effects during this period. Based on this study, further research on these long-term psychological and psychiatric disorders in individuals who survived epidemic diseases is necessary to add more contributions and knowledge about the depth of the psychic crises of patients who survive epidemic diseases with far-reaching—like pandemics.

Although COVID-19 has not bid farewell yet, we can begin to talk about a post-pandemic scenario that demands as much attention as the initial crisis period. After the most critical moment of the health emergency has passed, we are left with social, economic, and emotional crises. Therefore, future studies can be conducted to assess whether psychological symptoms persisted 2 years after the COVID-19 pandemic among different segments of society, including survivors. It would also be important to compare the level of psychological impacts with the severity of the disease developed by infected individuals, determining whether these impacts were directly caused by the infection or its secondary consequences. Collectively, these studies can guide the development of public policies focused on the mental health damages caused by the pandemic.

4.1. Limitations

The present study's main limitation was the data collection methodology. As this was an exclusively remote survey carried out during the COVID-19 pandemic, all information collected was self-reported by participants through electronic forms. Thus, it was not possible to test the participants to identify whether any subject in the control group, despite having reported no symptoms, was not infected with SARS-CoV-2.

5. Conclusion

Overall, this study found a higher prevalence of post-traumatic stress disorder, depression, anxiety, and insomnia in patients affected by COVID-19 when compared to uninfected ones. Despite this, the only statistically significant difference between the studied populations was in the levels of insomnia. In summary, the surviving population of SARS-CoV-2 virus infection tends to show little difference in terms of the development of PTSD, anxiety, and depression when compared to non-infected individuals. On the other hand, disorders such as

insomnia are more prevalent and with a significant difference between the groups, appearing more in infected individuals.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the Comitê de Ética em Pesquisa do Instituto de Ciências e Saúde da Universidade Federal do Pará. The patients/participants provided their written informed consent to participate in this study.

Author contributions

OS: study conception and design. SS, LC, FB, RS, and OS: methodology and data collection. SS, LC, FB, and RS: modeling, statistical, and descriptive analysis. SS, LC, and FB: article edition. RS and OS: scientific consultants and correction supervision. 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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The psychological symptoms and behavioral problems of children with mothers working as medical staff in the crisis of Covid-19 outbreak in Hamadan, Iran

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Background and objectives: The purpose of this study was to investigate the psychological symptoms and behavioral problems of children with mothers working as medical staff in the crisis of Covid-19 disease in Hamadan.

Methods: This descriptive causal-comparative study was conducted on all mothers with children aged 6 to 12 years in Hamadan from September 2 to November 29, 2020. In this study, eligible individuals were selected using random sampling and were assigned to two groups of mothers working as the medical staff and the control group. The research instruments included the Child Behavior Checklist (Achenbach) and the Child Symptom Inventory-4 (CSI-4).

Results: The results showed that the mean scores of psychological and behavioral symptoms of children in terms of group membership (group of mothers working in the medical staff and control group) had a significant difference. There was a significant difference between the mean scores of depression and aggression in children of the staff group and the control group meaning that for depression and aggression scores of children of the staff group are higher than children of the control group ($p<0.05$). There was no significant difference between the mean anxiety scores and there was almost a significant difference between the attention scores of the staff group and the control group ($p<0.05$).

Conclusion: Children whose mothers worked as medical staff during Covid-19 show more depression, attention, and aggression problems than children whose mothers do not work as medical staff.

Introduction

The first known human coronavirus infection occurred in early December 2019. This virus first out broke in mid-December 2019 in Wuhan, China, and soon after, it quickly spread throughout the world, including Iran, causing many deaths (1–4).

In the COVID-19 outbreak crisis, there were reports about the prevalence of psychiatric symptoms in all relevant individuals, including patients, medical staff, patient caregivers, and the general public. As a result, psychological prevention seemed essential. According to statistics, in the early variants of the Coronavirus, children had much fewer clinical symptoms of the respiratory tract than adults, and the mortality rate in children was very low. However, as carriers of the Coronavirus with mild clinical symptoms, they had a large share in the epidemiology of the virus (5). Although the prevalence of this virus in children is reportedly low and with different clinical manifestations; its effects, including the working conditions of parents who are members of health care providers and medical staff, have a direct and significant relationship with the health status of family members including children (6, 7).

