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# Psychological impact of COVID-19 on individuals: Through active choices and passive adaption

**Edited by**
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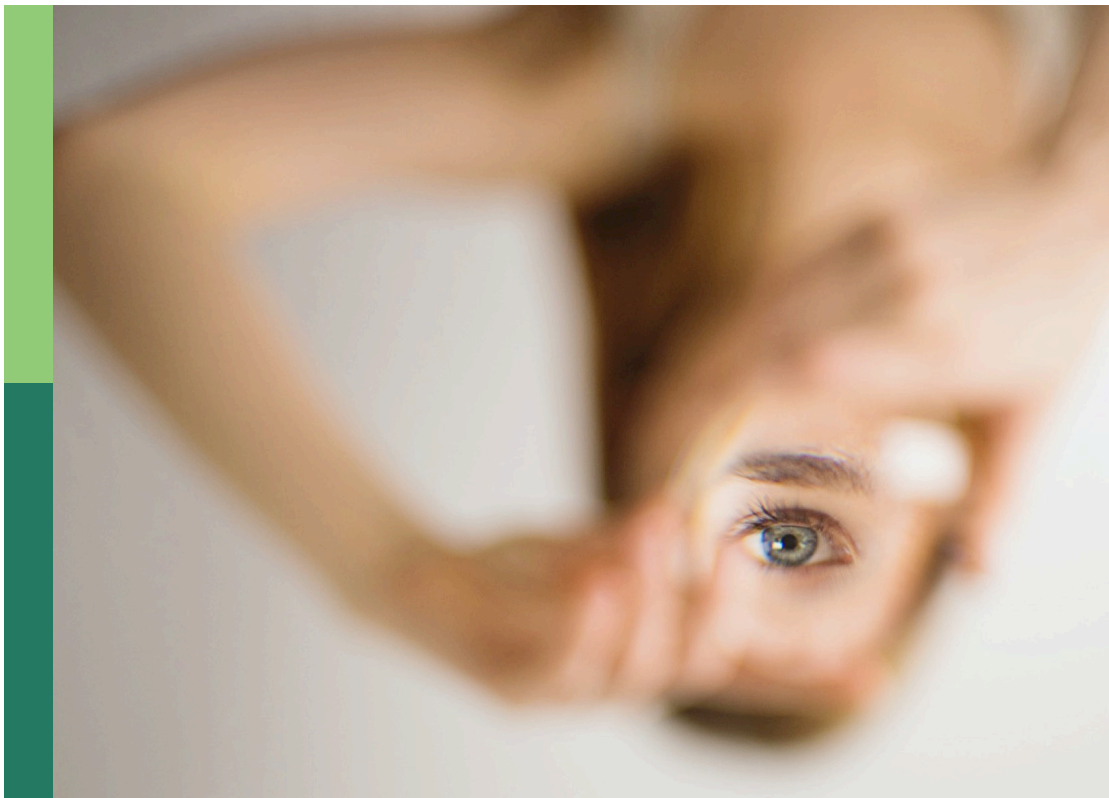
**Published in**
Frontiers in Psychology
Frontiers in Public Health



ISSN 1664-8714
ISBN 978-2-8325-4481-5
DOI 10.3389/978-2-8325-4481-5

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# Psychological impact of COVID-19 on individuals: Through active choices and passive adaption

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**Citation**

Fang, J., Lau, C., Yan, C., eds. (2024). *Psychological impact of COVID-19 on individuals: Through active choices and passive adaption*.

Lausanne: Frontiers Media SA. doi: 10.3389/978-2-8325-4481-5

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frontiers | Frontiers in Psychology

TYPE Editorial
PUBLISHED 06 February 2024
DOI 10.3389/fpsyg.2024.1356562



OPEN ACCESS

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RECEIVED 15 December 2023
ACCEPTED 29 January 2024
PUBLISHED 06 February 2024

CITATION
Wu W, Liu H, Liu S, Fang J, Lau MCK and Yan C (2024) Editorial: Psychological impact of COVID-19 on individuals: through active choices and passive adaption.
*Front. Psychol.* 15:1356562.
doi: 10.3389/fpsyg.2024.1356562



# Editorial: Psychological impact of COVID-19 on individuals: through active choices and passive adaption

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KEYWORDS

**editorial, impact, COVID-19, choices, adaption**

Editorial on the Research Topic
Psychological impact of COVID-19 on individuals: through active choices and passive adaption

The emergence of the COVID-19 outbreak led to a global socio-economic crisis and widespread psychological distress (Pedrosa et al., 2020; Serafini et al., 2020). Various studies have examined the effects of the pandemic on psychological wellbeing, targeting diverse populations (e.g., Jiang, 2020; Di Riso et al., 2021). However, limited research has focused on the adverse effects on vulnerable groups. In addition, amidst the stress caused by the global health crisis, collective concern centers on how to cope with this pandemic effectively. Previous works have highlighted the role of family support and better education (e.g., Hu et al., 2022; Liu et al., 2023). More studies are needed to explore the potential mechanisms to mitigate the detrimental impact of the pandemic, including both active choices and passive adaptation.

This Research Topic aims to present a comprehensive overview of opportunities and gaps in the field, offering insights and perspectives for the future. That is, it focuses on exploring how the uncertain environment caused by the COVID-19 pandemic affects individuals' work, lifestyles, and mental wellbeing. It delves into how people respond actively and adapt passively to the challenges posed by the pandemic. We offer a Research Topic of sixteen articles encompassing both review and research studies. These manuscripts provide a better understanding of the diverse effects of COVID-19 on individuals across various nations, income brackets, and sectors, revealing heterogeneity in the impact.

Firstly, some studies have examined the detrimental effect of the COVID-19 pandemic lockdown on the psychology of children and adolescents. Specifically, Jin et al. have found that students in secondary and high school from northwest China experience prominent anxiety sensitivity. Factors such as gender, education level, family involvement in anti-COVID-19 efforts, illness during the lockdown, and specific fears related to the pandemic contribute to elevated anxiety sensitivity levels. Limone and Toto have documented a positive association between excessive digital technology usage and negative psychological and emotional outcomes for individuals aged 14–18. Therefore, adolescents within these age groups face adverse psychological consequences when their digital involvement rises

during the global pandemic. Moreover, Pena-Shaff et al. have revealed that caregivers' anxiety increases following the outbreak of COVID-19 and thus has a negative effect on their children's emotional states. In addition, English et al. have highlighted the unique challenges of COVID-19 stress faced by Chinese international students, including fear of infection and acculturation-related stress.

Secondly, some studies have investigated the changes in women's psychological state during the COVID-19 pandemic. Specifically, Omiya et al. have found that almost half of Japanese women in this study experience a decrease in sense of coherence during the pandemic. However, good mental and physical health conditions, rich social capital, and having a job at the pre-pandemic stage can help mitigate the adverse effect. Phutong and Thaithae have revealed moderate anxiety levels in pregnant women during the pandemic outbreak in Thailand, with health literacy and social support identified as significant predictors.

Thirdly, some studies have focused on the adverse impact on elderly people and patients. Mameli et al. have shown that the COVID-19 pandemic has adverse effects on the mental health of individuals with Parkinson's disease, attributed to disrupted healthcare services, loss of routine activities and support, and reduced physical activity.

Fourthly, COVID-19 pandemic can result in more serious problems such as suicide. Bahk et al. have found that the increased levels of social distancing caused by the pandemic are associated with worsening depressive and anxiety symptoms, higher suicide risk, and heightened psychological distress among participants in South Korea. Besides, based on the sample from the northeastern Mexican border population, Villarreal Sotelo et al. have further supported this finding. Moreover, Ausserhofer et al. have suggested that emotional burden (i.e., depression, anxiety, and stress) can increase the probability of infection and have shown an interplay involving psycho-neuroendocrine and immune mechanisms. Put differently, the mental disorder resulting from the global health crisis can lead to higher infection by SARS-CoV-2, which is the virus responsible for causing this disease.

While available evidence indicates that mental health can be adversely affected across all age groups during the global pandemic, some studies have explored factors that can alleviate the detrimental effects on people's psychological wellbeing. Firstly, the negative impact on children's emotions can be alleviated through factors such as health literacy, wise reasoning, family support, and social support. Specifically, Huang L. et al. have suggested that factors like a supportive family environment (e.g., moderate financial and emotional support) and higher parental education contribute to better mental health. For Chinese international students, traditional coping strategies such as acceptance, reframing, and striving—methods involving accepting trauma, adjusting to reality, and reinterpreting tragic events—along with family support, do not alleviate the anxiety induced by COVID-19 stress. However, the application of wise reasoning, which signifies adept decision-making in intricate circumstances, has proven to be effective in mitigating this anxiety.

Furthermore, some studies have further explored how to decrease the negative impact on other age groups. In particular, Huang Y. et al. have found that the presence of meaning and self-esteem can substitute the role of social support in reducing death anxiety. Yang et al. have documented that higher income has a positive effect on mental health during the pandemic by investigating China's families. Additionally, factors such as the number of cigarettes smoked per day, education level, marital status, and exercise frequency also contribute to mental health. Moreover, Zheng et al. have identified a positive association between the perceived risk of unemployment and depression, with a greater impact on rural adults compared to urban adults.

Finally, except for mental health, Ma et al. have investigated the social-economic effect following the outbreak of the global pandemic. Their analysis has identified new factors contributing to financial vulnerability, including the pandemic itself, the digitization of the economy, financial literacy, addiction to digital technology, and changes in financial behavior. In addition, Phulkerd et al. have found food insecurity prevalence in Thailand during the COVID-19 pandemic.

In conclusion, this Research Topic presents a comprehensive overview of the various aspects related to the adverse impact of the COVID-19 pandemic on individuals' mental health, social dynamics, financial vulnerability, and food security across diverse populations and regions. In terms of mental health, health literacy, wise reasoning, family and social support, education level, as well as well-paid jobs can help people actively and passively adapt to the pandemic situation. Besides, the presence of meaning and self-esteem can also play a pivotal role in mitigating the adverse impact. Moreover, special attention should be directed toward vulnerable social groups such as girls, younger students, women, and those from low-income families. However, how to mitigate the adverse effect on the society and economy remains unsolved. In this case, all the research highlights the need for targeted interventions and policy considerations to address the challenges posed by this global health crisis. Future research can further investigate individuals' work, lifestyles, and socio-economic challenges caused by the COVID-19 pandemic, exploring effective coping strategies for navigating the uncertainty in this context. Finally, additional long-term studies are needed to investigate its lasting effects.

## Author contributions

WW: Funding acquisition, Writing – original draft. HL: Formal analysis, Writing—original draft. SL: Writing—original draft. JF: Conceptualization, Data curation, Writing—original draft. ML: Writing—original draft, Conceptualization, Data curation, Investigation, Methodology, Software. CY: Conceptualization, Formal analysis, Project administration, Resources, Supervision, Validation, Visualization, Writing—original draft, Writing—review & editing.

## Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. We thank Zhejiang Provincial Natural Science Foundation of China under Grant No: LZ20G010002.

## Acknowledgments

We express our gratitude to all contributors for their passion and valuable input on this subject. Special thanks to Frontiers for their unwavering editorial support throughout this endeavor.

## Conflict of interest

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SYSTEMATIC REVIEW
published: 07 July 2022
doi: 10.3389/fpsyg.2022.938965

# Psychological and Emotional Effects of Digital Technology on Digitods (14–18 Years): A Systematic Review

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**Background:** The use of smartphones and other technologies has been increasing in digitods aged 14–18 years old. To further explain this relationship and explore the gap in research, this paper will appraise the available evidence regarding the relationship digital technology use and psychological/emotional outcomes and report on the strength of the associations observed between these variables.

**Methodology:** To select relevant studies, five separate computerized searches of online and electronic databases were performed. These included PubMed (MEDLINE, National Library of Medicine), ScienceDirect, Cochrane, Scopus, and Web of Science to attain literature from January 2017 to April 2022. The author independently reviewed studies for eligibility as per the inclusion/exclusion criteria and extracted the data according to a priori defined criteria. Risk of bias was assessed using the Agency for Healthcare Research and Quality (AHRQ) for healthcare studies and Cochrane Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) assessment tool.

**Results:** Seven studies were included in this review. A positive relationship was found between excessive digital technology usage and negative psychological and emotional outcomes in digitods aged 14–18 ($p \leq 0.005$). A statistically significant difference was found between girls and boys, with girls experiencing more negative outcomes than boys.

**Conclusions:** As the evidence in this review is distinctive, it is imperative that further research be conducted to investigate any synergistic relationships among these variables on a larger scale in order to better advise public health initiatives to specifically target heightened digital technology usage in adolescents.

**Keywords: psychological and emotional implication, digital technologies (DTs), adolescents, techno addictions, review**



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***Specialty section:***
*This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology*

***Received:*** *08 May 2022*
***Accepted:*** *06 June 2022*
***Published:*** *07 July 2022*

***Citation:***
*Limone P and Toto GA (2022) Psychological and Emotional Effects of Digital Technology on Digitods (14–18 Years): A Systematic Review. Front. Psychol. 13:938965. doi: 10.3389/fpsyg.2022.938965*

## INTRODUCTION

The youth of the twenty-first century have extraordinary access to digital and media technologies as a result of developing as a digital population. Consequently, the range of digital devices and media activities accessible to children is continuously growing. Due to these current swift revolutions in digitalization, researchers have reported that the youth of today belong to a multifaceted digital generation, with adolescents novel digital environments opposing those from previous cohorts

(Livingstone and Helsper, 2007; Livingstone et al., 2018). Subsequently, investigating how recent digital changes can affect the psychological and emotional wellbeing of adolescence is critical in understanding implications for adolescence in the current digital era.

Existing research proposes that "digitods", or children born after 2008, have divergent patterns of digital behavior compared to those born a decade earlier (Leathers et al., 2013; Holloway et al., 2015). As a result, digitods are among the first cohort to grow up in homes with access to transportable touch-screen devices with heightened computation power and mobility (Livingstone and Helsper, 2007; Kucirnova and Sakr, 2015). Additionally, this current cohort of digitods have parents who incline to be experienced digital operators and consumers themselves and who often approve "new" digital parental intervention approaches to indorse adolescents' safe media use and digital literateness (Brito et al., 2018). As a result of this, adolescents are progressively exposed to an assembly of digital technologies from a very early age (Mascheroni and Cuman, 2014), and this holds implications for potential wellbeing complications connected with disproportionate screen-time or inappropriate media use. To date, however, especially following the COVID-19 pandemic, little has been reported on the impact of current adolescent digital engagement on wellbeing compared to previous generations. Our study addresses this critical question to further understand children's lives and wellbeing in contemporary societies.

## Adolescences and Digital Technology Use

Hardell and Carlberg (2009) define adolescence as the period of time between the age of puberty and adult independence, during which the personality of adolescents dynamically advance and change. According to Hardell and Carlberg (2015), when equated with adults, adolescents typically are more open-minded, socially preoccupied, less agreeable, and less conscientious. They are also characteristically more impetuous and less proficient in constraining behavior (Gandhi et al., 2012). Furthermore, risk-taking and sensation-seeking are often documented in adolescents (Hardell and Carlberg, 2015) as a result of their wellbeing and life gratification being derived from other peers (Hardell, 2018). Research has reported that during adolescence, universal levels of gratification with life and self-esteem fluctuate, occasionally dropping to an all-time low (Söderqvist and Bergman Nutley, 2015; Neophytou et al., 2021). In association with this, the use of media has been reported to typically increase, reaching an initial peak in late adolescence (Tian et al., 2020). However, interestingly, research has shown that the life satisfaction and health status of the current generation does not seem to do better or worse as a result of increased media and technology use than previous generations'. This study was conducted to analyze the progression of numerous wellbeing-related factors among 46,817 adolescents and young adults in Europe. The evidence demonstrated that, while overall internet usage rose robustly, both life satisfaction and health problems remained stable. Nonetheless, concerns about the effects of new technology on adolescent development and their perceived susceptibility to the influence of digital technology as a supposedly vulnerable group have been widely debated.

The umbrella term "digital technology" incorporates countless devices, services, and types of use. Most adolescent digital technology use, however, presently tends to take place on mobile devices (Tian et al., 2020; Macedo et al., 2021). Offering the functions of many other media such as Instagram and Snapchat, smartphones play a crucial role in adolescent media use and are thus considered a "metamedium". An illustrative survey conducted by Shelley et al. (2021), on teens in the US revealed that the utmost frequently used digital amenities are YouTube (85%), followed closely by Instagram (72%) and Snapchat (69%). All devices and services offer different functionalities and affordances; therefore, when on social media, adolescents can actively conversate with others, post, like, or share. Contrastingly, adolescents can also passively engage in use through simply loitering and observing the content of others. Lastly, a significant distinction amongst diverse types of use is whether technology use is social or non-social. Social use captures all kinds of active interpersonal communication, such as conversating and texting or liking photos or sharing posts, while non-social use encompasses (definite forms of) reading and playing, hearing music, or viewing videos. Comprehending digital technology use as a universal and generic behavior disregards the several forms such behavior can take. As a result, investigating the impact of digital technology use on adolescent psychology and emotions requires the awareness that digital technology usage is far from a uniform notion.

## Effect of COVID-19 Pandemic on Adolescent Technology Use

The COVID-19 pandemic has created obstacles in the lives of most people across the world following the implementation of social distancing and eventual lockdowns in many countries. Although lockdowns were evidenced to be crucial in curtailing the spreading of COVID-19 (Lilleri et al., 2020; Serra et al., 2021) an added mounting alarm is the impact of the lockdown on the behavioral, emotional, psychological, and neurological wellbeing of adolescents. The use of smartphones and other technologies during the pandemic has been increasing noticeably in not only parents, but children as well as they engage in activities such as gaming, online lessons, and passing the time. More specifically, the overuse of technology is also measured as an alarming factor to the mental health of adolescents (Drouin et al., 2020). Conferring to one particular study, there has been a notable 15% upsurge in technology in adolescents who reported using it "all the time" (Ammar et al., 2021). This rise in technology usage has been documented as a risk to the development of psychological conditions. Similarly, one study conducted by Hueso et al. (2021) found that the 16.4% prevalence of smartphone use in children during the pandemic was problematic.

Despite the growing body of literature on how digital technologies impact child wellbeing, previous research has provided little evidence on recent digital trends, including data from the COVID-19 pandemic. To address this gap, this systematic review examines the psychological and emotional

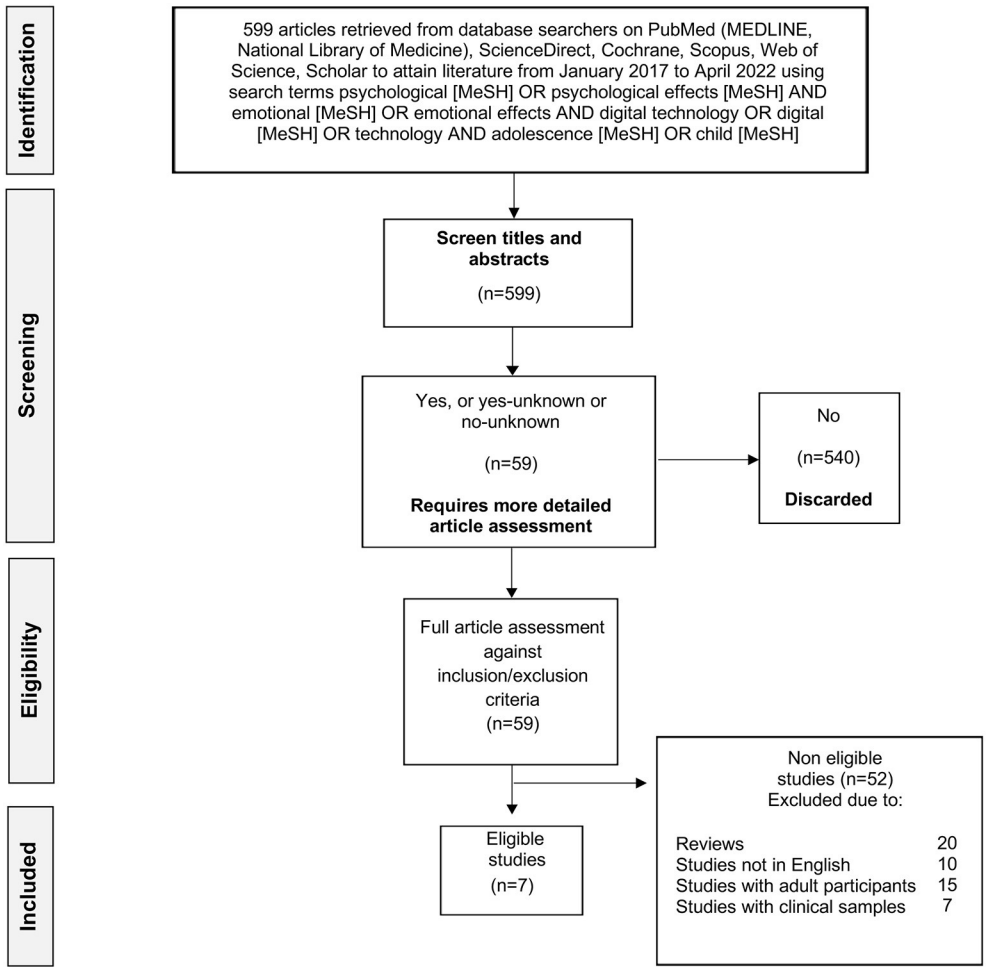


**FIGURE 1 |** Prisma diagram of the search and selection process.

effects of digital technology on adolescents (14–18 years), including studies conducted during the COVID-19 pandemic.

## METHODOLOGY

This systematic review was structured according to the PRISMA 2020 Statement, which is a description of 27 items to be observed when reporting on literature and systematic reviews (Panic and Ford, 2013; Agha et al., 2016; Page et al., 2021).

The primary stage of the review encompassed scoping the literature and exploring the current subject. Following this, the review questions were set and a search strategy was articulated retrospectively. Then, literature detailing data from the studies exploring the psychological and emotional effects of digital technology on adolescents (14–18 years) was reviewed. To select these studies, computerized searches of online and electronic databases were performed on PubMed (MEDLINE, National Library of Medicine), ScienceDirect, Cochrane, Scopus, Web of Science and Schola to attain literature from January 2017 to April 2022. Initially, the search terms psychological [MeSH] OR psychological effects [MeSH] AND emotional [MeSH] OR emotional effects AND digital technology OR digital [MeSH] OR technology AND adolescence [MeSH] OR child [MeSH] were used. To cover any gray areas in the literature, a search was also performed on Google Scholar using the aforementioned terms. First, to eradicate duplicates and remove non-relevant literature, all studies from all electronic databases were screened by their titles. The abstracts and full texts of all the remaining literature were then screened for eligibility using an inclusion and exclusion criteria.

The articles were selected on the basis of three guiding ideas: "psychological effect of digital technology in children or adolescents," "emotional effect of digital technology in children or adolescents," "psychological and emotional effects of digital technology on adolescents," and the "effect of digital technology on adolescents in a pandemic". Concerning the inclusion and exclusion criteria, the articles were carefully selected from peer-reviewed English journals that aimed to describe or evaluate the dimensions and variables expressed vis-à-vis the research

**TABLE 1** | Search strategy.

| Database | Search terms | Population |
|---|---|---|
| PubMed (MEDLINE, National Library of Medicine), ScienceDirect, Cochrane, Scopus, and Web of Science | Psychological [MeSH] OR psychological effects [MeSH] AND emotional [MeSH] OR emotional effects AND digital technology OR digital [MeSH] OR technology AND adolescence [MeSH] OR child [MeSH] | Children and adolescents: studies including children aged 14–18 years old |

topic aforementioned above. Publications that did not comprise the topic of interest of this systematic review or age group were excluded, as were those publications where the full text (eligibility) was not established.

The process of including studies in the systematic review is described in **Figure 1**.

After the elimination of duplicates and articles in languages other than English, the search identified 599 studies consistent with the research parameters. After excluding the publications that were not relevant, seven remaining studies met the inclusion criteria.

## Inclusion Criteria

1. Studies conducted in all geographical locations, allowing for globally appropriate scientific understanding.
2. Studies conducted on Asian, Black, and Caucasian ethnicities to improve generalizability.
3. Studies conducted on child participants (between 14 and 18 years old), who constitute the population of interest.
4. Articles published between 2017 and 2022 to generate prevailing research in this area.
5. Articles in the English language for ease of scientific understanding.

## Exclusion Criteria

1. Reviews, conference abstracts, and letters to editors rather than original data to allow for fair and scientifically objective comparisons.
2. Studies where participants were diagnosed with a psychological or mental disorder to decrease risk of bias within intervention characteristics that may alter the effect of the measured outcomes.
3. Animal studies, as this is not of interest to this research topic.

## Data Extraction

The literature that passed the screening for relevance and eligibility was used for data extraction. **Table 1** displays a summary of the characteristics of each study grouped by findings. Statistical significance of the effort was extracted were provided and possible. To extract the data from the literature, the following enciphering procedure was followed: (1) author/authors and year of publication, (2) title of the literature, (3) place or country of publication, and (4) key ideas of the research.

## Quality Assessment

Of the selected literature that passed the screening for relevance and eligibility, data were extracted on the applied inclusion and exclusion criteria as well as the justification of these criteria. To evade data entry errors, data was extracted by the author of the paper according to the defined criteria first for literature on the psychological and emotional impact of digital technology on adolescents aged 14–18 years old. Once relevant literature was identified and obtained, they were evaluated for quality using an appropriate quality grading tool. Five studies included in this review were of non-randomized-control-trial design, thus, the Cochrane Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) assessment tool was utilized to measure the methodological quality of the five included studies. A rating of "low" reflects the lowest risk of bias, "medium" represents an immediate and potential risk of bias in one domain, and "high" indicates the presence of bias risk in one or more of the domains. This tool has been successfully used by several reviews (Farrah et al., 2019; Igelström et al., 2021) and is sourced from a reliable institute (Cochrane); therefore, it was considered effective for use in this review. Details of the tool can be found at https://www.riskofbias.info/welcome/home/current-version-of-robins-i/robins-i-template-2016.

Two studies included in this review were of survey design, thus, the Agency for Healthcare Research and Quality (AHRQ) assessment tool was used to assess the methodological quality of the three included studies. Again, a rating of "low" reflects the lowest risk of bias, "medium" represents an immediate and potential risk of bias in one domain and "high" indicates the presence of bias risk in one or more of the domains. This tool has been successfully used by numerous reviews (Dennis et al., 2015), and therefore, it was considered effective for use in this review. Details of the tool can be found at https://effectivehealthcare.ahrq.gov/sites/default/files/pdf/assessing-the-risk-of-bias-in-systematic-reviews-of-health-care-interventions-01_0.pdf.

An independent assessment of the study quality was conducted by the author of this review. Although there was high agreement, any differences were objectively concluded. The overall quality rating of all the studies can be observed in **Table 3** and will be discussed later on in this review.

# RESULTS

The seven selected studies included in the quality assessment are summarized in **Tables 2**, **3**.

In five of the seven studies, the primary objective was to assess the psychological or emotional impact of digital technology use in adolescents aged 14–18 years old (Neira and Barber, 2014; Kim, 2017; Jensen et al., 2019; Sanders et al., 2019; Vuorre et al.,

**TABLE 2 |** Characteristics of selected studies grouped by outcome measure for the psychological and emotional effects of digital technology on adolescents aged 14–18 years prior to and during the COVID-19 pandemic.

| References | Population | Exposure and outcome measures | Level of significance | Effect size |
|---|---|---|---|---|
| Neira and Barber, 2014 | A cross-sectional study conducted with a sample of 1,819 adolescents aged 13–17 in Australia | Exposure measure: digital technology use<br>Outcome measure: social self-concept, self-esteem, depressed mood | Results from the hierarchical regression model were considered statistically significant at $p < 0.05$ and highly significant at $p < 0.001$ | Effect size was stated in terms of β and $R^{2-}$ values<br><br>Social self-concept $R^2 = 0.03$<br>SNS frequency β = 0.21<br>SNS investment β = −0.05<br>Self-Esteem $R^2 = 0.05$<br>SNS frequency β = 0.05<br>SNS investment β = −0.13<br>Depressed Mood $R^2 = 0.09$<br>SNS frequency β = −0.05<br>SNS investment β = −0.26 |
| Sanders et al., 2019 | A repeated measure study conducted on 4,013 Australian children initially aged 10–11 years who were followed longitudinally for 4 years | Exposure measure: screen time<br>Outcome measure: social and emotional functioning and temperament profile | Paired *t*-tests used to compare baseline data with data collected after 6 weeks. ANOVA performed for between-group comparisons in the changes of study parameters at baseline and at 6-weeks follow-up. Statistical significance was set at $p < 0.05$. | Effect size was stated in terms of small effect: β = 0.1; medium effect: β = 0.3; large effect: β = 0.5.<br><br>Quadratic effects in adjusted models with covariates:<br>total screen time and hyperactivity SDQ subscale [βLinear = 0.028 (0.013–0.043); βQuadratic = – 0.001 (0.002–0.000); turning point: 12.29 (6.44–18.14) h; zero point: 24.59 (12.90–36.28) h]<br>social screen time and peer SDQ subscale [βLinear = – 0.096 (– 0.159–0.034); βQuadratic = 0.011 (0.003–0.019); turning point: 4.48 (3.42–5.53) h, zero point: 8.96 (6.85–11.06) h] |
| Jensen et al., 2019 | Observational study conducted in a sample of 388 adolescents aged 10–17 years old in US | Exposure measure: digital technology screen time<br>Outcome Measure: mental health symptoms | A multilevel model and Linear regression models were tested at a 95% level of significance | Effect size estimates are reported as Odds Ratios, Incident Risk Ratios (OR), and standardized regression coefficients (β)<br><br>Multilevel Model for cross-sectional associations<br>Conduct:<br>Texts sent OR = 1.00<br>Tech school work OR = 1.07<br>Tech communication OR = 1.05<br>Tech entertainment OR = 1.01<br>Tech creating content OR = 1.09<br>Total screen time OR = 1.03<br>Inattention/hyperactivity:<br>Texts sent IRR = 1.00<br>Tech school work IRR = 1.02<br>Tech communication IRR = 1.00<br>Tech entertainment IRR = 0.99<br>Tech creating content IRR = 1.01<br>Total screen time IRR = 1.00<br>Depression:<br>Texts sent β = 0.04<br>Tech school work β = 0.02<br>Tech communication β = −0.05 |

*(Continued)*

**TABLE 2 |** Continued

| References | Population | Exposure and outcome measures | Level of significance | Effect size |
|---|---|---|---|---|
| | | | | Tech entertainment β = −0.02<br>Tech creating content β = −0.03<br>Total screen time β = −0.04<br>Worry:<br>Texts sent β = −0.01<br>Tech school work β = 0.04<br>Tech communication β = −0.02<br>Tech entertainment β = −0.02<br>Tech creating content β = 0.01<br>Total screen time β = −0.01<br>Regression Model for Longitudinal associations adjusted for T1 risk:<br>Conduct:<br>Phone ownership β = −0.02<br>Social media access β = 0.07<br>Social media use frequency β = 0.06<br>Inattention/hyperactivity:<br>Phone ownership β = −0.02<br>Social media access β = −0.02<br>Social media use frequency β = −0.03<br>Depression:<br>Phone ownership β = 0.03<br>Social media access β = 0.03<br>Social media use frequency β = 0.06<br>Worry:<br>Phone ownership β = 0.04<br>Social media access β = −0.01<br>Social media use frequency β = 0.02 |
| Kim, 2017 | Multicentre prospective survey study conducted in 2,099 Korean adolescents aged 12–15 years old | Exposure measure: Social Media (e frequency of online communication or networking)<br>Outcome measure: mental health and or suicidal thoughts | A multilevel model was tested at a 95% level of significance | Effect size estimates are reported as standardized regression coefficients (β), Odds Ratios (OR), Intraclass Correlation Coefficient (ICC), Deviance (-2LL); Social media → Mental health β = −0.016; Deviance (−2LL) = −474.60<br>Social media → Suicidality OR = −0.016; ICC(%) = 3.6 |
| O'Sullivan et al., 2020 | A qualitative observational study conducted in adolescents aged 14–18 in Ireland | Exposure measure: digital technology and COVID-19 lockdown<br>Outcome measure: psychology impact | Qualitative study. A thematic approach was used. Themes are emerged by common themes and subthemes and frequencies calculated | - |
| Vuorre et al., 2021 | A longitudinal observational study conducted in 430.561 US and UK adolescents aged 10–15 years | Exposure measure: digital technology and social media usage<br>Outcome measure: mental health problems and symptoms | Pearson's correlations and regression models tested at 95% confidence intervals. significance was set at $p < 0.05$ | Model fit was measured through the Akaike information criterion (AIC) difference.<br>Technology use and mental health AIC difference = >3 |
| Ravens-Sieberer et al. (2021) | A survey study conducted in 1,586 adolescents aged 11–17 years in Germany | Exposure measure: digital technology and COVID-19 pandemic<br>Outcome measure: mental health outcomes | Independent *t*-test and linear regression model was applied at 95% level of significance. Significance was set at $p < 0.05$ | Effect size was stated in terms of Cohen's *f*2<br>During vs. before pandemic → Mental health problems $B = 2.18$; Adjusted $R^2 = 0.10$; parent-rpeorted (Cohen's $f2 = 0.04$) |

*SNS, social networking site.*

2021). The primary objective of two of the seven studies was to assess the impact of digital technology during the COVID-19 pandemic on the psychological and or emotional wellbeing of adolescents aged 14–18 years old (O'Sullivan et al., 2020; Ravens-Sieberer et al., 2021). Two of the studies had cross-sectional designs (Neira and Barber, 2014; Vuorre et al., 2021), which are a form of observational study whereby the investigator measures the outcome and the exposures in the study participants

**TABLE 3 |** Summary of the association digital technology use and psychological/emotional outcomes in adolescents pre-and post-COVID-19.

| References | Variable (digital technology or COVID-19) | Association with psychological, emotional impact on adolescents | Risk of bias rating |
|---|---|---|---|
| Kim, 2017 | Digital technology | + | Medium |
| Ravens-Sieberer et al., 2021 | Digital technology and COVID-19 pandemic | + | Medium |
| **Cochrane risk of bias in non-randomized studies—of interventions (ROBINS-I) assessment tool** | | | |
| Neira and Barber, 2014 | Digital technology | + | Medium |
| Vuorre et al., 2021 | Digital technology | + | Medium |
| Sanders et al., 2019 | Digital technology | + | Medium |
| Jensen et al., 2019 | Digital technology | – | Medium |
| O'Sullivan et al., 2020 | Digital technology and COVID-19 pandemic | + | Medium |

*Table includes study scores for risk of bias quality criteria as per the AHRQ tool for healthcare research and the ROBINS-I tool for non-randomized clinical trial studies.*
*+ increase in variable found; x no significant association found; – decrease in variable found; Medium = Study judged to raise some quality concerns in at least one domain but not to be at high risk of bias for any domain for result.*

simultaneously. One study employed a repeated measure design (Sanders et al., 2019), which is a research design where subjects are measured two or more times on the dependent variable and, rather than using different participants for each level of treatment, the participants are given more than one treatment and are measured after each. Two studies employed a survey (Kim, 2017; Ravens-Sieberer et al., 2021), which is a systematic method to gather information from (a sample of) entities for the purposes of constructing quantitative descriptors of the attributes of the larger population. One study was observational in design (Jensen et al., 2019), which involves a research technique where participants are observed in their most natural settings. This consequently enables researchers to assess subjects in their natural setting as opposed to structured ones like research labs or focus groups. Finally, one study was qualitative observational in design (O'Sullivan et al., 2020), which allows researchers to detect developing themes or patterns of behavior that might be ignored or obscured when using alternative methods. All the studies included an objective assessment for psychological and emotional measurement and were published in the last 10 years.

The quality scores assessed according to the AHRQ outcome and analysis reporting bias framework for the survey study revealed a medium risk of bias rating scores for two studies (Kim, 2017; Ravens-Sieberer et al., 2021). This is because for all these studies, multiple eligible outcome measures were proposed; however, no information was given regarding definitions and time points within the outcome domain. This limits the strength of the body of evidence due to the potential presence of confounding factors (from limited time point information) that have been unaccounted or unadjusted statistically for. One study received a low risk of bias rating score rating as all five domains of the quality assessment tool were accounted for (Mogharnasi et al., 2019).

The ROBINS-I tool is recommended for assessing the risk of bias in non-randomized studies of interventions, including Cochrane reviews that were observational, cross-sectional, and repeated measures levels of evidence. The quality scores, according to the tool, revealed a medium risk of bias scores for two studies that were cross-sectional in design (Neira and Barber, 2014; Jensen et al., 2019; Sanders et al., 2019; O'Sullivan et al., 2020; Vuorre et al., 2021). This is because in these studies, there were some quality concerns bias in measurements of outcomes. In particular, it is likely that the outcome assessors were aware of the intervention received by the study participants. This presents predicted direction of bias, thus limiting the strength of the body of evidence.

## Gender Differences in Emotional Impact of Digital Technology Social Media Use

Two studies reported evidence of gender differences in the emotional impact of digital technology use, particularly those centered around the use of social media. Neira and Barber (2014) reported that the main effect of the presence of a social media network profile was found to be depressed mood $p < 0.001$. Depressed mood was reported to be markedly higher for adolescents who had a social network profile compared to those who did not. The foremost impact of gender was significant for depressive moods, with females having greater levels of depressed moods than males ($p < 0.001$). The researchers also reported that the interaction between social media network profiles and gender was statistically significant for depressed mood ($p < 0.001$). There was no significant difference in depressed mood between males with and without an SNS profile.

Vuorre et al. (2021) investigated changes in mental health in relation to technology use among adolescents. The researchers reported no significant findings of the estimates that were scientifically different from zero, signifying no variation over a period of time between boys and girls aged 14–18 years old.

## Emotional Impact of Digital Technology Use

One study reported a negative relationship between digital technology use and poorer emotional consequences in adolescents aged 14–18 years old. Neira and Barber (2014) reported that the use of social network sites was not a significant forecaster of self-esteem levels; however, they found that investment in social network site usage through technology was a significant negative prognosticator of self-esteem. Additionally, the researchers reported that the more adolescents that were invested in their technology use and subsequent social network site usage, the lower their self-esteem was demonstrated to be. The association between emotional problems and social media was reported to increase by Vuorre et al. (2021). However, their association with TV remained stable. Further, these researchers revealed no credible changes in the relationship between suicidal ideation and behavior with the digital use of either social media or television mediums.

## Psychological Impact of Digital Technology Use

Two studies reported a positive relationship between digital technology use and poor psychological outcomes in adolescents aged 14–18 years old. Sanders et al. (2019) reported that weaker prosocial behavior and lower perseverance and determination were aligned with increased passive digital screen time. However, it is important to note that these results were prior to the statistical adjustment for covariates, thus weakening the power of the evidence. The researchers also reported that social screen time was linearly correlated to subordinate health-related quality of life, amplified reactivity, and worse emotional wellbeing. Similarly, Ravens-Sieberer et al. (2021) reported a positive association between digital technology use and diminished psychological health by revealing a negative impact of spending more time on the computer on mental health outcomes in adolescents in the following year, specifically, the increase in suicidal thoughts among this cohort ($p < 0.005$).

However, one study reported contrasting results. Jensen et al. (2019) reported that the adolescent use of technology did not forecast later mental-health symptoms. Furthermore, it was found that worsening mental health was not reported in the days following increased digital technology usage. The evidence from this study instead reports that adolescents were at a statistically significant risk of amplified mental-health complications. It was concluded that the findings from this study did not support the account that adolescents' digital technology use was linked with elevated mental-health indications.

## Impact of COVID-19 and Digital Technology on the Psychological and Emotional Wellbeing

Two studies reported negative psychological and emotional wellbeing outcomes due to the use of digital technology during the COVID-19 pandemic among adolescents aged 14–18 years old. O'Sullivan et al. (2020) found that children and adolescents experienced adverse mental health effects, including feelings of social isolation, depression, and anxiety and increases in maladaptive behavior. Similarly, Ravens-Sieberer et al. (2021) also found that adolescents aged 11–17 years self-reported considerable psychosomatic complaints, with approximately half of the sample ($n = 554$; 53.2%) feeling irritable and a substantial proportion of this cohort reporting sleeping problems ($n = 449$; 43.3%) and low emotions and feelings ($n = 352$; 33.8%). Additionally, girls were found to be more affected than boys with regard to and feeling low ($p < 0.002$).

# DISCUSSION

The youth of the twenty-first century have astonishing access to digital and media technologies and increased digital companies and devices as a consequence. As a result, investigating the impact of digital technology use on adolescent psychology and emotions requires the awareness that digital technology usage is far from a uniform notion. The objective of this systematic review was to investigate the psychological and emotional impact of digital technology use in adolescents aged 14–18 years. This is of utmost importance to ensure suitably and targeted public health interventions that directly address the repercussions of the relationship that these factors hold over the health status of growing adolescents. The studies were selected according to robust inclusion and exclusion criteria focused on the association between digital technology and the psychological and emotional outcomes of adolescents aged 14–18 years old.

Researchers have documented that digital technology impacts the psychological and emotional outcomes of adolescents. The evidence of this systematic review revealed that the use of digital technology, especially in excess, negatively impacts the psychological and emotional health of adolescents ($p < 0.005$). This is consistent with the aforementioned historical studies.

Researchers have also documented that there are gender differences in the impact digital technology has on the psychological and emotional outcomes of adolescents. The evidence of this systematic review revealed that the use of digital technology impacts girls more negatively than boys, especially as a consequence of the use of social media ($p < 0.005$). These findings are consistent with previous research, which found similar trends (Montag and Elhai, 2020; Lehtimaki et al., 2021; Marciano et al., 2021). According to literature, female youth use digital technologies, and in particular the Internet, to seek feedback es from others (Valkenburg et al., 2005), and as the tone of feedback has been linked to self-evaluations (Valkenburg et al., 2006), it is possible that they perceive some of the feedback to be negative, which has subsequently influenced their adjustment (Neira and Barber, 2014).

Moreover, the results of this study indicate that adolescents experienced adverse mental health effects, including feelings of social isolation, depression, anxiety, and increases in maladaptive behavior as a result of increased digital technology usage during the COVID-19 pandemic (Limone and Toto, 2021). However, to the best of our knowledge, there is currently no research related to these variables or available in population groups similar to this paper's. Thus, these results cannot be compared nor can

inferences be extrapolated. As such, future research is encouraged to investigate this further.

This study significantly contributes to the psychological education of technology in a variety of ways. Initially, the study found little statistically significant or negative connotation amongst digital-screen engagement and wellbeing in adolescents. Instead, largely negative relations were found in studies employing both self-reports of technology use and wellbeing measures, which could be a result of traditional method variance or discrepancies in such large-scale questionnaire data. This is in line with results from previous research presenting associations between digital-technology use and psychological or emotional outcomes in adolescents (Twenge et al., 2018a,b; Orben and Przybylski, 2019). Consequently, these collective results may infer that there is a minor significant negative association between technology use and psychological or emotional outcomes, which may be microscopic when compared with other activities in an adolescent's life (Orben and Przybylski, 2019).

Third, this study was also one of the first to examine whether digital-screen engagement before bedtime is especially detrimental to adolescent psychological wellbeing. Public opinion seems to be that using digital screens immediately before bed may be more harmful for teens than screen time spread throughout the day. Our exploratory and confirmatory analyses provided very mixed effects: some were negative, while others were positive or inconclusive. Our study, therefore, suggests that technology use before bedtime might not be inherently harmful to psychological wellbeing, even though this is a well-worn idea both in the media and in public debates.

The studies included in this review also highlighted positive outcomes. For example, Neira and Barber (2014) found that males with a Social Network Site (SNS) profile reported higher self-esteem levels than did males without an SNS profile, supporting the hypothesis that SNS could be associated with a positive social self-concept. Also results from Sanders et al. (2019) support the less-is-better hypothesis–qualified showing that educational screen time was associated with positive educational outcomes. Educational screen time, therefore, appears beneficial, suggesting that the detrimental effects may be domain-specific. In addition to this, the findings from Jensen et al. (2019), showing that frequent texters are the least depressed, are consistent with the extant literatures on social connections both online and face to face (Seabrook et al., 2016). Daily text messaging has been found to be associated with less daily depression symptoms, as adolescents reported lower levels of depression on days when they were most connected to others online *via* text messaging (George et al., 2018).

The limited quantity of studies used in this review, of which most were non-randomized in design, is a limitation. Because of this, some studies were subjected to risk of bias due to methodological techniques used, as evidenced in scores from quality assessment tools. Nevertheless, the findings from this systematic review are advantageous in encouraging further research exploring the impact of digital technology use during the COVID-19 pandemic among adolescence and, perhaps, cohorts younger than 14 years old.

The psychological and emotional wellbeing of adolescents following the impact of digital technology use is an imperious global and public health alarm, particularly as epidemiology advises of rising technology use across geographies. The results from this systematic review suggests robust connotations between the frequency of digital technology use and negative psychological and emotional behaviors and outcomes among adolescents aged 14–18 years old, which are consistent with previous studies in this field. Given that technology has become entrenched within the livelihood of adolescents, it is paramount to understand its influence on health and wellbeing. Although digital technology and media screen use has constructive benefits, such as enriching a learning environment, mounting data also suggests that misuse and overuse has adversative effects on a wide range of cognitive and emotional/behavioral complications. Childhood and adolescence are perilous and critical opportunities for development and throughout which youth tend to be predominantly vulnerable to the undesirable psychological effects of digital technology screen media usage. Therefore, rendering more research in this area indispensable.

More specifically, while research studies have extensively investigated the effects of screen media overuse on sleep disturbances, there continues to be conflicting data with regard to internalizing mechanisms, such as psychological and emotional wellbeing, as well as potential bidirectional relationships shared with the adverse outcomes discussed in this review. The comprehension of its impacts and its associated mechanisms are vital to producing screen time recommendations and guidelines and developing effective prevention/intervention strategies to alleviate screen media overuse and its adversative outcomes in children and adolescents.