Factors such as lack of long leave or non-standard leave and working hours are consistently associated with adverse consequences on children's health. Most studied health outcomes are behavioral and mental health problems of children, which can affect family relationships including the time spent with children, parental supervision, and the parent's closeness to children and the home environment. Studies have shown that maternal working hours at night, in the evening, or at irregular times increase the risk of behavioral problems in children. Also, late or irregular return of both parents to home has led to a negative impact on the child's mental health and has been associated with a decrease in the frequency of parent–child interactions (8–10). Such working hours led to reduced parent–child interaction and reduced quality of parenting and family environment. Poor-quality parenting and lack of parent–child interaction (11–17) are associated with problems in children. Studies have shown that children whose parents return home late due to long working hours show behavioral problems such as hyperactivity and or inattention. In addition, non-standard parental work shifts such as night work and irregular working hours can increase the risk of depression, especially among children (8, 12, 13).

In addition to non-standard working hours, other job-related factors affect children's health. Fatigue due to sleep deprivation and psychological stress associated with inappropriate working conditions lead to lower quality of time spent with children and subsequently affects their upbringing, which eventually leads to more intense behavioral disorders. Also, instability in the family and a sharp increase in the level of maternal anxiety can lead to less parental support and more children's externalized symptoms such as aggression. In broken families, children may demonstrate more disturbing behaviors and less interaction with parents which can generate behavioral problems to attract parental attention. On the other hand, some children may distant themselves from their parents and show signs of anxiety (14–17).

Learning about parental anxiety through parental role modeling, parental information transfer, and parenting can reinforce children's anxious behaviors and can also play an important role in increased anxiety in children (18). Regarding the transfer of workplace stress to the family, research shows that anxious parents inadvertently transfer their insecurity and anxiety to their children, which ultimately leads to a variety of unreasonable fears and worries in them (19).

Due to the crisis of the Covid-19 outbreak, healthcare providers report symptoms of anxiety and distress due to difficult working conditions, long working hours, and extreme fatigue as well as worry and fear of transmitting the disease to their relatives, especially children. Families, television images, and decreased interaction with children are expected to increase the prevalence of psychological symptoms and behavioral problems in children in health care providers compared to children whose parents have unrelated occupations.

This study aimed to investigate the psychological symptoms and behavioral problems of children with mothers working as medical staff during the Covid-19 outbreak crisis in Hamadan.

Methodology

Research design

An explanatory research design was adopted to carry out this study.

Sample and setting

The participants of this case–control study were 118 mothers working as medical staff and their children, and 118 non-working mothers and their children in Hamadan. Mothers responded to all the questions on questionnaires from September 2 to November 29, 2020.

Mothers' age, children's age, and children's gender were matched in the 2 groups. Inclusion criteria were having a 6 to 12-year-old child, being a primary caregiver, and completing the study questionnaires online.

Data collection and measures

The study tools were the following:

(1) The Achenbach Child Behavior Checklist: it is one of the parallel forms of The **Achenbach** System of Empirically Based Assessment (**ASEBA**) and evaluates the problems of children and adolescents in 8 categories of anxiety/depression, isolation/depression, physical complaints, social problems, thinking problems, attention problems, ignoring rules, and aggressive behavior. In this study the Persian form of the questionnaire was used and subscales of attention problems and aggressive behavior have been used. Regarding Cronbach's alpha, the overall validity coefficients of Child Behavior Checklist (CBCL) forms was 0.97, and it was 0.94 by retest validity (20).

(2) The Child Symptom Inventory-4 (CSI-4): This questionnaire includes subscales of Attention Deficit Hyperactivity Disorder, Stubbornness Disobedience Disorder, Behavioral Disorder, Anxiety Disorder, Mood Disorder, Psychotic Disorder, Pervasive Developmental Disorders, and Excretory Disorders. In this study the Persian form of the questionnaire was used. The reliability of the questionnaire was determined through a

retest on 4 diagnostic groups from 0.70 to 0.89 and its validity was reported at 0.80 (21).

Statistical analysis

Results were summarized as mean ± standard deviation (SD) for quantitative variables and frequency (percentage) for categorical variables. Continuous variables were compared using the t-test or the Mann–Whitney test if the data did not appear to have a normal distribution or if the assumption of equal variances in the study groups was violated. Categorical variables, on the other hand, were compared using chi-square tests. p values of ≤ 0.05 were considered statistically significant. SPSS statistical software version 23.0 for Windows (IBM, Armonk, New York) was used for statistical analysis.