Finally, it is vital for public health practitioners and policy makers to propose targeted public health interventions that are synergistic in their action, comprising several variables linked to technology mediums, recommended usage times, and social media app guidance for guardians of children this age. The small quantity of studies encompassed in this systematic review should not be discounted, but rather used as a foundation for further investigation on the relationship between digital technology use and the psychological and emotional outcomes in children.

The findings of this review should also be interpreted in light of the limitations of this work. First, English-language literature and studies published between 2017 and 2020 have been assessed and may, therefore, this study has overlooked significant findings reported in other languages or published in other years. Second, although the author aimed to conduct an exhaustive search, a relevant search term may have been omitted and consequently relevant studies may have not been retrieved. Third, although there has been the attempted to screen the retrieved studies thoroughly, it is possible that some salient studies were overlooked.

## CONCLUSION

In summary, this systematic review concludes that there is strong evidence of a relationship between each independent variable

(digital technology use prior to and during the COVID-19 pandemic) and negative psychological and emotional outcomes among adolescents aged 14–18 years old. This systematic review also documents notable insignificant associations between general health of adolescents despite rising rates of technology usage (Aloufi et al., 2022; Guldager et al., 2022). Further studies are encouraged to assess the inconsistencies among these results. As the evidence in this review is compelling, it is important to emphasize the detrimental outcomes that amplified technology use has on the development of adolescents during this vulnerable phase of life (Borcoman and Sorea, 2022; Sokugawa, 2022). Therefore, it is important that further research on a larger scale, continues to assess any present synergistic relationships among these variables, in order to better advice public health initiatives dealing with technology use by children.

## 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.

## AUTHOR CONTRIBUTIONS

PL: introduction and conclusion. GT: methodology, results, and discussion. Both authors contributed to the article and approved the submitted version.

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frontiers | Frontiers in Psychology

ORIGINAL RESEARCH
published: 08 July 2022
doi: 10.3389/fpsyg.2022.933207

# Risk Factors Associated With Increased Anxiety Sensitivity in Children and Adolescents in Northwest China During COVID-19 Pandemic Lockdown

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**Purpose:** A large body of evidence has revealed that the sudden outbreak of public health emergencies induces dramatic effects on the mental health of the general public. We aimed to investigate the level of anxiety sensitivity and its risk factors in children and adolescents from northwest China during the COVID-19 pandemic lockdown in early 2020.

**Methods:** A cross-sectional survey was conducted through the Wenjuanxing platform using a convenience sampling method between 18 and 26 February 2020. The self-designed questionnaire contained sociodemographic characteristics, factors associated with the COVID-19 pandemic, and the Childhood Anxiety Sensitivity Index (CASI) scale. The data from 1,091 valid questionnaires from students aged 9–17 years were analyzed using ANOVA, multiple linear regression, and binary logistic regression.

**Results:** The average CASI scores were 11.47 ± 6.631, and 642 students (58.9%) had prominent anxiety sensitivity. Gender, education level, family members participating in anti-COVID-19 work, getting ill and needing medical help during the lockdown, feeling afraid or having heart palpitations on hearing things associated with COVID-19, believing that COVID-19 would have adverse impacts on themselves or their family in the future, and fear of infection were identified as significant factors for elevated levels of anxiety sensitivity ($p < 0.05$). We established a multiple linear regression model for the anxiety sensitivity score. Risk factors found for anxiety sensitivity in children and adolescents during the COVID-19 lockdown included studying in secondary or high school, becoming ill during the pandemic, feeling afraid or experiencing rapid heartbeat or palpitations on hearing about the COVID-19 pandemic, thinking that COVID-19 would have an adverse impact on themselves or their family in the future, and fear of infection.

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**Edited by:**
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**Specialty section:**
*This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology*

**Received:** *30 April 2022*
**Accepted:** *10 June 2022*
**Published:** *08 July 2022*

**Citation:**
*Jin Q, Ma W, Zhang Y, Wang H, Hao J, Geng Y, Zhong B, Li J, Hou W and Lu S (2022) Risk Factors Associated With Increased Anxiety Sensitivity in Children and Adolescents in Northwest China During COVID-19 Pandemic Lockdown. Front. Psychol. 13:933207. doi: 10.3389/fpsyg.2022.933207*

**Conclusions:** During the COVID-19 pandemic and home quarantine, scores measuring the prevalence of anxiety sensitivity in children and adolescents from northwest China were elevated. We should develop measures that especially target possible risk factors to intervene against and prevent anxiety sensitivity in children and adolescents in both the current and future pandemics.

**Keywords: anxiety sensitivity, children and adolescents, child psychology, COVID-19 pandemic, lockdowns, quarantine, risk factors**

## INTRODUCTION

Coronavirus disease 2019 (COVID-19) is an emerging infectious disease caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) (Commission, 2020) that has resulted in a global pandemic with an enormous impact on the health and routine activities of people worldwide (Fang et al., 2021a; Who, 2022). Sufficient data from previous studies on epidemics have revealed that public health emergencies arouse a series of mental health problems besides physical disease. In an investigation of a severe Legionnaires' Disease outbreak in Japan, 13.7% of the survivors demonstrated that they suffered from depressive symptoms (Tsuruta et al., 2005). In a survey on the 2005 SARS pandemic in China, Wu et al. reported that nearly 18% of respondents reported symptoms related to post-traumatic stress disorder (PTSD), anxiety, and depression (Wu et al., 2005). A more recent study reported that 83.1% of respondents had some anxiety about the swine flu outbreak in 2011 (Kanadiya and Sallar, 2011).

COVID-19, without exception, has been found to be a tremendous stressor affecting people's psychological wellbeing. For instance, Tian et al. (2020) found that COVID-19 had significant adverse sociopsychological effects on the Chinese public. Li et al. (2020) found that negative emotions (e.g., anxiety, depression, and indignation) and sensitivity to social risks increased, while scores of positive emotions (e.g., measured by the Oxford Happiness Questionnaire) and life satisfaction decreased 1 week after the declaration of the COVID-19 lockdown. Kim et al. (2021) found a high prevalence of depression and anxiety in society during the COVID-19 pandemic in Korea. Moreover, many Americans have increasingly used prescription drugs to deal with stress and anxiety related to the pandemic (Digon, 2020). These studies consistently showed that people's psychological wellbeing has been negatively influenced by the COVID-19 pandemic and its related control measures. These abnormal conditions of physiology drive behaviors that can include evacuation panic, resistance to public health measures, overburdening of hospitals and clinicians, blaming the government, and abandoning responsibilities to families and jobs. This cascade of effects has caused more severe and disabling ramifications from the COVID-19 pandemic than the disease itself.

Many studies of the impact of the pandemic on psychological conditions have focused on such changes in different populations, such as health care workers (Hao et al., 2021), medical students (ElHawary et al., 2021; Halperin et al., 2021), university students (Jiang, 2020; Mao et al., 2021), confirmed patients (Klaser et al., 2021; Shah et al., 2021), and sick persons with different illnesses (Colombo et al., 2020; Kotecha, 2020; Di Riso et al., 2021). Children and adolescents are a worthwhile study segment, as their comprehension of pandemic-related knowledge is limited, they have insufficient self-protective skills, and they heavily depend on adults for emotional support and physical care (Mollborn and Lawrence, 2018; Leach et al., 2021; Qiu et al., 2021). Therefore, they have been identified as a vulnerable segment of the population in psychosocial characteristics (Perrin et al., 2009; Stevenson et al., 2009) and are prone to suffering mental health problems when coping with disasters (Furr et al., 2010; Pfefferbaum et al., 2015).

Before the COVID-19 pandemic, however, few data existed on the effects of public health emergencies on the mental health of children and adolescents. Many researchers, realizing this lack, made calls for policymakers and clinicians to take the mental health needs of children and adolescents into account when making decisions during the influenza pandemic of 2009 (Perrin et al., 2009; Stevenson et al., 2009). During the COVID-19 pandemic, the psychological conditions of children and adolescents have attracted the attention of researchers. Studies revealed that this demographic suffers from a range of psychological disorders (Wang et al., 2020; Zhou et al., 2020a; McArthur et al., 2021; Ravens-Sieberer et al., 2021), such as depression, anxiety, insomnia, and stress. It is worth noting that, because of varying sociocultural and economic contexts (Dowd et al., 2011; Burgard et al., 2013; Fang et al., 2021b; Wu et al., 2022a), the mental health status of children and adolescents varies by region (Compton et al., 2006; Chen et al., 2020). Studies in China during the COVID-19 pandemic, however, have been conducted on a population mainly from the provinces in southeast and central China, including Henan (Xu et al., 2021), Hubei (Xie et al., 2020), Guangdong (Qin et al., 2021), Guangxi (Chi et al., 2021), Shanghai (Tang et al., 2021), Beijing, and Zhejiang (Chen et al., 2020). Few studies involved children and adolescents from northwest China, where population density is low, the economic situation is poor, and ethnic minorities are concentrated. Therefore, assessing the mental health condition of these children and adolescents was an unmet need.

Anxiety sensitivity refers to the belief that anxiety-related sensory arousal will have negative consequences for the individual, such as death, mental disorders, and social rejection; this belief, in turn, generates fear in the form of primary sensory arousal (Reiss et al., 1986; Taylor et al., 2007). In this way, anxiety sensitivity is a relatively stable indicator that reflects the

**TABLE 1 |** Demographics and COVID-19-related characteristics of survey participants.

| Variable | | *N* = 1,091 (%) |
|---|---|---|
| Gender | Female | 593 (54.4) |
| | Male | 498 (45.6) |
| Ethnicity | Han | 808 (74.1) |
| | Others | 283 (25.9) |
| Education level | Primary school | 524 (48.0) |
| | Secondary school | 296 (27.1) |
| | High school | 271 (24.9) |
| Residence | Urban | 214 (19.6) |
| | Suburban | 210 (19.2) |
| | Rural | 667 (61.2) |
| Living with parents during the lockdown | Yes | 948 (86.9) |
| | No | 143 (13.1) |
| Living with grandparents during the lockdown | Yes | 398 (36.5) |
| | No | 693 (63.5) |
| Living with siblings during the lockdown | Yes | 726 (66.5) |
| | No | 365 (33.5) |
| Living with others during the lockdown | Yes | 48 (4.4) |
| | No | 1,043 (95.6) |
| Suffered from chronic illness | Yes | 32 (2.9) |
| in the previous 6 months | No | 1,059 (97.1) |
| Suffered from illness | Yes | 101 (9.3) |
| in the previous 3 months | No | 990 (90.7) |
| Became ill and needed to go to hospital | Yes | 197 (18.1) |
| during the lockdown | No | 894 (81.9) |
| Discussion of COVID-19 pandemic | Never | 74 (6.8) |
| among family members | Sometimes | 404 (37.0) |
| | Often | 613 (56.2) |
| Level of understanding of COVID-19 | None | 51 (4.7) |
| | A little | 833 (76.4) |
| | Familiar | 207 (18.9) |
| Attitude toward taking protective measures | Actively | 738 (67.6) |
| | Passively | 325 (29.8) |
| | Not taking any protective measures | 28 (2.6) |
| Feeling afraid or having heart palpitations | Never | 429 (39.3) |
| on hearing about COVID-19 pandemic | Sometimes | 500 (45.8) |
| | Often | 119 (10.9) |
| | Always | 43 (4.0) |
| Family members involved | Yes | 156 (14.3) |
| in anti-COVID-19 work | No | 935 (85.7) |
| Perceived adverse impact of COVID-19 | Yes | 377 (34.6) |
| on self or family in future | No | 714 (65.4) |
| Fear of infection | No | 907 (83.1) |
| | Yes | 184 (16.9) |
| Family members or friends | Yes | 14 (1.3) |
| infected with COVID-19 | No | 1,077 (98.7) |
| Hours spent on entertainment | <1 h/day | 247 (22.6) |
| | 1–2 h/day | 523 (47.9) |
| | >2 h/day | 321 (29.5) |
| Hours spent on physical exercise | <1 h/day | 323 (29.6) |
| | 1–2 h/day | 492 (45.1) |
| | >2 h/day | 276 (25.3) |
| Hours spent on study | <1 h/day | 84 (7.7) |
| | 1–2 h/day | 273 (25.0) |
| | >2 h/day | 734 (67.3) |

*COVID-19, coronavirus disease 2019.*

degree of fear in individuals (Taylor et al., 2007). In addition to being a risk factor for anxiety disorders, anxiety sensitivity can predict anxiety, and non-anxiety disorders (Olatunji and Wolitzky-Taylor, 2009), such as depression, substance abuse, and suicide (Naragon-Gainey, 2010; Oglesby et al., 2015). Therefore, anxiety sensitivity can be used to screen high-risk populations with mental disorders (Schmidt et al., 2010; Noël and Francis, 2011). Indeed, research from the COVID-19 pandemic shows that anxiety sensitivity is increased in adults and is positively associated with suicidal ideation (Allan et al., 2021), depression, and anxiety (Avidor et al., 2021). Taken together, these studies demonstrate that anxiety sensitivity could be a significant predictor of COVID-19-related fear and consequent safety behaviors (Mayorga et al., 2022). Thus, the primary aim of the present study was to assess the anxiety sensitivity of children and adolescents in northwest China early in the pandemic. The purpose was to learn how to take measures to prevent and reduce adverse mental health outcomes and maladaptive behavioral responses resulting from current and future pandemics.

Since the outbreak of COVID-19, many efforts have been made to explore factors influencing psychological abnormalities in children and adolescents (Zhou et al., 2020b; Qin et al., 2021; Ravens-Sieberer et al., 2021; Tang et al., 2021). These researchers have confirmed that risk factors include mainly disturbance of routine life, lack of face-to-face contact with peers, fears of infection, and poor efficiency of online learning. However, the influence of physical conditions on mental health in this period has not been investigated, while evidence has shown that physical disease is a significant influencing factor (Ohrnberger et al., 2017; Felix et al., 2020). To fill these gaps, we explored risk factors associated with anxiety sensitivity in children and adolescents from northwest China during the COVID-19 pandemic. Our purpose was to provide a scientific basis for formulating precise psychological preventions and interventions.

## METHODS

It is well-known that cross-sectional questionnaire surveys are generally quick, easy, convenient, and cost-effective to perform. They are particularly suitable for estimating the prevalence of disease in a population and exploring or screening for possible risk factors (Sedgwick, 2014). Thus, we employed a cross-sectional questionnaire in our study. Because of home quarantine

**TABLE 2 |** CASI scale scores ($\bar{x} \pm SD$).

| Variable | All respondents ($N = 1,091$) | Respondents with anxiety sensitivity ($N = 642$) | Respondents without anxiety sensitivity ($N = 449$) | *t* value | *p* |
|---|---|---|---|---|---|
| Physical concerns | 7.23 ± 4.773 | 10.33 ± 3.480 | 2.81 ± 2.186 | 43.758 | <0.001 |
| Mental concerns | 1.45 ± 1.464 | 2.19 ± 1.405 | 0.39 ± 0.699 | 27.854 | <0.001 |
| Social concerns | 2.79 ± 1.346 | 3.34 ± 1.112 | 1.99 ± 1.251 | 18.729 | <0.001 |
| CASI score | 11.47 ± 6.631 | 15.86 ± 4.683 | 5.19 ± 2.921 | 46.249 | <0.001 |

*CASI, Childhood Anxiety Sensitivity Index.*

during the pandemic, face-to-face interviews could not be conducted. Therefore, the study questionnaire was distributed and retrieved online using the program "Questionnaire Star" (https://www.wjx.cn/), which is widely used and well-recognized as a professional online survey tool (Qin et al., 2021; Tang et al., 2021).

## Study Population and Procedures

Children and adolescents aged 9–17 years were recruited using a convenience sampling method from 18 to 26 February 2020, following a month of the COVID-19 outbreak and subsequent lockdown in China, i.e., the peak of the pandemic. The subjects were mainly from Gansu, Shaanxi, and Xinjiang provinces, all located in northwest China. Teachers sent the link address of the questionnaire to a WeChat group that included teachers, participants, and parents. Then, participants were directed to the Questionnaire Star program by the link address and completed the questionnaire if they were interested. Before filling out the questionnaire, participants provided informed consent. Meanwhile, the teachers were responsible for explaining the manual procedures for the survey in detail. A phone number and WeChat ID for a pediatrician were also included in the questionnaire so that participants could consult and interact with the pediatrician at any time. The entire survey was carried out using voluntary, anonymous, and confidential principles.

## Ethics Statements

In the preface, the purpose and organization of the survey were described. According to the wishes of the students and their guardians, every student filled out the questionnaire voluntarily. All participants could submit, terminate, and repost the questionnaire directly, even though they had started to fill it out with prior consent. The study was approved by the ethics committee of the Second Affiliated Hospital of Xi'an Jiaotong University and carried out following American Association for Public Opinion Research (AAPOR) reporting guidelines.

## Measurements

The survey questionnaire was self-designed and consisted of three sections. Its rationality and functionality were assessed by a pilot study that preceded the study.

### Sociodemographic Characteristics

Sociodemographic characteristics were chosen by the authors. They included a set of questions regarding sex, age, ethnicity, place of residence, education level, and the number of people residing in the same home during the lockdown.

### Factors Associated With the COVID-19 Pandemic

Using factors that may affect anxiety sensitivity in the context of a pandemic, as reported in previous literature, the research team selected factors associated with the COVID-19 pandemic. All the factors were probed as close-ended questions. The response options allowed various levels of choice. Generally, factors were divided into three categories.

The first category asked about the condition of the respondent's physical health. Participants were asked to indicate the following: (1) whether you have suffered from chronic disease in the 6 months prior to the pandemic (i.e., up to now, illness that has lasted for at least 6 months); (2) whether you have gone to see a doctor due to illness in the 3 months prior to the pandemic; and (3) whether you have gone to see a doctor due to illness during the period of the pandemic.

The second category dealt with the knowledge of COVID-19. Participants were asked the following: (1) Whether your family often talks about the COVID-19 pandemic. Answer options were: never, sometimes, or often. (2) How well do you understand the novel coronavirus and its outbreak (assessed by knowledge of its cause, transmission route, and preventive measures for COVID-19)? Answer options were: nothing, a little, or familiar. (3) What is your attitude toward taking self-protective measures (e.g., wearing a mask, hand washing)? Answer options were: actively, passively, or not taking any protective measures. (4) Whether you feel afraid or your heart beats fast when you hear things associated with COVID-19. Answer options were: never, sometimes, often, or always. (5) Whether family members have been involved in anti-COVID-19 efforts. Answer options were: yes or no. (6) Whether you perceive that the pandemic will have adverse impacts on yourself or your family in the future. Answer options were: yes or no. (7) Whether you think you might have COVID-19 at this time. Answer options were: yes or no. (8) Whether you have close contacts diagnosed with COVID-19. Answer options were: yes or no.

The last third and final category were about the routines of the participants. Participants were asked: (1) How much time do you spend on entertainment (e.g., playing games, listening to music, browsing the web, watching TV, etc.) per day? Answer options were <1, 1–2, or >2 h/day. (2) How much time do you spend on physical activity per day. Answer options

**TABLE 3 |** CASI scores by variable.

| Variables | | CASI ($\bar{x} \pm SD$) | *t*/*F* | *p* |
|---|---|---|---|---|
| Gender | Female | 12.00 ± 6.449 | 2.928* | 0.003 |
| | Male | 10.83 ± 6.793 | | |
| Ethnicity | Han | 11.86 ± 6.697 | 3.360* | 0.001 |
| | Others | 10.33 ± 6.314 | | |
| Education level | Primary school | 10.42 ± 6.248 | 14.997 | <0.001 |
| | Secondary school | 11.91 ± 6.942 | | <0.000[a] |
| | High school | 13.01 ± 6.668 | | 0.045[b] |
| Residence | Urban | 10.95 ± 6.465 | 1.043 | 0.353 |
| | Suburban | 11.87 ± 6.521 | | |
| | Rural | 11.50 ± 6.717 | | |
| Living with parents during the lockdown | No | 10.85 ± 7.354 | −1.098* | 0.274 |
| | Yes | 11.56 ± 6.514 | | |
| Living with grandparents during the lockdown | No | 11.18 ± 6.739 | −1.902* | 0.057 |
| | Yes | 11.97 ± 6.415 | | |
| Living with siblings during the lockdown | No | 11.18 ± 6.820 | −0.999* | 0.318 |
| | Yes | 11.61 ± 6.534 | | |
| Living with others during the lockdown | No | 11.45 ± 6.607 | −0.436* | 0.663 |
| | Yes | 11.88 ± 7.192 | | |
| Suffered from chronic illness in the previous 6 months | Yes | 13.72 ± 7.587 | 1.953* | 0.051 |
| | No | 11.40 ± 6.592 | | |
| Suffered from illness in the previous 3 months | Yes | 12.41 ± 6.771 | 1.495* | 0.135 |
| | No | 11.37 ± 6.612 | | |
| Became ill and needed to go to hospital during the lockdown | Yes | 12.40 ± 6.444 | 2.189* | 0.029 |
| | No | 11.26 ± 6.657 | | |
| Discussion of COVID-19 pandemic among family members | Never | 8.42 ± 7.038 | 9.719 | <0.001 |
| | Sometimes | 11.29 ± 6.521 | | 0.001[c] |
| | Often | 11.95 ± 6.559 | | <0.001[c] |
| Level of understanding of COVID-19 | Nothing | 7.80 ± 7.733 | 9.652 | <0.001 |
| | A little | 11.81 ± 6.404 | | 0.000[d] |
| | Familiar | 10.97 ± 6.959 | | 0.002[d] |
| Attitude toward taking protective measures | Not taking any protective measures | 8.43 ± 8.871 | 3.051 | 0.048 |
| | Passively | 11.61 ± 6.662 | | 0.016[e] |
| | Actively | 11.52 ± 6.501 | | 0.015[e] |
| Feeling afraid or having heart palpitations on hearing about COVID-19 pandemic | Never | 9.09 ± 6.320 | 33.653 | <0.001 |
| | Sometimes | 12.81 ± 6.089 | | <0.001[f] |
| | Often | 13.51 ± 7.551 | | <0.001[f] |
| | Always | 13.88 ± 6.036 | | <0.001[f] |
| Family members involved in anti-COVID-19 work | Yes | 12.71 ± 6.160 | 2.526* | 0.012 |
| | No | 11.26 ± 6.687 | | |
| Perceived adverse impact of COVID-19 on self or family in future | Yes | 13.26 ± 6.484 | 6.628* | <0.001 |
| | No | 10.52 ± 6.514 | | |
| Fear of infection | Yes | 13.33 ± 7.549 | −3.768* | <0.001 |
| | No | 11.09 ± 6.367 | | |
| Family members or friends infected with COVID-19 | Yes | 13.07 ± 6.911 | 0.911* | 0.362 |
| | No | 11.45 ± 6.628 | | |
| Hours spent on entertainment | <1 h/day | 11.78 ± 7.035 | 0.485 | 0.616 |
| | 1–2 h/day | 11.47 ± 6.406 | | |
| | >2 h/day | 11.22 ± 6.681 | | |

*(Continued)*

**TABLE 3 |** Continued

| Variables | | CASI ($\bar{x} \pm SD$) | *t*/*F* | *p* |
|---|---|---|---|---|
| Hours spent on physical exercise | <1 h/day | 11.96 ± 6.691 | 2.042 | 0.130 |
| | 1–2 h/day | 11.48 ± 6.680 | | |
| | >2 h/day | 10.87 ± 6.445 | | |
| Hours spent on study | <1 h/day | 12.56 ± 6.541 | 1.407 | 0.245 |
| | 1–2 h/day | 11.18 ± 6.594 | | |
| | >2 h/day | 11.45 ± 6.651 | | |

*t test.
[a]Compared to those of secondary school students.
[b]Compared to those of high school students.
[c]Compared to those whose family members never discussed the pandemic of COVID-19.
[d]Compared to those who thought they knew nothing about COVID-19.
[e]Compared to those who did not take any protective measures.
[f]Compared to those who never felt afraid and alarmed to the point of experiencing rapid heartbeats or palpitations when hearing things related to the epidemic.
CASI, Childhood Anxiety Sensitivity Index.

**TABLE 4 |** Factors related to respondents' level of anxiety sensitivity during the COVID-19 outbreak.

| Model | Unstandardized coefficients' | | Standardized coefficients | *t*-test score | *p* value | 95% CI |
|---|---|---|---|---|---|---|
| | *B* | *SE* | | | | |
| (Constant) | 7.749 | 2.647 | | 2.927 | 0.003 | 2.554∼12.943 |
| Gender | 1.224 | 0.377 | 0.092 | 3.244 | 0.001 | 0.484∼1.965 |
| Age | −0.161 | 0.518 | −0.059 | −0.987 | 0.324 | −0.482∼0.159 |
| Ethnicity | 0.231 | 0.149 | 0.015 | 0.446 | 0.656 | −0.786∼1.248 |
| Education | 1.968 | 0.489 | 0.244 | 3.753 | 0.000 | 0.939∼2.997 |
| Number of people living together during the lockdown | 0.050 | 0.333 | 0.009 | 0.332 | 0.740 | −0.243∼0.342 |
| Became ill and needed to go to hospital during the lockdown | −1.047 | 0.423 | −0.061 | −2.140 | 0.033 | −2.006∼ −0.087 |
| Discussion of COVID-19 in family | 0.240 | 0.379 | 0.023 | 0.723 | 0.470 | −0.412∼0.893 |
| Level of understanding of COVID-19 | −0.119 | 0.253 | −0.008 | −0.281 | 0.779 | −0.948∼0.711 |
| Attitude toward taking protective measures | −0.514 | 0.541 | −0.039 | −1.357 | 0.175 | −1.258∼0.229 |
| Feeling afraid or having heart palpitations on hearing about COVID-19 | 1.961 | 0.416 | 0.233 | 7.738 | 0.000 | 1.464∼2.458 |
| Family members involved in anti- COVID-19 work | −1.188 | 0.505 | −0.063 | −2.197 | 0.028 | −2.249∼ −0.127 |
| Perceived adverse impact of COVID-19 on self or family in future | −1.442 | 0.163 | −0.103 | −3.465 | 0.001 | −2.258∼ −0.625 |
| Fear of infection | 2.091 | 0.524 | 0.118 | 4.141 | 0.000 | 1.100∼3.081 |

$F = 14.329$; $p < 0.001$; $R^2 = 0.147$; adjusted $R^2 = 0.137$. Stepwise selection procedure was admitted to select the model as well as variables including age, number of people living together during lockdown, and significant factors in the level of anxiety sensitivity (total CASI scores) listed in **Table 4**.

were: <0.5, 0.5–1, or >1 h/day. (3) How much time do you spend studying per day? Answer options were: <1, 1–2, or >2 h/day.

## The Chinese Version of the Childhood Anxiety Sensitivity Index

The Childhood Anxiety Sensitivity Index (CASI) is an 18-item self-reported Likert scale that can be used to assess anxiety sensitivity. It was developed by Silverman et al. (1999) on the basis of the Anxiety Sensitivity Index. The scale is rated on a 3-point scale ranging from 1 to 3 ("none" to "a lot"), and total scores range from 0 to 36, with higher scores indicating a higher level of anxiety sensitivity. Ren Fang (2008) demonstrated that the Chinese version of CASI has good reliability, validity, and strong internal consistency. The internal consistency for the present sample is 0.896, and the cutoff values are 9 for boys and 11 for girls, indicating anxiety sensitivity, respectively (Ren Fang, 2012). Although several hierarchical models have been proposed for the factor structure of CASI, in this study, a 3-factor model was administered because of its stability and consistency (Francis et al., 2019).

## Statistical Analysis

Categorical variables were presented as numbers and percentages, and continuous variables were presented as the mean ± SD. A two-sample independent *t*-test was used for comparisons between the two groups. One-way ANOVA was used for multigroup comparisons, and the least significant difference (LSD) method was used for pair comparisons. Multiple linear regression analysis was used to analyze factors influencing the CASI score. Binary logistic regression was used to analyze risk factors associated with high anxiety sensitivity. $p < 0.05$ was considered significant. All statistical tests were undertaken using SPSS Statistics software version 16.0 (IBM, Armonk, NY, USA).

# RESULTS

A total of 1,141 questionnaires were retrieved in this study. Questionnaires with incomplete information and time spent of <90 s were deleted to ensure the reliability of data. In the final analysis, 1,091 (95.62%) questionnaires were included.

## Population Information

The general demographic data are shown in **Table 1**. Study participants comprised 593 females (54.4%) and 498 males (45.6%) with an average age of 13.27 ± 2.443 years. Among participants, 808 (74.1%) were of Han nationality, and 283 (25.9%) were others. In terms of education level, 524 (48.0%) respondents were enrolled in primary school, 296 (27.1%) were in secondary school, and 271 (24.8%) were in high school. Participants were from urban (19.6%), suburban (19.2%), and rural (61.1%) areas. Among respondents, 156 (14.3%) stated that their family members participated in anti-COVID-19 work. The average number of people living in the same home during the lockdown was 4.58 ± 1.258; among them, 948 (86.9%) were living with their parents, 398 (36.5%) were living with their grandparents, 726 (66.5%) were living with their siblings, and 48 (4.4%) were living with other people. Other respondent demographics and characteristics associated with the COVID-19 pandemic are presented in **Table 1**.

## Factors Associated With CASI Scores

The total CASI scores in this study ranged from 0 to 36, with an average score of 11.47 ± 6.631. Overall, 642 (58.8%) respondents reported anxiety sensitivity. Owing to sex differences in the threshold for anxiety sensitivity, the prevalence rates of anxiety sensitivity in female and male participants were 56.8 and 61.2%, respectively (**Table 5**). Additionally, as **Table 2** shows, an in-depth analysis of three dimensions of anxiety sensitivity found that the levels of physical concerns, mental concerns, and social concerns differed significantly between respondents with or without anxiety sensitivity.

One-way ANOVA and the *t*-test were used to analyze factors influencing CASI scores. The results are shown in **Table 3**. Several factors were significantly related to CASI scores: gender, ethnicity, educational level, physical condition during the lockdown, discussion about COVID-19 within the family, knowledge about COVID-19, attitude toward taking protective measures, feeling afraid or experiencing rapid heartbeat or palpitations on hearing about COVID-19, perceiving that COVID-19 had adverse impacts on self or family, family members being involved in anti-epidemic work, and fear of infection. Further analysis by the LSD method found that the scores of high school students were significantly higher than those of secondary school students ($p = 0.045$), and those of secondary school students were significantly higher than those of primary school students ($p = 0.002$). The scores of those whose family members discussed the pandemic of COVID-19 sometimes ($p = 0.001$) or often ($p < 0.001$) were significantly higher than those whose family members did not. The scores of those who thought they were familiar with ($p = 0.002$) or knew a little ($p < 0.001$) about COVID-19 were significantly higher than those who did not ($p < 0.001$); the scores of those who took protective measures actively ($p = 0.015$) or passively ($p = 0.016$) were significantly higher than those who did not. Lastly, the scores of those who felt afraid and alarmed to the point of experiencing rapid heartbeats or palpitations when hearing things related to the epidemic were significantly higher than those who did not have these responses ($p < 0.001$).

In addition, we conducted multiple linear regression analysis by a variable with the aforementioned significant factors, age, and number of people in the same home during the lockdown in order to identify the significant factors correlated with the level of anxiety sensitivity. Finally, we constructed a multiple linear regression model of anxiety sensitivity scores from the factors obtained (**Table 4**), including gender, school grade level, seeking medical help because of illness during the lockdown, feeling afraid, or experiencing rapid heartbeat on hearing things related to COVID-19, family members participating in anti-COVID-19 work, perceiving that COVID-19 would have an adverse impact on self or family, and fear of infection.

## Risk Factors for Anxiety Sensitivity in Children and Adolescents

We performed a binary logistic regression analysis to identify risk factors for anxiety sensitivity in children and adolescents from northwest China. As **Table 5** shows, there were several risk factors for anxiety sensitivity in children and adolescents during lockdown: learning stage in secondary school (OR, 1.743; 95% CI [1.274–2.384]) or high school (OR, 2.151; 95% CI [1.544–2.997]); becoming ill and needing to go to hospital during the lockdown (OR, 1.462; 95% CI [1.038–2.059]); being afraid of hearing things related to COVID-19 either sometimes (OR, 2.900; 95% CI [2.187–3.846]), often (OR, 2.522; 95% CI [1.595–3.988]), or always (OR, 4.061; 95% CI [1.945–8.480]); believing that COVID-19 would have an adverse impact on self or family (OR, 1.513; 95% CI [1.135–2.017]); and fear of infection (OR, 1.703; 95% CI [1.187–2.444]).

# DISCUSSION

This is one of few studies, to our knowledge, that describes the psychological condition of children and adolescents from the northwest China during the pandemic. We found that the

**TABLE 5 |** Factors related to anxiety sensitivity in children and adolescents during the COVID-19 lockdown.

| Variable | Frequency *n* (%) of anxiety sensitivity (*N* = 642) | *p value* | Odds ratio (95%CI) |
|---|---|---|---|
| **Gender** | | | |
| Female | 337 (56.8%) | | 1 |
| Male | 305 (61.2%) | 0.070 | 1.272 (0.981–1.650) |
| **Education level** | | | |
| Primary school | 272 (51.9%) | | 1 |
| Secondary school | 188 (63.5%) | 0.001 | 1.743 (1.274–2.384) |
| High school | 182 (67.2%) | <0.001 | 2.151 (1.544–2.997) |
| **Became ill and needed to go to hospital during the lockdown** | | | |
| No | 513 (57.4%) | | 1 |
| Yes | 129 (65.5%) | 0.030 | 1.462 (1.038–2.059) |
| **Feeling afraid or having heart palpitations on hearing about COVID-19** | | | |
| Never | 184 (42.9%) | | 1 |
| Sometimes | 346 (69.2%) | <0.001 | 2.900 (2.187–3.846) |
| Often | 80 (67.2%) | <0.001 | 2.522 (1.595–3.988) |
| Always | 32 (74.4%) | <0.001 | 4.061 (1.945–8.480) |
| **Family members involved in anti- COVID-19 work** | | | |
| No | 539 (57.6%) | | 1 |
| Yes | 103 (66.0%) | 0.099 | 1.378 (0.941–2.018) |
| **Perceived adverse impact of COVID-19 on self or family in future** | | | |
| No | 377 (52.8%) | | 1 |
| Yes | 265 (70.3%) | 0.005 | 1.513 (1.135–2.017) |
| **Fear of infection** | | | |
| No | 514 (70.3%) | | 1 |
| Yes | 128 (52.8%) | 0.004 | 1.703 (1.187–2.444) |

*Forward stepwise selection procedure was conducted to select the model from variables listed in* ***Table 4*** *that had significant differences in levels of anxiety sensitivity.*

level of anxiety sensitivity became dramatically elevated during the pandemic. We also revealed several possible risk factors associated with high anxiety sensitivity: studying in secondary or high school, becoming ill, feeling afraid or having heart palpitations on hearing about the COVID-19 pandemic, thinking that COVID-19 would have an adverse impact on self or family in the future, and fear of infection. Together, these results will help us to better understand the mental health conditions of children and adolescents when faced with current or future emerging infectious disease outbreaks and epidemics. Thus, we will be able to provide scientific guidance to formulate targeted policies to prevent such mental illness and intervene when it occurs.

Initially, our results showed that the level of anxiety sensitivity in children and adolescents from northwest China during the pandemic increased significantly, exceeding that of children and adolescents assessed prior to the outbreak of COVID-19 (Ren Fang, 2012). Due to the lack of data on the anxiety sensitivity of children and adolescents in other parts of China during the pandemic, it is not possible to compare the levels of anxiety sensitivity of children and adolescents in northwest China with those from other parts of China. In our sample, 58.8% of participants met the screening criteria for anxiety sensitivity. In related research, Tang et al. (2021) reported on the prevalence of depressive symptoms (19.7%) and anxiety symptoms (24.9%) in children and adolescents from Shanghai during the pandemic, and Xie et al. (2020) reported on the prevalence of depressive symptoms (26.5%) and anxiety symptoms (19.6%) in children and adolescents in Wuhan. Although the rate of abnormal psychological status among children and adolescents varied in the different studies, these findings consistently suggest that the COVID-19 pandemic has had an adverse impact on the psychological status of children and adolescents.

As is well-known, the physical disease can influence psychological conditions. However, the most interesting and concerning findings of the present study are that becoming ill and needing medical treatment during the lockdown was a risk factor for anxiety sensitivity, whereas having the chronic disease in the preceding 6 months or experiencing illness and seeking medical advice in the past 3 months was not a risk factor. This difference might be due to the variety of clinical symptoms of COVID-19 (Huang et al., 2020). Also, it is difficult for children and adolescents to distinguish the symptoms of the general disease from those of COVID-19, and they may have guessed that they were infected with COVID-19, thus elevating their levels of anxiety sensitivity. Those with chronic diseases or experience seeking medical advice previously, by contrast, knew their health

conditions well and were less likely to make false assumptions and guesses.

Similar to the findings of Zhou et al. (2020b), our study revealed that the higher the school grade level, the higher the CASI score. This correlation may be due to the fact that middle school students attach more importance to their academic achievements and interpersonal communication (Wang et al., 2007). Moreover, as school age increases, students' academic stress significantly increases, and interpersonal relationships become more complicated. After the outbreak of COVID-19, lockdown measures and postponement of the spring semester disturbed learning schedules and daily life (Fang et al., 2019, 2021c; Wu et al., 2022b). Although students could study and communicate online, poor learning efficiency and restrictions on communication with peers may have increased their anxiety sensitivity.

The COVID-19 pandemic is the most serious public health event these children and adolescents have experienced. In this survey, 62.4% of the respondents felt afraid and experienced a rapid heartbeat when they heard information about COVID-19. Further analysis found that concerns about the adverse impacts of COVID-19 on themselves and their families in the future, fears of being infected with COVID-19, and fears upon hearing information about the pandemic were all risk factors for anxiety sensitivity. On the one hand, this might be related to their young age and lack of mental resilience in response to adversity (Liu Wen and Lin, 2019). On the other hand, a virus that is highly contagious has a high rate of mortality, has no specific treatment, and has increasing numbers of confirmed cases and deaths might have aggravated their fears and anxiety sensitivity. Meanwhile, in order to control the spread of disease, governments implementing strict lockdowns might also have disturbed parents' careers and family economics (Chen et al., 2022; Fang et al., 2022), while postponement of school re-openings might have interfered with children's schoolwork, resulting in enhanced anxiety sensitivity among children and adolescents.

Because the pandemic was ongoing during the investigation period, the study had to take a convenience sampling approach and be conducted online; thus, the sample size is relatively small, which limits the applicability and generalizability of the results. Also, because of the nature of a cross-sectional study, the ability to establish causal relationships between risk factors and anxiety sensitivity was limited. Therefore, longitudinal follow-up studies should be conducted that expand sample sources and investigate the respondents face to face. This will improve the study design and increase the applicability and generalizability of the results.

## CONCLUSION

During the COVID-19 pandemic and home quarantine, children and adolescents from northwest China experienced elevated levels of anxiety sensitivity. Therefore, the whole society should be aware of the negative impact of the pandemic on the mental health of children and adolescents and develop timely and effective interventions to prevent and intervene during pandemics so as to avoid more severe and disabling consequences. Specifically, parents should pay more attention to the physical health of their children during lockdowns and help them to seek medical help as soon as symptoms appear. Doctors should give them professional advice and allay their doubts and concerns about COVID-19, thereby reducing their anxiety sensitivity. The media should report information related to the pandemic accurately to avoid excessive exaggeration of its seriousness. At the same time, because the pandemic is dangerous, it is imperative to take strict control measures that interfere with people's daily routines. Schools and parents should encourage students to view the pandemic from a long-term perspective with a positive, optimistic aspect. In this way, they will help children to accept and adapt to lockdown measures with heartfelt understanding so as to relieve their anxiety.

## 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 Second Affiliated Hospital of Xi'an Jiaotong University. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## AUTHOR CONTRIBUTIONS

QJ, WM, and YZ designed the questionnaire, organized the survey, and carried out the literature searches and manuscript preparation. HW, YG, and JH assisted with data acquisition and analyses. BZ and JL carried out manuscript editing. WH and SL undertook a manuscript review. All authors approved the final version of the manuscript.

## FUNDING

This work was supported by the Foundation of the Second Affiliated Hospital of Xi'an Jiaotong University [Grant No. YJ (QN)201808] and the Project of Shaanxi Province to Improve Public Science Quality (Grant No. 2021PSL93).

## ACKNOWLEDGMENTS

We would express our gratitude to the participants for completing the survey questionnaire. We especially appreciate the teachers who were responsible for assigning the online questionnaire to students. We further thank the guardians of children and adolescents for their assistance in filling out the questionnaires.

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frontiers | Frontiers in Psychology

TYPE Systematic Review
PUBLISHED 22 July 2022
DOI 10.3389/fpsyg.2022.939520



OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology

RECEIVED 09 May 2022
ACCEPTED 27 June 2022
PUBLISHED 22 July 2022

CITATION
Mameli F, Zirone E, Capetti B, Mellace D, Ferrucci R, Franco G, Di Fonzo A, Barbieri S and Ruggiero F (2022) Changes in non-motor symptoms in patients with Parkinson's disease following COVID-19 pandemic restrictions: A systematic review. *Front. Psychol.* 13:939520. doi: 10.3389/fpsyg.2022.939520



# Changes in non-motor symptoms in patients with Parkinson's disease following COVID-19 pandemic restrictions: A systematic review

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This review discussed the effects of the impact of the Coronavirus Disease 2019 (COVID-19) pandemic on the psychological wellbeing of people with Parkinson's disease (PD) focusing specifically on depressive symptoms, anxiety levels, sleep, and quality of life (QoL). Together with motor symptoms, psychological symptoms are common and disabling conditions in the clinical course of PD becoming a relevant topic as a result of the lockdown measure due to alter their everyday life. We searched on PubMed online electronic databases for English articles published between January 2020 and 31 December 2021. Twenty-eight relevant studies were found and included in the review. Heterogeneous data emerged from the topics analyzed. Overall, data from depression studies showed significant depressive symptoms if the patient was analyzed longitudinally or vs. a control group consisting in healthy subjects, while these differences become minimal when the control group is a family member. Differently, in most of the studies reviewed there is no evidence of a statistically significant impact on anxiety disorders, nor on the quality of sleep. Conversely, PD patients showed a statistically significant negative impact of QoL compared with control groups or other neurological conditions. Although these findings must be interpreted carefully in the light of the studies' limitations, both in methodology and design, collectively our review showed that COVID-19 pandemic has had negative effects on the mental health of people with PD, due to disruption of healthcare services, loss of usual activities and supports and reduction in physical activity.

KEYWORDS

**Parkinson's disease, COVID-19, pandemic restrictions, non-motor symptoms, anxiety, depression, sleep disturbances, quality of life**

## Introduction

In December 2019, the first cases of a disease called Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) were identified in Wuhan, in the province of Hubei, China (Del Prete et al., 2021). Available data suggest that the outcome of the new Coronavirus Disease 2019 (COVID-19) can be worse in elderly people and patients vulnerable due to pre-existing conditions (Hall and Church, 2020).

Faced with the spread of the virus and the growing pressure on healthcare facilities and workers, hospitals also had to limit patients' access, a decision that greatly impacted routine diagnosis and treatment of chronic diseases, including Parkinson's disease (PD) (Guo et al., 2020), a neurodegenerative disease characterized by movement disorders, cognitive impairment, vulnerability, and comorbidities.

Healthcare services provided to patients with PD were swiftly adapted to the restrictive measures in place (Brown et al., 2020). In fact, to ensure continuity in healthcare, alternatives to the classic in-person visit have been adopted, including telemedicine (Bloem et al., 2020) and remote advanced therapeutic management (Fasano et al., 2020; Miocinovic et al., 2020), taking into account differences in accessibility and usability for some patients (Garg and Dhamija, 2020).

Besides the motor symptoms, neuropsychiatric disorders such as anxiety, depression, apathy, and sleep disturbances, are common and highly disabling in the clinical development of PD (Weintraub and Burn, 2011) becoming even more relevant as a result of the lockdown measure. PD patients, as well as other at-risk groups, were forced to alter their everyday life in a way that deeply affected their social interactions, routines, and physical training, which normally allow PD patients to reduce the stress associated with their condition and to optimally cope with the disease (Haahr et al., 2011; Corti et al., 2018). Normal dopaminergic functioning is essential to a flexible adaptation to new circumstances (Macht et al., 2007; Robbins and Cools, 2014), which means that PD patients may be more likely to suffer from the negative psychological and psychosocial effects of self-isolation and of other measure in place to contain the pandemic, thus negatively affecting the disease burden (Helmich and Bloem, 2020; Papa et al., 2020).

The aim of the present review was, therefore, to identify and narratively summarize available studies, conducted in different countries, investigating the potential impact of the COVID-19 pandemic and subsequent social restrictions on non-motor symptoms (NMS) in patients with PD, focusing specifically on depressive symptoms, anxiety levels, sleep, and quality of life (QoL).

## Methods

To identify available studies, a search was carried out through the PubMed/Medline online database on articles published between January 2020 and the end of December 2021. The choice of this time interval was dictated by the World Health Organization who had declared the international SARS-CoV-2 outbreak a Public Health Emergency of International Concern on 30 January 2020.

The designed search strategy resorted to the use of MeSH terms and keywords to search the database for the disease in combination with the pandemic context and NMS [disease (e.g., Parkinson's Disease) AND context (e.g., COVID-19)] AND [NMS (e.g., anxiety)].

Two independent reviewers and qualified researchers in clinical psychology screened records of search outputs for pertinence to the topic and English language only. A flow chart of the systematic literature search is reported in Figure 1.

Experimental studies were included if they addressed the impact of the COVID-19 pandemic restrictions on depressive symptoms, anxiety, sleep, and QoL in patients with PD. No restrictions were applied as to sex, age and ethnicity of subjects, disease duration, and disease severity. Reviews, qualitative studies, correspondences, single case reports and studies written in languages other than English were all excluded. The articles passed a first screening phase, checking titles and abstracts, and a second screening phase, analyzing the full-text if they met the above criteria.

Since some of the studies investigated several NMS at once, we extrapolated data on each one of them. The present review is structured into sub-sections dedicated to individual topics (depression, anxiety, sleep, and QoL) and therefore the same study might figure in more than one sub-section. Finally, within each sub-section, we organized the results according to the experimental design of symptoms evaluation: assessment of patients before and after lockdown, comparisons between patients and control groups, and individual assessments conducted only in the PD patient group.

## Results

After checking for duplications and compliance to selection criteria, 28 studies focusing on the impact of COVID-19 restrictions on depressive symptoms, anxiety levels, sleep, and QoL were included in the review process (out of the 86 initially scrutinized articles). Figure 1 illustrates the search and selection process. The selected studies were conducted in different countries, where restrictions started at different times and with different degrees of strictness (e.g., recommended social distancing, compulsory lockdown). Most studies evaluated PD

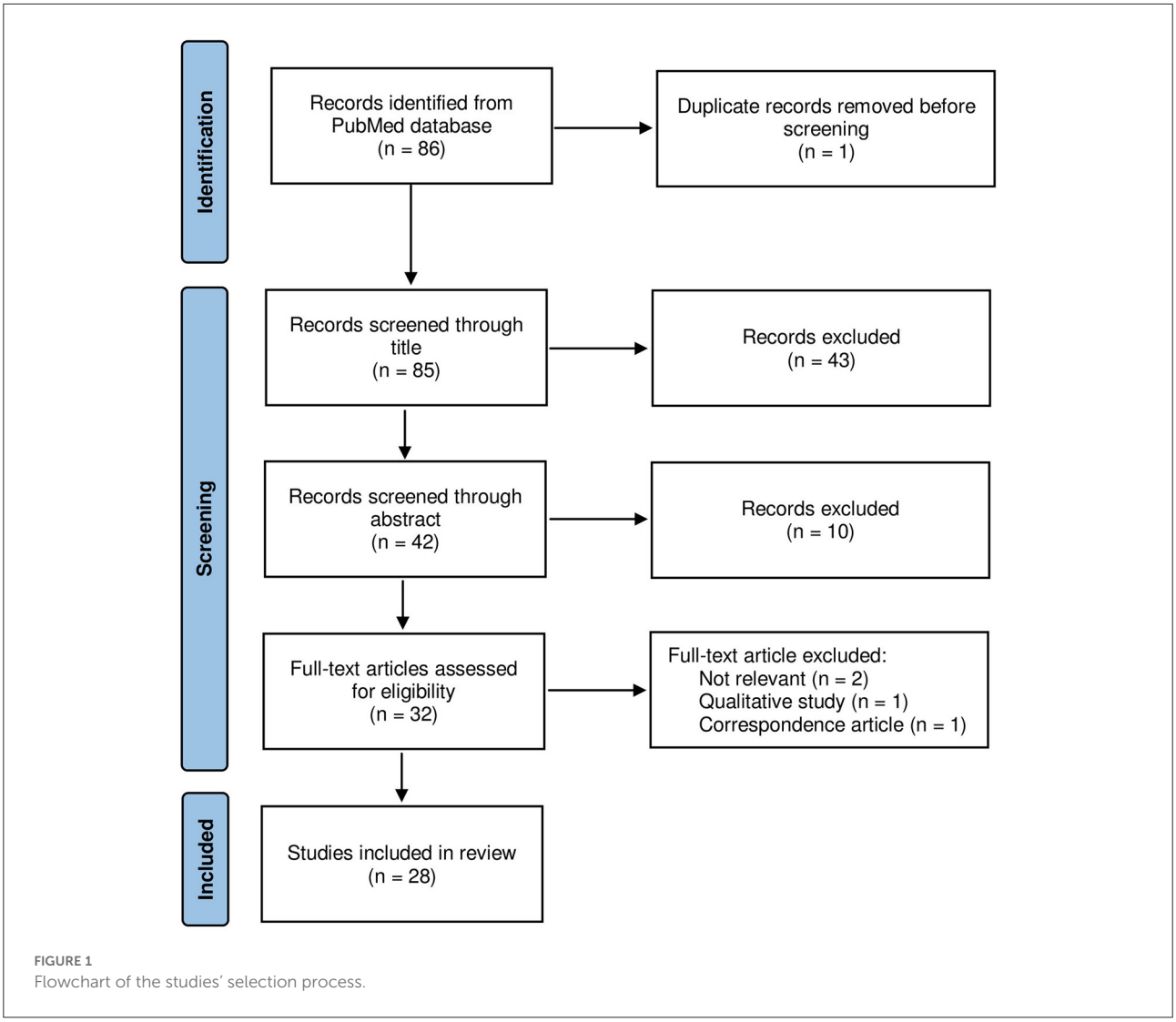


FIGURE 1
Flowchart of the studies' selection process.

patients' symptoms during or immediately after the first wave of COVID-19 infections, resorting to different validated scales or questionnaires specifically designed to assess subjective perception of change in NMS. Only two studies included in this work collected data during 2021, following successive waves of COVID-19. Results are narratively summarized below, in subsections focusing on depression, anxiety, sleep, and QoL. An overview of the data extracted from each study is detailed in Supplementary Table 1.

## Depression

### Longitudinal monitoring

A study by HØrmann Thomsen et al. (2021) assessed depression between August–November 2018 (baseline) and April–June 2020 (follow-up) in two different samples, using the Beck Depression Inventory-II (BDI-II) for Danish patients and the Patient Reported Outcome in Parkinson's Disease (PRO-PD) for Swedish patients. The results showed no statistically significant differences between the two assessments for either cohort; Swedish patients reported lower scores for depression at baseline, whereas in the Danish cohort the scores were almost identical between the two evaluations. Only one parameter indicated a worsening of mood: by analyzing the scores obtained on the Parkinson's Disease Questionnaire-8 (PDQ-8), the authors found a worsening at T1 in the "felt depressed" item in both cohorts. However, considering that data at T0 were collected 2 years before the pandemic, it is indeed possible that other variables might have come into play.

To assess depression symptoms, El Otmani et al. (2021) evaluated 50 PD patients at the start of lockdown in Morocco (16 March 2020) and again after 6 weeks of home confinement, by online submission of the Moroccan version of Hospital

Anxiety and Depression Scale (HADS). Their results showed no differences either in the mean scores of depression subscale of HADS (HADS-D) or in the total number of depressed patients. More specifically, at follow-up they observed that 5 patients improved their HADS-D score while 12 showed a clinical worsening of depression, a change in both cases not correlated to disease severity. Among the 12 worsening patients, 8 of them were comparatively young (≤60 years old) and 3 had already undergone Deep Brain Stimulation (DBS) treatment; thus, as reported by telephone interview at follow-up, their worsening could well have been a consequence of the restrictions in place, which caused a reduction of physical activity and changes in daily routine.

Finally, Falla et al. (2021) evaluated 14 PD patients [disease severity ≤ III according to the modified Hoehn and Yahr scale (H&Y)] by administering the Geriatric Depression Scale (GDS) *via* telemedicine visits, and compared the data acquired during the last week of lockdown in Italy (24 April−1 May 2020) with those obtained during an evaluation conducted in February 2020, shortly before the lockdown. Results showed that patients did not exhibit depression, and no statistically significant difference between the two assessments was found. However, by analyzing individual scores, 4 out of the 5 patients who showed a clinically significant score for depression at baseline were found to still show the same score at follow-up. These data are consistent with existing studies pointing to a high incidence of affective disorders, including depression, in PD patients. No association was found between the difference from baseline to follow-up of GDS score and disease duration.

## Case-control studies

To investigate the impact of the COVID-19 pandemic on depressive symptoms, Shalash et al. (2020) administered the Depression, Anxiety and Stress Scale-21 (DASS-21) by telephone to 38 PD patients and 20 controls in Egypt; the control group included volunteers and relatives of patients suffering from other medical conditions. They found that more PD patients (60.5%) than controls (30%) showed significantly mood deflection. Moreover, DASS-21 score for depression showed a positive correlation with pre-lockdown motor severity–off and with pre-lockdown Beck Depression Inventory (BDI), and a negative correlation with pre-lockdown Mini Mental State Examination. However, the study does not clearly state when the pre-lockdown evaluation was performed.

A study by Xia et al. (2020), conducted on a cohort of 119 Chinese PD patients and 169 healthy subjects, retrospectively investigated the levels of depression experienced between February and April 2020 by administering the HADS-D *via* an online survey. According to the results, patients showed significantly higher HADS-D scores when compared to controls. Additionally, patients affected by sleep disorders were more likely to show a worsening in depression levels. Furthermore, when comparing data by gender, it emerged that more females ($n = 20$, 34.5%) than males ($n = 7$, 11.5%) manifested clinical levels of depression ($p = 0.003$).

In order to investigate the effect of increased stress levels caused by the pandemic on patients' mood, the authors of the study by Oppo et al. (2020) administered the HADS to 32 PD patients and to their caregivers through a structured telephone interview conducted over the course of the last 10 days of the first lockdown in Italy (may 2020). The authors found no statistically significant differences between the two groups in the mean HADS-D score. However, results showed that patients who subjectively experienced worsening stress levels due to isolation also showed significantly worse mood/cognition scores on the Non-Motor Symptom Scale (NMSS). This outcome may be explained by the fact that the items belonging to the mood/cognition domain cannot be unbundled, therefore it is impossible to clearly establish whether the worse score is due to the cognition or to the mood component.

In line with these findings, Suzuki et al. (2021) performed retrospective evaluations between June and December 2020 through an online survey, asking 100 Japanese patients and their caregivers/spouses to answer the questions by focusing only on their conditions after mid-April 2020, when the health emergency was declared. HADS was administered to both patients and caregivers to assess depression, while the Patient Global Impression of Change (PGIC) scale was applied to patients with PD to assess the impact of the pandemic on motor symptoms and mood. In addition, caregivers/spouses of PD patients were asked about the changes in the patients' symptoms they observed. The HADS score results showed no statistically significant differences between the percentage of patients ($n = 20$, 20%) and caregivers ($n = 17$, 17%) who suffered from clinical depression during the COVID-19 pandemic, while PGIC results revealed that, whereas 36% of patients ($n = 36$) reported mild to moderate mood worsening, 56% ($n = 56$) reported no change, while only 8% ($n = 8$) reported mild to moderate improvement. Additionally, a high rate of agreement was observed between patients' accounts and caregivers' reports of symptom change.

Kitani-Morii et al. (2021) invited 88 people to participate in a survey. The response rate was 80% ($n = 71$). They assessed depressive symptoms in 38 PD patients and 31 of their relatives through the Japanese version of the 9-item Patient Health Questionnaire, sent to the subjects by email (from 22 April to 15 May 2020). The results highlighted that more patients ($n = 15$, 39%) than controls ($n = 2$, 6%) showed moderate to severe depressive symptoms ($p = 0.002$), and that more female patients ($n = 7$, 50%) than females in the control group ($n = 1$, 3.8%) had depression ($p = 0.001$). Additionally, duration and severity of disease did not emerge as risk factors for clinical depression, while the patients' perceived severity of motor symptoms did.

A telephone interview was conducted on 45 patients and 43 healthy controls after the end of the lockdown in Turkey (15–20 June 2020) by Balci et al. (2021), asking the participants to refer

to the period 11 March−1 June 2020. Depressive symptoms were evaluated by administering the HADS in relation to physical activity measured with the Physical Activity Scale for the Elderly. Their results showed that, although a worsening of motor and NMS was reported by 31 patients (68.9%), no statistically relevant mood differences or deviations in the HADS-D score were found, not in patients nor in healthy subjects.

Lastly, Montanaro et al. (2022) enrolled 100 PD patients undergoing different therapies [DBS, levodopa/carbidopa intestinal gel infusion (LCIG), standard medical treatment (SMT)] and 60 caregivers. The authors administered HADS-D *via* telephone interviews during the lockdown in Italy (April–May 2020), to both patients and caregivers. Patients were evaluated at T0 (April–May 2020) and at T1 (June–August 2020), while caregivers were only evaluated at T0. Results showed that more patients (35%) than caregivers (21.7%) experienced depression, and a significantly higher mean HADS-D score was observed in patients compared to caregivers during the 2 months of lockdown in Italy (T0). Comparing the two patients' assessments, 35% of them showed depressive symptoms at T0, with a mild, medium, or severe intensity, and a similar trend was observed at T1 (34.1%), suggesting no change happened in patients' depression levels. Moreover, no statistically significant difference in depressive symptoms was observed both at T0 and T1 between patients treated with DBS, LCIG, and SMT, and no correlation was found between HADS-D score and disease duration. However, the absence of a pre-pandemic assessment of both groups and also of a post-lockdown assessment of caregivers prevents further comparisons, therefore it is impossible to establish whether the higher incidence of depressive symptoms in patients is actually related to the restrictions in place or if it is due to pathophysiologic predisposition or progression of PD.

## Cross-sectional studies

Song et al. (2020) evaluated the change in NMS by asking the patients a single question: whether they felt "subjectively" depressed or not. In the study were enrolled 100 patients with PD (H&Y stage $\leq$ III) who were able to walk independently and who visited their clinic a first time between December 2019 and January 2020 (baseline) and a second time in May 2020 (follow-up during the COVID-19 crisis). Results showed a low impact of the pandemic on depressive symptoms: only 5% of the patients reported feeling subjectively depressed.

A study by Guo et al. (2020) investigated the insurgence or worsening of depressive symptoms on February-March 2020 with a two-question survey, administered to 113 patients with PD (H&Y stage I-IV). The response rate was 95.6% ($n = 108$). Among the 86 (79.6%) patients who reported new or exacerbated symptoms, 54 (50%) indicated "feeling depressed" as the main trait; it was also the most reported symptom. However, the authors did not explore the possibility of a correlation between the subjective perception of depression and the stage of the disease, and with no pre-COVID-19 data it is impossible to determine whether the worsening is due to the pandemic or rather to the progression of the disease.

Similar findings emerged from the study of Janiri et al. (2020), who conducted a telephone survey in April 2020 on 134 PD patients, 101 of which (75.4%) already suffering from long lasting psychiatric symptoms. All participants answered the interview questions. Results showed that a worsening of psychiatric clinical condition during COVID-19 outbreak was reported by 23 (22.8%) of the 101 patients, while the others reported no change. Almost all of the patients ($n = 19$, 82.6%) with worsening symptoms reported a worsening in depression. In line with these findings, a case-control survey of COVID-19 and other clinical features in PD patients living in Tuscany was conducted by Del Prete et al. (2021) on 740 subjects. All subjects were telephonically interviewed from 10 April to 4 May 2020 by a neurologist specialized in movement disorders; patients were asked about COVID-19 positivity, comorbidities, anti-Parkinson's therapy, mood, and other clinical signs. Among the 733 (99%) non-COVID-19 patients, the majority ($n = 549$, 74.9%) did not notice any pandemic-related mood worsening. However, this outcome was gathered through a single question. Additionally, DASS-21 was performed on 120 non-COVID-19 patients but no specific data were available for the depression subscale.

Fabbri et al. (2021) investigated perceived changes in depressive symptoms by resorting to a survey designed by the France Parkinson association to specifically target the French community of PD patients, which was administered online or as part of classic routine consultation or outpatients' telemedicine visits performed by a hospital-based Parkinson Expert Center. All patients were evaluated from 16 March to 16 May 2020, assessing changes occurred between mid-March to mid-April. The authors used the same standardized questionnaire, assessing both motor symptoms and NMS (including depression) by administering the Patient's Global Impression-Improvement scales (PGI-I) and asking patients to report new/worsening symptoms. Results showed that, out of the 2,653 responses analyzed, 1,085 (40.9%) patients reported a change in symptoms and only 3.4% ($n = 90$) of all patients reported a worsening of depressive symptoms. However, according to the PGI-I, worsening of the psychic state (including depression and anxiety) was among the most reported symptoms ($n = 1,211$, 46.3%), in addition to general motor symptoms ($n = 1,451$, 55.8%) and pain ($n = 1,336$, 51.5%). Nevertheless, as only few patients reported a change in their depressive symptoms, the result of this scale could have been influenced more by a worsening of anxiety.

A study conducted in India by Saluja et al. (2021) assessed the presence of depression symptoms: over the course of a telephone interview (June–September 2020), the authors administered the NMSS to 64 patients and asked their caregivers

to report the changes they had perceived in the patients' symptoms. The authors found agreement among patients and caregivers in reporting an increase in sadness and low mood. Mood disturbances were the most common NMS to worsen: more specifically, 26 patients reported a worsening of symptoms and 42.3% of these reported an increase in mood deflection. The impact of lockdown on NMS might have been critical in patients with PD as dopamine depletion can already lead to cognitive inflexibility, inability to adapt, and reduced ability to cope with stress (Saluja et al., 2021).

Kumar et al. (2021) investigated the impact of the pandemic on depression symptoms by assessing sleep as an indirect measure of mood. The authors administered an online survey to 832 patients through a specifically tailored questionnaire, created and validated by them in order to assess changes in sleep parameters, together with mood. Analysis on all 832 responses showed that patients who experienced new or increased sleep disturbances following the lockdown were characterized by a higher prevalence of depressive symptoms ($n = 112$, 56.3%), compared to those with no sleep disorders ($n = 192$, 35.7%) and patients with pre-existing sleep disorders that did not exacerbate during the pandemic ($p < 0.001$). This study also suggests that there is indeed a relationship between depression and sleep disturbances.

In a study conducted in Canada (de Rus Jacquet et al., 2021), 417 PD patients from two cohorts (median H&Y stage II), 177 from Alberta and 240 from Québec, were enrolled by three associations: the Canadian Open Parkinson Network, the Quebec Parkinson Network, and the Calgary Parkinson Research Initiative. Participants were asked to fill an online survey, available from 20 May to 16 September 2020, about the impact of COVID-19 confinement (starting from mid-March 2020) on perceived physical and mental wellbeing, daily activities, disease management, and continuity of health care. Questionnaires were self-administered online or on the telephone by researchers. Changes in mood ranked third in the list of the main effects of confinement. Among patients who perceived a change in depression level ($n = 56$, 13.4%) the majority of them ($n = 38$, 67.86%) reported an increase in depression, while the others ($n = 18$, 32.14%) registered only day-to-day changes.

A study by Knapik et al. (2021) assessed depression levels in 30 PD patients (H&Y stage I–III, none of whom had previously received DBS treatment) 90 days after the onset of social isolation in Poland. From the administration of the HADS by telephone interview, they observed that 40% of patients did not report depression, that 33.33% of them had a borderline HADS-D score for the presence of that disorder, while the remaining 26.67% had clinical depression. In this study, the high levels of depression may be partially explained by the patients' perception of their physical fitness, but not by the physical activity they actually engaged in, while staying at home or when leaving home during the pandemic. The authors also divided the patients into two groups, "people living alone" and "people living with a spouse or family" ($n = 6$ vs. $n = 24$), and compared the mean HADS-D scores of the two subgroups. No statistically significant differences emerged and this could perhaps be due to the fact that the two groups had different sample sizes.

In a study by Dommershuijsen et al. (2021), 844 PD patients answered a questionnaire administered online and, in a few cases, on paper or by telephone, from 14 April 2020 to 25 February 2021, aimed to identify subgroup differences in the associations between COVID-19 stressors and mental health in PD patients. Specifically, when focusing on the relationship between pandemic-related stressors and depression, the authors found that higher care stressors (e.g., limited access to care, nursing, and medication), social stressors (e.g., reduced social contact, lack of social events, and tension/conflict at home), and stressors sum score were associated with higher BDI total score (BDI beta: 0.07, 95% CI: 0.04–0.10; BDI beta:0.06, 95% CI: 0.04–0.08; 95% CI: 0.02–0.05) and sub score. The authors also measured a greater impact of care stressors on depression levels in women rather than men, and on patients suffering from more severe PD symptoms.

Finally, Krzysztoń et al. (2022) made an online survey available between 23 December 2020 and 23 June 2021, asking several questions aimed at investigating the impact of the COVID-19 pandemic on PD patients. Forty-seven patients completed the survey and 9% ($n = 4$) of them reported subjective worsening of depressive symptoms. Additionally, a statistically significant correlation was found between the worsening of depressive symptoms and the feeling of being alone/isolated ($p = 0.017$).

## Anxiety

### Longitudinal monitoring

A study conducted in Italy by Falla et al. (2021) highlighted that, in their sample (H&Y stage $\leq$ III), more PD patients reported anxiety at follow-up during lockdown (T1) compared to baseline performed shortly before the lockdown beginning (T0). Furthermore, the mean of the 12-item Parkinson Anxiety Scale (OR-PAS) total score was higher at T1 ($16.9 \pm 7.4$) than at T0 ($11.8 \pm 8.4$) and, more specifically, the avoidance subscale significantly increased at T1 ($7.5 \pm 1.7$) compared to T0 ($1.8 \pm 2.2$). Thus, anxiety levels measured at baseline were already above the cut-off, further worsening during the lockdown period. Because no association was found between the difference in OR-PAS score from baseline to follow-up and disease duration, this increase may be a consequence of the social isolation experienced during the lockdown in addition to the restrictions.

In line with this result, another study conducted on two different PD cohorts, one Swedish and one Danish (HØrmann Thomsen et al., 2021), showed a statistically significant

worsening of anxiety between the baseline period (2018) and the first COVID-19 wave in both cohorts, although in the Danish cohort just one item extracted from the BDI-II scale was used as a measure of anxiety. However, qualitative data from narrative reports about the impact of COVID-19 on everyday life provided by Danish patients supported this finding. In particular, these descriptive texts suggest that the increase in anxiety may be associated with the hardship of rebuilding a daily routine after this challenging period. It is worth noting that, as this study compared data collected in 2018 with an assessment during the social isolation period, differences should be treated with caution since multiple events may have occurred in a 2-year timeframe, possibly impacting on anxiety levels measured during the social restrictions period. Besides, such an increase in the anxiety levels of patients over the course of time has not been found in other studies.

Contrary to the aforementioned results, the assessment of a sample of 50 PD patients in Morocco (El Otmani et al., 2021) showed that, after 6 weeks of home confinement, the anxiety subscale of the HADS (HADS-A) showed a substantial stability on anxiety levels. In fact, 32% of patients reported anxiety at the beginning of confinement, and the mean HADS-A score was 7.98; similarly, after 6 weeks of self-isolation, 30% reported anxiety and the mean HADS-A score was 8.24. Thus, the authors found no statistically significant differences for anxiety levels, either by comparing the patients' ratio or the mean HADS-A scores in the two assessments. Noteworthy, out of the 8 patients who showed a worsening in anxiety levels, 7 were under the age of 60 and 2 had undergone DBS treatment: the negative effect observed in younger patients and in patients treated with DBS may be explained by the impact of the governmental restrictions on daily routines witch limited their opportunities to exercise. The authors found that disease severity had no impact on the HADS-A score. Thus, despite the trend toward an increased anxiety symptomatology seen in previous studies, this study showed that confinement did not have a statistically significant impact on anxiety scores: the overall effect on anxiety seems null, although in this sample some patients improved and others worsened.

## Case-control studies

Among the studies that produced statistically significant results, there is an online case-control survey which included the Persian version of Beck Anxiety Inventory-II (BAI-II), conducted online by Salari et al. (2020). In this study, based on a sample of 137 PD patients, 95 caregivers, and 442 healthy controls, the authors concluded that the mean BAI-II total score was consistently higher in PD patients than in both controls and caregivers ($p < 0.001$). Similarly, moderate to severe anxiety levels were more frequently observed in PD patients than in controls and caregivers. PD disease duration was also considered in this study, but no statistically significant correlation was found between this parameter and the severity of anxiety levels. The authors argue that this outcome could be due to worsening of pre-existing anxiety, uncertainty of treatment during isolation, and increased vulnerability to COVID-19 due to a chronic condition.

A study by Shalash et al. (2020), collected data from 38 PD patients and 20 age- and sex-matched controls (volunteers and patients' relatives) by administering on the telephone a version of the DASS-21 and asking a few additional questions to investigate PD patients' perceptions of the impact of the first wave of the COVID-19 pandemic. The authors found that PD patients showed significantly higher mean DASS-21 anxiety score and prevalence of anxiety ($n = 23$, 60.5%) compared to controls ($n = 5$, 25%). In addition, they found a positive correlation between anxiety and pre-lockdown off-motor severity. Instead, from the subjective report, it appeared that 20 patients (52.6%) reported anxiety/stress caused by COVID-19. Although the causes for subjective anxiety and stress cannot be disaggregated, the paper concluded that anxiety is frequently aggravated by restrictions.

However, it is worth noting that neither of the two aforementioned studies (Salari et al., 2020; Shalash et al., 2020) mention the data collection period.

Conversely, Oppo et al. (2020) failed to find a statistically significant difference between PD patients' and caregivers' anxiety levels, also in relation to disease duration. Moreover, by dividing the sample into two groups, active patients—who continued to engage themselves in physical activity—and inactive patients, and comparing them, the study concluded that the first group had significantly lower anxiety levels than the second one. The results indicated that physical activity could exert an influence on anxiety levels: in fact, a statistically significant inverse relationship between anxiety and physical exercise was observed and, furthermore, anxiety was the only statistically significant determinant for the subjective assessment of worsening stress caused by lockdown in PD patients, measured through a verbal rating scale.

In a quantitative study, Xia et al. (2020) studied the impact of the COVID-19 pandemic on several dimensions, including anxiety, through the HADS. Compared to healthy controls ($n = 29$, 17.2%), PD patients ($n = 25$, 21%) did not have a significantly higher prevalence of anxiety ($p = 0.410$). Moreover, patients with sleep disorders showed a higher anxiety level than those who did not experience sleep disturbances, indicating that anxiety has a powerful effect on sleep quality. Furthermore, results showed that females ($n = 19$, 32.8%) reported a significantly higher incidence of anxiety levels compared to males ($n = 6$, 0.1%, $p = 0.002$), suggesting that female patients are more likely to experience anxiety.

Kitani-Morii et al. (2021) compared anxiety levels in 39 PD patients and 32 family members through the administration of the 7-item Generalized Anxiety Disorder by email without finding differences. Participants were also asked on the

telephone if they had subjectively experienced a worsening in anxiety levels and the response rate was 100%. Although PD patients ($n$ = 19, 48%) were significantly more likely to suffer from clinical anxiety than controls ($n$ = 11, 34%) results revealed that, among both patients and controls, 36.6% ($n$ = 26) reported subjective worsening of anxiety and, surprisingly, the percentage was higher in controls ($n$ = 14, 43.7%) than in PD patients ($n$ = 12, 30.7%), but still not in the range of statistical significance ($p$ = 0.25). Overall, results suggest that PD patients, especially those potentially suffering from pre-existing psychological issues, may be more likely to develop clinical anxiety in response to social distress; although, due to the lack of data on the patients' neuropsychiatric status prior to the COVID-19 pandemic, the study fails to demonstrate that the COVID-19 pandemic worsened the neuropsychiatric status of patients with PD.

In a study by Suzuki et al. (2021) that investigated the determinants of QoL on 100 PD and their caregivers, the HADS was administered to assess anxiety. The prevalence in both groups was similar: in fact, anxiety was observed in 6% ($n$ = 6) of both PD patients and caregivers, while other factors, such as disease severity, impacted negatively on patients with PD and were overall related to the worsening of their QoL. These findings may also indicate that, during the lockdown, the caregiver's daily burden intensified, and this may have contributed to the rise of anxiety levels not only in patients, but also in caregivers.

Balci et al. (2021) examined the severity of anxiety in PD patients compared with healthy individuals under lockdown conditions. Contrary to expectations, neither patients nor controls showed an increase in anxiety levels; in fact, the 45 patients and 43 healthy subjects showed similar median HADS-A scores and, more importantly, there was no difference between the two groups.

Lastly, Montanaro et al. (2022) assessed anxiety levels in 100 advanced PD patients who were experiencing severe symptoms and motor complications and in 60 caregivers by administering on the telephone the HADS-A between April 2020 and May 2020, while social restrictions were in place (T0). Subsequently, only PD patients were re-evaluated after the lockdown ending, between June 2020 and August 2020 (T1). The authors found that both groups showed a similar prevalence of anxiety symptoms (39% PD patients vs. 40% caregivers) and no statistically significant difference emerged on the mean HADS-A score at T0. Comparing the two patient assessments, fewer subjects from this sample showed anxiety at T1 after lockdown (30.6%) than at T0 (39%) ($p$ = 0.023). Furthermore, among the patients enrolled in this study, there were subjects treated with DBS, LCIG, or SMT, so potential differences in anxiety symptoms between patients undergoing different treatment were also evaluated; a statistically significant correlation emerged between anxiety and different therapies: HADS-A scores were higher in SMT and LCIG than in DBS patients at T0, while at T1 a significance was only found for LCIG. This study highlighted how different treatments have different psychological effects. In fact, patients treated with DBS showed lower levels of anxiety than the other groups, probably due to the fact that DBS devices can be handled more independently. This study provides a snapshot of anxiety status in the middle of restrictions, however it only allows for comparison between groups at T0 and not after lockdown at T1, as caregivers were not re-assessed, nor are there any pre-pandemic measures to interpret the data collected during lockdown.

## Cross-sectional studies

van der Heide et al. (2020) assessed whether the COVID-19 pandemic was associated with increased psychological distress, and if and how these changes may prove useful in identifying predictors of increased psychological distress in PD patients during health emergencies. Resorting to the subscale of the Parkinson Anxiety Scale (PAS), the researchers questioned 358 patients through an online survey (response rate was 71.9%), who reported higher levels of stress and anxiety during the pandemic. Moreover, in a retrospective comparison, they found a statistically significant and strong correlation between the Perceived Stress Scale score, the PAS episodic anxiety subscale score (both administered during lockdown), and the State-Trait Anxiety Inventory (STAI) score collected before the COVID-19 pandemic. These results indicate that the presence of anxiety before the pandemic led to a higher perceived stress and a greater manifestation of anxiety symptoms during the lockdown. Additionally, the authors of this study reasoned with the relation between psychological distress and symptom severity, arguing that motor symptoms are particularly sensitive to stress, as stated by previous work (Boman, 1971; Zach et al., 2015), as well as to the reduction of physical activity.

In a study by de Rus Jacquet et al. (2021), based on an online survey, the authors observed that 125 (29.7%) of a sample of 417 Canadian PD patients (median H&R stage II) reported subjective changes in anxiety levels after lockdown. Among them, 94 (75.2%) reported an increase in anxiety and 29 (23.2%) reported daily changes. Only two patients reported a reduction of anxiety levels.

Knapik et al. (2021) evaluated a group of Polish patients (H&Y stage I-III, not subjected to DBS) after about 3 months of social restriction: half of them exhibited no anxiety levels to HADS-A. Among the remaining patients, 30% had a borderline score and 20% showed anxiety which, according to the study, was only partially explained by patients' self-assessment of their physical fitness, but not by the actual physical activity they engaged in. Furthermore, the authors failed to find statistically significant differences in the mean HADS-A score between patients living alone and patients living with relatives.

A questionnaire-based study by Kumar et al. (2021), focused on sleep disturbance, found a significantly higher prevalence of anxiety symptomatology among patients who experienced an onset or exacerbation of sleep disturbances during confinement ($n = 119$, 60%) compared with patients who did not ($n = 210$, 39.1%) or patients with pre-existing sleep disorders that did not worsen during the pandemic ($p < 0.001$). Anxiety is known to induce hyperarousal that is pathophysiologically associated with insomnia. However, lacking a measure of anxiety levels at baseline, the study cannot determine whether anxiety was a predisposing factor for the development of sleep issues during lockdown or, vice-versa, if sleep issues arisen during lockdown triggered the onset of anxiety.

Dommershuijsen et al. (2021) administered a questionnaire to investigate potential associations between COVID-19 stressors and anxiety levels measured through the STAI. They found that higher care stressors (STAI beta: 0.06, 95% CI: 0.04–0.09), social stressors (STAI beta: 0.06, 95% CI: 0.04–0.08) and stressors sum score (95% CI: 0.02–0.05) were associated with higher STAI total score and subscore. They also highlighted that social stressors had a greater impact on anxiety levels in patients with a higher level of education, while care stressors had a greater impact on anxiety in women and on patients with a disease duration longer than 5 years and with more severe PD symptoms.

Although anxiety was not the focus of their study, Del Prete et al. (2021) found that 74.6% ($n = 547$) of a sample of 733 PD patients did not experience a subjective worsening of anxiety during lockdown. Furthermore, as mentioned in a previous sub-section (see Cross-Sectional Studies), the study reported a mean DASS-21 total score that cannot be disaggregated into subscales, therefore not informative about patients' anxiety status. For this reason, it is not possible to make a comparison between the subjective experience of the patients and the results of the standardized scale, nor was a baseline value of the DASS-21 recorded to verify the presence of a change in anxiety levels.

With the purpose of evaluating changes in motor and NMS occurring after the first month of the 2020 lockdown (mild-March to mid-April 2020) as well as its psychosocial impact, Fabbri et al. (2021) administered validated scales (PGI-I scale, PDQ-8) and a self-report questionnaire both online or during a routine follow-up consultation by a movement disorder specialist. Two thousand six hundred fifty-three patients were included in the analysis and, although the majority of them reported no subjective worsening of PD symptoms ($n = 1{,}568$, 59.1%), 6.1% ($n = 162$) reported a worsening of anxiety symptoms, with anxiety being the fourth most frequently worsened symptom and the first non-motor one. Unsurprisingly, the aggravation of psychic state alteration was probably related to several self-reinforcing factors, such as the concomitant aggravation of motor symptoms, which are particularly sensitive to stress and may cause an anxiety/depression aggravation, and the diffuse interruption of physiotherapy and of any outdoor physical activities.

In another study (Krzysztoń et al., 2022) conducted in Poland through an online survey, 38% ($n = 18$) of the 47 PD patients who agreed to participate reported feeling anxious since the onset of the pandemic. Particularly, it was found that patients who exhibited the highest levels of anxiety were those with shorter disease duration, who were not involved in any patients' associations, and who were more frequently looking for information about potential PD/COVID-19 interactions on the Internet. Additionally, reduced social contacts and feelings of isolation had a significant impact on anxiety ($p = 0.035$; $p = 0.007$). These findings could be explained by a worsening of existing anxiety, insecurity associated with taking medication during isolation, and an increased perceived risk of contracting SARS-CoV-2 due to age and chronic condition.

## Sleep

### Longitudinal monitoring

An Italian study by Falla et al. (2021) investigated potential changes in sleep patterns using the Movement Disorders Society-Unified Parkinson Disease Rating Scale (MDS-UPDRS). Results showed a statistically significant increase in score during lockdown compared to before the onset of the pandemic (February 2020). In detail, 5 out of 14 patients reported worsening sleep issues, and 8 of them experienced daytime sleepiness. However, as discussed by the authors themselves, it is not possible to estimate whether the worsening of sleep quality was due to lockdown or to other disease-related factors, as no data were collected from a control group, possibly formed by healthy subjects.

Different results were found in the study by HØrmann Thomsen et al. (2021), who assessed sleep using the PRO-PD in a cohort of Swedish patients and also using a single item from the Parkinson's Disease Questionnaire-39 (PDQ-39) in a cohort of Danish patients. Results showed that a statistically significant improvement in the second evaluation was only found for the Swedish cohort. Indeed, analyzing individual scores, the authors found that almost all patients reported fewer sleep problems during social restriction, despite the ongoing of the health emergency: this may be explained by a change in routine and a decrease in perceived pressure in their daily-life (Frazier, 2000). Nevertheless, it is difficult to ascertain if the improvement in sleep quality was real because the baseline measures are too far behind and multiple factors may have affected the results.

### Case-control studies

A study by Xia et al. (2020) administered the Pittsburgh Sleep Quality Index (PSQI) self-report questionnaire online to 119 PD patients and 169 healthy controls in China. Results

showed that PD patients, compared with healthy subjects, reported significantly worse mean PSQI scores and a higher prevalence of sleep disturbance (PSQI > 5; $n = 82$, 68.9% PD patients vs. $n = 75$, 44.4% healthy controls, $p < 0.001$). More specifically, PD patients reported a statistically significant worsening in several sleep patterns: quality, sleep duration, sleep disturbance, and daytime dysfunction ($p < 0.001$). No statistically significant differences emerged for sleep latency, sleep efficiency, and use of sleeping medication. Moreover, analyses showed that anxiety and exacerbation of PD symptoms were possible risk factors for developing sleep problems and, furthermore, it was observed that female compared to male patients showed significantly worse total PSQI scores ($p = 0.009$), worse sleep quality and duration, and more daytime sleepiness, resulting in poorer sleep. In line with the literature, the results of the study highlighted the presence of greater sleep disturbances in PD patients compared to healthy controls. The absence of clinical data on patients, such as duration of illness or severity of symptoms, does not allow for the investigation of the impact on sleep in individual patients.

A study by Kitani-Morii et al. (2021) investigated insomnia in patients and in a control group consisting of family members. They administered the 7-item Insomnia Severity Index paper-based questionnaire by email, and also asked participants if they had experienced a subjective worsening of insomnia. No differences emerged between patients and controls, on either the standardized scale ($n = 13$, 33% vs. $n = 7$, 21%, $p = 0.286$) or the subjective report ($n = 5$, 12.8% vs. $n = 3$, 9.3%, $p = 0.64$). However, from a qualitative observation, patients presented moderate to severe insomnia symptoms more frequently than their family members.

## Cross-sectional studies

Guo et al. (2020) measured the presence and the worsening of sleep disorders as a factor that may have negatively impacted on patients' QoL during the COVID-19 pandemic. The results showed that, out of 108 patients, 43 (39.8%) reported new or worsening sleep disturbance.

Following the COVID-19 outbreak, Janiri et al. (2020) used telephone surveys to assess subjective sleep disturbances, including insomnia and rapid eye movement sleep behavior disorder (RBD), in 134 PD patients. Among a total of 23 (22.8%) patients who reported the worsening of symptoms during lockdown, 12 of them (52.2%) reported worsened insomnia and 5 (21.7%) reported worsened RBD. Insomnia was the second most widespread symptom listed by patients.

In their study, Del Prete et al. (2021) administered an *ad hoc* questionnaire by telephone to investigate new and worsening PD symptoms, including insomnia, following the beginning of the 2020 lockdown in Italy. Most patients ($n = 567$, 77.4%) did not report new or worsening symptoms of insomnia as a consequence of COVID-19 restrictions.

Fabbri et al. (2021) asked patients to subjectively report the three most worrying new or worsened symptoms experienced since the start of the lockdown. Only 4.1% ($n = 109$) of patients, out of a cohort of 2,653, mentioned a worsening of sleep disturbances.

Song et al. (2020) investigated sleep quality as an indirect measure of the impact of limited physical activity due to pandemic. They asked patients if they felt a worsening of their Parkinsonian symptoms after the onset of the COVID-19 pandemic and, if so, to choose which motor and NMS had worsened the most; among these, sleep was also listed. Results showed that only 5 (5%) out of 100 patients reported reduced sleep hours.

In order to quantify the changes in sleep, Templeton et al. (2021) administered a self-report, *ad hoc* survey to 28 PD patients during or after the lockdown, in an unspecified timeframe. Patients were asked to indicate the perceived change in various motor and NMS caused by restrictions. The results showed that patients, on average, experienced a slight worsening of sleep, which was more frequent in females than males.

To retrospectively investigate the effects of social restrictions on sleep, Balci et al. (2021) studied a cohort of 45 Turkish patients through a telephone interview. They found that, among the older patients (≥65 years), 7 suffered from worsening sleep problems and 6 from daytime sleepiness, while only 2 of the younger patients (<65 years) were similarly affected; both of them reported worsening sleep problems but only one mentioned daytime sleepiness. Although this difference is not statistically significant, it may be associated with a longer disease duration and therefore a greater progression of NMS.

To investigate changes in sleep in PD patients after the beginning of lockdown, Suzuki et al. (2021) administered the PGIC scale through a survey at the end of the restrictions. They tested 100 patients, and also asked their caregivers and spouses to report any sleep changes they observed. The results showed that 41% ($n = 41$) of patients reported mild to moderate worsening of sleep and 48% ($n = 48$) reported no change. The authors found agreement between the patients' and caregivers' reports of sleep changes. However, the use of the PGIC scale to assess changes in sleep quality may not be sensitive enough to detect such changes.

Kumar et al. (2021) investigated the impact of lockdown on sleep parameters in a cohort of 823 Indian patients through an online questionnaire, *ad hoc* developed and validated by nine experts, all proficient in managing patients with PD following standard procedure. They found that 295 (35.4%) patients experienced sleep disturbances and 199 (23.9%) reported new issues or a worsening of existing symptoms in all sleep parameters investigated. Among the entire cohort, the most reported symptom was insomnia ($n = 152$, 51.5%), followed by restless legs syndrome ($n = 73$, 24.7%), RBD ($n = 67$, 22.7%), and sleep disordered breathing ($n = 47$, 15.9%). Moreover, by comparing patients with and without new or worsening sleep

disturbances, the authors detected that sleep problems were significantly associated with duration of home confinement >60 days, duration of PD ≥7 years, inadequate family support during lockdown, worsening of most motor and NMS, poor QoL, and not engaging in exercise or hobbies during lockdown. In addition, low physical activity and screen time >3 h/day before and during home confinement were associated with new or worsening sleep disturbances ($p = 0.01$; $p = 0.015$).

To assess sleep problems, Saluja et al. (2021) administered a structured questionnaire (NMSS) after the end of the lockdown. Both patients and caregivers were interviewed, thus comparing the subjective perception of patients with that of their caregivers. Results showed that, among a total of 26 PD patients who reported worsening during lockdown, 34.6% of patients reported worsened insomnia and 7.7% hypersomnolence, and caregivers substantially agreed with their judgments.

de Rus Jacquet et al. (2021) investigated the impact of self-isolation on sleep through an online survey completed by 417 patients from two Canadian cohorts, one from Alberta and one from Québec. The majority of PD patients ($n = 263$, 63.37%) did not notice any change in sleep, whereas 117 of them (28.19%) reported worsened sleep quality. Only a small number of patients ($n = 35$, 8.43%) reported improved sleep quality during home confinement for COVID-19.

Finally, a study by Montanaro et al. (2022) evaluated the impact on sleep as a consequence of the pandemic. To reach this goal, the authors administered by telephone an *ad hoc* questionnaire in which patients were asked to indicate their degree of agreement or disagreement with the statement "I have more difficulty falling asleep." The results showed that 54% of 100 patients reported no change in falling asleep.

## Quality of life

### Longitudinal monitoring

Among the authors of longitudinal studies that reached statistically significant findings, Guo et al. (2020) conducted a detailed interview resorting to face-to-face assessments, telephone calls, and social media during and after COVID-19 prevention and control measures in China (1 February−31 March 2020). Through the PDQ-39, they found that PD patients (H&Y stage I–IV) showed a significantly worse QoL during the restrictions imposed to prevent the spreading of COVID-19, compared with the following stage of gradual slackening of the prevention and control measures. Although telemedicine has been predominantly used to provide care since the onset of the pandemic, patients referred that their main difficulty was not being able to get in touch with their physician. Reduced healthcare accessibility affected the QoL of chronic patients: it is the case of PD patients who, due to the lockdown, were unable to get doctors' advice or had to change their routine medication, resulting in poorer QoL.

Similar results emerged from a study by Song et al. (2020), in which the authors retrospectively collected baseline data from medical records dating from before the COVID-19 emergency (T0), and then assessed PD patients (H&Y stage ≤ III) in May 2020 (T1), during the restrictions issued by the Korean government. In order to assess patients' autonomy, the authors used the Schwab and England scale of Activities of Daily Living (SE-ADL): they found a significantly decreased mean SE-ADL score at T1 compared to the T0, indicating an increased difficulty in performing daily activities and, consequently, a worse QoL, although there was no increase in the Unified Parkinson's Disease Rating Scale part 3 score.

A discrepant result emerged from a study by HØrmann Thomsen et al. (2021). In the two groups examined (Swedish vs. Danish patients) a statistically significant improvement in QoL after the beginning of social restrictions was found at both PDQ-8 for the Swedish cohort and PDQ-39 for the Danish cohort. Data analysis suggests that there was an improvement in "ability to concentrate" and "difficulty getting around in public places," and a parallel worsening in "close relationships" and "feeling depressed." The improvement may be due to reduced social pressure, while the worsening of the last two items is consistent with the restrictions faced by the patients. More generally, this study, contrary to the previously mentioned studies and to expectations, highlights the possibility that some of the demands and impositions of pre-pandemic life may have inadvertently reduced QoL in PD patients.

Two longitudinal studies concluded for a non-impaired QoL in PD patients during the confinement. In the study performed by Falla et al. (2021), QoL was longitudinally assessed using structured questionnaires at baseline (in-person, February 2020) and at follow-up (*via* online video, during the lockdown in Italy, in spring 2020). The PDQ-39 summary index (PDQ-39-SI), filled out by 14 PD patients during the last week of the lockdown, showed no statistically significant difference compared to the pre-lockdown baseline. In addition, no statistically significant correlations were found between the difference in PDQ-39-SI score from baseline and follow-up and disease duration. The results could be explained by the fact that telemedicine evaluation appears to provide continuity of care, while also reducing the risk of infection in PD patients.

Likewise, in a sample of 12 PD patients no statistically significant findings on the impact of COVID-19 restrictions on QoL were found (Luis-Martínez et al., 2021): the study could not find statistically significant changes in PDQ-39, Activities of Daily Living, Instrumental Activities of Daily Living, and Parkinson's Disease Cognitive Functional Rating Scale completed 2 weeks before isolation (T0) and after 2 months of isolation (T1), on May 4, 2020. Authors supposed that the continuous contact with a multidisciplinary team during the lockdown contributed to the mitigation of negative effects on patients. Overall, the results of these two studies did not find an

influence on QoL but, since both samples were small, they must be considered with reservations.