Results

After removing incomplete questionnaires, 236 subjects (118 mothers working as medical staff and their children, and 118 nonworking control subjects and their children) were included in the study. The two groups were matched for the average age of the mothers, the age of the children, and the gender of the children.

According to the results in Table 1, the average age of mothers working as medical staff is 36.08 and the average age of the control group is 36.89. In addition, the mean age of children in the control group is 6.85, and the mean age of children of medical staff mothers is 7.85 (see Table 1). According to Table 2, the participants in the medical staff mothers group include 45.8% girls and 54.2% boys and the participants in the control group include 55.9% girls and 44.1% boys. According to Table 3, the mean scores of children's psychological and behavioral symptoms differ between the group of medical staff mothers and the control group. Children in the medical staff mothers group had higher mean scores for depression, attention problems, and aggression as compared to children in the control group; but there was no significant difference between the mean scores of general anxiety among children of medical staff mothers group and the control group. The descriptive indicators of the research variables were illustrated in Table 3. The results show that the mean scores of children's psychological and behavioral symptoms differ in terms of group membership (medical staff mothers group and a control group). The results of the independent t-test show that there is a significant

difference between depression and aggression in the two groups of children of working mothers and the control group ($p < 0/05$). It means that depression and aggression scores of the children of medical staff mothers are higher than children in the control group ($p < 0.05$).

Discussion

The working conditions and the effects on the mental health of the individuals and those around them have been the focus of health research. This study examined and compared behavioral problems and psychological symptoms in children of medical staff mothers during the crisis of COVID-19 outbreak as compared to the control group. Much research has been carried out on the effect of parents' working conditions on their children's mental health, such as Han WJ et al., (22) study in China, that found "children whose fathers worked night shifts had internalizing behaviors" (23). However, there has been no research on critical situations such as the outbreak of pandemics, including COVID-19. Given the critical nature and prolongation of the epidemic, the involvement of the medical staff, as parents, and longer working conditions and exacerbated psychological stress, affecting their mental health, research was needed to design intervention projects to improve the mental health of working mothers and their children by assessing the current situation. The results of the present study showed that children with parents working as the medical staff showed problems and symptoms of aggression and depression, and attention problems significantly more than children in the control group whose parents were not working as the medical staff. However, in terms of anxiety symptoms, no significance, and in terms of attention almost significance was observed in these two groups. These results are in line with the research by Kizuki et al., (8) who surveyed 2,987 children and their families in Japan. In their study, they found that children with both parents returning home late or having irregular working hours were more likely to demonstrate behavioral and attention problems. In addition, a study conducted by Vieira et al., (21) on parent-family work experiences and children's behavioral problems in Portugal showed that parent-work–family conflicts have a positive relationship with children's externalized problems [aggression, attention, etc., (8, 24)].

According to research, employment, and its conditions have different psychological effects on children's health. Factors such as lack of leave and long and non-standard working hours are consistently associated with adverse outcomes in children's health (6, 10). We cannot determine the exact mechanism of these relationships through the results of our research, but some possible explanations can be as follows. In the current critical situation, long and irregular working hours lead to less interaction between parents and children and lower quality of parenting and the family environment. These non-standard working conditions and working hours have an independent impact on the child's mental health. Also, children whose parents returned home late due to long working hours had behavioral problems and inactivity/inattention. In addition, children whose mothers did shift work were more likely to exhibit delinquent behaviors and behavioral problems than others. These behaviors were mainly surfaced at school. In addition, non-standard parental work shifts such as night shifts and irregular working hours can increase the risk of inattention followed by aggression among children (8, 9, 11, 13, 22).

Mental health symptoms may have been common during the COVID-19 outbreak among the general population, especially among

TABLE 1 Mean age of mothers and children according to group membership.

Group		Mean ±SD	p.Value
Age of mothers	Mothers Working as medical staff	36.08 ± 6.46	0.408
	Control	36.89 ± 6.58	
Age of children	Mothers Working as medical staff	7.85 ± 4	0.821
	Control	6.85 ± 3.01	

infected individuals, people with suspected infection, and people who might have contact with patients with COVID-19. Some measures, such as quarantine and delays in returning to work, had been also associated with mental health of the public (25).