## Case-control studies

Shalash et al. (2020) administered the PDQ-39 to 38 patients and 20 controls, but the paper does not state when they collected the data. In their sample, the total PDQ-39 score and most of the PDQ-39 domains, except for social support and communication, were significantly higher for PD patients compared with controls: therefore, PD patients had worse QoL. This result highlights that a worse QoL is associated with worse mental health status, an expected outcome consistent with the indirect impact of COVID-19.

Additionally, a study including 100 PD patients and 100 caregivers showed that, during the COVID-19 pandemic, PD patients suffered from a worsened QoL compared to controls (Suzuki et al., 2021). Authors registered the subjective point of view of PD patients and of their caregivers using the Japanese version of Short Form-8; subjects reported worse scores in half of the domains investigated by the aforementioned scale (physical function, role-physical, general health, vitality, and physical component summary). Additionally, the authors found that disease severity, disease duration, gait impairment, rigidity, anxiety, depression, and stress had a negative impact on QoL perception. Furthermore, researchers highlighted the relationship between patients' depression and stress and caregivers' negative mood. This finding demonstrates that the QoL of patients and their caregivers are closely related, and that the QoL of caregivers was also affected by the heavier burden experienced during the lockdown.

Another study (Sahin et al., 2021), collecting data during the lockdown in Turkey, which started in March 2020, compared the assessment of 98 PD patients and other patients suffering from various chronic neurological diseases, such as headache, multiple sclerosis, epilepsy, polyneuropathy, and cerebrovascular disease. The authors, through the Turkish version of the World Health Organization Quality of Life short form questionnaire, found lower scores in the social subscale that assesses the social relationships domain in PD patients compared to patients with other conditions, although data analysis did not show any statistically significant differences in the physical, mental, and environmental scores in both groups. This means that, for PD patients, lockdown had a greater impact on QoL in the social domain compared to other aspects of QoL: this was expected, presumably also because the PD patients' group was older and more vulnerable, therefore subjected to stricter isolation measures which severely reduced their social interactions. Conversely, the PD group showed the lowest distress level caused by the health emergency: this outcome suggests that isolation may have protected patients from COVID-19 infection (PD patients showed the lowest infection rates in the sample) and resulting post-traumatic symptoms.

## Cross-sectional studies

Among the reviewed studies, the following works assessed the impact of COVID-19 self-isolation and social distancing on QoL in PD patients using the same tool: the PDQ-8 scale.

Oppo et al. (2020) studied the overall influence of home confinement on different PD symptoms and, therefore, on QoL. Although the authors conducted a case-control study, they administered the PDQ-8 by telephone only to the PD patients' group during the last days of the first Italian lockdown. They observed a low impact on QoL, suggesting a minimal impact on the perception of the QoL. It should be noted that results should be interpreted with caution due to the small sample.

In another study, Subramanian et al. (2020) developed a specific survey to examine the general perception of QoL on 1,451 PD patients, including the items from the Patient-Reported Outcomes Measurement Information System. Findings suggested that social isolation was associated in a statistical significance range with PD severity, measured by the PRO-PD, and worse QoL ($p < 0.01$). Moreover, the latter correlated with loneliness and worse social health: patients reported a worsening in their social health and in social satisfaction and performance, while symptoms severity increased. These results confirmed that worse QoL is associated with both progression of disease symptoms and loneliness.

In another observational study based on PDQ-8, Fabbri et al. (2021) recorded a negative impact of lockdown on QoL in about half of the cohort. Based on the patients' perception assessed by a PGI-I scale, a correlation was found between worse QoL and severe worsening clinical symptoms (i.e., at least 5 reported aggravated domains). QoL worsened as the severity of motor and NMS increased, which is unsurprisingly and probably related to the first COVID-19 self-isolation, the imposed social distancing, and the abrupt onset of the lockdown but also of the pandemic itself. The concomitant aggravation of motor symptoms, such as tremor and rigidity, which are particularly sensitive to stress, may be related to increased anxiety/depression as well as to the diffuse interruption of physiotherapy and any outdoor physical activities, all factors that are widely recognized as having a higher negative impact on QoL.

Similarly, in a study by Saluja et al. (2021) conducted between June and September 2020 on Indian patients, an association between NMS severity and QoL was found. All participants were interviewed on the telephone according to the PDQ-8 and the NMSS. Over the course of the lockdown period, an increase in NMS (mood changes, insomnia, and pain, which were observed, respectively, in 42.3, 34.6, and 34.6% of patients) was registered, as well as of the total NMSS score (in the last 4 weeks), as reported by patients. In line with the previous studies, worsening of NMS during the lockdown became an independent predictor of poor QoL among patients with PD. Moreover, a selective isolation from other family members was proven to have deleterious impact on their QoL.

In addition to the objective data measured with standardized and validated scales, a useful insight comes from studies that investigated patients' subjective perception of lockdown-related change in QoL through *ad hoc* questionnaires (Subramanian et al., 2020; Kumar et al., 2021; Silva-Batista et al., 2021; Templeton et al., 2021). However, these studies as well-reported discrepant results.

In Kumar et al. (2021), more than a half of the PD patients ($n = 451$, 54.2%) who replied to a single-question on an *ad hoc* questionnaire reported that they were unsatisfied with their QoL during home confinement, especially due to worsening of both motor and NMS ($n = 320$, 38.5%), and fear of contracting COVID-19 ($n = 162$, 19.5%). Among patients who reported dissatisfaction with their QoL, almost half of them were patients who had reported new onset or worsening of sleep disturbances related to isolation. In line with these data, a statistically significant association between poorer QoL and the new onset or worsening of sleep disturbances was found ($p < 0.001$). Thus, sleep may have had an impact on the QoL of these patients.

The results of another study (Silva-Batista et al., 2021), conducted by administering to Brazilian PD patients a questionnaire by telephone about the perception of negative changes in QoL during social distancing, showed that half of the participants reported low PDQ-8 scores (49.7%), indicating a good QoL, and almost one third (30.3%) reported no variation. Further analysis showed that the self-reported decline in the QoL was a common predictor of self-reported clinical worsening, i.e., MDS-UPDRS part IB, MDS-UPDRS part II, and emotional and mental health scores. Therefore, the subjects' perception of a worsened QoL had also negatively affected the perception of the motor and non-motor aspects of daily life and of their own emotional and mental health status.

In Templeton et al. (2021), PD patients were asked to reply to a survey about their QoL to assess when they felt their best and how various factors influenced that feeling, such as the time of the day and typical daily events or settings. In terms of hours, results showed that participants felt their best in the morning, then the sensation progressively faded and at evenings they felt their worst. In terms of typical events or settings, this feeling of wellbeing grew after engaging in physical activity ($n = 19$, 67.86%) or in comfortable environments ($n = 17$, 60.71%). Authors also found that per-day minutes of activity and the number of total activities decreased significantly ($p = 0.022$) due to COVID-19 restrictions, and that 82.14% ($n = 23$) of subjects self-reported that at least one symptom had worsened from moderate to severe. The authors argued that not being able to participate in structured in-person programs because of lockdown had a direct negative effect on patients' overall activity levels and disease progression, which in turn affected their QoL: such programs provide an opportunity to exercise and find a supportive environment that promotes social relationships, both relevant factors for wellbeing.

In a study conducted in the Netherlands by Dommershuijsen et al. (2021), the authors investigated in a cohort of PD patients the impact of COVID-19 stressors on mental health using a questionnaire, and also assessed their QoL with PDQ-39. An association was observed between stressors sum score (95% CI: 0.02–0.04), social stressors (beta: 0.06, 95% CI: 0.04–0.08), care stressors (beta: 0.05, 95% CI: 0.02–0.08), and the PDQ-39 score. Furthermore, patients who perceived COVID-19 stressors as "troublesome" also had a worse QoL.

Lastly, Krzysztoń et al. (2022) studied a sample of 47 PD patients through an online survey regarding differences in QoL during the pandemic, to which a considerable amount of respondents reported a decrease of 1 ($n = 22$, 47%), 2 ($n = 9$, 19%), or 3 ($n = 2$, 4%) points (on a scale from 1, signifying a very poor QoL, to 5, indicating a very good QoL, evaluating changes between pre-pandemic times and the survey completion). Patients suffering from PD for over 5 years experienced a significantly greater decrease in QoL compared to patients with a shorter history of the disease. Furthermore, a statistically significant association was found between changes in QoL and feelings of isolation ($p = 0.009$) and reduced social contact ($p = 0.022$).

In conclusion, the studies presented in this section highlight a direct and indirect impact of lockdown for COVID-19 on the QoL of PD patients.

## Discussion

The purpose of this paper was to perform a critical review of the literature that investigated the psychological impact of COVID-19 and restrictive measures on patients with PD. We therefore focused in particular on psychological aspects such as depression and anxiety, as well as on indirect measures such as the impact on sleep and QoL.

The results on depression showed that, when comparing data collected during the pandemic and before, there was not a statistically significant impact on patients (El Otmani et al., 2021; Falla et al., 2021; HØrmann Thomsen et al., 2021). However, the pre-pandemic evaluations often date back to up to 2 years, therefore it is difficult to exclude that other variables may have intervened (HØrmann Thomsen et al., 2021). Data are more heterogeneous when patients are compared with a control group. In fact, while the comparison with healthy subjects reveals statistically significant differences in depressive symptoms (Xia et al., 2020). A greater deviation in mood in PD patients than in the general population is in line with the literature (Reijnders et al., 2008) and could be partially explained by the pathophysiology of PD, which naturally increases the risk of mood deviation as reduced dopamine levels compromise coping mechanisms for depression (Marsh, 2013; Helmich and Bloem, 2020). Conversely, when the participants' family members or caregivers belong to the control group, the

differences become minimal (Oppo et al., 2020; Suzuki et al., 2021). Only one study fails to show a statistically significant difference when comparing patients with healthy subjects (Balci et al., 2021). These results highlight how the patient's emotional load has important psychological repercussions also on family members and caregivers.

The literature shows that PD patients reported a growing presence of anxiety symptoms during isolation both over the course of time (compared with pre-lockdown data) (Falla et al., 2021; HØrmann Thomsen et al., 2021) and against other control groups (caregivers and healthy subjects). Overall, from a qualitative point of view, this overview indicated that PD patients show higher anxiety levels than control groups, which can either include caregivers or healthy controls. However, only two studies were able to find a statistically significant difference (Salari et al., 2020; Shalash et al., 2020), whereas the remaining studies reported no differences between PD and other control groups (Oppo et al., 2020; Xia et al., 2020; Balci et al., 2021; Kitani-Morii et al., 2021; Suzuki et al., 2021). Therefore, although the reduction of physical and social activity as well as the dopamine-related failure to adapt may be a vulnerability factor in coping with stress during the COVID-19 pandemic (HØrmann Thomsen et al., 2021; Kumar et al., 2021), in most of the studies reviewed the results of the assessments anxiety levels were not statistically significant. These findings must be interpreted carefully in the light of the studies' limitations, both in methodology and design. From a longitudinal perspective, there are several ways in which time can be factored into the design of studies: the aforementioned authors have variously compared anxiety levels registered before or at the beginning of the restrictions and during or after the 2020 lockdown period. The absence of pre-lockdown anxiety levels measures impedes the interpretation of the effect direction. In fact, reverse causation could importantly influence the explanation of results, as patients with pre-existing anxiety symptoms might have reported a greater influence of COVID-19 stressors on their mental health.

Findings from studies on sleep disturbances are also heterogeneous. However, as for other of the examined topics, PD patients showed a greater probability of suffering from sleep disorders than healthy subjects, while no statistically significant difference emerged from the comparison with family members (Kitani-Morii et al., 2021), thus confirming the heavy psychological burden experienced by caregivers and already detected by previous studies. Few articles indicate a subjective worsening of sleep quality or the onset of sleep disturbances during isolation (Guo et al., 2020; Janiri et al., 2020; Song et al., 2020; de Rus Jacquet et al., 2021; Fabbri et al., 2021; Kumar et al., 2021; Saluja et al., 2021; Suzuki et al., 2021; Templeton et al., 2021). Overall, across the studies, only a minority of PD patients reported changes in sleep quality. The moderate worsening of sleep quality, with no pre-lockdown available data, could indicate that restrictions did not have a drastic effect on sleep.

Finally, various published studies focused on the impact of COVID-19 restrictive measures on the QoL in PD patients. Results are mixed and heterogeneous, probably due to the complex effects of the pandemic on the motor and NMS in PD patients. In fact, several studies showed a post-lockdown worsening in PD patients (Guo et al., 2020; Song et al., 2020), while another group of studies showed an unexpected improvement (HØrmann Thomsen et al., 2021) or no variation in the QoL of PD patients compared to pre-lockdown (Falla et al., 2021; Luis-Martínez et al., 2021). A possible explanation is that researchers assessed QoL in distinct time points, resorting to different measures that have been used in clinical settings or research, or as an indirect measure from other studies. Despite some variations in results, compared with control groups composed by healthy subjects, caregivers, and patients with other neurological conditions, PD patients showed a statistically significant deterioration of QoL (Shalash et al., 2020; Sahin et al., 2021; Suzuki et al., 2021). Considering the highly disabling nature of PD, it is logically arguable that restrictions might have had a greater impact on PD patients due to the inability to move, exercise, maintain social relationships, participate in support groups, and preserve daily routines.

## Limitation

The selected papers for this work have limitations that are worth consideration. First of all, the data presented by the studies are only preliminary findings, as most of them relate to the first wave of COVID-19. Secondly, we have selected the articles from a single database and only in English, so we cannot exclude that other studies have shown different results. Moreover, an important limitation is that most studies did not consider the potential effect of disease duration and symptom severity on changes in NMS. In regard to experimental designs, several studies based on groups and/or on a single assessment during or after the lockdown are marked by a lack of pre-pandemic data; vice-versa, in longitudinal studies a control group is often missing. As a result, it is difficult to determine whether the detected changes are due to restrictions or to disease progression. In addition, some studies have small normative samples and, therefore, are not representative. The heterogeneity of samples across studies does not allow for accurate comparison of results, which is also made difficult by the different restrictions in place in different countries.

# Conclusion

In conclusion, the data summarized in this review suggest that the restrictions adopted by different countries to contrast

COVID-19 have led to a negative psychological impact on PD patients. The pandemic, which is currently still ongoing, may have also caused additional changes on NMS of PD. Thus, in the future, it would be interesting to conduct further longitudinal studies, to follow the long-term impact of restrictions implemented in subsequent COVID-19 waves on PD patients.

This review emphasizes the importance of providing ongoing healthcare to monitor and support the mental health of PD patients during a public health emergency or in any situation of forced social isolation. This can be accomplished by implementing the use of telehealth and complementary resource such as peer support that can improved relationships with providers, care engagement, and various recovery-related outcomes in people with chronic illness (Suresh et al., 2021).

## Data availability statement

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

## Author contributions

FM and FR conceptualized the study. EZ, BC, and DM edited the data. FR, EZ, RF, and FM contributed to methodology. SB supervised the drafting of the manuscript and acquired the funds. FR, FM, EZ, BC, and DM wrote the first draft of the manuscript. FR, FM, EZ, GF, and AD revised and edited the manuscript. All authors contributed to the article and approved the submitted version.

## Funding

Open Access article charges are covered by Ricerca Corrente (IRCCS RC-2022 Grant no. 01) from the Italian Ministry of Health.

## 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/fpsyg.2022.939520/full#supplementary-material

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 11 August 2022
DOI 10.3389/fpsyg.2022.977609



OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology

RECEIVED 24 June 2022
ACCEPTED 22 July 2022
PUBLISHED 11 August 2022

CITATION
Yang D, Hu B, Ren Z and Li M (2022) Impact of income on mental health during the COVID-19 pandemic: Based on the 2020 China family panel survey. *Front. Psychol.* 13:977609. doi: 10.3389/fpsyg.2022.977609



# Impact of income on mental health during the COVID-19 pandemic: Based on the 2020 China family panel survey

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Since December 2019, the COVID-19 has continued to rage, and epidemic prevention policies have limited contact between individuals, which may has a great influence on the income of individuals, exacerbate anxiety and depression, and cause serious mental health problems. The current study aims to examine the association between income and mental health during the COVID-19 pandemic by using the data of 9,296 observations from the 2020 China Family Panel Studies. Employing ordinary least squares regression and two-stage least squares regression, we find the significant positive effect of income on Chinese mental health during this pandemic. In addition, the number of cigarettes smoked per day has significant negative effects on mental health. Education level, marriage and exercise frequency have significant positive correlation with mental health. Furthermore, the impact of income on individuals of different groups is heterogeneous during this pandemic. The impact of income for well-educated individuals is less strong than their less-educated counterparts. People who exercise regularly respond less strongly to changes in income than those who do not exercise. Finally, individuals' salary satisfaction and interpersonal relationship are shown to be the potential mechanism for the effect of income on Chinese mental health.

KEYWORDS

**income, mental health, salary satisfaction, interpersonal relationship, COVID-19, China**

## Introduction

Income has a critical impact on people's living conditions. Many researchers exploring their impact on dietary nutrition and aspects such as vaccinations, renewable energy, attention deficit and hyperactivity disorder, physical activity, and household water consumption (Baigorri et al., 2022; Jiménez-Zazo et al., 2022; Jin et al., 2022; Mehmood et al., 2022; Valsta et al., 2022; Wang et al., 2022). All of them prove that income can affect people's lives and physical health. Also, the personal income is closed relationship with people's state of depression, anxiety, etc (Gou et al., 2022). Those persons with lower income are less able

to access health-promoting goods and services and are difficult to maintain a feeling of control or security over their lives. Therefore, low-income people are more likely to suffer from mental disorders (Golberstein, 2015; Kiely et al., 2015; Thomson et al., 2022).

The importance of mental health is confirmed by the World Health Organization (Grad, 2002), which defines health as "the state of complete physical, mental and social well-being and not just the absence of disease or infirmity." Mental health is closely related to individuals' living quality and work efficiency. Many studies have shown that mental illness has great harm to individuals and society, such as domestic violence, physical illness and poor interpersonal relationships (Yanguas et al., 2011; Bradbury-Jones and Isham, 2020; Usher et al., 2020; Pelissier et al., 2021; Larsson et al., 2022). Severe mental illness can even lead to suicide (Czeisler et al., 2022). In the world, approximately 703,000 people die by suicide every year (World Health Organization, 2021a).

The novel coronavirus disease (COVID-19) was first detected in December 2019 (Zhu et al., 2022) and spread rapidly. The World Health Organization (WHO) declare it is a global pandemic in the second week of March 2020 (World Health Organization, 2021b). COVID-19 is widely disseminated, lacks specific drugs, and is life-threatening if not treated in time. In addition, the information overload of the epidemic has caused a huge impact on the public's psychology, causing them to feel panic, anxiety and depression. In order to stop the continued spread of the COVID-19 epidemic, the government has implemented strict epidemic prevention measures and limited contact between individuals (Fang et al., 2021a), which has a great influence on individuals' income and may exacerbate anxiety and depression.

Related research shows that the COVID-19 pandemic has had a significant negative impact on people's mental health (Killgore et al., 2022; Zhai and Du, 2022). Most scholars' analyses take the COVID-19 pandemic as a whole. For example, Xiong et al. (2022) reported that the COVID-19 pandemic had caused high levels of anxiety, depression, and stress in many different countries, which may have a negative impact on individual's mental health. This result was also confirmed by Sánchez et al. (Huremović, 2019; Cao et al., 2020; Galli et al., 2022; Sánchez-Rodríguez et al., 2022). McAlearney et al. (2022) studied the mental health status of first responders (including police, firefighters, and emergency medical services) and their influencing factors during the pandemic, and many similar studies have been conducted in the literature (Cohen Veterans Network, 2020; Stogner et al., 2020; Hendrickson et al., 2022). The economic developments of all countries in the world are severely hampered by the COVID-19 pandemic (Islam, 2021; Mishra and Mishra, 2021; Nwosa, 2021; Fang et al., 2022a; Huang et al., 2022; Nawo and Njangang, 2022). Also, a large number of residents' incomes have declined significantly during the COVID-19 pandemic (Fang et al., 2021b, 2022b; Umiński and Borowicz, 2021). The reduction of income may influent the individuals' mental health. Ao et al. (2020) and Liang et al. (2021) examined the impact of income on mental health during the pandemic and showed that very wealthy people had the lowest levels of anxiety during the COVID-19 pandemic. In contrast, the proportion of participants showing significant depressive symptoms was significantly higher among those who are disadvantaged in economy.

Recent trends have also led to a proliferation of research on the link between human activity and mental health during the COVID-19 pandemic. For example, Quarta et al. (2022) analyzed the association of physical activity and outdoor leisure time with the mental health of college students. Foong et al. (2022) conducted a study on the relationship between Internet use and mental health in the elderly. Laurinaitytė et al. (2022) studied the association between health risk behaviors and mental health among Lithuanian university students. In addition, studies have shown that persistent loneliness and social isolation have adverse effects on the mental health of college students (Charbonnier et al., 2022).

Though the existing literature has investigated the determinants of mental health during the COVID-19 pandemic from different perspectives, little attention has been paid to the impact from the specific economic perspective, such as individual income, especially for Chinese. This article attempts to fill a gap in the relevant literature on the impact of income on mental health during the COVID-19 pandemic. We used data from the 2020 China Family Panel Study (CFPS; China Family Panel Studies, 2021), whose stratified and multi-stage sampling design enables the sample to represent almost 95% of the Chinese population, covering different ages, education levels, and national region, useful in determining the general impact of income on individual mental health. We focus on China for three reasons. First, China's social security system is imperfect, with a series of problems such as narrow coverage, low level of security, and inadequate laws. Given this, income has a bigger impact on the Chinese. Second, many Chinese are facing serious challenges of mental health problems. The latest epidemiological survey shows that the weighted lifetime prevalence of various mental illnesses among the Chinese population over the age of 18 is 16.6% (Huang et al., 2019), and the overall mental health literacy is at a moderately low level. Third, in Chinese social life, the importance of mental health is often overlooked. In fact, mental health issues affect the quality of development in China.

This paper not only investigates the impact of income on mental health, but also considers the heterogeneous effects and mechanisms of income on mental health. Therefore, our study proposes 5 hypotheses.

Individual's life is affected by income from different aspects (Ettner, 1996). For example, lower income can bring huge economic pressure to person's life, which may makes individuals face more psychological crises, showing psychological symptoms such as anxiety, loneliness, and sensitivity to human relationships. On the other hand, higher income increases people's financial ability to afford a better budget for the higher living standards and professional services for maintaining healthy lifestyles, improving factors such as depression, impaired relationships, and food security (Ao et al., 2020; Thomson et al., 2020; Xiao et al.,

2020; Liang et al., 2021; Jiang et al., 2022). Based on the above analysis, we propose Hypothesis 1.

*Hypothesis* 1. Income has a significant positive effect on individual's mental health.Covid-19 had a greater impact on the mental health of less-educated participants (Sánchez-Rodríguez et al., 2022). First, well-educated people have more social and economic resources than less-educated people. They tend to have higher incomes and live without economic pressure, which is beneficial to mental health. Second, most of well-educated people have an optimistic outlook on life. It is important to cope with the difficulties in the life, including the negative effects of low incomes (Xiao et al., 2020). In sum, the impact of income on mental health may not be the same for people with different educational levels. Therefore, Hypothesis 2 arises.

*Hypothesis* 2. The impact of income for well-educated individuals is less strong than it is for their less-educated counterparts. Caponnetto et al. (2021) argue that appropriate exercise helps avoid physical and mental problems in children and adults by promoting neuronal plasticity. In addition, the existing studies indicates that physical exercise can reduce anxiety, stress and depressive symptoms (Marques et al., 2020; Loureiro et al., 2021).Those who exercised regularly were less negatively affected by low income. The effect of income on mental health may not be the same for people with different frequency of exercise. Based on the above analysis, we propose Hypothesis 3.

*Hypothesis* 3. People that exercises regularly show a less strong responses to changes of income than those who do not.There is an influence mechanism in the relationship between income and mental health. Income is an objective variable, while the mental health is come from the individual's subjective feelings. Considering the same income, people may have completely different subjective feelings. So we take salary satisfaction as a mediation variable. Existing research shows that salary satisfaction has a positive impact on personal mental health, because people with high salary satisfaction have more active emotions and life attitudes than those with low salary satisfaction (Sorhagen and Wurster, 2017). In addition, research by Wu and Zhou (2017) also shows that higher income than one's own expectations will lead to higher happiness. Therefore, we propose Hypothesis 4.

*Hypothesis* 4. Personal income affects mental health through its effect on salary satisfaction. Pelissier et al. (Pelissier et al., 2021; Larsson et al., 2022) point out that person who is lack of social activity is apt to the psychological stress caused by social isolation and social exclusion. During the COVID-19 pandemic, socially inactive people are at higher risk for psychological stress. Furthermore, good interpersonal relationship is the result of participation in various social activities. The high self-evaluated score of interpersonal relationships is beneficial to erase psychological distress due to the social activity. And income has a direct impact on interpersonal relationship. Research by Lee et al. (2021) shows that low-income boys are at higher risk for smartphone addiction, and that smartphone use reduces the frequency and quality of their interactions with friends. Han (2013) finding that the interpersonal interactions of students at all levels are significantly affected by their family's economic status. Therefore, we propose Hypothesis 5.

*Hypothesis* 5. Personal income has an impact on mental health through its effect on interpersonal relationship.

# Materials and methods

## Study design

The data used in this study come from the China Family Panel Study (CFPS), a nationally representative, biannual longitudinal survey of Chinese communities, families, and individuals launched in 2010 by the Institute of Social Science Survey of Peking University, China. The CFPS is designed to studies on economic activities, education outcomes, family dynamics and relationships, migration, and health. Its stratified multi-stage sampling design enables the sample to represent almost 95% of the Chinese population, which is conducive to further heterogeneity analysis. CFPS takes individuals and families as the main research subjects at the same time. The on-site interviews use three technical tools: CAPI (computer-aided face-to-face interview), CATI (computer-aided telephone interview) and CAWI (computer-aided online interview). Face-to-face interviews are the mainstay, supplemented by internet and telephone interviews. The project will be carried out in 25 provinces/cities/autonomous regions in China (excluding Hong Kong, Macau, Taiwan, and Xinjiang Uygur Autonomous Region, Tibet Autonomous Region, Qinghai Province, Inner Mongolia Autonomous Region, Ningxia Hui Autonomous Region, and Hainan Province) in 2020. Unfortunately, for the purpose of protecting the privacy of the respondents, we cannot learn how CFPS participants were recruited and invited to the study. To examine the impact of income on mental health during the COVID-19 pandemic, this study used the 2020 baseline survey for analysis. Out of 28,590 observations, only 9,296 could be used for the current study due to concerns over missing data or uncertain answers. Ordinary least squares (OLS) and two-stage least squares (TSLS) were used for econometric analysis to investigate the impact of income on mental health.

## Statistical analysis

Statistical analysis was performed using the econometric software STATA version 16. We report the mean, standard deviation, minimum and maximum values of the variables in Table 1. Given that mental health is a continuous variable, we constructed the OLS and TSLS to investigate the causal relationship between income and mental health. In our robustness check, we used logit and probit models to estimate the effect of income on mental health. To investigate the mechanisms,

TABLE 1 Descriptive statistics of the key variables.

| Variable | Definition | Mean | SD | Min | Max |
|---|---|---|---|---|---|
| Mental Health | Individual's mental health | 0.035 | 4.071 | −21.165 | 4.537 |
| Income | Income for the past year(in log) | 10.399 | 0.885 | 7.313 | 12.255 |
| Wage | Per hour wage | 2.593 | 0.970 | −1.138 | 6.070 |
| Gender | Dummy variable equals 1 if the individual is male, and 0 for female | 0.592 | 0.492 | 0 | 1 |
| Marital | Dummy variable equals 1 if the individual is married, and otherwise 0 | 0.774 | 0.418 | 0 | 1 |
| Age | Individual's age | 39.432 | 12.040 | 16 | 83 |
| Smoke-do or not | Dummy variable equals 1 if the individual has smoked in the past month, and otherwise 0 | 0.339 | 0.473 | 0 | 1 |
| Smoke-number | Number of cigarettes smoked per day | 4.694 | 8.206 | 0 | 60 |
| Drink | Dummy variable equals 1 if the individual drank alcohol more than 3 times per week, and otherwise 0 | 0.149 | 0.356 | 0 | 1 |
| Insurance | Individual has social insurance (1 for yes) | 0.904 | 0.294 | 0 | 1 |
| Medical expenses | Individual's medical expenses | 3.095 | 3.325 | 0 | 10 |
| Exercise | Exercise frequency | 1.550 | 2.157 | 0 | 7 |
| Education Level | Highest degree completed | 2.606 | 1.469 | 0 | 7 |
| Salary satisfaction | Individual's salary satisfaction | 3.481 | 0.982 | 1 | 5 |
| Interpersonal relationship | Relationship between popularity | 6.986 | 1.752 | 0 | 10 |

we estimate the impact of natural disasters on individuals' salary satisfaction and interpersonal relationship using both OLS and the ordered probit model. All reported $p$-values were two-tail. The level of statistical significance was set at $p < 0.05$.

The ordinary least squares method is used to estimate the impact of income on individual mental health for testing Hypothesis 1. The specific equation is as follows:

$$\mathrm{MentalHealth} = \beta_0 + \beta_1 \mathrm{Income} + \sum_{1}^{j} \beta_j \mathrm{Control}_j + \varepsilon \quad (1)$$

$$\mathrm{MentalHealth} = \beta_0 + \beta_1 \mathrm{Wage} + \sum_{1}^{j} \beta_j \mathrm{Control}_j + \varepsilon \quad (2)$$

Among them, $\mathrm{MentalHealth}$ represents the dependent variable (mental health index); $\mathrm{Income}$ represents the explanatory variable (the natural logarithm of the individual's annual income); $\mathrm{Wage}$ represents the explanatory variable (hourly wages); $\mathrm{Control}_j$ is a series of other explanatory variables, includes dummy variables for gender, marital status, smoking, drinking, medical insurance, and continuous variables for age, number of cigarettes smoked daily, medical expenses, exercise times weekly and education level, and the random error term is determined by $\varepsilon$ express.

Since the above model may ignore the biases caused by reverse causality, this study uses the instrumental variable method to further examine the impact of income on individual mental health. According to the study of Yang and Li (2019), the two-stage least squares method was used to obtain unbiased parameter estimates, and then a consistent estimate of the effect of endogenous variables on the explained variables was obtained. The specific equation is as follows:

First stage: $\mathrm{Y} = \beta_1 + \beta_2 \mathrm{Fund} + \sum_{1}^{\mathrm{j}} \beta_\mathrm{j} \mathrm{Control}_\mathrm{j} + \varepsilon$ (3)

Second stage: $\mathrm{MentalHealth} = \beta_1 + \beta_2 \mathrm{Y}' + \sum_{1}^{\mathrm{j}} \beta_\mathrm{j} \mathrm{Control}_\mathrm{j} + \varepsilon$ (4)

In Equation (3), Y is the dependent variable (the natural logarithm of the individual's annual income or per hour wage), and Fund is the instrumental variable (whether to provide housing provident funds). In Equation (4), $Y'$ is the predicted value in the first stage, $\mathrm{Control}_j$ is the control variable, includes dummy variables for gender, marital status, smoking, drinking, medical insurance, and continuous variables for age, number of cigarettes smoked daily, medical expenses, exercise times weekly and education level, and $\varepsilon$ is the residual item.

Finally, we drive a mediation effect test based on the mediating effect model (Sobel, 1987) and analyze whether income affects individual mental health through salary satisfaction and interpersonal relationship for testing Hypothesis 4 and 5. The specific equation is as follows:

$$\mathrm{MentalHelath} = \beta_0 + \beta_2 \mathrm{X} + \sum_{1}^{j} \beta_j \mathrm{Control}_j + \varepsilon_1 \quad (5)$$

$$M = \gamma_0 + \gamma_1 X + \sum_{1}^{j} \lambda_j \text{Control}_j + \varepsilon_2 \tag{6}$$

$$\text{MentalHealth} = \delta_0 + \delta_1 X + \delta_1 M + \sum_{1}^{j} \delta_j \text{Control}_j + \varepsilon_3 \tag{7}$$

In Equation (5), $X$ is the independent variable (person's annual income or hourly wage); in Equation (6), $M$ is the mediator variable (salary satisfaction or interpersonal relationship). $\text{Control}_j$ is the control variable, includes dummy variables for gender, marital status, smoking, drinking, medical insurance, and continuous variables for age, number of cigarettes smoked daily, medical expenses, exercise times weekly and education level. Equation (5)–(7) are used to estimate the total, allocation and mediation effect of income on individual mental health.

## Measures

### Dependent variable: Mental health

The dependent variable in this paper is the mental health status of individuals in China. In order to evaluate individual's mental health more objectively and comprehensively, following existing studies (Zhang et al., 2022), the mental health index is derived from the 6-item short form of the Center for Epidemiologic Studies of Depression (CES-D) in the CFPS. (CES-D questions: 1. In the past week, how many times have you felt down? 2. In the past week, how many times did you feel that you were struggling to do anything? 3. In the past week, how many times have you had poor sleep? 4. In the past week, how many times have you felt lonely? 5. In the past week, how many times have you felt sad? 6. In the past week, how many times have you felt that life could not go on? Individuals were asked to indicate the frequency of their feelings on a four-scale metric— "Almost never (less than a day)," "Sometimes (1–2 days)," "Often (3–4 days)," "Most of the time (5–7 days)." These responses are assigned a value of 4 to 1, respectively).

The Center for Epidemiological Studies Depression Scale (CES-D) is a self-rating tool developed by the National Institutes of Mental Health (Radloff) in 1977 to evaluate the current level of depression in community populations (Radloff, 1977). This scale has been translated and used in many countries and has good reliability and validity (Van de Velde et al., 2011). We used SPSS26 to calculate the reliability of the questionnaire, and the Cronbach's alpha coefficient for the CES-D scale was 0.763, which showed that the CES-D scale has good reliability.

Referring to the method of Cheng et al. (Kling et al., 2007; Chen and Wu, 2021), the personal mental health index is an equally weighted sum of the standardization of score variable (z-score) of the above 6 components. The specific equation is as follows:

$$\text{MentalHealth}_i = \sum_{j=1}^{6} \frac{x_{ij} - u_j}{\sigma_j} \tag{8}$$

In the equation, $\text{MentalHealth}_i$ represents the mental health index of the individual, $x_{ij}$ represents the individual data of each variable, $u_j$ and $\sigma_j$ represent the overall mean and standard deviation of the variable, respectively. The mental health index calculated from this is −21.165 to 4.537. The higher the mental health index, the better the individual's mental health, and vice versa.

### Independent variable: Income

We use two measures of income as independent variables. The first variable is the individual's annual income (Income), which is calculated as the sum of the after-tax wage income from the main job and general job in the past 12 months. The second variable is hourly wage (Wage). It measures how much an individual earns per hour worked. In order to obtain regression results with economic implications, income and wage were processed by taking the natural logarithm.

### Mediating variable

In order to study the mechanism by which income affects individual mental health, we selected two variables: salary satisfaction and interpersonal relationship. Salary satisfaction ranges from 1–5, with 1 being the least satisfied and 5 being the most satisfied. Interpersonal relationship ranges from 0 to 10, with 0 representing the worst relationship and 10 representing the best relationship.

### Control variables

In order to better address the problem of selection bias caused by omitted variables, this study selects as many control variables as possible that affect both personal income and mental health. Mainly include the following control variables: dummy variables for gender, marital status, smoking, drinking, medical insurance, and continuous variables for age, number of cigarettes smoked daily, medical expenses, frequency of exercise and education level. Among them, smoke-do or not means have you smoked in the past month? 1 means yes, 0 means no; smoke-number indicates how many cigarettes you currently smoke on average per day; drink indicates whether you drank more than 3 times a week in the past month. 1 means yes, 0 means no; the frequency of physical activity reflects how often you have participated in physical fitness and leisure activities in the past 12 months. Ranges from 0 to 7 (never participates = 0; average less than 1 time per month = 1; average more than 1 time per month but less than 1 time per week = 2; 1–2 times per week =3; 3–4 times per week on average = 4; 5 and more times per week on average = 5; 1 time per day = 6; 2 times per day or more = 7). Education level ranges from 0 to 7 (illiteracy = 0; primary school = 1; junior high school = 2; high school/secondary

TABLE 2 The variance inflation factor of each variable.

| Variables | VIF | VIF |
|---|---|---|
| Income | 1.26 | |
| Wage | | 1.24 |
| Gender | 1.61 | 1.58 |
| Marital | 1.25 | 1.24 |
| Age | 1.49 | 1.48 |
| Smoke-do or not | 3.25 | 3.25 |
| Smoke-number | 2.87 | 2.87 |
| Drink | 1.15 | 1.15 |
| Insurance | 1.03 | 1.03 |
| Medical expenses | 1.01 | 1.01 |
| Exercise | 1.10 | 1.11 |
| Education Level | 1.49 | 1.52 |
| Mean VIF | 1.59 | 1.59 |

VIF represents variable inflation factor.

school/technical school/vocational high school = 3; junior college = 4; undergraduate = 5; master = 6; Ph.D. = 7).

### Instrumental variable

Appropriate instrumental variables need to be strongly correlated with endogenous explanatory variables and not correlated with disturbance terms. Therefore, exogenous policy intervention or exogenous interference to some samples is a better choice as an instrumental variable. Existing research shows (Kling et al., 2007; Jin, 2018; Zhan et al., 2018; Lu and Wan, 2020) that housing provident funds have a significant impact on income, which is exogenous relative to mental health. That is to say, the housing provident fund has an impact on residents' mental health by affecting changes in income, and endogenous variables are the only way for the housing provident fund to ultimately affect the dependent variable. Therefore, the housing provident fund is determined as the instrumental variable of this research. In the CFPS questionnaire, "whether to provide housing provident fund" was selected as the measure of housing provident fund.

## Participants characteristics

The descriptive statistics of the variables used in this paper are shown in Table 1. It can be seen that the average age of individuals in the sampled sample is 39.63 years old, and 59.2 percent of them are male. The mental health index of the sample ranges from −21.16 to 4.537, and the insured sample accounts for 90.45% of the total sample.

# Empirical results

## Baseline results

When investigating the causal relationship between income and mental health, a person's smoking and drinking behaviors are usually highly correlated, and the high correlation between variables raises concerns about multicollinearity, which may lead to larger biases. We use the variable inflation factor (VIF) to check for multicollinearity in our model. Table 2 reports the VIF of each variable. In each case, the VIF was less than the empirical value of 10, indicating that multicollinearity was not a major problem.

TABLE 3 OLS results of the effects of income on mental health.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Income | 0.554*** | 0.286*** | | |
| | (11.71) | (5.51) | | |
| Wage | | | 0.536*** | 0.281*** |
| | | | (12.42) | (6.00) |
| Gender | | 0.749*** | | 0.777*** |
| | | (7.10) | | (7.44) |
| Marital | | 0.897*** | | 0.902*** |
| | | (8.21) | | (8.28) |
| Age | | 0.008 | | 0.006 |
| | | (1.85) | | (1.36) |
| Smoke-do or | | −0.109 | | −0.111 |
| not | | (−0.70) | | (−0.71) |
| Smoke-number | | −0.026** | | −0.026** |
| | | (−3.10) | | (−3.05) |
| Drink | | 0.099 | | 0.098 |
| | | (0.80) | | (0.80) |
| Insurance | | 0.295* | | 0.286* |
| | | (2.09) | | (2.03) |
| Medical | | −0.203*** | | −0.202*** |
| expenses | | (−16.40) | | (−16.34) |
| Exercise | | 0.087*** | | 0.082*** |
| | | (4.37) | | (4.12) |
| Education | | 0.237*** | | 0.226*** |
| Level | | (6.97) | | (6.62) |
| _cons | −5.728*** | −4.622*** | −1.356*** | −2.280*** |
| | (−11.59) | (−8.47) | (−11.35) | (−9.63) |
| *N* | 9,296 | 9,296 | 9,296 | 9,296 |
| $R^2$ | 0.015 | 0.065 | 0.016 | 0.066 |
| Adj. $R^2$ | 0.014 | 0.064 | 0.016 | 0.065 |

*t* statistics in parentheses.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Table 3 reports baseline results regarding the impact of income on individual mental health. Columns (1) and (3) include only the individual's annual income and hourly wages, respectively. Columns (2) and (4) contain a set of control variables that affect individual's mental health. The effects of columns (1) and (3) show that increase in income have a significant positive effect on individual mental health. When controlling for a set of covariates in columns (2) and (4), results from the OLS model showed that income are a significant predictor of individual mental health, showing a positive correlation. These results validate Hypothesis 1.

As for the control variables, gender is shown as a positive number in columns (2) and (4). This suggests that men's mental health is better than women's. The education Level regression coefficient is positive, indicating that education has a positive effect

on mental health. The marital status coefficient was positive and statistically significant. The results showed that married adults had higher mental health than unmarried adults. The coefficient of exercise frequency is positive, indicating that regular physical exercise has a positive impact on individual mental health. The number of cigarettes smoked per day and medical expenses had significant negative effects on mental health.

## Endogeneity

In the regression results of the first stage in Table 4, the instrumental variables have a significant positive effect on the core explanatory variables, indicating that there is a strong correlation between the instrumental variables and the endogenous variables. The *F* values of the first-stage regression results were 276.99 and 210.55, both greater than 10, indicating that there is no weak instrumental variable phenomenon in the two-stage model, and the housing provident fund is a good instrumental variable; In addition, the Hausman endogeneity test was used, and the Hausman results passed the 1% statistical level test, indicating that individual annual income and hourly wages as endogenous explanatory variables have endogeneity problems, and instrumental variables need to be used for unbiased estimation. From the results of the second stage, it can be seen that after using instrumental variables to adjust the estimation bias, the impact of personal annual income and hourly wage on mental health is still positive and significant, regression coefficients up to 0.672 and 1.386. Comparing the results of OLS regression with the results of two-stage regression, it can be seen that there is a significant gap between the estimation results of the instrumental variable method and the estimation results of OLS, there is a large bias in the OLS estimation.

TABLE 4 Two-stage least squares regression results.

| | One stage regression | Second stage regression | One stage regression | Second stage regression |
|---|---|---|---|---|
| Income | | 0.672** | | |
| | | (2.92) | | |
| Wage | | | | 1.386** |
| | | | | (2.85) |
| Gender | 0.383*** | 0.606*** | 0.283*** | 0.471** |
| | (18.88) | (4.51) | (12.37) | (2.73) |
| Marital | 0.268*** | 0.791*** | 0.259*** | 0.612*** |
| | (12.68) | (6.30) | (10.84) | (3.62) |
| Age | −0.006*** | 0.011* | 0.000 | 0.006 |
| | (−7.74) | (2.38) | (0.12) | (1.50) |
| Smoke-do | 0.028 | −0.122 | 0.036 | −0.153 |
| or not | (0.91) | (−0.78) | (1.05) | (−0.95) |
| Smoke- | 0.004* | −0.027** | 0.001 | −0.027** |
| number | (2.23) | (−3.20) | (0.80) | (−3.07) |
| Drink | 0.071** | 0.070 | 0.076** | 0.012 |
| | (2.96) | (0.56) | (2.81) | (0.09) |
| Insurance | 0.118*** | 0.254 | 0.145*** | 0.132 |
| | (4.28) | (1.77) | (4.68) | (0.82) |
| Medical | −0.004 | −0.200*** | −0.008** | −0.192*** |
| expenses | (−1.67) | (−16.04) | (−2.96) | (−14.21) |
| Exercise | 0.006 | 0.083*** | 0.026*** | 0.051* |
| | (1.52) | (4.13) | (5.83) | (2.09) |
| Education | 0.181*** | 0.152* | 0.242*** | −0.062 |
| level | (27.94) | (2.53) | (33.04) | (−0.47) |
| Housing | 0.068*** | | 0.033*** | |
| provident | (22.33) | | (9.58) | |
| fund | | | | |
| _cons | 9.652*** | −8.324*** | 1.439*** | −3.832*** |
| | (216.69) | (−3.76) | (28.60) | (−5.31) |
| *N* | 9,296 | 9,296 | 9,296 | 9,296 |
| $R^2$ | 0.247 | 0.060 | 0.200 | 0.010 |
| Adj. $R^2$ | 0.246 | 0.059 | 0.199 | 0.009 |

*t* statistics in parentheses.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

## Robustness check

In the robustness test, we apply the logit model and the probit model to estimate the impact of income on individual mental health. To do this, we substitute a dummy variable for the individual's mental health. This false value takes 1 if the mental health value is greater than the mean of mental health index, and 0 otherwise. Columns (1), (3), and (5) in Table 5 report the estimated results of the income on mental health measured by dummy variable under the conditions of OLS, logit model and probit model, respectively. Columns (2), (4) and (6) report the results of wage. According to the results, the personal income and wage coefficients are both positive and statistically significant. That is, increased income has a positive effect on mental health. All in all, the results in Table 5 are basically consistent with those in Table 3.

## Heterogeneity

To better understand the relationship between income and mental health, we examine the heterogeneity of effects by dividing the sample into different levels of education and frequency of exercise.

In order to test Hypothesis 2, the research samples were divided into Less-educated group and Well-educated group (If the education level reaches 3 or above, it is Well-educated, otherwise it is Less-educated). Table 6 presents the results of the heterogeneous effect of income on mental health at different levels of education. The results of the study show that people with lower education levels show a stronger response to changes in income, regardless of whether the study is based on individual annual income or hourly wage income. These results validate Hypothesis 2.

To test Hypothesis 3, we included a dummy variable to measure exercise frequency. The dummy equals 0 if the individual never participates in physical activity, and otherwise 1. Table 7 presents the results of the heterogeneous effect of income on

TABLE 5 Robustness test results.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | OLS | OLS | Logit | Logit | Probit | Probit |
| Income | 0.027*** (4.17) | | 0.112*** (4.16) | | 0.070*** (4.18) | |
| Wage | | 0.029*** (5.05) | | 0.123*** (5.03) | | 0.123*** (5.03) |
| Control variable | YES | YES | YES | YES | YES | YES |
| _cons | 0.081 (1.21) | 0.295*** (10.13) | −1.779*** (−6.23) | −0.875*** (−7.05) | −1.102*** (−6.24) | −0.875*** (−7.05) |
| *N* | 9,296 | 9,296 | 9,296 | 9,296 | 9,296 | 9,296 |
| $R^2$ | 0.044 | 0.045 | | | | |
| Adj. $R^2$ | 0.043 | 0.044 | | | | |

*t* statistics in parentheses.
***$p < 0.001$.

TABLE 6 Heterogeneous effects of different education levels on income.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Less-educated | Well-educated | Less-educated | Well-educated |
| Income | 0.447*** (6.27) | 0.200** (2.63) | | |
| Wage | | | 0.389*** (5.96) | 0.232*** (3.40) |
| _cons | −6.376*** (−8.14) | −2.334** (−2.83) | −2.606*** (−8.12) | −0.822* (−2.50) |
| *N* | 4,942 | 4,354 | 4,942 | 4,354 |
| $R^2$ | 0.075 | 0.042 | 0.074 | 0.043 |
| Adj. $R^2$ | 0.073 | 0.040 | 0.072 | 0.041 |

*t* statistics in parentheses.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

mental health at different exercise frequencies. The results of the study showed that people who did not exercise were more responsive to changes in income than those who exercised regularly, regardless of individual annual income or hourly wage as the research object. The results in Table 7 validate Hypothesis 3.

## Mechanisms

In order to explore the mechanism by which income affects mental health, this section uses the Causal Steps Approach to analyze whether income affects individual mental health through the relationship between salary satisfaction and interpersonal relationship.

To test Hypothesis 4, we estimated the effect of individual annual earnings, hourly wage on salary satisfaction, and salary satisfaction on mental health by OLS. Given that salary satisfaction is recorded on an ordinal scale, we also employed an ordered probit model to investigate the impact of personal income on mental health. Columns (1)–(4) of Table 8 report the effect of individual's annual income and hourly wage on salary satisfaction, and columns (5) and (6) report the effect of salary satisfaction on mental health. As can be seen from Table 8, positive and statistically significant coefficients are shown. This suggests that income has an impact on individual's mental health through its effect on salary satisfaction. The results in Table 8 validate Hypothesis 4.

To test Hypothesis 5, we estimated the effect of personal annual income, hourly wage on interpersonal relationship, and the effect of interpersonal relationship on mental health by OLS. Given that interpersonal relationship is recorded on an ordinal scale, we also employ an ordered probit model to investigate the effect of income on interpersonal relationship. Columns (1)–(4) in Table 9 report the effect of individual's annual income and hourly wage on interpersonal relationship, and columns (5) and (6) report the effect of interpersonal relationship on mental health. As can be seen from Table 9, positive and statistically significant coefficients are shown. This suggests that income has an impact on mental health through its impact on interpersonal relationship. The results in Table 9 validate Hypothesis 5.

## Discussion

Since the outbreak of the COVID-19 pandemic in 2019, its influence has attracted a lot of attention and research. Many studies are related to the mental health that we study in this article. Compared with the current study, the novelty of this paper is four-fold. First, previous studies focused on specific populations, such as first responders, college students, the elderly, and were not nationally representative. Our research investigates the general impact of personal income on individual's mental health. Second, we select housing provident fund as an instrumental variable to solve the possible endogeneity problem. Third, we examine the

TABLE 7 Heterogeneous effects of different exercise frequencies on income.

| | (1) | (2) | (2) | (3) |
|---|---|---|---|---|
| | No exercise | Regular exercise | No exercise | Regular exercise |
| Income | 0.383*** (5.30) | 0.153* (1.97) | | |
| Wage | | | 0.337*** (5.13) | 0.205** (2.85) |
| _cons | −5.982*** (−7.84) | −2.549** (−3.15) | −2.767*** (−8.60) | −1.380*** (−3.58) |
| *N* | 5,534 | 3,762 | 5,534 | 3,762 |
| $R^2$ | 0.068 | 0.052 | 0.068 | 0.053 |
| Adj. $R^2$ | 0.066 | 0.049 | 0.066 | 0.050 |

*t* statistics in parentheses.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

TABLE 8 With salary satisfaction as a mediating variable.

| | Salary satisfaction | | | | MentalHealth | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Variable | OLS | OLS | Ordered probit | Ordered probit | OLS | OLS |
| Income | 0.183*** (14.36) | | 0.194*** (13.58) | | 0.202*** (3.89) | |
| Wage | | 0.144*** (12.50) | | 0.155*** (12.03) | | 0.215*** (4.59) |
| Salary satisfaction | | | | | 0.456*** | 0.455*** (10.89) |
| | | | | | (10.87) | |
| Control variable | YES | YES | YES | YES | YES | YES |
| _cons | 1.521*** (11.33) | 3.071*** (52.58) | | | −5.315*** (−9.73) | −3.678*** (−13.72) |
| *N* | 9,296 | 9,296 | 9,296 | 9,296 | 9,296 | 9,296 |

*t* statistics in parentheses.
***$p < 0.001$.

heterogeneity of effects by dividing the sample into different education levels and frequency of exercise. These results help us understand the heterogeneity of the effects of personal income on mental health. Finally, existing research fail to provide mechanisms on how income affects mental health. This paper reveals that income can affect mental health through the impact on salary satisfaction and interpersonal relationship.

One feature of current research is tending to focus on specific populations and regions. For example, Brasso et al. (2022) conducted a meta-analysis of the existing literature and found that the COVID-19 pandemic has produced a significant impact on the mental health of young people. Rapisarda et al. (2022) analyzed mental health symptoms of mental health workers in Lombardy and Quebec during COVID-19. However, the above studies are based on descriptive studies and lack empirical support. Our study employs ordinary least squares and two-stage least squares (TSLS) to investigate the causal effects of income on individual mental health and to provide empirical evidence. Baseline results were consistent with previous studies (Sánchez-Rodríguez et al., 2022). Furthermore, most studies used non-probability samples. Unlike Pais-Ribeiro et al. (Pais-Ribeiro et al., 2022), our study is derived from large-scale micro survey data. Also we provide a mechanistic analysis. Different from the previous studies that the effect of income appears to be mediated largely by debt (Jenkins et al., 2008), our study identifies the mechanism variables are salary satisfaction and interpersonal relationship.

Another feature of current research is apt to prove that there is a positive correlation between income and mental health. For instant, most scholars (Ao et al., 2020; Thomson et al., 2020; Liang et al., 2021) believe that income has a positive impact on mental health during COVID-19. However, due to the obvious endogeneity between income and mental health, it is difficult to obtain consistent estimates by OLS. Obviously, there is a bidirectional causal relationship between income and mental health. Chisholm et al. (2016) found that higher income improves mental health, which can further improve livelihoods or economic security by increasing productivity, promoting labor market participation, and increasing the income. This study attempts to solve this problem by selecting the housing provident fund as an instrumental variable. The empirical results report the causal effect of personal income on mental health and test the hypotheses. Furthermore, little discuss is on the heterogeneity of income's effect on individual mental health. Our research shows that income affects individuals' mental health differently, depending on the individual's level of education and frequency of exercise. That is, less education showed a stronger response to changes in income, regardless of whether they were based on annual personal income or hourly wages. People who did not exercise were more responsive to changes in income than those who exercised regularly.

TABLE 9 With interpersonal relationship as a mediating variable.

| | Interpersonal relationship | | | | MentalHealth | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Variable | OLS | OLS | Ordered probit | Ordered probit | OLS | OLS |
| Income | 0.084*** (3.68) | | 0.044** (3.23) | | 0.262*** (5.10) | |
| Wage | | 0.078*** (3.76) | | 0.042*** (3.40) | | 0.259*** (5.58) |
| Interpersonal relationship | | | | | 0.276*** (11.82) | 0.275*** (11.80) |
| Control variable | 5.272*** (21.87) | 5.969*** (57.07) | | | −6.076*** (−10.94) | −3.923*** (−14.36) |
| _cons | 9,296 | 9,296 | 9,296 | 9,296 | 9,296 | 9,296 |

*t* statistics in parentheses.
**$p < 0.01$; ***$p < 0.001$.

However, this paper has limitations in some aspects. First, the sample data is cross-sectional. We can only estimate the short-term effects of income on individual's mental health, not taking into account the long-term effects. Also the conclusions that can be drawn from our survey results only involve absolute income, we cannot analyze whether income loss occurred during the epidemic and the impact of income loss on individual mental health. Second, although we try our best to include factors that may affect individual's mental health, the model cannot include all external factors that affect individual's mental health. Third, aside from data limitations, we measure mental health in a very general way. An interesting avenue of future research can be predicted regarding the long-term and dynamic effects of income on individual mental health. In addition, studies can investigate the causal relationship between income and specific psychological problems, such as postpartum depression.

Several policy implications can be derived from this analysis. First, our research shows that income has a significant positive effect on an individual's mental health. Therefore, governments and society as a whole may need to provide assistance to low-income people. This help should be directed not only to financial subsidies, but also to effective mental health care. Particular attention should be paid to those who are less educated and do not exercise regularly. Finally, the government should also develop mental health services for vulnerable groups and encourage social workers to conduct home visits. Additionally, programs involving outdoor activities can be provided to encourage low-income groups to get out of their homes and start interacting with others, while maintaining appropriate social distancing to prevent the spread of COVID-19, improve their relationships, and reduce their depression.

## Conclusion

Given the importance of mental health in daily life, there has been an increasing amount of research on this topic during the COVID-19 pandemic. This paper uses 9,296 items of data from the 2020 CFPS survey to investigate the causal relationship between income and mental health. One of the most important findings to emerge from the paper is that income has a positive effect on mental health during the pandemic.

The effect of heterogeneity was further analyzed by segmenting the sample according to education level and exercise. On the one hand, the findings show that changes in income have a slightly stronger effect on people with less education than those with well education. On the other hand, those who exercised regularly showed a less strong responses to changes in income than those who do no. Our study also investigates the mechanisms by which income affects mental health, showing that income affects mental health through its effects on salary satisfaction and interpersonal relationship.

## 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.

## Author contributions

DY conceived and designed the research, provided guidance throughout the entire research process, and responsible for all R&R works. BH and ZR participated in data analysis. BH and ML wrote the article. All authors contributed to the article and approved the submitted version.

## Funding

This research was funded by the National Social Science Fund of China (Grant number: 21AJL006), Northeast Revitalization Program of Jilin University (Grant number: 22dbzx13), Labor relations Program of Jilin University (Grant number: 2021LD011), Special Fund of Jilin University (Grant number: YSZ202109), and Adolescent Development Program of Jilin Province (Grant number: 2022jqy-zj2).

## Acknowledgments

The authors would like to express sincere gratitude to Geoffrey Hewings from University of Illinois at Urbana-Champaign and the peer reviewers for their valuable suggestions.

## 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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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 05 October 2022
DOI 10.3389/fpsyg.2022.983875



OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology

RECEIVED 01 July 2022
ACCEPTED 06 September 2022
PUBLISHED 05 October 2022

CITATION
English A, Ding Y, Zhang Q and Kulich SJ (2022) Underpinning Chinese international students' stress and anxiety during the first wave of COVID-19 outbreak: The moderating role of wisdom. *Front. Psychol.* 13:983875. doi: 10.3389/fpsyg.2022.983875



# Underpinning Chinese international students' stress and anxiety during the first wave of COVID-19 outbreak: The moderating role of wisdom

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During the first wave of the COVID-19 outbreak, the Chinese diaspora, especially Chinese international students, were subjected to greater stress than others, because they were under pressure from both fear of infection and coping with acculturation (e.g., discrimination). Consequently, more research is needed to understand the anxiety induced by COVID-19 stresses on this specific cultural group. The main purpose of this study is to investigate the relationship between COVID-19 stress and individuals' anxiety, and the moderating roles of Acceptance, Reframing, and Striving (ARS) coping, the family support coping strategy, and wise reasoning. To test our predictions, we collected data from 224 Chinese international students (CIS). Results indicated a strong and positive relationship between pandemic stress and anxiety. Surprisingly, both ARS and family support coping did not moderate the association between COVID-19 stress and anxiety. Instead, wise reasoning as a potential reflective coping strategy interacted with COVID-19 stress to predict anxiety. Specifically, wise reasoning predicted more anxiety when individuals perceived a low-level of COVID-19 stress, however, such a relationship disappeared when individuals perceived a high-level of COVID-19 stress. These findings about wise-reasoning extends our understanding of wisdom and how it plays a role in the context of COVID-19.

KEYWORDS

**acculturation, collective coping, COVID-19 stress, anxiety, wise-reasoning**

## Introduction

In January 2020, the COVID-19 pandemic broke out across China, and in the ensuing months, spread around the world. Over 601 billion individuals have been infected by the pandemic as of this writing (Sep 4, 2022), and more than 6 million have died worldwide (World Health Organization, 2021). However, looking back at that first lockdown time in

early March, 2020 "the virus had spread to more than 118,000 cases and caused 4,291 deaths in 114 countries" (Bavel et al., 2020). Furthermore, many countries enacted public health policies during the first wave of the COVID-19 outbreak (e.g., lockdowns, social distancing, face-mask mandates) and due to its early ambiguity, lifestyles and personal freedoms were upended.

Against this background, the Chinese international students (CIS) faced additional grievances and stress (Shimizu, 2020; Esses and Hamilton, 2021). When COVID-19 first spread throughout China, on the one hand, CIS had to worry about family and friends back home, and on the other hand, incidents where Chinese people were violently attacked, emotionally abused, or racially blamed for the virus have been frequently reported (Li et al., 2021; Nam et al., 2021). Furthermore, CIS faced tremendous challenges due to the disruption of their spring semester in college, social isolation as a result of lockdown measures, and travel restrictions that closed borders, all of which led to uncertainty, stress, and anxiety (Xu et al., 2021). Some researchers have noted this "double blow" situation faced by CIS and found alarming increases in depression and anxiety, including traumatic experiences like switching overnight to remote learning and emotional distress from buying food or going outside (Chi et al., 2020; Lin et al., 2022). Therefore, the focus of this paper is to further understand various aspects of CIS's psychological health at the start of the pandemic—we aim to explore the relationship between stress and anxiety and how wise-reasoning and adaptative-coping mechanisms might have played an important role in their adaptation.

# Literature review

## Stress and anxiety

Pandemic-related stress represents numerous psychosocial stressors including "severe disruptions of routines, separation from family and friends, shortages of food and medicine, wage loss, social isolation due to quarantine or other social distancing programs, and school closure" (Taylor, 2019). Bavel et al. (2020) notes that loneliness and social isolation can exacerbate stress and have harmful impacts on mental, cardiovascular, and immune health. In addition, students who are away from family members in another country also more prone to emotional difficulties (English et al., 2022).

Yet not only do the Chinese diaspora (and the CIS group among them) have to deal with pandemic stress, but also acculturative stress-stress from living in a cross-cultural environment-which can present psychosomatic symptoms such as anxiety (Berry, 2006; Szabo et al., 2017; English et al., 2021). Previous research suggests perceived discrimination is associated with heightened acculturative stress (Torres et al., 2012). Researchers have proposed that threat of an infectious illness might lead to bias and violence towards marginalized or blamed populations (Bavel et al., 2020). As the pandemic originated from China, some individuals blamed the Chinese diaspora for the appearance and spread of COVID-19 overseas (Siu and Chun, 2020). For example, in the United States, President Donald Trump labeled COVID-19 the 'Chinese Virus' (Forgey, 2020), prompting widespread discrimination toward Asians (Misra et al., 2020; Shimizu, 2020; Yu, 2020). Furthermore, pandemic-related discrimination perceived by the Asian group published through social media made them feel accused and distressful (Fan et al., 2021). While not all CIS may have been directly discriminated against, they could nevertheless perceive a sense of discrimination. Acculturating to new cultures can already be a stressful experience, but can be especially difficult when there is perceived discrimination (Torres et al., 2012).

Based on past research, we propose the following hypothesis:

> *H1*. COVID-19 stress will be positively related to anxiety.

## Coping with stressful situations

Given the anxiety induced by the COVID-19 related stress, how to cope with this pandemic is a shared concern. In other words, effective coping strategies might reduce virus-related stress and anxiety. Coping is defined as taking proactive, inner-psychic steps to deal with demands brought on by stressful situations (Taylor and Stanton, 2007). Previous studies on coping strategies like primary (exerting control over the problem or environment) and secondary coping (adjusting oneself or cognitively reinterpreting the problem) were mainly conducted in Western contexts. Therefore, researchers have started to examine the link between coping and psychological adaptation in non-Western regions (Sahin et al., 1993; Pretorius and Diedricks, 1994; Heppner et al., 2002; English and Geeraert, 2020).

Following this goal, Heppner et al. (2006) developed the Collectivistic Coping Styles (CCS) that is "based on collectivistic Asian values and philosophies and included both primary and secondary control." For a collectivistic culture, research has shown that Asians commonly use five coping strategies (Heppner et al., 2006): (1) Acceptance, reframing, and striving (ARS); (2) Family support; (3) Religion-spirituality; (4) Avoidance and detachment; and (5) Private emotional outlets. Some research has shown that collectivistic coping might serve as a moderator to influence the relationship between stress and psychological distress (Wei et al., 2007; Aldwin, 2009).

The current study focuses on two increasingly recognized coping strategies: (1) ARS and (2) family support.

### ARS

Heppner et al. (2006) used the terms "acceptance, reframing, and striving" to show that people from collectivistic cultures cope with traumatic events by accepting the trauma, accommodating to reality, and changing their understanding to the tragedy. Individuals from collectivistic cultures might be more likely to adjust and reframe themselves in severe situations, trying not to trouble others around them. In consistent with such statement,

Ma and Zhan (2022) found that when CIS encountered mask discrimination from Americans, they were more likely to reframe or conceal mask wearing problems (e.g., avoiding clashes) instead of challenging (or confronting) the American (lack of) mask norms. In a longitudinal cross-cultural adjustment study of Chinese international students in the United States, Wang et al. (2012) found ARS coping was most effective in reducing acculturative stress overtime. As a result, we argue that ARS coping might benefit Chinese international students who find themselves in a somewhat passive "uncontrollable state" and not capable of directly confronting pandemic related problems. Accordingly, we propose the following as our second and third hypotheses:

> *H2*. The coping strategy of acceptance, reframing, and striving (ARS) will moderate the relationship between COVID-19 stress and anxiety.

### Family support

As an integral construct or approach in collectivistic coping, family support refers to asking for help from loved ones and respected elders (Heppner et al., 2006). Collectivistic cultures believe in and practice an interdependent and inseparable relationship with family members (Markus and Kitayama, 1991), which means that looking to family members for help can be a primary choice for students to cope with stress and overcome difficulties while overseas. Kim et al. (1999) identify how Asian values like being compliant to family expectations and believing in the importance of family can help to mitigate psychological problems. In a recent qualitative study on 30 CIS in the United Kingdom, researchers found that family support functioned as a collective strategy in close collaboration between family members overcoming the increasing challenges like anxiety and fear during the early days of the pandemic (Hu et al., 2022). We argue that during pandemic times, family support will be paramount in overcoming the challenges of COVID-19 related problems, and thus propose the following additional hypotheses.

> *H3*. Family support will moderate the relationship between COVID-19 stress and anxiety.

## Role of wisdom as an additional coping strategy

Wisdom, or wise-reasoning, has been characterized as a form of excellence in ethical and practical deliberation about the best course of action in complex situations (Grossmann et al., 2020; Phan et al., 2021; Zhang et al., 2022). Researchers suggest that one aspect of wise reasoning represents the sensitivity to possible changes in perspectives, recognition of limit in knowledge and comprise or willingness to accept uncertainty and different situations (Bangen et al., 2013). Wisdom is also a workable guide for people to cope with life challenges or uncertain situations (Glück, 2018). Thus, we anticipate that wisdom might be an additional coping strategy to handle the abrupt life change during a pandemic.

There is ample literature on how wise individuals make realistic decisions, recognize limits of one's knowledge, consider multiple ways in which a situation may unfold, and recognize others' perspectives and interests (Arriaga and Rusbult, 1998; Peetz and Grossmann, 2021). In recent years, wisdom research has shifted from a person-centric phenomenon to context dependent approach through social-ecological perspective (Grossmann et al., 2020).

From a socio-ecological perspective, wise-reasoning considers the cultural context in which individuals' manifestation of these related qualities. One aspect of wise-reasoning is metacognitive flexibility which suggests that things are changing all the time and influenced by different factors (Grossmann et al., 2013). We argue that metacognitive flexibility will be important during an uncontrollable situation that is life changing. Perhaps, the utility of wise-reasoning might be interrelated with coping to cultivate healthy mindsets in response to traumatic events. However, a global pandemic could be by far one of the most abrupt life changes one can undergo, calling for metacognitive flexibility. Grossmann et al. (2022) interviewed over 50 world-renowned scholars in the field of behavioral and social sciences to give advice on what kind of wisdom people would need to adapt to a post-COVID era. That interview study made four recommendations toward coping with stress and uncertainty: (1) focus on long-term goals; (2) remain positive on human's ability; (3) remain positive to intentionally master the situation; and (4) believe in social connectedness. On such an occasion, someone might be uprooted and forced to face the pandemic suddenly, therefore we argue there is a need to be realistic about and "ready to react" (e.g., be alert) quickly to the uncertainty.

Based on the above review and given that different social-ecological contexts can significantly and ultimate affect individuals, we expect that wise reasoning will play a vital role during traumatic situations in the following ways.

First, the conscientiousness engendered by wise-reasoning allows individuals to critically scrutinize ideas about what needs to be done to cope intelligently and effectively with a pandemic. This could include the importance of having personal protective equipment (e.g., masks, using hand sanitizer or disinfectant) but also adhering to strategies implemented by local health authorities and government officials.

Second, wise-reasoning may increase compliance measures such as washing hands regularly, practicing social distance, and showing concern for others, since "wise" people might actually take the pandemic more seriously and do all they can to prevent potential dangers (Peetz and Grossmann, 2021; Grossmann et al., 2022). This would include critically analyzing courses of action if

one contracted COVID-19, imaginatively developing new coping strategies to stay wisely alert during the pandemic.

Simply put, wise-reasoning helps people gain insight into the emerging or changing epidemic, remain vigilant, be flexible in dealing with uncertainty, and perhaps even better embrace stress. Thus, wise reasoning, as a potential coping strategy, may weaken the relationship between stress and anxiety. Thus, we form the hypothesis below regarding the moderation effect of wisdom.

> *H4*. Wise-reasoning will moderate the relationship between COVID-19 stress and anxiety.

## Significance and focus of the current study

This study sets out to understand how CIS were coping with COVID-19 while living abroad during the initial outbreak and first lockdown in 2020. We construe the pandemic as a strong and abrupt life change that is stressful and seek to explore the relationship between the stress and anxiety.

As noted in the review above, multiple coping strategies have been proposed, and some specifically for Chinese populations. Yet, there appears to be both an assumption of generalizing to collective coping and a gap of not including the wisdom orientation of Chinese. Therefore, we seek to address this gap and test whether wise-reasoning might moderate the stress-anxiety relationship in comparison to the role of other coping strategies commonly noted (ARS and family support).

To test the hypotheses proposed, the current study collected data from CIS who were scattered in Western countries like the United Kingdom and United States as well as culturally close ones like South Korea and Japan (English et al., 2021). Different cultural environments, lockdowns, and mask mandates lead to different countries' response mechanism to pandemic control. These factors can obviously influence international students' COVID-19 stress, coping strategies, wise-reasoning, and anxiety.

# Materials and methods

## Participants and procedure

Data was collected from 224 CIS studying abroad in 15 countries through snowballing from April 3rd to 8th, 2020, when the initial period when the COVID-19 virus was quickly spreading to and across the whole world. The researcher designed an online questionnaire on *Wenjuanxing*, a web-based survey platform, and posted it on WeChat and Weibo. To be specific, sampling occurred in three different ways. First, the researcher personally asked a group of friends who studied abroad during that period to take this survey. Second, these friends helped to forward the questionnaire to their classmates studying abroad. Third, the researcher posted the web link on moments on WeChat and Weibo, asking those who met the requirement to take the questionnaire. Some respondents had returned to China within 2 weeks of our data collection period and were also allowed to participate (requested to reflect on their fresh experiences). Outliers and bad cases were removed, including those always clicking the first option button and evidence not taking this survey seriously. Among the included sample, 145 students (64.7%) were in their host countries while 79 students (35.3%) had returned to China. Results exploring responses of the "returning home" sample are addressed in Supplemental Material S2.

Participants consisted of 142 females (63.4%) and 82 males (36.6%). The average age of the participants was 23.9 years ($SD$ = 2.6; range = 18–38 years). A majority of the participants were studying for masters or equivalent degrees (141 students; 62.9%), while 55 students (24.6%) were studying for their bachelors or equivalent degrees, and 25 students (11.2%) were studying for their doctoral or equivalent degrees. Three students (1.3%) were in study abroad programs. More comprehensive details of the sample can be found in Supplemental Material S1.

Participants were studying in their host countries for an average of 1.6 years ($SD$ = 2.4). The participants resided on three major continents—**Europe**: United Kingdom (34.4%) Germany (8.9%), France (4.9%), Netherlands (4.9%), Switzerland (0.4%), Spain (2.7%) Italy (1.3%); **North America**: United States (15.6%) and Canada (3.1%); **Asia Pacific**: Australia (4.5%), New Zealand (1.8%), South Korea (0.9%), Singapore (8%), Japan (8%), and Nepal (0.4%). Supplementary Figure S1 describes the sample breakdown.

## Measures

### COVID-19 stress

The self-designed COVID-19 stress scale consisted of 10 items on a 5-point scale (1 = *Not stressful*, 5 = *Very stressful*). One sample question was "*how stressful do you feel when going out to buy daily necessities?*" The COVID-19 stress scale was designed after semi-structured interviews with 10 Chinese international students based on the real situations they encountered during the early days of the outbreak (see Supplemental Materials S3 and S4). The scale was subject to exploratory factor analysis and met thresholds (See Supplemental Material S2). Scale reliability was $\alpha = 0.84$.

### Stress-related anxiety

Students' anxiety affecting levels of stress was assessed by the "worries" subscale from the Perceived Stress Questionnaire (Levenstein et al., 1993). The "worries" subscale asked students to what degree they agreed with each item on a 5-point scale (1 = *Not at all*, 5 = *Always*). A sample item asked of these students included "I have many worries" and "I am afraid for the future." The scale is designed to assessed individuals' general worries they have. The subscale was highly reliable ($\alpha = 0.88$).

### Coping strategies

ARS and family support coping strategies were assessed with the corresponding subscales of the Collectivistic Coping Styles inventory (Heppner et al., 2006), which is specifically designed within an Asian cultural orientation (details see Supplemental Material S7).

The ARS scale is the largest subscale (ARS; 11 items; a sample item: "Believed that I would grow from surviving the outbreak of the coronavirus"), which reflects a blend of acceptance, reframing, and striving. It taps into how participants interpret a stressful situation and adjust their interpretation of the stress to adapt to it. The ARS scale was highly reliable ($\alpha = 0.85$).

Family Support was also assessed (FS; 6 items; a sample item: "Shared my feelings with my family") and this subscale reflects the extent to which one seeks support from one's family or respected elders. Items were prefaced with the following instruction:

How have you responded to difficulties of the COVID-19 outbreak? These questions below ask which strategies you are presently using and have used in the past 2 weeks.

Participants were asked to indicate their frequency on a 5-point Likert scale from 1 (*Not at all*) to 5 (*Always*). The Family Support scale was also reliable ($\alpha = 0.86$).

### Wise-reasoning

A fairly recently newly-developed situated wise-reasoning scale (SWIS) was used to examine participants' wisdom in critically thinking about the COVID-19 pandemic (Brienza et al., 2018). After writing out their COVID-19 event response, a statement to participants requested their further response:

We would like you to continue to think about uncertainties created by the COVID-19 pandemic and report the extent to which you engaged in the following thoughts and behaviors as you have reflected on the issue.

Students responded to 10-items that were rated on a 5-point scale from 1 (Never) to 5 (Always). A sample item would be: "While I have been reflecting on this issue, I thought the issue could unfold in many different ways." The reliability of the SWIS subscale was $\alpha = 0.78$.

## Analytic strategy

The statistical analysis was performed using IBM SPSS software 23.0 (IBM Corp, Armonk, New York, United States). Before analyses were conducted, researchers first evaluated the normality of the data (Ghasemi and Zahediasl, 2012). We used Q-Q plot and the skewness and kurtosis measurement to assess the normal distribution of the data. If the data is clustered close to the line of Q-Q plot, it is normally distributed. In addition, the result of the skewness and kurtosis should be in the range of [-1.0 to 1.0] to prove the data are normally distributed.

We then start the analyses for hypotheses testing. First, a Pearson correlation and point-biserial correlation were calculated to examine the basic relationships among the variables of interest. Next, three three-step hierarchical regression analyses were performed with anxiety being the dependent variable (DV). The hierarchal linear regression was used to understand how much variance in anxiety is explained by COVID related stress and whether this is moderated by cognitive coping, familial support, or wise reasoning. Independent variables (COVID-19 stress, the two coping strategies of ARS and family support, and wisdom) were standardized. In step 1, demographic variables were added to control for gender, age, length of stay. In step 2, COVID-19 stress and moderators (two coping strategies and wise-reasoning) were entered in the model. Finally, on the third step, each interaction was introduced into the model: COVID-19 Stress × ARS Acceptance, reframing, and striving (Regression Model 1); COVID-19 Stress × Family support (Regression Model 2); COVID-19 Stress × Wise-reasoning (Regression Model 3).

# Results

## Preliminary analysis

We first check the Q-Q plot, and the data of the main variables are all clustered close to the normal-distributed line (see Supplementary Figure S3). Table 1 showed that the skewness and kurtosis of all variables were less than 1 or greater than −1, indicating that the data followed a normal distribution. Further details for other normality tests can be found in the Supplemental Material S8.

Analysis revealed that COVID-19 stress was positively associated with anxiety ($r = 0.42$, $p < 0.001$) thus supporting H1. ARS coping was positively associated with familial support ($r = 0.35$, $p < 0.001$), wise-reasoning ($r = 0.41$, $p < 0.001$), but not stress ($r = -0.12$, $p = 0.06$) or anxiety ($r = -0.12$, $p = 0.08$). Family support was positively associated with wise-reasoning ($r = 0.23$, $p < 0.01$), but not stress ($r = 0.08$, $p = 0.24$) or anxiety ($r = 0.01$, $p = 0.93$). Wise-reasoning was positively associated with anxiety ($r = 0.17$, $p < 0.05$), but not stress ($r = 0.01$, $p = 0.90$). Results are presented in Table 1.

## Regression analyses

To examine the relationship between anxiety and COVID-19 stress, we conducted a three-step hierarchical regression to test how ARS coping (H2) would influence the relationship between stress and anxiety (see Supplementary Table S1). In the first step, anxiety was regressed on control variables. Next, we added in main variables: ARS coping and COVID-19 stress. In the final step, the two-way interaction of COVID-19 stress by ARS was not significant ($\beta = -0.05$, $p = 0.43$), thus rejecting H2.

Next, we tested if family support (H3) would impact the relationship between anxiety and COVID-19 stress (see Supplementary Table S2). We conducted the same three-step hierarchical regression technique. In the first step, anxiety was regressed on control variables. Next, we added in main variables: family support and COVID-19 stress. In the final step, the

TABLE 1 Bivariate correlations of core variables.

| *N* = 224 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | *M*(*SD*) | α | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.COVID-19 Stress | / | | | | | | | 2.73(0.81) | 0.85 | −0.03 | −0.60 |
| 2. Wise-reasoning | 0.01 | / | | | | | | 3.71(0.52) | 0.78 | −0.20 | 0.53 |
| 3. ARS Coping | −0.12 | 0.41*** | / | | | | | 3.84(0.67) | 0.85 | −0.32 | 0.69 |
| 4. Family Support | 0.08 | 0.23*** | 0.35*** | / | | | | 3.53(0.82) | 0.81 | −0.46 | 0.06 |
| 5. Anxiety | 0.42*** | 0.17** | −0.12 | 0.01 | / | | | 3.17(0.98) | 0.88 | −0.11 | −0.81 |
| 6. Age | −0.01 | 0.18** | 0.04 | −0.03 | −0.01 | / | | 23.89(2.64) | / | / | / |
| 7. Gender | −0.03 | −0.05 | −0.03 | −0.04 | 0.07 | −0.20** | / | 63.4% | / | / | / |
| 8. Time in host country | −0.01 | −0.01 | 0.01 | 0.06 | 0.08 | −0.12 | −0.05 | 190.08 (80.44) | / | / | / |

**$p < 0.01$, ***$p < 0.001$.
ARS = Acceptance, Reframing, and Striving; Gender is coded (1 = Male, 0 = Female); Time in host country is in days.

TABLE 2 The moderating effect of wise reasoning on the relationship between COVID-19 stress and anxiety.

| | step 1 | | step 2 | | step 3 | |
|---|---|---|---|---|---|---|
| | beta | SE | beta | SE | beta | SE |
| Gender | −0.08 | 0.14 | −0.09 | 0.13 | −0.09 | 0.12 |
| Age | 0.01 | 0.03 | −0.009 | 0.02 | −0.002 | 0.02 |
| Time in host | 0.08 | 0.001 | 0.09 | 0.001 | 0.09 | 0.001 |
| COVID-19 Stress | | | 0.42*** | 0.06 | 0.43*** | 0.06 |
| Wise-reasoning | | | 0.17** | 0.06 | 0.15** | 0.06 |
| Wise-reasoning × COVID-19 | | | | | −0.13* | 0.06 |
| **model statistics** | | | | | | |
| $R^2$ | 0.01 | | 0.22 | | 0.23 | |
| $\Delta R^2$ | 0.01 | | 0.20 | | 0.02 | |
| *F* | 0.85 | | 28.23 | | 4.70 | |
| *df* | (3, 220) | | (2, 218) | | (1, 217) | |

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Gender is coded (1 = Male, 0 = Female).
Wise-reasoning and COVID-19 Stress were standardized in prior.

two-way interaction of COVID-19 stress by coping was not significant ($\beta = -0.09$, $p = 0.15$). Thus, contrary to our predictions, hypothesis 3 failed to be supported.

Finally, to test if wise-reasoning (H4) would impact the relationship between anxiety and COVID-19 stress, we conducted the same three-step hierarchical regression technique (Table 2). In the first step, anxiety was regressed on control variables. Next, we added in main variables: wise-reasoning and COVID-19 stress. In the final step, the two-way interaction of COVID-19 stress by wise-reasoning was significant ($\beta = -0.13$, $p < 0.05$). The interaction term added 2% of unique variance in anxiety, $\Delta F\,(1, 217) = 4.70$, $p < 0.05$. Thus, Hypothesis 4 was supported.

To decompose this interaction, simple slope analyses were performed. The first simple slope analysis (Figure 1A) showed that wise-reasoning decelerated the positive association between stress and anxiety. Specifically, when participants reported low levels of wise-reasoning, stress was positively associated with anxiety ($\beta = 0.61$, $p < 0.001$, $d = 1.06$). However, with high levels of wise-reasoning, stress was also positively associated with anxiety, but to a smaller degree ($\beta = 0.30$, $p < 0.01$, $d = 0.40$). To further understand the interaction, we conducted a second simple slope analysis, swapping the independent and moderating variables (Figure 1B). Results showed that for low-level COVID-19 stress, wise-reasoning is positively associated with anxiety ($\beta = 0.32$, $p < 0.001$, $d = 0.56$), but in the contrast, for high-level COVID-19 stress, the relationship between wise-reasoning and anxiety is eliminated ($\beta = 0.01$, $p = 0.92$).

## Discussion

This study investigated how Chinese international students (CIS) responded to an abrupt lifestyle change because of the COVID-19 pandemic outbreak. We argue that these individuals experienced a "double blow" because their first exposure to the pandemic included "remote" worries and anxiety for their family members back in China, and then they later experienced first-hand lockdowns and pandemic stressors. These lockdowns led to important life changes for many people around the world. In this study, we found an unsurprising result that COVID-19 stress was associated with more anxiety especially among CIS. We further expanded COVID-19 research [as called for by Kulich et al. (2021)] by investigating the potential moderating effect of two coping strategies (ARS and family support) and an alternative strategy wise-reasoning. While we did not observe the buffering effect of ARS and family

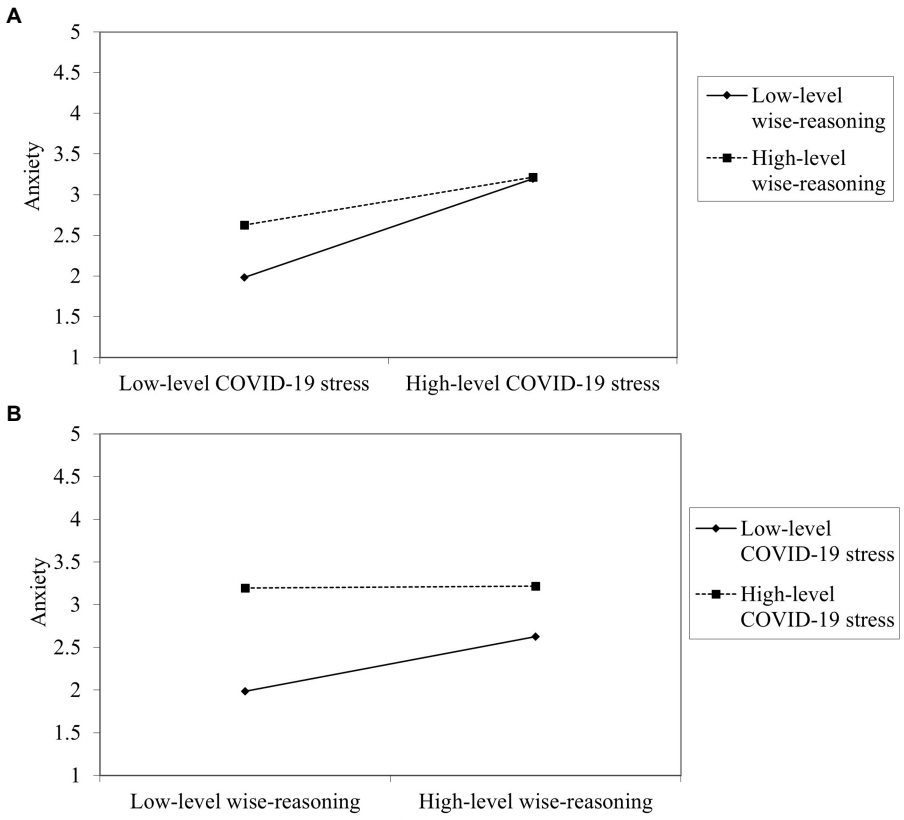


FIGURE 1
**(A)** Simple slope analysis of the moderating effect of wise-reasoning on the relationship between COVID-19 stress and anxiety; **(B)** Simple slope analysis of the moderating effect of COVID-19 stress on the relationship between wise-reasoning and anxiety.

support on the relationship between COVID-19 stress and anxiety, our results found support for the wisdom-approach literature, yet in a surprising moderating way. Our major contributions are described below.

## Traditional coping did not mitigate anxiety induced by stress

Interestingly, our results show that the two coping strategies ARS and family support were not associated with anxiety. Though a surprising finding of this study, it is perhaps explainable. In a cross-national COVID-19 related study of more than 8,000 people in 67 countries (van Mulukom et al., 2020), researchers found coping mechanisms were not effective in reducing the negative effects of pandemic stress. They noted,

> "…that these coping mechanisms (adaptative coping and instrumental support) are possibly not as effective as they would be in a life outside of lockdown, thus frustrating the individuals more than they contribute"(van Mulukom et al., 2020).

Our coping results follow this pattern as we find little empirical evidence in this sample that collective coping strategies like acceptance, reframing and striving (ARS) and family support aided CIS in reducing pandemic uncertainty and COVID-19 stress.

## Wise-reasoning did moderate anxiety and stress

The major contribution of this study is uncovering the moderation effect of wisdom. As stated above, wise reasoning is a tendency to reflect deeply on a social situation, that is, to consider different perspectives (Zhang et al., 2022). We discovered that CIS with a high-level of wise-reasoning appeared to be already alert to the COVID-19 situation when stress was low, thus when they perceived an increase in COVID-19 stress, it did not affect them as dramatically as CIS with a low level of wise-reasoning. For example, during that first lockdown, COVID-19 stress might have prompted people's immediate responses of stocking up on food and personal protective equipment and dealing with the abrupt changes in schools (closure or online class) and personal life (Ben Hassen et al., 2021). Wise-reasoners tend to critically manage a tumultuous crisis like the pandemic and though they might have

more anxiety at times, this can be advantageous in guiding them to good wise decisions that then help protect them from a higher level of stress.

According to earlier research, wisdom plays a crucial role in cross-cultural adaptation and dealing with upcoming obstacles in life (Bao et al., 2022) especially for those from collective traditions. Our finding is consistent and further revealed the effect of wise-reasoning and its role moderating the relationship between stress and anxiety in the context of COVID-19 pandemic. A wise-reasoner will adopt different perspectives, embrace change, or take it into careful consideration to advance the best way to better manage the drastic life shifts or stresses that COVID-19 entails. At times of low-level COVID-19 stress, these anticipatory thoughts and actions may at times cause individuals with high-level wise-reasoning to feel more anxious than individuals with low-level wise-reasoning. However, our research highlights that being vigilant is not negative and should be considered alongside other indicators, such as infection rates and response behaviors that help control the spread of COVID-19. In fact, research on Yemen health care providers offers evidence for supporting the positive link between moderate anxiety and health preventative behaviors towards COVID-19 (Alrubaiee et al., 2020). This implies that mild anxiety is positive in encouraging people to establish healthy coping actions when a crisis arises. Future research is needed to fully understand how wise-reasoning, anxiety, health preventative behaviors, and COVID-19 infection rates are related.

## Strengths and limitations

The strengths of the current study are noteworthy. First, we reported findings from a unique sample during a sensitive window of the pandemic shutdown. From the acculturation perspective, we argued that sojourners are more impacted by COVID-19 than other majority member groups. To our knowledge, very limited acculturation literature has surfaced on how sojourning groups have encountered COVID-19 life in the first wave of COVID-19 (Lee and Waters, 2021). Specifically, our study has investigated the Chinese international students and argued they were a vulnerable group as they suffered the "double blow" effect of the COVID-19 pandemic and encountered a great variety of challenges during the shutdown.

Second, we found supportive evidence of the role of wise-reasoning and its link to pandemic stress and anxiety. Specifically, when stress levels are low, wise-reasoning might promote people's anxiety, but once stress reaches a certain point, this impact vanishes. This could be connected to wise-reasoning characteristics that extend people's perspectives and keep them alert when faced with uncertainty. During the pandemic, an increased vigilance and recognition of the extenuating circumstances is warranted and Chinese international students or other types of sojourners should be realistic about the devasting nature of this pandemic.

However, several limitations must be mentioned.

First, while researchers collected a relatively-large sample, one third (n = 79) had already returned to China. Pandemic samples for other studies, especially those in the early stages of the pandemic, are unevenly distributed and this study is no different as we sought to collect data at that critical time from students in 15 countries. Since each country had different pandemic policies and the timing and intensity of the infection varied, responses from students naturally may differ. Different data might have been needed, other statistical tools, or a greater size of samples may have been needed to tease apart any meaningful differences.

Second, the study did not follow up the CIS's acculturative adjustment towards the COVID-19 pandemic over time. There were many unknown, ever-changing situations that might have had an impact on students' coping strategies, wisdom, or their psychological outcomes. Had it been possible, a longitudinal study would have been helpful to mitigate uncertainties of each population over time.

## Implications

Despite the limitations above, this study has several implications.

First, we address a noted gap by studying a sample from a large contingent of international students. Before the COVID-19 in 2020, a total of 993,367 Chinese students studied overseas at a tertiary level, among which 333,935 were in the United States, 143,323 in Australia and around 200,000 students in European countries(United Nations Educational, Scientific and Cultural Organization, 2020). These Chinese international students (CIS) have been overlooked, displaced, and in some situations misunderstood as a result of the pandemic, and are not only worthy of study, but serve as a sample that may provide some unique insights into the coping literature due to their being a from an acknowledged collective- and wisdom-oriented culture. Future research can further uncover more problems and possible solutions for what sojourners and migrant groups are experiencing in this continuing (and hopefully soon past post-) COVID-19 era.

Next, while the protective role of wise-reasoning for international students under the COVID-19 crisis has been brought to the fore, finding effective strategies to foster this feature is also a promising research direction. One of the primary techniques that researchers rely on to foster wise-reasoning is ego-decentering (i.e., self-distancing), which includes considering an issue or situation from the standpoint of a detached observer rather than one's own perspective (Kross and Ayduk, 2011; Kross and Grossmann, 2012; Grossmann and Dorfman, 2019). Some evidence suggests that ego-decentering strategies that promote wise reasoning can enhance various behaviors, such as long-term environmental protection, healthy eating behaviors, and interpersonal perceptions (Leitner et al., 2017; Hou et al., 2018; Hussain et al., 2021). However, research on improving wise reasoning through self-decentralization strategies to protect individuals, especially international students, from the pressure of COVID-19 is scarce. As a result, future research could use this study as a starting point to investigate whether cultivating wise reasoning can be effective in reducing the epidemic's

maladjustment among international students, and even expand it to the broader community.

## Conclusion

In conclusion, this research pinpoints clear ways in which wise-reasoning might be a part of the reappraisal of stressful experiences and might be associated with a more "realistic pandemic mindset." This research addressed an important gap in the wisdom literature by uncovering how wise reasoning can sometimes moderate the relationship between stress responses and anxiety. Possibly the wisest response in such an uncertain situation is to be adequately anxious (alert, vigilant) and become better prepared (for an adaptive response).

## 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 Intercultural Institute at Shanghai International Studies University (Research Project Protocol # 2020-UNI-0211). The patients/participants provided their written informed consent to participate in this study.