These results are consistent with the results of our study. In addition, anxiety is another issue that children with parents having stressful jobs might develop. Research on the transfer of workplace stress to the family in the city of Kerman, Iran has shown that anxious parents inadvertently transmit their insecurity and anxiety to children, which ultimately leads to a variety of unreasonable fears and worries (19). However, the results of the present study indicate that there is no significant difference in the anxiety of children in the two groups. In some studies, such as the one by Vieira et al., (21) they found that non-standard working conditions and long and variable shifts were directly related to externalized problems in children (such as aggression, disobedience, and attention problems); however, they had no association with internalized problems such as emotional symptoms of anxiety. This could be because work–family conflicts also lead to the exaggeration of externalized problems in children through negative effects on the quality of the parent–child relationship, but these problems do not contribute to the development of internalization. Evidence shows that reduced parental control over children, which includes frequent interactions and conversations with children about their activities and friends, leads to loneliness in children and externalized

behavioral problems such as aggression, attention problems, and hyperactivity. These externalized behavioral problems are some ways to attract the attention of parents (24, 26, 27). Therefore, the parents of the medical staff are not able to interact positively and adequately with their children, due to having long and irregular working hours, night shifts, and exhaustion during the outbreak of Corona crisis, as well as critical conditions and worries for those around. This has led to an increase in children's feelings of loneliness, followed by behavioral problems such as aggression and attention problems, and perhaps this loneliness and lack of communication between parents and other friends and relatives have led to parents cannot convey much of the anxiety caused by the work environment and critical situations to their children.

Conclusion

This study examined and compared behavioral problems and psychological symptoms in children of medical staff during COVID-19 outbreak crisis and a control group including children of mothers with unrelated jobs. The results showed that the children in the group of medical staff mothers had higher mean scores for depression and aggression than the children in the control group. However, there was no significant difference between the mean scores for general anxiety, and there was almost a significant difference between the mean scores for attention among the children in the group of medical staff mothers and the control group.

Although it seems that the special working conditions of the medical staff lead to their work and family conflicts and these conflicts leave negative effects on the children, in some ways, it can be pointed out that these children experience a different lifestyle from a younger age. So, they show more psychological compatibility in some aspects of life. Also, job conditions increase the tolerance threshold of mothers and make them more adaptable to specific work and family conditions, which reduces the transmission of anxiety from mothers to children. It is suggested that this study should be done in other organizations with an emphasis on the issue of children of mothers with special job conditions. In addition to the negative effects, its positive effects should also be addressed and analyzed so that appropriate solutions be presented. Also, educational and work–family conflict management workshops should be held in hospitals and other medical centers. In addition, it is suggested to conduct this research in older age groups.

TABLE 2 Gender distribution by group membership.

Group	Frequency (%)		p.Value
Mothers Working as medical staff	Girl	54(45.8)	0.067
	Boy	64(54.2)	
Control	Girl	66(55.9)	
	Boy	52(44.1)	

TABLE 3 Descriptive indicators of psychological and behavioral symptoms of children based on the group membership.

Variable	Group	Mean±SD	Mean difference	p.Value*
anxiety	Medical staff mothers	13.81 ± 9.31	0.32	0.78
	Control	13.49 ± 8.07		
Depression	Medical staff mothers	2.52 ± 1.89	−0.78	0.01
	Control	3.30 ± 2.53		
Attention	Medical staff mothers	3.36 ± 2.61	−0.80	0.05
	Control	4.16 ± 3.46		
Aggression	Medical staff mothers	7.29 ± 6.02	−2.83	<0.001
	Control	10.12 ± 7.90		

*Results of independent t-test to compare the behavioral symptoms and problems of children in terms of mother's group membership based on the alpha extract from Bonferroni correction ($\alpha = 0.05 / 4 = 0.0125$).

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by Hamadan University of Medical Sciences, Hamadan,

Iran. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin (IR. UMSHA.REC.1402.155).

Author contributions

RR, SG, MRK, AHD, and MKD conception and design of the work, also the acquisition, analysis, and interpretation of data for the work. AND drafting the work and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. RR, SG, MRK, AHD, and MKD revising final approval of the version to be published. 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.

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