## Author contributions

AE and YD were responsible for the concept and design of the study, data collection and analysis, interpretation of results, and writing and critical review of the manuscript. QZ was responsible for data analysis, interpretation of results, revision, and review of the manuscript. SK was responsible for providing overall program supervision and reviews of the manuscript. All authors contributed to the article and approved the submitted version.

## Funding

This research and the APC were funded by National Natural Science Foundation of China, grant number 72101232.

## 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/fpsyg.2022.983875/full#supplementary-material

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frontiers | Frontiers in Psychology

TYPE Brief Research Report
PUBLISHED 24 October 2022
DOI 10.3389/fpsyg.2022.1049077



OPEN ACCESS

EDITED BY
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SPECIALTY SECTION
This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology

RECEIVED 20 September 2022
ACCEPTED 10 October 2022
PUBLISHED 24 October 2022

CITATION
Huang L, Zhu Y, Kang W and Zhu C (2022) A survey study of Chinese adolescents' mental and interpersonal quality: Evidence from COVID-19 pandemic.
*Front. Psychol.* 13:1049077.
doi: 10.3389/fpsyg.2022.1049077



# A survey study of Chinese adolescents' mental and interpersonal quality: Evidence from COVID-19 pandemic

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Since 2019, the COVID-19 pandemic, as a global public health emergency, has led to stringency measures (such as lockdown) of various degrees worldwide. As these measures such as social distancing measures and mandatory lockdown are intended to minimize social mobility, they have exerted remarkable impact on individuals' mental health, particularly, adolescents and children. The mental health problems caused include fear, anxiety, sense of isolation and development of more maladaptive behaviors due to prolonged lockdown and restricted interpersonal contact. However, well adaption status and stable interpersonal relationships play an important role in maintaining and promoting the mental health of adolescents and children. This study aims to gain a new sight of understanding of the mental health quality of Chinese adolescents during the COVID-19 Pandemic in terms of adaptation and interpersonal quality. The study is based on a survey on a total of 7,318 junior and senior high school students aged 12–18years in various regions of China, and intended to examine the differences in adolescent mental health quality by sociodemographic variables such as gender, grade, urban and rural areas, only child, and parental education level. Our study finds that Chinese adolescents show an overall good adaptation and interpersonal quality during the lockdown. However there exists disparity across different categories in developmental patterns of adaptation and interpersonal quality. In addition, good family environment, moderate financial and emotional support, higher parental education level, etc. contribute to the cultivation and improvement of adolescents' mental health quality. Finally, we suggest that the government and researchers should pay more attention to adolescents' mental health issues in terms of adaption status and interpersonal relationships during the COVID-19 pandemic, especially for disadvantaged social groups such as girls, younger students, and low-income family students.

KEYWORDS

**COVID-19, adolescents, adaptation status, interpersonal quality, grade differences**

## Introduction

During COVID-19 pandemic, governments adopt strict anti-virus measures and restrict human contact to avoid the spread of the virus (Fang et al., 2021; Galli et al., 2022), but this had a very negative impact on the mental health and behavior of individuals (Conti et al., 2020; Velavan and Meyer, 2020; Panda et al., 2021). Studies have found that after isolation and lockdown, children between the ages of 1.5 and 18 are more likely to experience irritability, obsessive–compulsive disorder, post-traumatic stress disorder, and thinking problems among others (Conti et al., 2020). It has also been reported that children who lack outdoor activities and opportunities to interact with their peers feel fearful, anxious, isolated, and develop more maladaptive behaviors due to the prolonged closure of public places such as schools, parks, and theaters (Duan et al., 2020; O'Sullivan et al., 2020; Yeasmin et al., 2020). This has a serious impact on their schooling and daily life, and can even lead to the development of mental illness and pose security risks to social development (Czeisler et al., 2020). Primary and secondary school is a critical period of growth and development for individuals who experience a series of significant physiological and psychological changes, and mental health is as important as physical health. Studies have shown that anxiety, depression, irritability, learning difficulties, adjustment disorders in interaction, and difficulties in adapting to the social environment are among the various common behavioral and psychological problems during COVID-19 pandemic (Colizzi et al., 2020; Duan et al., 2020). These problems also partly reflect the huge impact of the pandemic on the psychological growth of adolescents in both China and other countries (Cao et al., 2020; Husky et al., 2020; Charbonnier et al., 2022).

WHO defines health as "complete physical, mental, and social well-being, not merely negatively as the absence of disease or infirmity" (Grad, 2002). The mental health of adolescents is closely related to good adaption status and stable interpersonal relationships (Killgore et al., 2020; Wang et al., 2021). These intrinsic and relatively stable psychological qualities, formed by a combination of genetic and environmental factors, influence or determine the social, psychological, and physiological functions of individuals, which in turn affects their mental health status.

Therefore, the measures such as social distancing and mandatory lockdown have exerted remarkable impact on Chinese adolescents' mental health. This paper aims to give a new sight of the mental health quality of Chinese adolescents during the COVID-19 pandemic in terms of adaptation and interpersonal quality. It is based on a survey on a total of 7,318 junior and senior high school students aged 12–18 years in various regions of China, and intended to examine the differences in adolescent mental health quality by sociodemographic variables such as gender, grade, urban and rural areas, only child, and parental education level. COVID-19 is spreading rapidly worldwide starting in late 2019 (Lima et al., 2020). As the case and severity of COVID-19 pandemic increase, mental health issues in adolescents need to be given high priority along with psychosocial support for patients and medical personnel (Xiong et al., 2022). Considered a survey on a total of 7,318 junior and senior high school students aged 12–18 years in various regions of China, this study intends to examine the differences in adolescent mental health quality by sociodemographic variables such as gender, grade, urban and rural areas, only child, and parental education level.

In addition, with regard to education policy, the issue of health care and reducing the burden of studies for China's adolescents and children has been repeatedly urged and emphasized. Through documents such as the policy of ease the burden of excessive homework and off-campus tutoring for students undergoing compulsory education, the policy is clear in terms of reducing the burden in and outside school, reducing the burden of examination, evaluation, homework, and regulating the use of electronic products, etc., and the need to care for the health of primary and secondary school students in terms of eyesight, sleep, and body has been pointed out, urging schools and parents to raise awareness of students' physical and mental health development. However, with the education disruptions and uncertain future during the pandemic, a large number of students reported experiencing various problems, such as studies troubles, emotional frustrations, and conflicts between parents and children among others (Lee, 2020).

The psychological state of students has been affected by the changes in society and the times. However, there are few studies on the impact of the COVID-19 epidemic and its related control measures on the mental health quality of adolescents. Therefore, in the context of COVID-19 pandemic and the policy of ease the burden of excessive homework and off-campus tutoring for students undergoing compulsory education, it is important to investigate the latest situation of the adaption status and interpersonal quality of Chinese adolescents, understand their trend, and analyze their influencing factors to more effectively carry out mental health education that is in line with the development characteristics of the times and the actual needs, and eliminate as much as possible the negative psychological and emotional influences, so that students' physical and mental health can be promoted.

## Materials and methods

### Respondents

From April 1st to 30th, 2022, a total of 8,013 questionnaires were distributed to junior and senior high school students in China's East and North regions using cluster sampling, and 7,318 valid questionnaires were obtained, with an effective rate of 91.3%. To select these regions, Chinese adolescents in these areas are well educated and participate in rich extracurricular activities. Their mental and interpersonal quality after the suddenly epidemic are more enlightening. More, these regions are relatively developed in China's economy, which provided more communications for

Chinese adolescents. Among them, 3,351 (45.79%) were male students and 3,967 (54.21%) were female students; 4,258 (58.19%) were junior high school students (19.20% in the first year, 20.59% in the second year and 18.40% in the third year) and 3,060 (41.81%) were senior high school students (20.11% in the first year and 21.70% in the second year); 4,017 (54.89%) were rural students and 3,301 (45.11%) were urban students; 2,625 (35.87%) were only child, 4,693 (64.13%) were non-only child. The 7,318 junior and senior high school students ranged in age from 12 to 18 years, with the average age of 15.37 ± 1.46 years, no history of neurological or mental disorders, and no pervasive developmental disorders. All tested adolescents signed an informed consent form before took the test.

## Tools

Our study uses Adaptation Scale for Adolescent (ASA). ASA contains six dimensions, including biological adaptation, emotional adaptation, interpersonal adaptation, study adaptation, social adaptation, and living adaptation, with a total of 22 questions. The higher the ASA score, the easier the individual is to adapt to the environment and physical and mental changes, i.e., the better the adaptation status. In this study, the Cronbach's alpha coefficient for this scale was 0.95.

The study also uses Interpersonal Communication Scale (ICS). ICS contains three dimensions, including the ability of communication, interpersonal monitor, and interpersonal perception, with 16 questions. Scale items are scored from 1 point (not at all) to 5 point (fully), and the scores of each dimension are summed and averaged as the dimension score; the total average score is calculated by summing the scores of all items. The higher the ICS score, the better the individual is at interpersonal communication, the more he/she is able to perceive and experience the needs of others in communication, and more prominent the initiative and effect at interacting with objects. In this study, the Cronbach's alpha coefficient for this scale was 0.94.

## Statistical processing

Excel was used to enter and organize the data. Subsequently, SPSS 23.0 software was used for statistical processing of the data. Statistical methods such as descriptive statistics, t test and analysis of variance were mainly used to analyze the data. Differences were considered statistically significant at $p < 0.05$.

# Results

## Characteristics of the adaptation status of Chinese adolescents

Figure 1 Frequency distribution of Chinese adolescents on adaptation scores.

The data of 7,318 adolescents who participated in the survey were analyzed, and the results showed that the mean of the adaptation score of Chinese adolescents was 3.87, the standard deviation was 0.73, and the 95% confidence interval of the overall mean was 3.85 to 3.88. Data distribution was in line with normal distribution, with a skewness coefficient of-0.43. The skewness coefficient is less than 0; that is, when the heavy tail is on the left, the distribution is biased to the left. And, a kurtosis coefficient of 0.36. The kurtosis is greater than 0, the overall data distribution is steep compared with the normal distribution, which is a peak. The results are shown in Figure 1.

## Characteristics of interpersonal quality of Chinese adolescents

Figure 2 Frequency distribution of Chinese adolescents on interpersonal quality scores.

The data of 7,318 adolescents who participated in the survey were analyzed, and the results showed that the mean of the adaptation score of Chinese adolescents was 3.77, the standard deviation was 0.73, and the 95% confidence interval of the overall mean was 3.76 to 3.79. Data distribution conformed to a normal distribution, with a skewness coefficient of-0.22. The skewness coefficient is less than 0; that is, when the heavy tail is on the left, the distribution is biased to the left. And, a kurtosis coefficient of 0.25. The kurtosis is greater than 0, the overall data distribution is steep compared with the normal distribution, which is a peak. The results are shown in Figure 2.

## Analysis of the trend of adaptation status and interpersonal quality of Chinese adolescents

One-way ANOVA results showed significant differences in overall scores across grades on ASA ($F = 6.06$, $p < 0.001$), but not on the ICS ($F = 0.90$, $p > 0.05$). Further analysis of the dimensions of each scale revealed that there was a grade effect ($p < 0.05$) for all dimensions except emotional adaptation on the ASA and interpersonal monitor on the ICS. As can be seen from Table 1, in terms of biological and study adaptation, the scores were highest in junior one students, gradually decreasing as the grade went up, lowest in junior three, rebounding in the first year of senior high school, but decreasing again after that; in terms of interpersonal, social, and living adaptation, the highest scores were obtained in junior one, gradually decreasing as the grade increased, the lowest scores were obtained in junior third, and the trend of recovery was observed in the first and second years of senior high school; as to the ability of communication, the highest score was obtained in junior one, gradually decreasing as the grade increased, the lowest score was obtained in junior three, and the recovery trend was shown in the first and second years of senior high school; the score of interpersonal perception was the lowest in junior one, increasing in two, and decreasing in junior three, and the highest

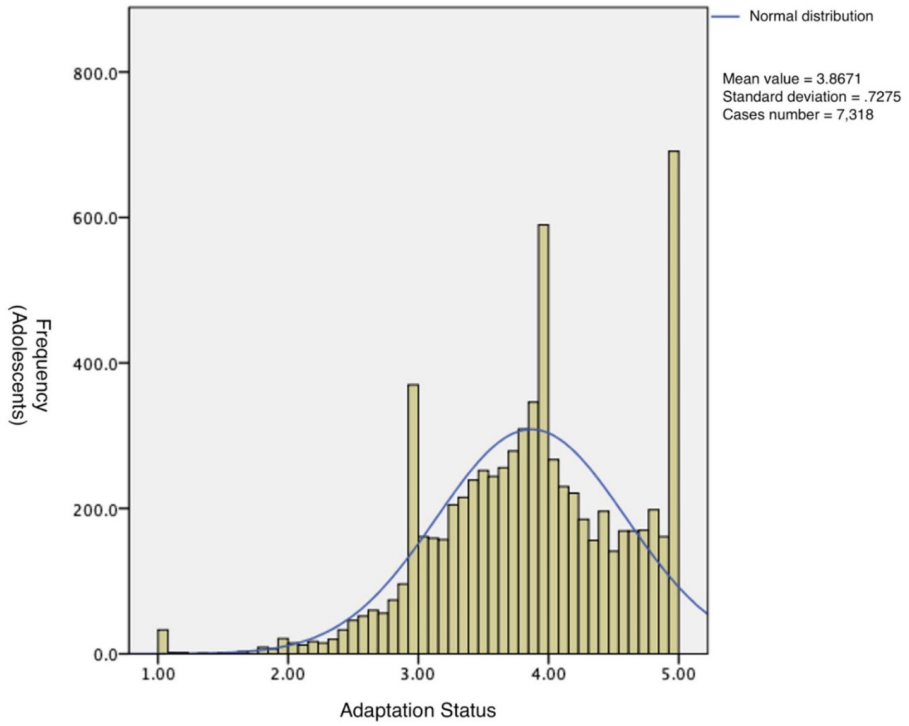


FIGURE 1
Adaptation status of Chinese adolescents. Horizontal coordinates describe the frequency of adolescents. And, the vertical coordinates describe the adaptation status.

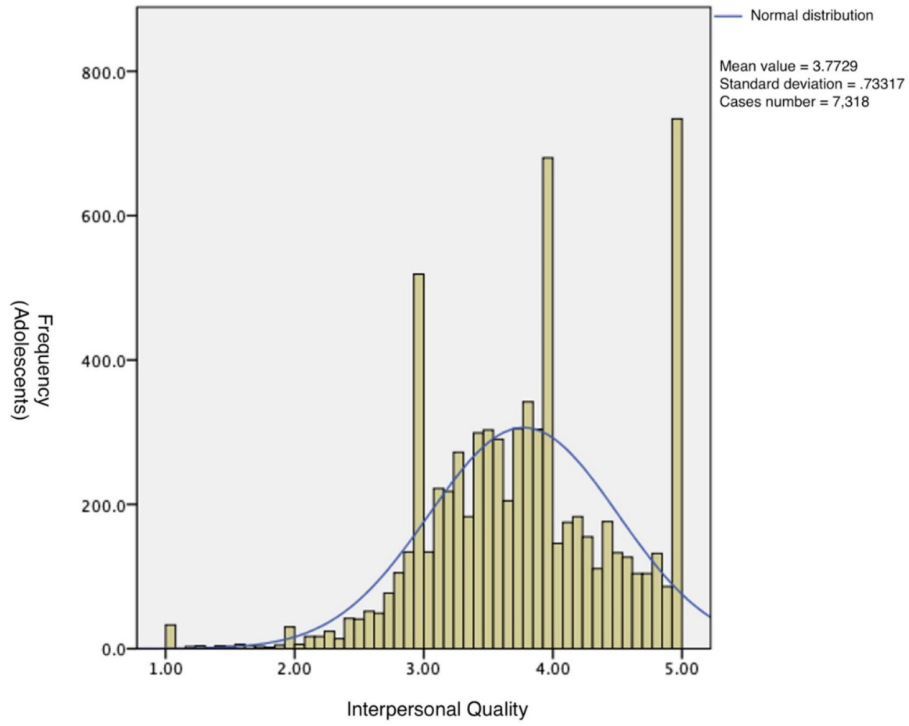


FIGURE 2
Interpersonal quality of Chinese adolescents. Horizontal coordinates describe the frequency of adolescents. And, the vertical coordinates describe the interpersonal quality.

TABLE 1 Trends in adaptation and interpersonal quality of Chinese adolescents in post-epidemic era.

| Variables | Dimension | Junior one ($n$ = 1,405) | Junior two ($n$ = 1,507) | Junior three (n = 1,346) | Senior one ($n$ = 1,472) | Senior two ($n$ = 1,588) | $F$ value | $p$ value |
|---|---|---|---|---|---|---|---|---|
| Adaptation status | Biological adaptation | 3.89 ± 1.01 | 3.86 ± 0.99 | 3.75 ± 1.07 | 3.90 ± 0.96 | 3.87 ± 0.96 | 4.88 | 0.001 |
| | Emotional adaptation | 3.84 ± 0.85 | 3.78 ± 0.89 | 3.76 ± 0.88 | 3.79 ± 0.85 | 3.78 ± 0.81 | 1.59 | 0.175 |
| | Interpersonal adaptation | 3.89 ± 0.83 | 3.83 ± 0.87 | 3.76 ± 0.89 | 3.82 ± 0.82 | 3.86 ± 0.80 | 4.34 | 0.002 |
| | Study adaptation | 3.95 ± 0.84 | 3.81 ± 0.91 | 3.76 ± 0.91 | 3.77 ± 0.87 | 3.76 ± 0.87 | 12.31 | 0.000 |
| | Social adaptation | 3.94 ± 0.85 | 3.92 ± 0.85 | 3.85 ± 0.88 | 3.89 ± 0.83 | 3.91 ± 0.80 | 2.47 | 0.042 |
| | Living adaptation | 3.96 ± 0.86 | 3.86 ± 0.89 | 3.82 ± 0.90 | 3.85 ± 0.87 | 3.86 ± 0.86 | 5.20 | 0.000 |
| | Overall score | 3.94 ± 0.70 | 3.87 ± 0.73 | 3.80 ± 0.77 | 3.86 ± 0.73 | 3.87 ± 0.70 | 6.06 | 0.000 |
| Interpersonal quality | Ability of communication | 3.77 ± 0.87 | 3.67 ± 0.94 | 3.65 ± 0.95 | 3.67 ± 0.93 | 3.67 ± 0.88 | 3.65 | 0.006 |
| | Interpersonal monitor | 3.99 ± 0.75 | 4.00 ± 0.76 | 3.96 ± 0.80 | 3.97 ± 0.74 | 3.99 ± 0.72 | 0.78 | 0.541 |
| | Interpersonal perception | 3.57 ± 0.88 | 3.66 ± 0.89 | 3.61 ± 0.90 | 3.71 ± 0.83 | 3.70 ± 0.82 | 6.52 | 0.000 |
| | Overall *score* | 3.78 ± 0.71 | 3.78 ± 0.74 | 3.74 ± 0.78 | 3.78 ± 0.73 | 3.79 ± 0.70 | 0.90 | 0.460 |

score was obtained in senior one, but decreasing trend was observed after that.

## Analysis of adaptation status and interpersonal quality differences among Chinese adolescents

According to the analysis results, male students scored significantly higher than female students on both ASA and ICS ($p$ <0.001), urban students were higher than rural students ($p$ <0.001), only children were higher than non-only children ($p$ <0.001), and statistically significant differences existed between the scores of students with different levels of parental education ($p$ < 0.001).

In terms of adaptation status and interpersonal qualities, students with fathers' education level of junior high school and below scored significantly lower ($p$ < 0.05) than students with fathers' education level of senior high school, specialized secondary school, junior college, Bachelor, Master and above; students with mothers' education level of junior high school and below scored significantly lower than students with mothers' education level of senior high school, specialized secondary school, junior college, and Bachelor ($p$ < 0.001) (see Table 2).

# Discussion

The study result showed that Chinese adolescents performed better in terms of adaptation status and interpersonal quality during the COVID-19 pandemic, with mean scores above 3, and their overall level was high. This indicates that, when facing various problems in school, life, and society brought about by major public health emergencies, Chinese adolescents are able to flexibly adopt strategies and methods to positively adapt and solve them. On the one hand, most of the respondents are located in East and North China, which have large populations, better economic development, abundant medical resources and a complete medical system, where epidemics can be effectively controlled and prevented, thus greatly enhances the sense of security and well-being of adolescents in these regions. On the other hand, the policies set forth and implemented by the Chinese government provide unique opportunities and conditions for youth to highly develop their adaptive and interpersonal skills, which have a positive impact on the mental health quality of adolescents. For example, Chinese teachers usually play melodic and soothing music after school online to shape students' values and relieve their stress, and encourage regular and moderate exercise at home, which not only improves physical function and health, but also regulates individual emotions and improves poor mood and psychology (Lin and Xu, 2020). Therefore, during the pandemic, Chinese adolescents showed good performance in terms of adaptive skills, social interactions, and building good interpersonal relationships.

Chinese adolescents' scores on most dimensions of adaptation show a trend of higher scores from the first year of junior high school, decreasing as grade increases, and increasing in senior one and two, which is consistent with previous studies (Zhou et al., 2020). This may be due to the fact that learning tasks and social life are relatively simple in junior high school, and there are fewer psychological conflicts and contradictions, so students have a good self-perception of their adaptation status in all aspects. However, as students grow older, the physiological changes in adolescent development, the increase of studies

TABLE 2 Comparison in adaptation and interpersonal quality among Chinese adolescents (M±SD).

| Variables | Classification | Adaptation status | Interpersonal qualities |
|---|---|---|---|
| Gender | Male ($n$ = 3,351) | 3.93 ± 0.76 | 3.82 ± 0.77 |
| | Female ($n$ = 3,967) | 3.81 ± 0.70 | 3.73 ± 0.69 |
| | $t$ value | −6.68 | −5.18 |
| | $P$ value | 0.00 | 0.00 |
| Urban and rural | City ($n$ = 3,301) | 3.94 ± 0.71 | 3.84 ± 0.71 |
| | Rural ($n$ = 4,017) | 3.81 ± 0.74 | 3.72 ± 0.75 |
| | $t$ value | 8.03 | 7.16 |
| | $P$ value | 0.00 | 0.00 |
| Only child | Yes ($n$ = 2,625) | 3.93 ± 0.71 | 3.82 ± 0.73 |
| | No ($n$ = 4,693) | 3.83 ± 0.73 | 3.75 ± 0.74 |
| | $t$ value | −5.22 | −3.78 |
| | $P$ value | 0.00 | 0.00 |
| Father's education level | Junior high school and below ($n$ = 3,851) | 3.78 ± 0.73 | 3.70 ± 0.75 |
| | Senior high school and specialized secondary school ($n$ = 2,035) | 3.93 ± 0.72 | 3.85 ± 0.71 |
| | Junior college ($n$ = 775) | 4.01 ± 0.67 | 3.86 ± 0.70 |
| | Bachelor ($n$ = 585) | 4.00 ± 0.71 | 3.86 ± 0.70 |
| | Master and above ($n$ = 72) | 4.04 ± 0.75 | 3.96 ± 0.78 |
| | $F$ value | 32.28 | 20.83 |
| | $p$ value | 0.00 | 0.00 |
| Mother's education level | Junior high School and Below ($n$ = 4,239) | 3.79 ± 0.73 | 3.70 ± 0.73 |
| | Senior high school and Specialized Secondary School ($n$ = 1,776) | 3.95 ± 0.73 | 3.86 ± 0.74 |
| | Junior college ($n$ = 699) | 4.03 ± 0.66 | 3.88 ± 0.69 |
| | Bachelor ($n$ = 545) | 4.02 ± 0.67 | 3.87 ± 0.69 |
| | Master and above ($n$ = 59) | 3.86 ± 0.86 | 3.84 ± 0.85 |
| | $F$ value | 34.36 | 22.13 |
| | $p$ value | 0.00 | 0.00 |

pressure, and the complexity of interpersonal relationships, psychological conflicts and contradictions arise constantly, and students may experience some degree of maladaptation in various aspects (Jin et al., 2022). The contrast between their independent self-consciousness and immature psychological development also leads to swings in interpersonal development. In addition, students at this stage are mainly devoted to intense studying, and the pressure of studies and further education may lead to a downward trend as they do not have sufficient time to consciously experience and enhance interpersonal relationships, limiting their opportunities for interpersonal interaction. Lin and Li (2005) found that students in the first and second years of senior high school have entered the mid-youth stage, as individuals' thinking (cognitive, intellectual) and morals (sociality) are gradually stabilizing, physiological and psychological development also tend to mature, personality has been basically set, lifestyle basically tends to be fixed and habitual, adaption status and social skills increase, and therefore, tend to be stable and rebound in terms of adaptive status and interpersonal quality. It is clear from this that adaptation in the lower grades is not at the same level of that in the upper grades, i.e., adaptation in the lower grades is only at a low level, while adaptation in the upper grades is at a high level. However, this study was not able to select college students as subjects, so further research is needed to support this conclusion.

This study also found that male students scored significantly higher than female students on both ASA and ICS.

Compared with rural students, urban students have better living conditions and educational resources, a good family environment, and their parents pay more attention to children's growth and education. Students from only child families receive more financial and emotional support in their studies and lives, and their adaptive skills and interpersonal relationships are better than those of students from non-only child families in all aspects. This is consistent with related research (Magnuson and Duncan, 2006). Rural students will be under more financial and psychological pressure, and, due to their limited family conditions and high studies and living expenses, most rural students will choose to earn their living expenses through tutoring and work-study program, which will increase their learning and social pressure at the same time. However, such students may be in financial difficulties due to the epidemic (Fang et al., 2022). Multiple stresses may contribute to rural students' mental health problems in adaptation, interpersonal communication among others. This is also true for students from non-only child families. Parents with higher education levels are more adaptable and socially competent, more optimistic in dealing with problems (Xiao et al., 2020), and more concerned about all aspects of their children's development and education, thus playing an important role in their children's growth, through genetic factors and by personal example as well as verbal instruction. Meanwhile, well-educated parents usually have higher socio-economic status, better material base and more social experience (Sánchez-Rodríguez et al., 2022), and are able to create a better learning and living environment for their children, especially with a reasonable education, which is conducive to their children's physical and mental growth (Cao et al., 2020). For example, during the COVID-19 pandemic, these parents engage their children in online classes, online interactions, and video games by means of smartphones and other digital technologies to enhance their children's studies motivation and well-being (Limone and Toto, 2022), and these parents strictly control their children's use of

smartphones and other digital technologies to prevent children from developing negative emotional and psychological problems due to excessive dependence on digital devices (Ravens-Sieberer et al., 2021; Vuorre et al., 2021). This suggests that, during the COVID-19 pandemic, a good family environment, moderate financial and emotional support, and higher parental education level, among others, contribute to the cultivation and improvement of adolescents' mental health qualities. Therefore, the government and schools should pay more attention to the psychological dynamics of vulnerable groups such as girls, lower grades students, poor students, and non-only child during the epidemic, and provide them with necessary economic support and mental health services.

## Limitations

First, this study lacks data from the pre-pandemic period and control groups in the longitudinal study. Second, the various assessment variables involved in the study were derived from subjects' self-perception reports, and there may be a social desirability effect. Finally, only two variables of mental health quality, adaptive ability and interpersonal quality, were selected for analysis, and thus we could not provide a systematic and in-depth understanding of the overall mental health quality of Chinese adolescents during the pandemic. However, the pandemic is now continuing to worsen and may bring additional changes and problems to the minds and bodies of children and adolescents. Future studies could conduct further longitudinal studies to expand the sample source and cover more psychological variables to track the long-term effects of the COVID-19 pandemic on various aspects of children's and adolescents' mental health.

## Conclusion

In this paper, we analyzed and compared the adaptation status and interpersonal quality of Chinese adolescents in different grades and categories, and found that a series of restrictive measures during the COVID-19 epidemic had a certain degree of negative impact on Chinese adolescents' mental health quality, but generally showed a good status. In addition, this study emphasizes the importance of a good family environment, moderate emotional communication, and peer support for adolescents' mental health during the lockdown and isolation of the pandemic.

## Data availability statement

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

## Author contributions

LH and YZ: conceptualizing, writing, and drafting-original draft. WK: data and methodology. CZ: review and editing. All authors contributed to the article and approved the submitted version.

## Conflict of interest

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

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 05 December 2022
DOI 10.3389/fpsyg.2022.1018097



OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology

RECEIVED 12 August 2022
ACCEPTED 16 November 2022
PUBLISHED 05 December 2022

CITATION
Huang Y, Guan Z, Yan F, Wiley JA, Reynolds NR, Tang S and Sun M (2022) Mediator role of presence of meaning and self-esteem in the relationship of social support and death anxiety. *Front. Psychol.* 13:1018097. doi: 10.3389/fpsyg.2022.1018097



# Mediator role of presence of meaning and self-esteem in the relationship of social support and death anxiety

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**Introduction:** Death anxiety has increased following the COVID-19 pandemic. Although terror management theory has suggested social support, presence of meaning and self-esteem functioned as death anxiety buffers, few existing works have explored the mechanism of how social support, presence of meaning, and self-esteem buffer death anxiety. To identify these mechanisms is the aim of this study.

**Methods:** Our cross-sectional study was conducted with 1167 people in China from 19 May 2020 to 1 June 2020 during the COVID-19 outbreak. The average age of participants was 26 years. Data were by questionnaire, including demographic information, the Templer's Death anxiety scale, the multidimensional scale of perceived social support, the presence of meaning scale, and the Rosenberg self-esteem scale.

**Results:** Results using structural equation modeling showed presence of meaning and self-esteem fully mediated the relationship between social support and death anxiety, respectively and sequentially. The proposed model showed good fit of indices: $\chi^2 = 243.384$, df = 58, $p < 0.001$; CFI = 0.968, TLI = 0.954, RMSEA = 0.052, SRMR = 0.044.

**Discussion:** This study demonstrates significant mediator roles of presence of meaning and self-esteem in the relationship of social support and death anxiety. Multi-component interventions are needed to manage death anxiety by targeting increasing social support, presence of meaning and self-esteem and increasing presence of meaning and self-esteem when social support is diminished in the pandemic.

KEYWORDS

**COVID-19, death anxiety, presence of meaning, terror management theory, self-esteem, social support**

## Introduction

The COVID-19 (Coronavirus Disease 2019) has caused tremendous damage throughout the world (Galea et al., 2020). According to the World Health Organization (WHO), 239,437,517 confirmed cases of COVID-19 including 4,879,235 deaths globally were reported, among which 125,162 confirmed cases and 5,695 deaths happened in China by 15 October 2021 (World Health Organization, 2021a,b). With the widespread disease and deaths caused by the COVID-19 and news about deaths and new cases reported, death anxiety has been accentuated and has become a public issue (Chen et al., 2020; Kavakli et al., 2020).

Terror Management theory (TMT) states that death anxiety is aroused from death-related thoughts and exists in all human beings because human intellectual ability allows them to realize the vulnerability and mortality of their lives and as a consequence produces existential concerns (Greenberg et al., 2014). A high level of death anxiety was observed in the general population as the COVID-19 pandemic continued (Chen et al., 2020; Kavakli et al., 2020). Death anxiety is thought to be associated with mental disorders, such as panic, generalized anxiety, and depressive disorders (Iverach et al., 2014; Lee et al., 2020). Given the nature of Chinese traditional culture, people are maladapted to death-related thoughts because they see death as something unfortunate (Yin et al., 2017). Mortality was made salient by the pandemic. Some observers argue that the death anxiety level in China may be higher than that of any other country (Yin et al., 2017; Khajoei et al., 2022). Considering the mental disorders that death anxiety could cause, looking for protectors against death anxiety in the context of COVID-19 pandemic is an important reflection at improving mental health of the general population.

According to the TMT (Rosenblatt et al., 1989), a leading theory explains the influence of death on individual behavior in the field of social psychology, social support, presence of meaning, and self-esteem which serve as death anxiety buffers when mortality is made salient (Rosenblatt et al., 1989; Schmeichel et al., 2009; Plusnin, 2018; Perach and Wisman, 2019). Social support is the support received from social network, namely the support that comes from family members, friends, and significant others (Zhou et al., 2015). Presence of meaning is a cognitive dimension that emphasizes the outcome of having meaning in life (Steger and Frazier, 2005; Li et al., 2021a,b). Self-esteem is the extent to which one holds positive views of oneself (Schmeichel et al., 2009). Previous research based on TMT focused on how each of these factors buffers the influence of death anxiety on individual behavior or well-being (Plusnin, 2018; Cox et al., 2021). Less research has focused on the interrelationships between social support, presence of meaning, self-esteem, and death anxiety. Consequentially, only one-sided interventions with limited effect have been developed to manage death anxiety and its effect on individual behavior or well-being (Greenberg et al., 2014; Breitbart et al., 2018). To develop targeted multicomponent interventions, the interrelationships among social support, presence of meaning, self-esteem, and death anxiety should be understood (Greenberg et al., 2014; Plusnin, 2018).

The TMT suggests (Schmeichel et al., 2009; Martela and Steger, 2016; Barnett et al., 2019; Dewitte et al., 2019; Harris and Orth, 2020) that social support, presence of meaning, and self-esteem are protective factors against death anxiety (Zhang et al., 2019; Bibi and Khalid, 2020). Apart from the TMT, other theoretical accounts predict the associations between social support, presence of meaning, and self-esteem. Attachment theory mentions that satisfying relationships with the attachment figures provide a sense of order and coherence, which are the main components of the presence of meaning in life (Martela and Steger, 2016; Dewitte et al., 2019; Li et al., 2021b). Additionally, positive psychology has pointed out the important role of the presence of meaning for mental health (Li et al., 2021b), and self-esteem is an important indicator of mental health (Schmeichel et al., 2009).

Previous researches on the interrelationships among social support, self-esteem, and presence of meaning show that these factors are positively correlated with each other (Zhang et al., 2019; Poudel et al., 2020; Li et al., 2021b). Moreover, self-esteem and presence of meaning were positively affected by social support (Poudel et al., 2020; Li et al., 2021b), suggesting that individuals with a higher social support tend to view themselves positively and live a more meaningful life (Li et al., 2021a). A previous study reported that presence of meaning is strongly associated with subjective well-being (Li et al., 2021a) and is an important source of self-esteem (Zhang et al., 2019). Moreover, presence of meaning can be considered as an external cause because it develops from a set of validated and credible norms and beliefs, while self-esteem can be seen as an internalized buffer (Lu et al., 2019; Zhang et al., 2019). It is possible that the achievement of meaning from a strong connection to cultural context may also support the internal development of self-esteem (Martela and Steger, 2016). Presence of meaning and self-esteem may mediate the relation between social support and death anxiety, individually and through a longer chain of connections (Lu et al., 2019).

Insufficient social interactions from social and physical distancing due to self-quarantine policies lead to a diminished social support (Labrague et al., 2021). The absence of an important buffer against death anxiety makes the examination of the relationships among social support, presence of meaning, self-esteem, and death anxiety an important research priority.

This study aimed to examine the relationships of social support, presence of meaning, self-esteem, and death anxiety. It was hypothesized that (H1) social support is protective against death anxiety and thus as social support increases, we should observe a corresponding decrease in death anxiety. (H2)

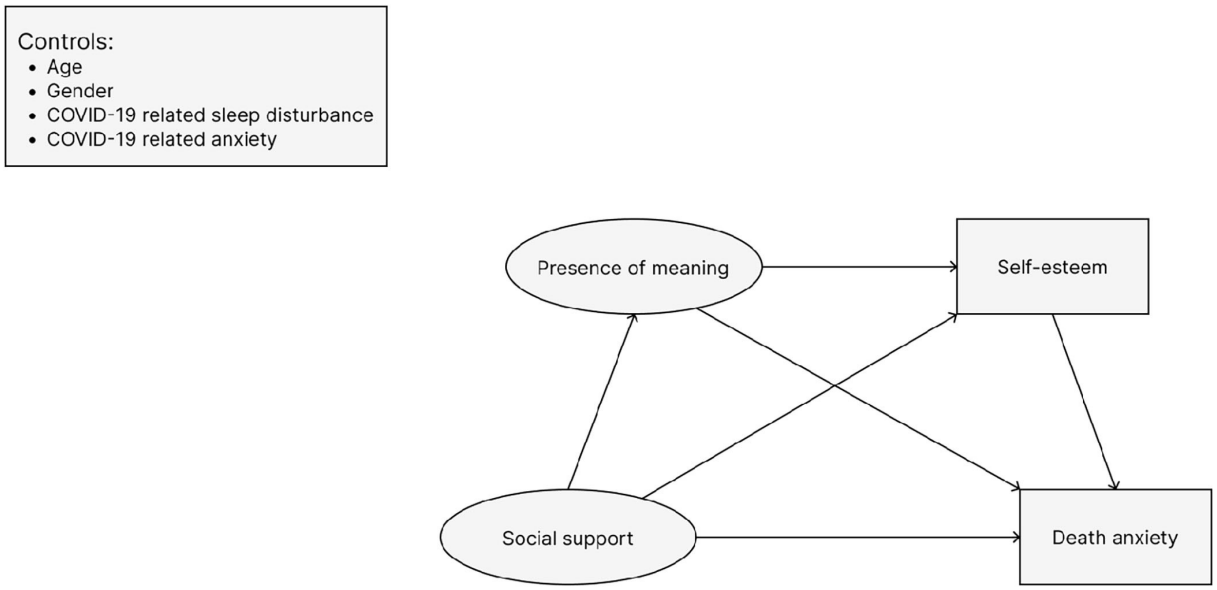


FIGURE 1
Hypothesized structural equation modeling. Circles indicate latent variables, while rectangles represent observed variables.

We expect social support to encourage both the presence of meaning and self-esteem as buffers against death anxiety. (H3) As mediating factors, meaning is antecedent to self-esteem, so that a chain of influence on death anxiety begins with social support and flows to presence of meaning and then to self-esteem. Additionally, a more nuanced look at which specific path is the most effective way from social support to buffer death anxiety is important to determine which component should be the main focus when developing multicomponent interventions to reduce death anxiety. We formulated the structural equation model (SEM) displayed in Figure 1 based on the TMT and the literature reviewed above. The circles represent latent variables which are represented in the structural equation analysis by multiple indicators. The squares are directly represented by values of scales designed to measure each construct.

# Methods

## Participants and procedure

A cross-sectional web-based study was conducted in mainland China from 19 May 2020 to 1 June 2020 during the COVID-19 outbreak. According to Jackson (2003), the number of participants for each parameter to be estimated should have to be 20 or greater. The number of parameters is 50 in this study, so at least (50 times 20=) 1,000 participants should have been included. Participants were recruited by the online WenJuanXing platform powered by WWW.wjx.cn *via* a snowball sampling method. Online informed consent was obtained from all participants and the responses were anonymous. The telephone number and email of the first author were attached at the beginning of the questionnaire in case participants had questionnaire-related questions. Participants were encouraged to forward a link or quick response code to other people they knew. The web survey required all participants to complete all items before submission and every participant was allowed to fill out only the questionnaire once due to preset equipment constraints, so that there were no missing data and repetitive filling out. The study procedure was approved by the Ethics Committee of the author's university (Approval No. E2020102).

The inclusion criteria for participation in this study were (1) being Chinese; (2) residing in mainland China (Considering that Hong Kong, Taiwan, and Macao belong to the special administrative regions of China, they are quite different from the mainland in terms of culture, policy, and economy). There were 1280 participants across China who participated in the survey. One hundred and thirteen participants were excluded, either because the time taken to answer the questionnaire was too short (<120 s) or because the responses were logically contradictory. The research team conducted a pilot test in six people to make a realistic estimate of the time taken to complete the questionnaire. The result of the pilot study showed that the completion time was no less than 120 s. Data from 1,167 participants were included in this study with an effective response rate of 91.17%. The number of participants per parameter is approximately 23.

TABLE 1 Descriptive statistics for demographic characteristics, death anxiety, presence of meaning, search meaning, self-esteem, social support, COVID-19 related sleep disturbance, and COVID-19 related anxiety ($N = 1167$).

| Variables | #/Mean | %/(SD) |
|---|---|---|
| Age | | |
| ≤24 year | 700 | 59.98 |
| 25–34 year | 282 | 24.16 |
| 35 year ≤ | 185 | 15.86 |
| Gender | | |
| Male | 279 | 23.91 |
| Female | 888 | 76.09 |
| Religion | | |
| Yes | 111 | 9.52 |
| No | 1,056 | 90.48 |
| Current residence | | |
| Urban area | 686 | 58.78 |
| Rural area | 481 | 41.22 |
| Income stability | | |
| Regular | 804 | 68.89 |
| Variable | 363 | 31.11 |
| Educational background | | |
| Middle school and below or equivalent experience | 48 | 4.11 |
| High school or equivalent experience | 231 | 19.79 |
| University or equivalent experience | 665 | 56.98 |
| Master and above | 223 | 19.12 |
| COVID-19 related sleep disturbance | | |
| Yes | 516 | 44.22 |
| No | 651 | 55.78 |
| COVID-19 related anxiety | | |
| Yes | 648 | 55.53 |
| No | 519 | 44.47 |
| Death anxiety | $M = 7.75$ | (3.21) |
| Social support | $M = 59.13$ | (11.81) |
| Presence of meaning | $M = 23.11$ | (5.63) |
| Self-esteem | $M = 28.88$ | (4.46) |

The descriptive statistics are shown in Table 1. The average age of the participants was 26.35 (SD = 10.05), with a range of 12–64 years. There were more female (76%) participants than male participants (24%). Most of the people (90%) did not have religion. Fifty-nine percent of participants lived in the urban area of China, while the remaining participants (41%) lived in a rural area. Many participants (69%) had a regular income. More than half of the participants (57%) had university or equivalent level of education. There were 44% of participants who had COVID-19 related sleep disturbance and approximately 56% of the participants who had COVID-19 related anxiety.

## Instruments

### Demographic characteristics

Age was calculated by subtracting the birth year from the survey year 2020. Gender (female = 1, male = 2), religion (yes = 1, no = 2), current residence (urban area vs. rural area), and income stability (regular vs. variable) were defined as binary variables. Educational background was categorized as middle school and below or equivalent experience, high school or equivalent experience, university or equivalent experience, and master and above, "Do you have COVID-19 related sleep disturbance?" (yes = 1, no = 2), "Do you have COVID-19 related sleep disturbance?" (yes = 1, no = 2) (Table 1). Age, gender, COVID-19 related sleep disturbance, and COVID-19 related anxiety were considered as control variables in our structural equation model (SEM) based on previous research showing associations with our core variables (Vittinghoff et al., 2011; Robah, 2017; Fernández et al., 2020).

### Death anxiety scale (DAS)

The Chinese version (Zhang et al., 2019) of Templer's (1970) was used to assess death anxiety. It is a 15-item unidimensional self-reported instrument with the response options being "yes" or "no" (yes = 1; No = 0) (Templer, 1970). Six items are reverse scored. A total DAS score is the sum of the score of response to 15 items after reverse scoring and ranges from 0 to 15. A score ≤6 indicates mild death anxiety, a cut-off score between 7 and 9 indicates moderate death anxiety, and a score ≥10 indicates severe death anxiety (Mohammadi et al., 2022). In this study, the DAS showed acceptable reliability (Cronbach's alpha was 0.75).

### The multidimensional scale of perceived social support (MSPSS)

The Chinese version (Zhou et al., 2015) of the MSPSS is a 12-item scale consisting of three dimensions, which are used to evaluate perceived support from three sources: family, friends, and significant others, with each item rated on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree) (Zimet et al., 1988). A total MSPSS score is the sum of responses to 12 items, which ranges from 12 to 84. Higher scores indicate higher levels of perceived support. Reliability of the MSPSS was good in the current sample with Cronbach's alpha being 0.93.

### Presence of meaning scale (MLQ-P)

The Chinese version (Zhang et al., 2019) of presence of meaning scale is derived from the meaning in life questionnaire (MLQ) (Steger et al., 2006). Research has showed that presence of a meaning scale can be used as a unidimensional scale, which is a 5-item scale (Li et al., 2021b). Each item is rated using a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree).

The total MLQ-P score is the sum of responses to five items and ranges from 5 to 35. People with higher scores possess higher levels of presence of meaning (Steger et al., 2006). In this study, presence of meaning scale shows good internal consistency with a Cronbach's alpha of 0.85.

### Rosenberg self-esteem scale (RSE)

The Chinese version (Tang et al., 2018) of the RSE is a 10-item unidimensional self-assessment scale that measures individual self-esteem. Each item was rated on a 4-point Likert scale (1 = strongly disagree to 4 = strongly agree) (Rosenberg, 1979). Four items are reverse scored. A total score is calculated by summing all the scores of responses after reverse scoring the negative worded relevant items and ranges from 10 to 40. In general, a score $\leq$25 indicates low self-esteem, a score between 26 and 32 indicates medium self-esteem, and a score $\geq$33 indicates high self-esteem (Rosenberg, 1979). In this study, the RSE has demonstrated acceptable reliability with a Cronbach's alpha was 0.86.

## Statistical analysis

Although there are cut-off thresholds for clinical relevance of the DAS and the RSE, our analysis focuses on the quantitative values of the scales in our implementation of the SEM. Descriptive statistics conducted by IMB SPSS Statistics version 21 (IBM Corp, 2012) are shown in Table 1. The total scores of death anxiety, social support, presence of meaning, and self-esteem were approximately normally distributed according to the QQ (quantile-quantile) plot. The characteristics of participants were described using frequencies with percentages. The Pearson correlations were used to investigate the correlations among social support, self-esteem, presence of meaning, and death anxiety. $P$-values $< 0.05$ determined statistical significance.

Confirmatory factor analysis (CFA), SEM, and pairwise contrasts were conducted in Mplus version 8.3 (Muthén and Muthén, 2017). When CFA and SEM were conducted, maximum likelihood estimation was applied. The method of 5,000 bootstraps was used to explore the significance of the mediation effect, which produces 95% bias-corrected confidence intervals (95% CIs). A "good fit" for the CFA and SEM suggested that the value of the comparative fit index (CFI) and Tucker–Lewis index (TLI) should be no lower than 0.90, and the value of the root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR) should be no higher than 0.08 (Hu and Bentler, 1999). The MODEL INDIRECT command was applied to test the standardized indirect effect presented in the multiple mediation model in this study (Cox et al., 2021). The MODEL CONSTRAINT command was used to examine whether the three indirect effects differed from each other statistically in pairwise contrasts. The difference was statistically significant, if 95% CI did not include zero.

TABLE 2 Pearson's correlation matrix for death anxiety, social support, presence of meaning, and self-esteem ($N$ = 1,167).

| | Death anxiety | Presence of meaning | Self-esteem | Social support |
|---|---|---|---|---|
| Death anxiety | 1 | | | |
| Presence of meaning | −0.239** | | | |
| Self-esteem | −0.256** | 0.591** | | |
| Social support | −0.169** | 0.429** | 0.482** | 1 |

**$P$< 0.010 (two-tailed).

# Results

## Descriptive statistics for death anxiety, social support, presence of meaning, and self-esteem

The scores for death anxiety (M = 7.75, SD = 3.21), social support (M = 59.13, SD = 11.81), presence of meaning (M = 23.11, SD = 5.63), and self-esteem (M = 28.88, SD = 4.46) are presented in Table 1. We found that average levels of death anxiety and self-esteem in our study were moderate (Rosenberg, 1979; Mohammadi et al., 2022).

## Correlation analysis

Pearson's correlation matrix for social support, presence of meaning, self-esteem, and death anxiety is provided in Table 2. Pearson's correlation analysis revealed the presence of meaning ($r = -0.239, p < 0.010$), self-esteem ($r = -0.256, p < 0.010$), and social support ($r = -0.169, p < 0.010$) negatively correlated with death anxiety. Presence of meaning was positively correlated with self-esteem ($r = 0.591$, $p < 0.010$) and social support ($r = 0.429$, $p < 0.010$). Self-esteem was positively correlated with social support ($r = 0.482, p < 0.010$).

## SEM and interpretation

The CFA of indices of social support is saturated: $\chi^2 = 0$, df = 0, $p < 0.001$, CFI = 1, TLI = 1, RMSEA = 0, SRMR = 0, and therefore fits the correlation matrix perfectly (Hu and Bentler, 1999). The fit of indices of presence of meaning is good: $\chi^2 = 51.242$, df = 5, $p < 0.001$, CFI = 983, TLI = 0.966, RMSEA = 0.089, SRMR = 0.024 (Hu and Bentler, 1999). The standard

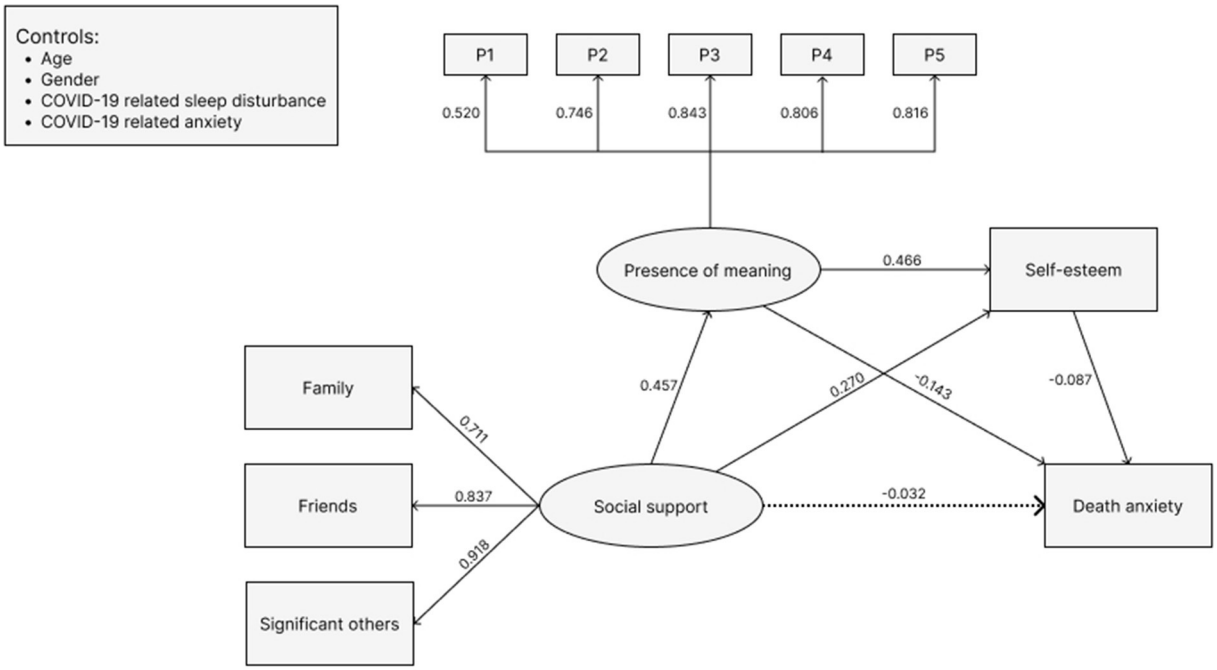


FIGURE 2
Final model for the whole sample ($N = 1167$), with standardized bate weights. Fit index: $x^2 = 243.384$, df = 58, $p < 0.001$; CFI = 0.968, TLI = 0.954, RMSEA = 0.052, SRMR = 0.044. Circles indicate latent variables, while rectangles represent observed variables. Solid lines indicate paths are statistically significant while dashed line indicate paths are noit statistically significant. Abbreviations: Items P1–P5 measure presence of meaning.

factor loadings in the measurement model of social support and presence of meaning are all significant and vary between 0.479 and 0.931, which are considered good (Wang, 2014), suggesting the items and observed variables were well explained by the latent variables (Wang, 2014). The final SEM is given in Figure 2, which shows a good fit for the multiple indicators and structural components of the full model: $\chi^2 = 243.384$, df = 58, $p < 0.001$; CFI = 0.968, TLI = 0.954, RMSEA = 0.052, SRMR = 0.044 (Hu and Bentler, 1999).

The unstandardized and standardized path coefficients for all pathways in the model of social support and death anxiety, mediated by presence of meaning, and self-esteem, are summarized in Table 3. The SEM was consistent with H1, H2, and H3 while controlling for covariates (age, gender, COVID-19 related sleep disturbance, and COVID-19 related anxiety). Results showed that a higher level of social support ($\beta = -0.032$, SE = 0.033), presence of meaning ($\beta = -0.143$, SE = 0.037), and self-esteem ($\beta = -0.087$, SE = 0.039) were associated with a lower level of death anxiety. A higher level of social support was associated with a greater level of presence of meaning ($\beta = 0.457$, SE = 0.033) and self-esteem ($\beta = 0.270$, SE = 0.032). A higher level of presence of meaning was associated with a greater level of self-esteem ($\beta = 0.466$, SE = 0.032). The relationships were all significant, except the direct effect from social support to death anxiety.

The standardized indirect effects in model of social support and death anxiety, mediated by presence of meaning, and self-esteem while controlling for covariates are presented in Table 4. The indirect effect of social support on death anxiety *via* presence of meaning was −0.065 (95% CI = −0.103, −0.032). The indirect effect of social support on death anxiety *via* self-esteem was −0.024 (95% CI = −0.047, −0.004). The indirect effect of social support on death anxiety *via* presence of meaning and self-esteem was −0.019 (95% CI = −0.037, −0.003). The results show that presence of meaning, self-esteem, and death anxiety can be explained by this model at 26.43%, 43.91%, and 23.74%, respectively.

The pairwise contrasts of the unstandardized indirect effects in model of social support and death anxiety, mediated by presence of meaning, and self-esteem are presented in Table 5. The results show that the mediation effect of presence of meaning was statistically different from the serial-multiple mediation effect of presence of meaning and self-esteem. Based on the comparison of indirect effects, the presence of meaning has a significantly stronger mediation than the serial-multiple mediation of presence of meaning and self-esteem. The effects of simple mediation between presence of meaning and self-esteem are not statistically significant (95% CI = −0.084, 0.005). The effects between simple mediation of self-esteem and the serial-multiple mediation of presence of meaning and

TABLE 3 The unstandardized and standardized path coefficients for all pathways in the model of social support and death anxiety, mediated by presence of meaning and self-esteem ($N = 1,167$).

| | *b* | B | S.E | *t* | *P* |
|---|---|---|---|---|---|
| Social support → Presence of meaning (a1) | 0.108 | 0.457 | 0.033 | 13.759 | < 0.001 |
| Social support → Self-esteem (a2) | 0.344 | 0.270 | 0.032 | 8.340 | < 0.001 |
| Social support → Death anxiety (c) | −0.029 | −0.032 | 0.033 | −0.976 | 0.329 |
| Presence of meaning → Self- esteem (d1) | 2.500 | 0.466 | 0.032 | 14.381 | < 0.001 |
| Presence of meaning → Death anxiety (b1) | −0.553 | −0.143 | 0.037 | −3.853 | < 0.001 |
| Self- esteem → Death anxiety (b2) | −0.063 | −0.087 | 0.039 | −2.258 | < 0.050 |

TABLE 4 The standardized indirect effect in the model of social support and death anxiety, mediated by presence of meaning, and self-esteem.

| Path | Estimate | SE | 95% CI | |
|---|---|---|---|---|
| | | | Lower | Upper |
| Social support → Presence of meaning→ Death anxiety (a1b1) | −0.065 | 0.018 | −0.103 | −0.032 |
| Social support→ Presence of meaning → Self-esteem→ Death anxiety (a1d1b2) | −0.019 | 0.009 | −0.037 | −0.003 |
| Social support→ Self-esteem→ Death anxiety (a2b2) | −0.024 | 0.011 | −0.047 | −0.004 |

The effect is statistically significant at $p < 0.050$ when the CI does not include zero. Abbreviations: CI, confidence interval.

TABLE 5 The pairwise contrasts of the unstandardized indirect effects in the model of social support and death anxiety, mediated by presence of meaning and self-esteem.

| Pairwise contrasts | Estimate | SE | 95% CI | |
|---|---|---|---|---|
| | | | Lower | Lower |
| Model 1 vs. Model 2 | −0.038 | 0.023 | −0.084 | 0.005 |
| Model 1 vs. Model 3 | −0.043 | 0.021 | −0.005 | −0.002 |
| Model 2 vs. Model 3 | −0.05 | 0.005 | −0.018 | 0.002 |

The effect is statistically significant at $p < 0.050$ when the CI does not include zero. Abbreviations: CI, confidence interval; Model 1: Social support→ Presence of meaning→ Death anxiety; Model 2: Social support→ Self-esteem→ Death anxiety; Model 3: Social support→ Presence of meaning → Self-esteem→ Death anxiety; SE, standard error.

self-esteem are also not statistically significant (95% CI = −0.018, 0.002).

## Discussion

To the best of our knowledge, this study is one of the few empirical investigations to examine the relationships among social support, presence of meaning, self-esteem, and death anxiety based on the TMT. This study has contributed to the existing evidence that presence of meaning and self-esteem could separately and serially mediate the relationship between social support and death anxiety. Findings are consistent with H1, H2, and H3. Among indirect effects, presence of meaning has a stronger mediation than that of serial-multiple mediation of presence of meaning and self-esteem. Findings add to the knowledge of the relationships among social support, presence of meaning, self-esteem, and death anxiety based on TMT, and have practical implications for developing multicomponent interventions to manage death anxiety targeting increasing social support, presence of meaning, and self-esteem or increasing presence of meaning and self-esteem when social support is diminished.

The death anxiety in participants in this study during the pandemic period is higher than that in the elderly people during the non-pandemic period (Sinoff, 2017). One of the reasons that account for the high death anxiety level in this study could be the participants' age. The average age of the participants is approximately 26 years old at which death anxiety peaked (Chopik, 2017). Young adults in China in their 20s generally start taking over the family responsibility of raising their children and taking care of their aging parents under the influence of Chinese culture (Lee, 2015). They may have anxiety about whether their "deaths" burden the whole family as they think "if anything happened to me, what would happen to my family?" (Lee, 2015). The other reason for the high death anxiety level in this study is the COVID-19 pandemic (Pradhan et al., 2020). The death anxiety level of the general population examined in the COVID-19 pandemic was found to be much higher than that examined in the non-pandemic period (An et al., 2018). Observers have noted that the number of deaths and strong infectiousness of COVID-19 have very likely increased death anxiety (Rosenblatt et al., 1989; Pradhan et al., 2020).

This study also found that participants' perceived social support level was far less than the cancer patient, cancer patient's caregivers, and health providers (Liu and Aungsuroch, 2019; Uslu et al., 2019). More attention has

been paid to cancer patients, cancer patient's caregivers, and health providers compared to the general population, and relatively comprehensive support systems (e.g., psychological consultation, palliative care) have been developed for these populations (West et al., 2016). The level of presence of meaning and self-esteem are similar to Lin's results tested in the non-pandemic situation (Lin, 2019). One reason that pre-pandemic and pandemic levels are similar could be that presence of meaning and self-esteem have high stability over time (Li et al., 2021b). In addition, TMT suggests that increased death anxiety would urge individuals to maintain their self-esteem and presence of meaning to buffer the anxiety (Greenberg et al., 2014). However, in the COVID-19 pandemic, people require more social support, presence of meaning, and self-esteem to protect against increasing death anxiety level (Zhang et al., 2019; He and Li, 2022). A more complete support system targeting increasing social support, presence of meaning, and self-esteem should be established for situations such as epidemics that by their nature reduce prospects for supportive social interactions.

Direct association between social support and death anxiety was reported before (Uslu et al., 2019; Bibi and Khalid, 2020). According to TMT and prior studies, supports from social network members play an important role in reducing death anxiety (Ebrahimi et al., 2018). In our study, a higher social support was associated with lower death anxiety in bivariate analyses. However, when adding and controlling for presence of meaning as predictor of self-esteem, and presence of meaning as well as self-esteem as predictors of death anxiety, social support was no longer related to death anxiety. This indicates presence of meaning and self-esteem fully mediate the relationship, respectively, and sequentially (Krause, 2007; Xia and Yang, 2019; Poudel et al., 2020). These mediators may capture the most important mechanisms at work in the relation between social support and death anxiety.

This study demonstrates that presence of meaning and self-esteem could fully mediate the relationship between social support and death anxiety which supports H2. To be specific, feeling being supported by social networking provides a deeper sense of meaning and the possibility for individuals to maintain their significance through a symbolic form of immortality, thus higher social support is associated with less death anxiety via increasing presence of meaning (Krause, 2007; Holt, 2018). Additionally, as TMT suggests, social support could provide a sense of personal value and security which contribute to forming positive thoughts about oneself and lead to a high level of self-esteem (Greenberg et al., 2014), thus higher social support is associated with less death anxiety *via* increasing self-esteem (Poudel et al., 2020). Previous studies have consistently reported that social support increases the level of presence of meaning and self-esteem, and that presence of meaning and self-esteem reduce death anxiety (Ebrahimi et al., 2018; Zhang et al., 2019; He and Li, 2022). However, previous studies have seldom considered the four variables in one multiple mediation model. This study provides empirical evidence for the relationships among social support, presence of meaning, self-esteem, and death anxiety based on TMT.

This study uniquely revealed the sequential mediation of presence of meaning and self-esteem between the relationship of social support and death anxiety. The sequential mediation of self-esteem and meaning in life in Lin's multiple mediation model differs from but does not contradict our results. In Lin's study (2019), self-esteem and meaning in life mediated the relationship of gratitude and suicidal ideation sequentially. People with a greater level of self-esteem tend to foster meaning in life through making people feel valued and important. In our research, having a meaningful life increases the feeling of self-worth, the positive emotion generated when individuals feel that their talents and personality are valued (Martela and Steger, 2016), and these emotions could boost self-esteem (Martela and Steger, 2016; Barnett et al., 2019). Although previous research implies the potential bidirectional association between presence of meaning and self-esteem (Barnett et al., 2019; Lin, 2019; Zhang et al., 2019), the relationship of presence of meaning and self-esteem needs to be discussed in the context of specific research purposes (Greenberg et al., 2014).

Another interesting finding we come across in this study is that presence of meaning had a stronger mediation than the serial-multiple mediation of presence of meaning and self-esteem. This demonstrates presence of meaning is important for death anxiety when increasing social support, more than the multiple influences of presence of meaning and self-esteem. Lin has pointed a similar result that meaning in life played a more important role than self-esteem in the relationship of gratitude and suicidal ideation, but the difference between the single mediation of meaning in life and the sequential multiple mediation of self-esteem and meaning in life was not examined (Lin, 2019). Presence of meaning is a broader concept compared with self-esteem. It represents a cluster of related factors, for instance, having significance, broader purpose, and certainty and comprehensibility in life, all of which transmit the effect of social support to death anxiety (Krause, 2007; Martela and Steger, 2016), thus presence of meaning buffers death anxiety directly and effectively (Krause, 2007; Greenberg et al., 2014; Holt, 2018).

## Implications

This research has profound theoretical and practical implications. Findings examine the relationships among social support, presence of meaning, self-esteem, and death anxiety based on the TMT and provide an understanding of death anxiety and placing more importance on developing multicomponent interventions targeting increasing social support, presence of meaning and self-esteem, or increasing presence of meaning and self-esteem when social support is diminished in the pandemic. Moreover, the result of this study also provides an empirical evidence for the TMT in

the context of COVID-19 pandemic, and also suggestions for future research.

First, strategies to improve social support are critical to buffer death anxiety when mortality is made salient, especially in the time of COVID-19. Joint efforts by government, social workers, health professionals as well as affected individuals are required to address these issues (Krause, 2007; Plusnin, 2018). Given the recommendation to follow minimum face-to-face intervention, a web-based public health emergency management system should be developed (Liang and Xue, 2004; Cao et al., 2020). Resources for daily necessities should be guaranteed and up-to-date information such as providing abundant information regarding disease itself, online courses for self-protection skills and health education, and online platforms for medical-care-seeking and entertainments systematically should be easily accessed. In addition, though physical distancing was forcibly required, mutual communications and emotional supports between individuals *via* telecommunication techniques to increase interactions are effective (Krause, 2007).

Second, meaning-oriented programs may be beneficial to individuals during the period of the COVID-19 pandemic. For instance, in a customized intervention called Life Crafting, people rediscover meaning by making sense of what has happened to them and trying to focus on their ideal future *via* online writing exercises through four steps (Dejong et al., 2020). Further meaning-oriented programs catering to Chinese culture should be developed (Li et al., 2021a).

Third, interventions increasing self-esteem should be taken into consideration by communities and individuals. Cognitive-behavioral therapy (CBT)-based programs have been proved to enhance self-esteem effectively (Terp et al., 2019; Lee et al., 2020). Further studies regarding CBT-based interventions in accordance with China's national condition should be conducted.

## Limitation

First, participants were recruited online via a non-probabilistic snowball sampling method, and they were restricted to people who used the internet. Where possible, we conducted analysis of the main relationships in subsamples of the main sample. Because the sample was largely female, the results reflect the views of women more than of men. And in the small sample of men, we found that social support (with controls on the other factors) was a significant and direct protective factor for death anxiety and self-esteem, in contrast to the results for women, was not significant. These intriguing differences await study in a larger and more representative sample. Second, the TMT also suggests that increased death anxiety would urge individuals to maintain their self-esteem and presence of meaning to buffer the anxiety. In this regard, there are potential bidirectional associations between death anxiety and self-esteem and between death anxiety and meaning in life. It would be useful and promising to conduct longitudinal studies to analyze the dynamic interrelationships of social support, presence of meaning, self-esteem, and death anxiety in the future.

## Conclusion

Overall, this study provides insights into interrelationships between social support, presence of meaning, self-esteem, and death anxiety based on the TMT: presence of meaning and self-esteem fully mediated the relationship between social support and death anxiety, respectively, and sequentially. Moreover, presence of meaning had a stronger mediation than the serial-multiple mediation of presence of meaning and self-esteem. This study provides a perspective on the mechanism of how social support, presence of meaning, and self-esteem work to buffer death anxiety. Findings provide an understanding of death anxiety and emphasize the importance of developing multicomponent interventions targeting increasing social support, presence of meaning, and self-esteem and increasing presence of meaning and self-esteem when social support is diminished in the pandemic.

## Data availability statement

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

## Ethics statement

The studies involving human participants were reviewed and approved by Ethics Committee of Xiang Ya School of Nursing, Central South University. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

## Author contributions

YH, NR, ST, and MS contributed to the conception and design of the study. YH and MS organized the database and performed the statistical analysis. YH wrote the first draft of the manuscript. YH, ZG, FY, JW, ST, and MS contributed to the manuscript revision. All authors have read and approved the submitted version.

## Funding

This research was supported by the Research Project of Teaching Reform in Colleges and Universities of Hunan Province under Grant Number HNJG-2022-0449.

## Acknowledgments

The authors want to acknowledge Xiangmin Tan who is a student in Xiangya Nursing School, Central South University, Changsha, Hunan Province, China for her help in this study. The authors want to acknowledge Jinnan Xiao who is a teacher in Xiangya Nursing School, Central South University, Changsha, Hunan Province, China for her help in this study.

## 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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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 13 December 2022
DOI 10.3389/fpsyg.2022.1073017



OPEN ACCESS

EDITED BY
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SPECIALTY SECTION
This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology

RECEIVED 18 October 2022
ACCEPTED 21 November 2022
PUBLISHED 13 December 2022

CITATION
Ma N, Siu YW, Cheong TS and Tung B (2022) Impact of COVID-19 on lifestyle and financial behaviour: The implications to research in financial vulnerability.
*Front. Psychol.* 13:1073017.
doi: 10.3389/fpsyg.2022.1073017



# Impact of COVID-19 on lifestyle and financial behaviour: The implications to research in financial vulnerability

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The outbreak of coronavirus pandemic in late 2019 posted unprecedented social-economic challenges and disruptions to societies and individuals. The "new-normal" styles of living and working could intertwined with other determinants complicating the investigation of individual's financial vulnerability. The purpose of this paper is to conduct literature survey to review and consolidate the recent scattered literatures to identify some possible factors to be considered in the research related to financial vulnerability, including pandemic's impact of COVID-19 to different aspects of personal finance issues, pandemic-driven digitisation of the economy activities, changes in financial behaviour and addiction to digital technology.

KEYWORDS

**personal finance, digitisation of the economy, COVID-19 pandemic, addiction to digital technology, financial vulnerability**

## Introduction

The outbreak of coronavirus pandemic in late 2019 has not only brought about health impacts worldwide. Lockdown and the measures to restrict social and economic activities have adversely affected both the business community as well as the financial conditions of individuals and households. The impacts of the pandemic on personal finances should not simply be attributed to the rising unemployment and declining household income. The COVID-19 pandemic has posted unprecedented social-economic challenges and disruptions to societies and individuals, leading to some other possible determinants of personal financial problem caused by the "new-normal" styles of living and working.

The above-mentioned new challenges and complicated socioeconomic changes in the recent years have made the root causes of financial vulnerability more difficult to analyse because there could be some new determinants of personal financial problem caused by the "new-normal" styles of living and working, such as more rely on digital services for consumption, entertainment and banking. At this moment, research covering those issues were scattered. There are very limited research covering all these issues holistically. It is necessary to spend effort to summarise the possible newer determinants of financial vulnerability of peoples.

The objective of this paper is to look into some relevant but scattered literatures in the area of financial literacy, pyshcology and consumer behaviour to synthesise prior works to identify factors deserved investigation due to the lifestyle and financial behavioural changes brought by the outbreak of COVID-19 pandemic, so as to create value and contribute to body of knowledge of personal finance and financial vulnerability.

# Literature survey

## Financial vulnerability

Financial vulnerability refers to individual's capacity to cope with adverse financial condition or the perceived feeling of being in a financially unstable situation, representing an early indicator of financial stress (European Credit Research Institute (ECRI) and Personal Finance Research Centre (PFRC), 2008; Klasen and Povel, 2013; de Clercq et al., 2015). Van Aardt et al. (2009) developed a heuristic financial vulnerability model concluding key factors leading to financial vulnerability, such as income fragility, expenditure, saving/income, consumption and debt.

After the model was built, which has categorised factors into base elements, many variables identified during the model development phase were not systematically analysed. More than 10 years later, some of these variables that might be less relevant then are now deserving re-investigation because of the social, economic and technological changes in our world, as well as COVID-19 pandemics. One example is the availability of credit and financial innovative products (Van Aardt et al., 2009). Also, some newer endogenous factors originating from new living and working styles brought about by the recent pandemic and technological advancement should also be investigated with along with the timely impact of the COVID pandemic. Such factors and their possible relationships with financial vulnerability are reviewed and discussed below.

## Factor 1: Impact of the COVID pandemic on financial well-being

Financial well-being is "…a state of being wherein you have control over day-to-day, month-to-month finances; have the capacity to absorb financial shock; are on track to meet your financial goals; and have the financial freedom to make the choices that allow you to enjoy life" (Consumer Financial Protection Bureau, 2015, p. 5). By analysing the relevant literatures after the outbreak of COVID-19, the associated economic downturns constitute a shock leading to changes in several aspects of personal finance, including cash inflow reduction, cash outflow increase, and/or asset value and wealth reduction. Our findings are summarised below.

### Cash inflow reduction

The causes for cash inflow reduction can be income shock (Achou et al., 2020; Hanspal et al., 2020; Jantan et al., 2020) due to unemployment, under-employment or reduction in work hours, and ineligibility/inaccessibility to the government emergency benefits (Thompson et al., 2017; Achou et al., 2020; Kempson and Evans, 2020; Roll and Despard, 2020; Round et al., 2020).

### Cash outflow increase

Common reasons for cash outflow increase are additional expenditures such as unusual cash spendings due to pandemics, health-related expenditure, new care-related responsibilities, and/or other life altering events (Round et al., 2020). Income shock might force people to enter into debt or to increase borrowing to make ends meet, including bills and rents, or, worse, turn manageable debts into unmanageable obligations (Round et al., 2020).

### Wealth reduction

Similarly, people might suffer from wealth shock when being forced to run down their savings as a result of adverse economic and stock market conditions, resulting in a drop-in investment value (Hanspal et al., 2020).

People who have been struggling financially before COVID-19 were more likely to experience further financial difficulties as a result of pandemic-related economic downturn (Roll et al., 2020; Round, 2020). Past literatures usually attempt to look for demographic factors and personal characteristics of the vulnerable groups, such as gender, age, family types, employment types, work sectors, education level, housing tenure, work status, marital status, etc. (Schicks, 2012; Disney and Bridges, 2016; Achou et al., 2020; Kempson and Evans, 2020; Roll and Despard, 2020; Round et al., 2020). Those research intended to identify which specific groups of people with specific features the past economic shocks caused them to be more vulnerable to financial difficulties. However, according to the more current literatures, the impacts of COVID-19 can be found more widely spread across a country or a city (e.g., Kempson and Evans, 2020). It deserves to explore what the possible new factors are, which may affect a bigger segment of people. The following are the findings from our literature survey efforts, by synthesising the new social-economic phenomenon under COVID-19 and the relevant past literatures.

## Factor 2: Digitisation of the economy since the outbreak of COVID-19

Due to technological advancement, many economic activities, such as shopping, entertainment, and payment platforms, have been digitised in recent years. COVID-19 has forced social contact to the minimal level, hence further accelerating social-economic digitisation to other aspects of daily life and financial management activities, such as working, meeting, learning, food and grocery

consumption, banking, and investment (Idris, 2019; Pinochet et al., 2019; Shang et al., 2021).

Due to fierce competition amongst in marketing and social media space, digital services providers mostly focus their marketing messages to be more visible in mass media including social media and make their services more easily accessible to consumers (Idris, 2019; Moenjak et al., 2020). The new working and learning style at home not only make digital services more accessible to people, but also the related marketing messages about consumption, entertainment and credits. The triggering of purchasing or consumption can result in over-consumption and over-indebtedness (Schicks, 2013). The attitudes towards using debt-financing to support consumption of non-durable goods were found to be significantly affected by the time spent on social media (Henrik and Anton, 2020). The adverse sequence of negative consequences leading to financial problems are not sufficiently investigated (Carlsson et al., 2017; Idris, 2019).

Similarly, fintech makes people view credit as money and not as debts (Ash et al., 2018). Fueled by social influence such as influencers, celebrities and push marketing efforts of financial services companies, people with specific characteristics, especially those with higher degree of personal innovation (e.g., youths and the younger population), have higher propensity to consume credit services, resulting in problematic indebtedness (Carlsson et al., 2017). Some individuals using digital credit were found to be more likely in financial troubles as demonstrated with this population segment experiencing a higher number of loans and a higher number of incidents of selling household assets to repay loans (Wamalwa et al., 2019).

Existing literatures acknowledge this research gap regarding the understanding of how personal consumption, financial and credit behaviour may change in relation to the development of digital technology and digital society (Carlsson et al., 2017; Idris, 2019). Specifically, the vulnerability of adolescents as early adopters of digital services needs further attention (Carlsson et al., 2017; Tung, 2018). Scholars have recommended that more studies should account for digital development and investigate the new skills required for the digital consumers in credit society to further understand the conditions of personal financial behaviour as well as financial literacy education and counselling in digital society (Carlsson et al., 2017).

Pandemic-driven lockdowns have forced people to adopt more types of digital services and spend more time on social media. COVID-19 has further accelerating social-economic digitisation to other aspects of daily life because it forced social contact to the minimal level. We believe additional research should be done by broadening coverage in digital services with potentially relevant financial vulnerability, such as e-payment platforms, banking, entertainment, gambling, and investment (e.g., crypto-currencies investment). Also, with the increase in the awareness and the exposure to the marketing information and promotion message of such services, how an individual may respond to these influence and consumers' adoption of such services bring about behavioural change in consumption, spending, use of debt and savings/investment should also be investigated in future research.

## Factor 3: Internal factors affecting financial management ability

As discussed above, digitisation of the economy and the increasingly easy availability of credit together with the flourishing innovative financial products can be taken as new external factors to fit into Van Aardt et al.'s financial vulnerability cause-and-effect chain. Nevertheless, these impacts still depend on other internal factors originating from an individual level that make a difference in terms of individual's ability to resist temptation in a digitised society and skills in financial management. This will be discussed in the following.

### Financial literacy

Financial literacy is a combination of awareness, knowledge, skill, attitude and behaviour necessary to make sound financial decisions and to achieve financial wellbeing (OECD/INFE, 2011; Tung, 2018). Empirical evidence has showed that this is a key factor explaining over-indebtedness (e.g., Lusardi and Tufano, 2009) and that a high level of financial literacy has a positive impact on management of personal finances and financial behaviour (Kotlikoff and Bernheim, 2001; Hilgert et al., 2003; Courchane and Zorn, 2005; Lusardi and Tufano, 2009; Capuano and Ramsay, 2011; Navickas et al., 2014). More importantly, financial literacy may improve one's ability and capability to deal with macroeconomic shocks (Klapper et al., 2013; Paiella, 2016; Tung, 2018). In reverse, people with limited financial literacy may not make informed decisions when consuming digital credits (Wamalwa et al., 2019).

Although empirical results showed that financial literacy reduces utilisation of digital credit, better financial knowledge may not always result in behaviour change because of other constraints or interfering factors (Seiling and Shockey, 2006). Individuals can experience cognitive functions deterioration (Agarwal et al., 2009; Ansong and Gyensare, 2012). For example, people are easily influenced by the regular and repeating marketing promotions that stimulate their financial behaviour in consumption and credit card usage, offsetting the effects of financial literacy (Tung, 2019). Facing the challenges of a digitised society and more social media marketing and promotion brought about by the pandemic, the financial behaviour of people after the outbreask of COVID-19 deserves a deeper investigation by considering their financial literacy and knowledge.

In addition, there are more current literatures concerning other factors interrelating to or interfering with the effect of financial literacy and the ability on financial management within certain segment(s) of the population. Low level of financial literacy coupled with self-control problems, leading to over-indebtedness and many other financial problems such as income shocks as well as unforeseen expenses on durables

(Gathergood, 2011). This is important to understand how some non-cognitive factors influencing financial behaviours (Alsemgeest, 2015). The following specifically focus on a new phenomenon after the outbreak of COVID-19.

### Addiction to digital technology

Pandemic lockdown has created an opportunity for people to spend more time on social media and digital services such as shopping, entertainment and money management in the digital economy. Since most digital services usually involve marketing and promotion to stimulate more utilisation, impulse spending, and borrowing, individuals and their digital service usage frequency may bring about behavioural change in consumption, spending, use of debt, and savings/investment. At the individual level, the inability to resist temptation, overspending, relaxed attitudes to borrowing, together with poor money management skills are common contributing factors to problem debt (Round et al., 2020). This is especially true for heavy digital service users.

Addiction is defined as impulse dependent on a habit of a specific activity or substance use that has destructive effects on social, emotional and even financial situations (Idris, 2019). The frequency of online shopping or the time spent on social media are the risk factors and can increase the likelihood of problematic spending (Lam and Lam, 2017; Henrik and Anton, 2020).

Existing studies are very limited in investigating the effects of digital technology addiction towards over-indebtedness (Idris, 2019). Available studies have only investigated the association of problematic online shopping and financial literacy (Lam and Lam, 2017). In response to scholars' recommendation of studying the effect of digital technology addictions towards individual financial well-being (Idris, 2019), future research can extend the scope of previous research to a broader coverage of more types of digital services and investigate how addiction to digital technology can impact financial vulnerability. Examples are digitised financial service and online entertainment such as online stock investment services, gambling platform and video-on-demand services.

## Factor 4: Changes in financial behaviour

According to Van Aardt et al.'s consumer financial vulnerability model (Van Aardt et al. 2009), the most immediate factors affecting financial vulnerability are individuals' income fragility and expenditure, where income fragility can be further decomposed into savings related and investment related conditions. Meanwhile expenditure can be further decomposed into spending-related and debt-related conditions. All these conditions inevitably are affected by the changes in related financial behaviour as responses to either internal personal and/or external environmental situations. By systematically and separately investigate what has happened to vulnerable groups in the following four area of behavioural change, we can obtain a clear picture of factors leading to their financial difficulties, especially in the recent years with the COVID-19 pandemic (Kempson et al., 2017; Thompson et al., 2017; Achou et al., 2020; Moenjak, 2020; Roll et al., 2020; Round et al., 2020).

1. Income/saving related: Better saving habits and plan for the future can improve financial condition. Under COVID-19, what action(s) people could take to increase income or saving, or what affect their ability to increase income or saving are not well documented in existing research and therefore more investigation is required.
2. Spending related: Spend more, for example on non-essentials, and live beyond one's means will worsen financial condition. Under COVID-19, are people forced to spend more on hygienic products or entertainment? How these affect their financial condition. More research is required.
3. Investment related: Investment is likely to increase one's wealth. Whilst the opposite is also true. An individual who is willing to take risks tends to exhibit high risk-taking behaviour such as investing in new products and borrowing to invest (Kannadhasan, 2015; Hanspal et al., 2020). During COVID-19, possible changes in investment behaviour can be the higher frequency because of fintech, invest in new investment products due to exposing to more investment news. The understanding is insufficient from existing research.
4. Debt related: Risky borrowing, use of credit for impulsive consumption, missing or defer loans payment will worsen financial condition. In addition, some may even borrow money when experiencing financial difficulties in order to pay off other credits or other commitments (Kempson, 2002). How COVID-19 leads to changes in debt related behaviour deserves more closer study. For example, is it common for people to borrow more because of job losses or sickness? More empirical studies is necessary.

# Conclusion and future research suggestions

Although Van Aardt et al. (2009) had developed a heuristic financial vulnerability model which draws conclusions in key factors leading to financial vulnerability, with the social, economic and technological changes in recent years with the coronavirus outbreak in 2019, there are new challenges for decomposing the root causes of financial vulnerability because new factors are coming into play.

By referring to the recent literatures, we identified several factors that can be mapped into the cause-effect chain of financial vulnerability of Van Aardt et al. (2009), either as new external factors (i.e., Pandemic), internal factors (i.e., financial literacy and addiction to digital technology), or the "new version" of existing variables. These are new factors related to the current pandemic and developing technological advancement (i.e., digitisation of the

economy), which in turn are bringing about new living and working styles as well as financial behavioural change (i.e., changes in financial behaviour). The emerging changes and factors were not sufficiently and holistically investigated in the existing literatures. These factors are summarised below.

Pandemic (an external factor) – COVID-19 and the associated economic downturn(s) constitute shocks leading to cash inflow reduction, cash outflow increase and/or asset value and wealth reduction. Cash inflow reduction can be the results of a combination of passive reasons, such as employers' decision, eligibility and accessibility to the government emergency benefits, and/or family/personal reasons, such as home caring responsibilities with children staying at home as overseas domestic helpers are unable to report duty due to lockdown or flight postponement. Cash outflow increases can be caused by additional credit or debt utilisation to support extra pandemic-driven expenditure, such as facilities and equipment to support work-from-home or study-from-home, additional consumption of hygienic and protective products. The question of whether people suffer from wealth shock because of the unmanageable debts, economic downturn and/or the more volatile investment environment as topics and factors are not fully examined. In addition, given the impacts of COVID-19 was found more widely spread across a country or a city, a deeper understanding can be achieved by knowing how asset value cash inflows, and outflows changes before and after the Covid-19 so as to identify which issues that Covid-19 impact the most.

Digitisation of the economy (a "new version" of credit availability and financial product innovation) – Technological advancement coincides with the COVID-19 pandemic, which forced social contact to minimal level, to accelerate social-economic digitisation in many aspects of daily life with impacts in economic and financial management activities ranging from shopping, personal consumption, banking, payment, and credit-related application. In addition, big data is enabling digital services providers to perform targeted advertising and push marketing more aggressively to trigger more consumptions and transactions. With a high smartphone penetration rate and abundant availability of different digitised services. Peoples' usage frequency of digitised services and awareness and exposure to related push marketing activities may increase because they have been spending more time at home to work-from-home, study-from-home arrangement, endure under-employment or even unemployment. We intent to investigate how the vulnerable groups of our population are affected by digitisation of the economy. It is important to explore how financial difficulties are caused by digitisation to potentially alter the pattern of personal consumption, financial transactions and credit behaviour due to the outbreak of COVID-19.

Financial literacy (an internal factor) – Financial literacy is a combination of awareness, knowledge, skill, attitude and behaviour necessary to make sound financial decisions and to achieve financial wellbeing. Financial literacy may improve one's ability and capability to deal with macroeconomic shocks and reduces utilisation of digital credit. Facing the challenges of digitised society brought about by the COVID-19 pandemic, individuals' financial competence to deal with the easier availability of digitised financial services deserves deeper investigation.

Addiction to digital technology (an internal factor) – Other factors may interfere with the effect of financial literacy and the ability to manage personal finance. Specifically, the addiction to digital technology is a phenomenon deserved attention. This is driven by the digitisation of the economy. Addiction is defined as an impulse dependent on a habit of a specific activity or substance use that can lead to destructive effects on social, emotional, and even financial conditions. The COVID-19 pandemic has created an opportunity for people to spend more time on social media and digital services to shop, to be entertained, and to manage their financial affairs. Since most digital services usually involve marketing and promotion activities to stimulate a higher levels of consumer utilisation, people may become more susceptible to impulse spending and borrowing. Essentially these impulse-driven usages may bring about behavioural change in consumption, spending, use of debt and savings/investment.

Inability to resist temptation, overspending, relaxed attitudes to borrowing, combined with poor money management skills are common contributing factors to individual debt problem. Existing studies are very limited in investigating the relational effects on digital technology addiction and people suffering from over-indebtedness. We propose to extend the scope of previous research, cover a broader range of digital services, and investigate how addiction to digital technology may impact financial vulnerability.

These two internal factors (financial literacy and addiction to digital technology) may intertwine to impact individual's ability to resist temptation in a digitised society and skill in personal financial management.

Changes in financial behaviour – According to Van Aardt et al.'s consumer financial vulnerability model, the most immediate factors affecting financial vulnerability are individuals' income fragility and expenditure. Income fragility can be further decomposed into savings-related and investment-related conditions. Meanwhile, expenditure can be further decomposed into spending-related and debt-related conditions. By systematically and separately investigating what behavioural changes might have happened to vulnerable groups in these four factors, we can obtain a clear picture about the causes leading to their financial difficulties in recent years, especially after the outbreak of the COVID-19 pandemic.

To conclude, the purpose of this paper is to conduct literature survey to review and consolidate the recent scattered literatures to identify some possible factors to be considered in the research related to financial vulnerability. Based on our literature survey above, four relevant issues have been identified for future research: (i) pandemic, (ii) digitisation of the economy, (iii) intertwining effect of financial literacy and addiction to digital technology, and (iv) four area of financial behavioural changes. Future research

covering the above elements could deepen our understanding of how personal and environmental factors, especially the COVID-19 pandemic outbreak and socio-economic changes, interrelate to affect peoples' financial vulnerability. One possible research plan is to focus on a particular segment of a country or city, such as people who need to seek for debt counselling services because they are in financial trouble after the outbreak of COVID-19, and study their characteristics of the above proposed issues, by questionnaire survey.

## 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.

## Author contributions

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

## Funding

This paper is produced as part of the Research Project "The characteristics of the Vulnerable Groups with Personal Financial Difficulties: The impact of COVID-19 and the implications to financial counselling needs" which has been funded by the Investor and Financial Education Council (www.ifec.org.hk). This research study was supported by Hainan Provincial Natural Science Foundation of China. The name of the project is "Research on Statistical Monitoring and Accounting of Digital Economy in Hainan Free Trade Port." The project number is 722RC724. This paper was also supported by the Hainan College of Economics and Business (Project reference number: hnjmk2021301).

## Acknowledgments

The authors of this paper like to thank the Healthy Budgeting Family Debt Counselling Centre of Tung Wah Group of Hospitals, especially the Centre Supervisor Chan Fuk Lung, Henry and Assistant Supervisor Law Wing Shan, for their collaboration and cooperation. We would also like to thank the Hainan Provincial Natural Science Foundation of China and Hainan College of Economics and Business for their financial support.

## 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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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 10 January 2023
DOI 10.3389/fpsyg.2022.984374



OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Health Psychology, a section of the journal Frontiers in Psychology

RECEIVED 01 July 2022
ACCEPTED 21 November 2022
PUBLISHED 10 January 2023

CITATION
Villarreal Sotelo K, Peña Cárdenas F, Zamorano González B, Vargas Orozco CM, Hernández Rodríguez I and Landero Pérez C (2023) Prevalence of suicidal behavior in a northeastern Mexican border population during the COVID-19 pandemic. *Front. Psychol.* 13:984374. doi: 10.3389/fpsyg.2022.984374



# Prevalence of suicidal behavior in a northeastern Mexican border population during the COVID-19 pandemic

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**Introduction:** Before the pandemic, suicide was already considered a global public health problem. The outbreak of COVID-19, a coronavirus-related infectious disease, began to impact people's physical and mental health. The factors that either contribute to or mitigate this risk need to be better understood, and this can only be accomplished through research. Therefore, this study aimed to study the prevalence of suicidal ideation and behavior in Tamaulipas, Mexico, during the COVID-19 pandemic.

**Methods:** A quantitative, descriptive, and cross-sectional study was conducted. The sample consisted of 659 participants, of whom 194 (29.5%) were men and 465 (70.5%) participants were oldwomen, ranging in age between 16 and 68 years (M = 22.56, SD = 7.26). An adapted version of the Spanish version of the Columbia Suicidal Severity Rating Scale was used to assess the seriousness of suicidal ideation and behavior.

**Results:** The higher rates of suicidal indicators were suicidal ideation with "wish to dead" (39.9%), while the lower was suicidal ideation with a specific plan (8.2%). A total of 18.2% of participants reported "suicidal attempts before COVID-19," of whom 40% reported "suicidal attempts in the last 3 months." Suicidal behavior rates were lower: 13.7% of participants reported "non-specific preparatory behavior" and 13.3% reported "actual suicide attempts." Women were more likely than men to exhibit almost all indicators of suicidal ideation and behavior (OR = 1.63–2.54; 95% CI = 1.11–2.41, 1.76–3.68), as well as confinement (OR = 2.60; 95% CI = 1.73–3.91). Confinement for more than 40 days (OR = 0.55–0.66; 95% CI = 0.40–0.75, 0.47–0.93) and knowing a person infected with COVID-19 (OR = 1.57–2.01; 95% CI = 1.02–2.42, 1.20–3.34) were associated with a higher risk of exhibiting several suicidal indicators and having previously attempted suicide.

**Conclusion:** Being a woman, knowing a person infected with COVID-19, and being confined, especially for longer than 40 days, are all risk factors for suicidal ideation. Therefore, intervention programs are needed to reduce the

suicide risk prevalence, especially these days because of the influence of the pandemic, and should be primarily focused on those who present the risk factors associated with suicidal behavior identified in this study.

KEYWORDS

**suicide, COVID-19, suicidal behavior, Mexican, suicidal ideation**

## Introduction

A large number of authors have contributed to the generation of knowledge on mental health, especially on suicidal ideation during the pandemic (Fitzpatrick et al., 2020; Longobardi et al., 2020; Cheung et al., 2021; Nomura et al., 2021; Smalley et al., 2021). All of them intend to understand the impact of COVID-19 on suicidal thoughts and behaviors, personality traits, and other psychosocial aspects. The first case of COVID-19 was reported in Wuhan, China, in December 2019 (Nomura et al., 2021). Afterward, the cases continued to increase exponentially. Faced with mounting cases, the World Health Organization (WHO) declared a pandemic in March 2020, which marked the beginning of a series of measures and strategies to prevent its spread. However, in many countries, the crisis still persists due to the daily increase in infections and, even worse, deaths, which are close to four million globally (Aragón-Nogales et al., 2019; Longobardi et al., 2020; World Health Organization, 2020).

The implementation of prevention measures has caused a drastic change in daily activities (Odone et al., 2020; Lee et al., 2022; Rahman et al., 2022). Most of these measures consist of maintaining physical isolation and social distancing, actions that, to this day, are effective methods to reduce the possibility of further transmission of the infection. Work-at-home and virtual work has disrupted daily life. The world faced temporary closures of schools and businesses, as well as all activities considered non-essential, which resulted in the loss of many people's sources of income. The population experienced a drastic change in their daily lives due to the pandemic containment measures. Under this context, some people lost their jobs, others stopped seeing their families due to the "stay-at-home" measures, and many others suffered from anxiety due to the fear of becoming ill with COVID-19 and ending up in an intensive care ward or, even worse, dying (Devitt, 2020; Ammerman et al., 2021).

The indirect consequences of the prevention actions began to manifest in the health of many people who presented some symptoms related to their mental health, such as stress, anguish, feelings of loneliness, and high levels of suicidal ideation, with adolescents and young adults being the most vulnerable population (Kiuchi et al., 2020; Nomura et al., 2021). Studies around the world reported a significant increase in psychological distress, COVID-19 anxiety syndrome, affective symptoms, allostatic load, and fatigue, which have been observed across different populations. Differences in mental health were described based on the country or culture of origin, age, sex, occupation, community, or clinical samples (Zhang et al., 2020; Brailovskaia et al., 2021; Mansueto et al., 2021, 2022).

Previous studies exploring the psychological impact of the COVID-19 population's mental health stated that how people perceive and deal with the COVID-19 situation can impact their mental and physical health (Galea et al., 2020; Salari et al., 2020). Some of them have focused on external factors such as perceived social support (Huang et al., 2021), stress related to the type of occupation, such as healthcare workers (Mansueto et al., 2021), or the use of social media (Brailovskaia et al., 2021). For example, in Germany and Italy, Brailovskaia et al. (2021) stated that social media use was positively linked to stress and burden caused by COVID-19 because social media is used as a COVID-19 information source.

Other studies focused on individual psychological resources that could act as risk or protective factors to deal with COVID-19-related consequences. In China, the study by Zhang et al. (2020) discovered that resilience and positive coping were protective factors for depressive, anxiety, and stress symptoms in junior high and high school students, whereas negative coping was a risk factor. For example, Zhang et al. (2020) pointed out that individual factors such as coping strategies are crucial to dealing with COVID-19-related consequences. A longitudinal study pointed out that, while some individuals experience the restrictions on daily life as a heavy burden, others adapt to the situation and try to make the best of it (Brailovskaia and Margraf, 2020).

The previously daid,or the previously exposed with regard to COVID-19 contingency has caused drastic changes in health statistics, especially those referring to mortality rates (Longobardi et al., 2020), forcing professionals and researchers to find ways to assess and intervene to address the mental health problems stemming from the sanitary crisis (Kar et al., 2020; Kahil et al., 2021). With regard to suicide, research showed that, for a person to commit suicide, it requires a "perfect storm" that includes the presence of some mental illness, some genetic predisposition, family history, the presence of certain personality traits, the consumption and abuse of alcohol or drugs, and some problematic events that cannot be addressed

(Devitt, 2020; Reger et al., 2020; Kahil et al., 2021). For example, studies pointed out that patients with higher total scores on affectively dysregulated temperaments are more likely to have higher levels of hopelessness, which is an important predictor of suicidality (Serafini et al., 2012).

Recent research showed that suffering from an illness that could prove burdensome for the family, like COVID-19, can raise feelings of anxiety, sorrow, and stress, leading some to consider suicide as a means to escape their moral and financial responsibilities to their loved ones (Devitt, 2020). For this reason, disorders related to mental health, particularly those related to suicide, represent a global public health problem affecting adolescents and young adults, which has been considered the second leading cause of death in these age groups in recent years (Han et al., 2020; Penninx et al., 2021).

Fear of the COVID-19 disease, the vulnerability of individuals, and a history of depressive symptoms are considered significant risk factors for suicidal ideation (Saricali et al., 2020). Negative lifestyles such as smoking, drinking, and drug use, which increased during the pandemic, also played a role (Nomura et al., 2021). On the other hand, staying at home has led to a mental burden that increases levels of depression and anxiety in the young, elderly, and fragile populations and cannot be ignored, making it a risk factor for suicidal ideation and behavior (Sayeed et al., 2020; Nomura et al., 2021; Rahman et al., 2021; Pathirathna et al., 2022).

Nevertheless, despite an increasing number of studies conducted worldwide, a gap in knowledge exists about Mexican studies. In the particular case of Mexico, the National Institute of Statistics and Geography (INEGI) described an increase in suicide rates between 2017 and 2018. The cases of self-inflicted deaths per 100,000 inhabitants in 2017 reached a value of 5.2, while in 2018, it was 5.4 (INEGI, 2020). The present study presented data obtained from the project "Suicide in times of COVID-19," conducted under the sponsorship of the Universidad Autonoma de Tamaulipas. The participants in the study were located in the northeastern region of Mexico, which is characterized by social vulnerability, social violence, migration, and social marginalization, mainly due to its proximity to the United States. The present study aimed to report the prevalence of suicidal ideation and behavior related to COVID-19 in the population along the northeastern border of Mexico. To that end, our first specific objective was to determine the prevalence of suicidal ideation and behavior in the people of the northeastern border of Mexico both before and during the COVID-19 pandemic. The second aim was to analyze the suicidal ideation and behavior associated with the risk factors of contagion from COVID-19. Finally, we sought to analyze the suicidal ideation and behavior associated with confinement during the COVID-19 pandemic. Based on the previous literature review, we hypothesized that, during the COVID-19 pandemic, there might be an increased prevalence of suicidal ideation and behavior in individuals on the northeastern border of Mexico. The second risk factor for suicidal ideation and behavior is COVID-19 contagion. Finally, confinement is a risk factor for suicidal ideation and behavior.

# Materials and methods

## Participants

In this study, a quantitative, descriptive, and cross-sectional study was conducted. The participants of the present study were an open population from the northeastern border of Mexico. The sample consisted of a total of 659 participants, of whom 194 (29.5%) were men and 465 (70.5%) were women, ranging in age from 16 to 68 years ($M = 22.56$, $SD = 7.26$). Participants were selected by a non-probabilistic convenience sampling procedure. Due to the pandemic lockdown measures, virtual sampling was combined with an online questionnaire because of the inability to reach the target population face-to-face. The online questionnaire was distributed by the study team's social media channels using a snowball technique. Participants were evaluated in September 2020, 6 months after the first cases of COVID-19 were detected in Mexico, and were recommended for population confinement and other sanitary measures to contain the first wave of the pandemic.

## Procedure

As previously stated, the process for data collection due to the health contingency was developed through an electronic questionnaire *via* Google Forms because of the inability to reach the target population face-to-face. A snowball procedure was followed to distribute the online survey through the research team's social media and digital platforms. This procedure was selected since the use of virtual sampling combined with an online survey has proven to be a reliable tool to guarantee an increase in the sample size and its representativeness of hard-to-reach target populations, as presented in the case of the COVID-19 lockdown. No compensation was provided to the participants. The information was processed to calculate descriptive statistics and reliability coefficients and determine the odds ratios (OR) at a 95% confidence interval using SPSS v22 statistical software.

## Instrument

A questionnaire requesting sociodemographic data and behaviors related to confinement was designed specifically for the COVID-19 pandemic.

The first section included questions regarding their sociodemographic characteristics, such as sex, age, marital status, living with, schooling, occupation, and place of residence, to assess demographic variables.

The second section included questions regarding COVID-19 status and confinement. This section asked participants to indicate whether they had been confined and whether they had been infected with COVID-19 at any point (current or in the past), as well as whether they knew someone who had been infected with the virus. The items included were as follows: "Have you been infected by COVID-19?," "Are you infected by COVID-19?," "Has anyone you know been infected with COVID-19?," and "Has anyone you know died of COVID-19?" Regarding personal confinement, the question included was, "Have you been in confinement?" with dichotomous answer options: "yes" or "not." To assess the time of confinement, the question included was, "If your previous answer was yes, for how long?" It included three answer options: "<14 days," "14–39 days," and "more than 40 days."

In addition, an adapted version of the Spanish version of the Columbia Suicidal Severity Rating Scale was used to assess the seriousness of suicidal ideation and behavior (Sp-CSSR-S). CSSRS is a well-known measure in suicide research because of its construction and validation in the English language (Posner et al., 2010, 2011); it has been translated into multiple languages and adapted to various cultures. The translated version into Spanish has been validated with Spanish-speaking psychiatric outpatients. It is a reliable and valid instrument for assessing suicidal ideation and behavior in daily clinical practice and research settings (Al-Halabi et al., 2016). Since the adaptation of an instrument is considered new, for the analysis of the instrument's reliability, the coefficient of Cronbach's alpha was calculated in our sample. The instrument presented a Cronbach's alpha of 0.92, which is considered high and, therefore, adequate to continue with the study.

The items evaluated ideas and behaviors in increasing order of intensity and risk. The general instruction was modified to ask whether these ideas and behaviors had occurred during the COVID-19 health emergency. Because the CSSRS is not a time-sensitive measure, we included three items to assess the period preceding the COVID-19 health emergency and one to assess the 3 months preceding the assessment. We described the items included below:

Suicidal ideation assessed by items 1–5 included ideas related to death, with or without a specific plan, and a desire to commit suicide, but there was no behavioral activation.

(a) The wish to be dead, in which the person confirmed that they had had ideas related to wishing to be dead or to no longer live, or the wish to fall asleep and not wake up, was asked if the participants answered "Yes" to Question 1: "Have you wished to be dead or to be able to fall asleep and not wake up?".
(b) Non-specific suicidal ideation, which explored general, non-specific thoughts regarding the desire to end one's life/suicide without ideas about how to do it, was explored in Question 2: "Have you actually had the idea of committing suicide?".
(c) Suicidal ideation without any method, which assessed whether the person had the idea of committing suicide and had thought about how they would do it, was explored in Item 3: "Have you thought about how you would carry this out?".
(d) Suicidal ideation (no specific plan), in which the person had the idea and thought about carrying out their plan, was assessed with Question 4: "Have you had these ideas and, to some degree, intended to carry them out?".
(e) Suicidal ideation with a specific plan, that is, ideas of taking one's own life are presented with details of the plan partially or fully elaborated, and the participant has the intention of carrying out this plan, as assessed by Question 5: "Have you started to elaborate or have you elaborated the details of how to commit suicide?".

Determination of the temporal spaces of suicidal ideation and behavior (Questions 6–8): These items were included to assess suicidal ideation and behavior before and during the COVID-19 pandemic.

(f) Previous suicide attempts, where the person had already moved from idea to action, were explored with Question 6: "Have you ever done anything, started anything, or prepared to do anything to end your life?".
(g) Using the previous questions as a reference, Question 7 on the time period was included: "If your previous answer was yes, was this in the last 3 months?".
(h) Previous suicidal ideation or behavior was explored with Question 8: "Have you had suicidal thoughts or attempts in other periods of your life?".
(i) Active suicidal behavior was assessed by Questions 9–11. Non-specific preparatory behavior by Question 9: "Have you started planning something to end your life?" At this point, there was active suicidal ideation without any method or plan.
(j) Preparatory behavior with a specific plan by Question 10: "Have you prepared something to end with your life?" At this point, there is active suicidal ideation with a specific plan but not the intent.
(k) Actual suicide attempt by Question 11, "Have you done something to end your life?," to assess. In this case, the person has already attempted to end their life, which has failed.

## Ethical considerations

The project that supports this manuscript was submitted for evaluation and approval by the Postgraduate and Research Committee of the Autonomous University of Tamaulipas

(Universidad Autonoma de Tamaulipas, Grant number: 38-UATINVES20). The study did not include any risk for the participants; however, according to the Declaration of Helsinki and the Code of Health Research in Mexico, online informed consent was requested from the participants in the survey to continue. It explained the study's purpose, the participants' anonymity, the confidential handling of the data, and voluntary participation. At the same time, participants were informed that if they wished to decline participation, they could do so at any time once the survey had begun.

## Statistical analyses

The information from the answered questionnaires was uploaded into a database, which was then edited and analyzed in the Statistical Package for the Social Sciences (SPSS) version

TABLE 1 Demographic data of the participants.

| Variable | *n* | % |
|---|---|---|
| **Sex** | | |
| Men | 194 | 29.4 |
| Women | 465 | 70.6 |
| **Marital status** | | |
| Single | 552 | 83.8 |
| Married or in free unión | 98 | 14.9 |
| Divorced | 6 | 0.9 |
| Widow | 3 | 0.5 |
| **Live with** | | |
| Family | 560 | 85 |
| Partner | 54 | 8.2 |
| Alone | 34 | 5.2 |
| Friends | 7 | 1.1 |
| Other | 4 | 0.5 |
| **Schooling** | | |
| Posgrade | 50 | 7.5 |
| Higher education | 461 | 70 |
| High school | 135 | 20.5 |
| Middle school | 13 | 2 |
| **Occupation** | | |
| Empresary/comerciant | 16 | 2.4 |
| Formal employee | 192 | 29.1 |
| Informal employee/temporary worker | 116 | 17.6 |
| Housewife/Not work | 19 | 2.9 |
| Student | 316 | 48 |
| **Place of residence** | | |
| Tamaulipas | 613 | 93 |
| Other | 46 | 7 |

Source: Data from study survey.

TABLE 2 Prevalence of suicidal ideation and behavior during contingency by COVID-19 total and by sex.

| Suicidal behavior | Total | | | | | Sex | | | | | | OR | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Women (*n* = 465) | | | | Men (*n* = 194) | | | |
| | | Yes | | No | | Yes | | No | | Yes | | No | | | |
| | *N* | Frec. | % | Frec. | % | Frec. | % | Frec. | % | Frec. | % | Frec. | % | | |
| 1. Wish to be dead | 656 | 262 | 39.9 | 394 | 60.1 | 209 | 45 | 255 | 55 | 53 | 27.6 | 139 | 72.4 | 2.15*** | 1.49–3.09 |
| 2. Unspecific suicidal ideation | 653 | 199 | 30.5 | 454 | 69.5 | 160 | 34.6 | 303 | 65.4 | 39 | 20.5 | 151 | 79.5 | 2.04*** | 1.36–3.05 |
| 3. Suicidal ideation with any method | 656 | 195 | 29.7 | 461 | 70.3 | 151 | 32.6 | 312 | 67.4 | 44 | 22.8 | 149 | 77.2 | 1.63** | 1.11–2.41 |
| 4. Suicidal ideation without a specific plan | 656 | 159 | 24.2 | 497 | 75.8 | 128 | 27.6 | 336 | 72.4 | 31 | 16.1 | 161 | 83.9 | 1.97** | 1.28–3.05 |
| 5. Suicidal ideation with a specific plan | 657 | 54 | 8.2 | 603 | 91.8 | 37 | 8 | 428 | 92 | 17 | 8.9 | 175 | 9.1 | 0.89 | 0.48–1.62 |
| 6. Previous suicidal attempts | 656 | 120 | 18.2 | 536 | 81.7 | 95 | 20.5 | 368 | 79.5 | 25 | 13 | 168 | 87 | 1.73* | 1.07–2.79 |
| 7. Suicidal attempts in the last 3 months | 120 | 48 | 40 | 72 | 60 | 39 | 41.1 | 56 | 58.9 | 9 | 36 | 16 | 64 | 1.23 | 0.49–3.08 |
| 8. Previous suicidal ideation or attempts | 653 | 276 | 42.3 | 377 | 57.7 | 225 | 48.5 | 239 | 51.5 | 51 | 27 | 138 | 73 | 2.54*** | 1.76–3.68 |
| 9. Non-specific preparatory behavior | 626 | 86 | 13.7 | 540 | 86.3 | 69 | 15.7 | 371 | 84.3 | 17 | 9.1 | 169 | 90.9 | 1.84* | 1.05–3.24 |
| 10. Preparatory behavior with a specific plan | 629 | 64 | 10.2 | 565 | 89.8 | 51 | 11.5 | 391 | 88.5 | 13 | 7 | 174 | 93 | 1.74 | 0.926–3.29 |
| 11. Actual suicide attempt | 631 | 84 | 13.3 | 547 | 86.7 | 70 | 15.8 | 372 | 84.2 | 14 | 7.4 | 175 | 92.6 | 2.35** | 1.28–4.29 |

Odds ratio, calculated for 95% certainty. When the confidence interval did not include the value 1. $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.

10.3389/fpsyg.2022.984374

TABLE 3 Prevalence of COVID-19 infection and confinement total, and in contrast by sex.

| Behavior | | Total | | | | Sex | | | | | | OR | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Women ($n = 465$) | | | | Men ($n = 194$) | | | | | | | |
| | | Yes | | No | | Yes | | No | | Yes | | No | | | |
| | *n* | Frec. | % | Frec. | % | Frec. | % | Frec. | % | Frec. | % | Frec. | % | | |
| Have you been infected by COVID-19? | 659 | 124 | 18.8 | 535 | 81.6 | 94 | 20.2 | 371 | 79.8 | 30 | 15.5 | 164 | 84.5 | 1.38 | 0.88–2.17 |
| Actually are you infected by COVID-19? | 659 | 7 | 1.1 | 652 | 98.9 | 4 | 0.9 | 461 | 99.1 | 3 | 1.5 | 191 | 98.5 | 0.52 | 0.12–2.49 |
| Has anyone you know been infected with COVID-19? | 659 | 546 | 82.9 | 113 | 17.1 | 390 | 83.9 | 75 | 16.1 | 156 | 80.4 | 38 | 19.6 | 1.26 | 0.82–1.95 |
| Has anyone you know died for COVID-19? | 659 | 361 | 54.8 | 298 | 42.5 | 265 | 57 | 200 | 43 | 96 | 49.5 | 98 | 50.5 | 1.35 | 0.96–1.89 |
| Have you been in confinement? | 659 | 538 | 81.6 | 121 | 18.4 | 401 | 86.2 | 64 | 13.8 | 137 | 70.6 | 57 | 29.4 | 2.60*** | 1.73–3.91 |
| If your previous answer was YES, for how long? | | | | | | | | | | | | | | | |
| Less than 14 days | 538 | 76 | 14.1 | | | 49 | 12.2 | | | 27 | 19.7 | | | | |
| 14–39 days | 538 | 145 | 27 | | | 106 | 26.4 | | | 39 | 28.5 | | | | |
| More than 40 days | 538 | 317 | 58.9 | | | 246 | 61.3 | | | 71 | 51.8 | | | | |

Odds ratio, calculated for 95% certainty. When the confidence interval did not include the value 1. *** $p \leq 0.001$.

22. Information was generated about the descriptive statistics for demographic data by percentages, mean scores, and standard deviation. To analyze the risk of suicidal indicators associated with sex, COVID-19 and confinement odds ratios (OR) for a 95% confidence interval (CI) were calculated. Significant differences were considered when the confidence intervals did not include the unit. Variables' answers were coded as 0 for "not" and 1 for "yes." Further, when contrasting by risk factor sex, 0 was used for "men" and 1 for "women." Similarly, the time of confinement, "40 days," was coded with 0 and "more than 40 days" with 1. The results can be seen in Tables 1–6.

## Results

Table 1, the demographic data of the participants, presents a summary of the main characteristics of the study population. Regarding the sex of the population, 465 women (70.6%) and 194 men (29.4%) were identified. Their marital status identified 552 single participants (83.8%) and 98 married participants (14.9%). Most of the participants lived with their families, 560 (85%), while 54 lived with a partner (8.2%), and 34 lived alone (5.2%). In terms of schooling, 461 were part of the higher education group (70%), followed by 135 high school students (20.5%) and 50 graduate students (7.5%). Regarding occupation, almost half of them were only students: 316 (48%); the rest of the participants did another activity: 192 participants (29.1%) were formal employees, while 116 subjects (17.6%) were informal employees or temporary contract workers. Regarding their place of residence, 613 participants (93%) responded that they reside in Tamaulipas, Mexico.

### Prevalence of suicidal ideation and behavior during the COVID-19 total and by sex

To meet the objective of presenting the prevalence of suicidal ideas and behaviors, these were first analyzed in all participants and later contrasted by sex. Our main findings showed that the most frequent indicators of suicidal ideation were "wish to be dead," reported by 39.9%, "unspecific suicidal ideation," reported by 30.5%, "suicidal ideation with any method," reported by 29.7%, and "suicidal ideation without a specific plan," reported by almost a quarter of the participants; less frequent were the indicators of suicidal behaviors such as "non-specific preparatory behavior," reported by 13.7% of the participants, "actual suicide attempts" (13.3%), and 10.2%, "non-specific preparatory behavior." Nearly a fifth of participants (18.2%) reported "previous suicidal attempts," of whom 40% reported "suicidal attempts in the last 3 months" and 42.3% had a history of "previous suicidal ideation or attempts" (see Table 2). Then, odds ratios (OR) for a 95% confidence interval (CI)

TABLE 4 Association between suicidal ideation and behaviors in relation to having sufferen from the COVID-19 infection.

| Suicidal behavior | Total | | | Ever infected | | | Actually infected | | |
|---|---|---|---|---|---|---|---|---|---|
| | *n* | Frec. | % | Yes | No | OR (95% CI) | Yes | No | OR (95% CI) |
| 1. Wish to be death | 656 | 262 | 39.9 | 48.4 | 38 | 1.53 (1.03–2.27)* | 42.9 | 39.9 | 1.12 (0.25–5.08) |
| 2. Unspecific suicidal ideation | 653 | 199 | 30.5 | 36.3 | 29.1 | 1.38 (0.91–2.09) | 14.3 | 30.7 | 0.37 (0.045–3.15) |
| 3. Suicidal ideation with any method | 656 | 195 | 29.7 | 36.3 | 28.2 | 1.45 (0.96–2.19) | 14.3 | 29.9 | 0.39 (0.04–3.26) |
| 4. Suicidal ideation without a specific plan | 656 | 159 | 24.2 | 27.4 | 23.5 | 1.23 (0.79–1.91) | 28.6 | 24.2 | 1.25 (0.241–6.52) |
| 5. Suicidal ideation with a specific plan | 657 | 54 | 8.2 | 7.3 | 8.4 | 0.85 (0.40–1.80) | 28.6 | 8 | 4.60 (0.87–24.29) |
| 6. Previous suicidal attempts | 656 | 120 | 18.2 | 19.5 | 18 | 1.10 (0.67–1.81) | 28.6 | 18.2 | 1.80 (0.34–9.39) |
| 7. Suicidal attempts in the last 3 months | 120 | 48 | 40 | 33.3 | 41.7 | 0.70 (0.27–1.79) | 0 | 40.7 | 1.02 (0.98–1.07) |
| 8. Previous suicidal ideation or attempts | 653 | 276 | 42.3 | 48.8 | 40.8 | 1.38 (0.93–2.05) | 42.9 | 42.3 | 1.02 (0.25–4.61) |
| 9. Non-specific preparatory behavior | 626 | 86 | 13.7 | 14.2 | 13.6 | 1.04 (0.59–1.85) | 0 | 13.9 | NA |
| 10. Preparatory behavior with a specific plan | 629 | 64 | 10.2 | 12.4 | 9.6 | 1.32 (0.71–2.45) | 14.3 | 10.1 | 1.47 (0.17–12.48) |
| 11. Actual suicide attempt | 631 | 84 | 13.3 | 14.2 | 13.1 | 1.09 (0.61–1.94) | 0 | 13.5 | NA |

Odds ratio, calculated for 95% certainty. When the confidence interval did not include the value 1. *$p \leq 0.05$.

TABLE 5 Association between suicidal ideation and behavior and the consequences of COVID-19 for an acquaintance.

| Suicidal behavior | Total | | | Known person infected | | | Known person death | | |
|---|---|---|---|---|---|---|---|---|---|
| | *n* | Frec. | % | Yes | No | OR (95% CI) | Yes | No | OR (95% CI) |
| 1. Wish to be dead | 656 | 262 | 39.9 | 42 | 29.7 | 1.71 (1.10–2.66)* | 40 | 39.9 | 1.00 (0.73–1.37) |
| 2. Unspecific suicidal ideation | 653 | 199 | 30.5 | 32.3 | 21.4 | 1.75 (1.07–2.85)* | 29.7 | 31.4 | 0.92 (0.66–1.28) |
| 3. Suicidal ideation with any method | 656 | 195 | 29.7 | 31.9 | 18.9 | 2.01 (1.20–3.34)** | 28.1 | 31.6 | 0.84 (0.60–1.18) |
| 4. Suicidal ideation without a specific plan | 656 | 159 | 24.2 | 25.9 | 16.2 | 1.80 (1.05–3.09)* | 23.9 | 24.7 | 0.95 (0.67–1.37) |
| 5. Suicidal ideation with a specific plan | 657 | 54 | 8.2 | 8.6 | 6.3 | 1.41 (0.62–3.21) | 7.8 | 8.8 | 0.87 (0.50–1.53) |
| 6. Previous suicidal attempts | 656 | 120 | 18.2 | 19.1 | 14.3 | 1.41 (0.80–2.51) | 19.2 | 17.2 | 1.14 (0.76–1.71) |
| 7. Suicidal attempts in the last 3 months | 120 | 48 | 40 | 42.3 | 25 | 2.20 (0.66–7.27) | 44.9 | 33.3 | 1.63 (0.77–3.45) |
| 8. Previous suicidal ideation or attempts | 653 | 276 | 42.3 | 44.1 | 33.3 | 1.57 (1.02–2.42)* | 41.1 | 43.7 | 0.89 (0.65–1.22) |
| 9. Non-specific preparatory behavior | 626 | 86 | 13.7 | 14.4 | 10.4 | 1.45 (0.74–2.84) | 12.5 | 15.3 | 0.78 (0.50–1.24) |
| 10. Preparatory behavior with a specific plan | 629 | 64 | 10.2 | 10.9 | 6.5 | 1.77 (0.78–4.00) | 10.1 | 10.3 | 0.97 (0.58–1.64) |
| 11. Actual suicide attempt | 631 | 84 | 13.3 | 14.1 | 9.3 | 1.59 (0.79–3.19) | 14.3 | 12.1 | 1.21 (0.75–1.93) |

Odds ratio, calculated for 95% certainty. When the confidence interval did not include the value 1.* $p \leq 0.05$; ** $p \leq 0.01$.

for each suicidal indicator were calculated to determine the risk associated with the sexes. It was considered statistically significant when the 95% CI did not include the value of 1; this identified the group at risk. It was found that the female sex was a risk factor for 8 of the 11 items evaluated: "wish to be death" (OR = 2.15, 95% CI = 1.49–3.09); "unspecific suicidal ideation" (OR = 2.04, 95% CI = 1.36–3.05); "suicidal ideation with any method" (OR = 1.63, 95% CI = 1.11–2.41); "suicidal ideation without a specific plan" (OR = 1.97, 95% CI = 128–3.05); "previous suicidal attempts" (OR = 1.73, 95% CI = 1.07–2.79); "previous suicidal ideation or attempts" (OR = 2.54, 95% CI = 1.76–3.68); "non-specific preparatory behavior?" (OR = 1.84, 95% CI = 1–05–3.24); and "actual suicide attempts" (OR = 2.35, 95% CI = 1.28–4.29). Details of the information can be seen in Table 2: Suicidal ideation and suicidal behavior during COVID-19. Or rates of suicidal ideation and suicidal behavior.

## Prevalence of COVID-19 infection and the total number of confinement days, as well as the sex of the participants

Table 3 presents a description of the data regarding COVID-19 infection, the **total number of** confinement days, and, in contrast, by sex. COVID-19 infected 18.8% of the participants, 82.9% knew someone who was infected, and

TABLE 6 Association between suicidal ideation and behavior in relation to confinement time.

| Suicidal behavior | | Total | | In confinement | | | Confinement > 40 days | | |
|---|---|---|---|---|---|---|---|---|---|
| | *n* | Frec. | % | Yes | No | OR (95% CI) | Yes | No | OR (95% CI) |
| 1. Wish to be dead | 656 | 262 | 39.9 | 42.4 | 28.9 | 1.81 (1.18–2.78)** | 46.2 | 33.8 | 0.59 (0.43–0.818)*** |
| 2. Unspecific suicidal ideation | 653 | 199 | 30.5 | 31.4 | 26.3 | 1.28 (0.82–2.01) | 34.8 | 26.2 | 0.66 (0.47–0.93)** |
| 3. Suicidal ideation with any method | 656 | 195 | 29.7 | 30.5 | 26.4 | 1.21 (0.78–1.90) | 30.9 | 28.6 | 0.89 (0.64–1.25) |
| 4. Suicidal ideation without a specific plan | 656 | 159 | 24.2 | 25.8 | 17.4 | 1.65 (0.99–2.75) | 28.4 | 20.2 | 0.63 (0.44–0.91)** |
| 5. Suicidal ideation with a specific plan | 657 | 54 | 8.2 | 8.2 | 8.3 | 0.99 (0.48–2.03) | 9.2 | 7.2 | 0.76 (0.43–1.34) |
| 6. Previous suicidal attempts | 656 | 120 | 18.2 | 17.8 | 20.7 | 0.82 (0.50–1.35) | 20.6 | 16 | 0.73 (0.49–1.09) |
| 7. Suicidal attempts in the last 3 months | 120 | 48 | 40 | 44.2 | 24 | 2.50 (0.92–6.84) | 46.3 | 32.1 | 0.54 (0.25–1.16) |
| 8. Previous suicidal ideation or attempts | 653 | 276 | 42.3 | 45.1 | 29.4 | 1.97 (1.28–3.03)** | 49.5 | 35.2 | 0.55 (0.40–0.75)*** |
| 9. Non-specific preparatory behavior | 626 | 86 | 13.7 | 14.2 | 11.7 | 1.25 (0.68–2.31) | 17.1 | 10.6 | 0.57 (0.36–0.91)** |
| 10. Preparatory behavior with a specific plan | 629 | 64 | 10.2 | 10 | 11 | 0.89 (0.47–1.70) | 11.4 | 9 | 0.76 (0.45–0.1.28) |
| 11. Actual suicide attempt | 631 | 84 | 13.3 | 13.7 | 11.8 | 1.18 (0.64–2.19) | 15.9 | 10.9 | 0.64 (0.40–1.03) |

Odds ratio, calculated for 95% certainty. When the confidence interval did not include the value 1. $^{**}p \leq 0.01$; $^{***}p \leq 0.001$.

54.8% knew someone who died from COVID-19. More than four-fifths of the participants reported living in confinement (81.6%). Then, odds ratios (OR) for a 95% confidence interval (CI) for each sex were calculated to determine the risk associated with the sexes. It was considered statistically significant when the 95% CI did not include the value of 1. The questions posed showed that there was no association between these variables, except for the question "Have you been in confinement?" (OR = 2.60, 95% IC = 1.73–3.91); this rate was higher in women (86.2%) than in men (70.6%).

## Association between suicidal ideation and behaviors in relation to personal COVID-19 infection

When comparing the rates of suicidal indicators between participants who were ever infected vs. "not" and infected vs. "not," the odds ratio (OR) was calculated to quantify the association between the possible risk factor and the percentage of each suicidal indicator, and it was considered statistically significant when the 95% CI did not include the value of 1; this identified the groups at risk. Table 4 shows the association between suicidal thoughts and behaviors related to having suffered from a COVID-19 infection. As it can be seen, those infected were only at a higher risk of reporting a "wish to be dead," with 48.4% of them doing so in contrast to the 38% of participants who were never infected (OR = 1.53, 95% CI = 1.03–2.27).

## Association between suicidal ideation and the consequences of COVID-19 for an acquaintance

When comparing the rates of suicidal indicators between the group of participants with a known person infected vs. "not" and a known dead person vs. "not," the odds ratio (OR) was calculated to quantify the association between the possible risk factor and the percentage of each suicidal indicator, and it was considered statistically significant when the 95% CI did not include the value of 1; this identified the groups at risk. Table 5 shows the association between suicidal ideation and the consequences of COVID-19 for an acquaintance. In that sense, when participants had an "infected acquaintance," it was identified as a risk factor, leading to significant values in the following suicide indicators: "wish to be dead" (OR = 1.71, 95% CI = 1.10–2.66); "unspecific suicidal ideation" (OR = 1.75, 95% CI = 1.07–2.85); "suicidal ideation with any method" (OR = 2.01, 95% CI = 1.20–3.34); "suicidal ideation without a specific plan" (OR = 1.80, 95% CI = 1.05–3.09); and "previous suicidal ideation or attempts" (OR = 1.57, 95% CI = 1.02–2.42). Further, it highlighted that knowing someone who died from COVID-19 was not associated with any suicidal indicators.

## Suicidal ideation in relation to confinement days

Table 6 shows the rates of suicidal indicators in relation to confinement. First, we compared the rates of suicidal indicators between the group of participants who "had been in confinement" vs. those who "had not." Subsequently, to contrast

the risk of suicidal ideas and behavior associated with the time of isolation, participants were re-categorized into two groups, first category where for participants who did not stayed in quarantine or who keep it for less than 40 days. Second category for those in self isolation for more than 40 days. The odds ratio (OR) was calculated to quantify the association between the possible risk factor and the percentage of each suicidal indicator. It was considered statistically significant when the 95% CI did not include the value of 1 to identify the groups at risk. The results showed that the group "in confinement" was a risk factor associated with the "desire to be dead" (OR = 1.81, 95% CI = 1.18–2.78) and "previous suicidal ideation or attempts" (OR = 1.97, 95% CI = 1.28–3.03). On the other hand, those who lasted "in confinement for more than 40 days" represented a higher risk of "wishing to be dead" (OR = 0.59, 95% CI = 0.43–0.818), "non-specific suicidal ideas" (OR = 0.66, 95% CI = 0.47–0.93), "suicidal ideation without a specific plan" (OR = 0.63, 95% CI = 0.44–0.91), "previous suicidal ideation or attempts" (OR = 0.55, 95% CI = 0.40–0.75), and "non-specific preparatory behavior" (OR = 0.57, 95% CI = 0.36–0.91).

## Discussion

Before the pandemic, suicide was already considered a global public health problem, and researchers developed theories to explain the factors that contributed to or mitigated this risk. For this reason, the present work examined ***the prevalence of suicidal ideation and behavior related to COVID-19 in the population of the northeastern border region of Mexico.***

Our first specific objective was **to describe the prevalence of suicidal ideation and behavior during the COVID-19 pandemic in the population of the northeastern border region of Mexico**. Our results indicated that the most frequent indicators of suicidal ideation were "wish to be dead," reported by 39.9% of participants, "unspecific suicidal ideation," reported by 30.5%, "suicidal ideation with any method," reported by 29.7%, and "suicidal ideation without a specific plan," reported by almost a quarter of the participants (24.2%); less frequent were the indicators of suicidal behaviors such as "non-specific preparatory behavior," reported by 13.7% of participants; "actual suicide attempts," reported by 13.3%, and "non-specific preparatory behavior," reported by 10.2%. Nevertheless, given that those are considered to be at a higher risk of committing suicide, we considered alert signs, especially considering that nearly a fifth of participants (18.2%) reported "previous suicidal attempts," of whom 40% had "suicidal attempts in the last 3 months" and 42.3% had a history of "previous suicidal ideation or attempts." The literature referred to the fact that, in terms of sex, women presented a 20–30% higher risk of manifesting suicidal ideation and behavior (Monteith et al., 2021; Nomura et al., 2021). The results of our study (Table 2) provide evidence for this situation, given that in most of the questions, women presented a higher risk of suicidal ideation and behavior during the COVID-19 contingency period. In a similar vein, some authors pointed out that, among their participants, suicidal thoughts were found to be in slightly more than half of the female participants (Fitzpatrick et al., 2020).

This statement is likely due to the expression of greater emotional sensitivity and because they manifest greater vulnerability to stressors that trigger negative psychological consequences, such as the death of family or friends (Hermosillo-de-la-Torre et al., 2021; Rahman et al., 2021).

The second specific objective was **to analyze the suicidal ideation and behavior associated with risk factors for the contagion of COVID-19**. In the present study, the questions addressed personal infection or that of any known person with COVID-19; in this sense, the results did not show significant sex differences. It is essential to point out that there were significant data regarding the period of confinement, suggesting that 86.2% of the women and 70.6% of the men maintained isolation (Table 3). It was observed that 61.3% of the women maintained confinement for periods longer than 40 days, compared to only 51.8% of the men. Although it is impossible to generalize, these results could be related to gender roles and the distribution of family activities. This situation becomes complex, as it requires studying the individual's identity, social role, and social relationships, which could influence the exposure and contagion of infectious diseases such as COVID-19 (Ya'qoub et al., 2021). The role of economic breadwinner falls on men rather than women, so men may need to continue to go out to work while women stay at home to care for children and the household. However, the probability of personal and family contagion is the same for both sexes since the person who needs to go out could infect the rest of the family.

The COVID-19 pandemic is exacerbating sex discrimination in the current society, which represents a complicated situation for the administration of public policies, given that, globally, only two-thirds of the data on COVID-19 infections have not been classified by sex (Nordhues et al., 2021). It is important to look at the data on infection analysis and to consider the vulnerability of individuals in terms of their level of health and their classification according to sex (Ya'qoub et al., 2021). While it is true that women have a higher perception of the threat of COVID-19, they are also the ones who are exposed to a higher level of infection, only when considering that healthcare workers are composed of at least 70% of the female population (Hermosillo-de-la-Torre et al., 2021; Nordhues et al., 2021). However, global figures indicate that male patients present a higher number of complications and deaths from COVID-19 (Ortolan et al., 2020).

Studies exploring gender differences in the association between stressful events and psychological diseases suggest that it is likely that there are gender differences in the association between stressful life events and psychological diseases such

as psychosis, depression, and anxiety (Kendler et al., 2001; Herbison et al., 2017; Mansueto and Faravelli, 2022).

With regard to the association between suicidal ideation and behaviors in relation to personal COVID-19 contagion, the findings of our work showed that 48.4% of the participants that have been infected commonly presented "the wish to be dead." This shows that people who had COVID-19 also had high levels of stress, anxiety, and depression that went unnoticed.

It is important to consider that the pandemic negatively affects individuals' mental health and emotional wellbeing, which, in the case of poor psychosocial and mental functioning, increases the risk of contracting COVID-19 disease (Elbogen et al., 2021). Based on this premise, the rates of infection, hospitalization, and death due to COVID-19 may have a higher prevalence of suicidal ideation and behavior in areas where the disease is more prevalent (Bonsaksen et al., 2021).

In other words, concerns arising from possible complications in the case of contracting the virus are associated with increased suicidal thoughts and behaviors (Bonsaksen et al., 2021). Those who confirmed COVID-19 infection were more likely to have negative mental health aspects, such as suicidal ideation and behavior of those who only suspected infection (Shi et al., 2021).

When assessing the association between suicidal ideation and the consequences of COVID-19 for an acquaintance, our results demonstrated the presence of an acquaintance infected with COVID-19 disease as a risk factor for the presence of suicidal ideation and behavior. In the following order, "having suicidal thoughts or attempts in other periods of his or her life; the wish to be dead; unspecific suicidal ideas; suicidal ideas with a method; and suicidal ideation without a specific plan" were the most significant items. It is likely that such thoughts and ideas result from excessive information shared by friends and family, mainly due to dissemination through social networks.

The presence of suicidal ideation and behaviors increases when a group of people or a certain population faces a disease outbreak that may affect them (Rahman et al., 2021). The impact of COVID-19-related experiences may be associated with suicidal ideation and contribute to suicidal behaviors, mainly in the wake of recent events (Ammerman et al., 2021). Moreover, recent studies suggest that psychological diseases related to the COVID-19 pandemic stressors may be exacerbated by COVID-19 dysfunctional coping strategies (e.g., the COVID-19 anxiety syndrome, worry, and rumination) in response to the fear or threat of the COVID-19 pandemic itself (Nikčević and Spada, 2020; Nikčević et al., 2021; Mansueto et al., 2022).

Our third objective was **to analyze the suicidal ideation and behavior associated with confinement during the COVID-19 pandemic**; our results indicated that living in confinement for more than 40 days represents a risk factor for the presence of suicidal ideation and behavior. The desire to be dead, unspecific suicidal ideas, and suicidal ideation without a specific plan, as well as suicidal thoughts and attempts at different periods in their lives, were the most significant issues. This implies that those who remained in confinement for long periods saw an increase in their stress and anxiety, affecting their mental health and even provoking negative thoughts of attempting suicide. Our results are consistent with the results revealed by Nikčević and Spada (2020), who pointed out that perceived social support and greater perceived loneliness were significantly related to greater thoughts of suicide/self-harm, which is consistent with the interpersonal theory of suicide (Joiner, 2007). In this case, to reduce the risk associated with confinement, despite its name, social distancing requires physical space between people, not social distance. Efforts can be made to stay connected and maintain meaningful relationships by telephone or video, especially among individuals with substantial risk factors for suicide (Reger et al., 2020).

Our results pointed out the risk related to the population with preexisting suicidal behaviors. It is probable that stress related to confinement could be a factor that decreases the coping mechanisms of participants and that adverse factors are summarized in the history of life adversity events related to a higher risk of suicidal behavior (Herbison et al., 2017; Kahil et al., 2021).

Our findings corroborate those of earlier studies, which found that family unity was strengthened by people staying at home and adhering to the restriction measures (Ammerman et al., 2021; Anzai et al., 2021). On the other hand, staying at home has led to a mental burden that increases levels of depression and anxiety in young populations, making it a risk factor for suicidal ideation and behavior (Sayeed et al., 2020; Nomura et al., 2021; Rahman et al., 2021).

In conclusion, our study results support what has been stated in previous studies about the chronicity of stressful events and different mental health outcomes related to exposure related to temporality, chronicity, and gender. For example, as stated by Herbison et al. (2017), in women, medium-to-high chronic stress exposure or exposure during puberty/adolescence predicted depression and anxiety symptoms, while low or reduced stress exposure over the life course did not. Further, for women, postnatal stress trajectory was more important than prenatal stress in predicting depression/anxiety symptoms. Meanwhile, high stress early in pregnancy was associated with depression and anxiety symptoms in men, regardless of postnatal stress trajectory.

The higher rates of suicidal ideation and behavior related to the risk factors of being a woman, having a previous suicide attempt, knowing a person infected with COVID-19, and having the time of lockdown reported in our study are risk factors that should be considered in clinical practice. Our results support studies that have reported the link between multiple stressors such as social isolation, stress, financial strain, and suicide (Elbogen et al., 2021). The consideration of sex and age of participants could play a role in what are considered risk factors for suicide, as stated by Elbogen et al. (2021) when

examining thoughts of suicide/self-harm. They found significant interactions between financial strain and being male, above the median age of 35 years, non-White, and Hispanic. Those factors could be related to financial strain and the roles of family economic providers.

Since the beginning of the pandemic, experts and early-career psychiatrists have called for global action to prevent suicide during this outbreak. Clinicians could benefit greatly from an accurate diagnosis that takes into account the risk factors for suicidal behavior as well as the underlying mental disorders involved (Nikčević and Spada, 2020; Mansueto et al., 2022). An adequate diagnosis and considering the risk factors for suicidal behavior and the underlying mental resources involved could be of great help to clinicians to ensure the quality of attention.

## Conclusion

The present study aimed to examine the prevalence of suicidal ideation and behavior related to COVID-19 in the population of the northeastern border region of Mexico. To this end, our main findings showed that 39.9% of participants wished they were dead. A total of 18.2% of participants had suicidal behaviors before the COVID-19 pandemic, of which 40% had suicidal behaviors during the 3 months before the study during the pandemic. Regarding differentiation by sex, we found significant differences in almost all suicidal ideation and behavior indicators before and during the pandemic, with women representing a higher risk. COVID-19 infected 18.8% of the participants, 82.9% knew someone infected, and 54.8% knew someone who died from COVID-19, without significant differences between sexes. Further, 81.6% of participants reported having lived in confinement, finding significant differences between the sexes, with this rate being higher in women (86.2%) than in men (70.6%). Being infected with COVID-19 is associated with a higher risk of wishing to be dead but not with the rest of the suicidal ideas and behaviors. Knowing a person infected with COVID-19 was associated with several suicidal thoughts and with previous suicidal ideas and attempts. While knowing a person who died from COVID-19 was not a risk factor for any of them, staying in confinement was associated with a higher risk of the wish to be dead, occurring in 42.4% of the participants who had maintained confinement vs. 28.9% of those who had not, and it was also associated with suicidal ideation and behaviors in other periods of life. Confinement time >40 days was a risk factor for several indicators of suicidal ideas and behaviors compared to not having been confined or kept in isolation for <40 days.

It will be complicated to establish definitive conclusions, given the temporality of the pandemic; however, future lines of research related to economic situations, employment, level of health, alcohol consumption, and drug use, among others, could be established.

Intervention programs and strategies are required to minimize the suicide risk statistics, especially in light of the pandemic's influence and the fact that the consequences on mental health may endure well beyond the duration of the pandemic. In clinical practice, given that the pandemic poses unprecedented risks, the clinical diagnosis tools, and intervention programs should be tailored to address specific situations. When facing cases of suicide-risk patients, recently created instruments and intervention proposals that consider disorders such as COVID-19 fear and anxiety syndrome are recommended. In the post-COVID-19 era, dissemination and training programs for clinicians will be essential.

It will be essential to develop protective, self-care, and social support skills, especially in those individuals who present risk factors for suicidal behavior identified in this study: women, those who knew a COVID-19-infected patient, those who were confined for longer than 40 days, and those who had a history of suicidal ideas and behaviors. It will also be important to take advantage of recent technological advances (e.g., videoconferencing), which could facilitate progress and make confinement and social distancing more bearable.

The authors consider that this study's main limitation consists of the evolution of the COVID-19 disease, which causes changes in daily life. Moreover, the data collection in this study was carried out in the early stages of the pandemic. In addition, given the lack of control and the nature of the procedure used—a convenience sample assessed by a self-reported online survey—there are no other control measures such as laboratory or result tests for COVID-19 contagion. Furthermore, since no instrument assessed suicidal risk during the COVID-19 health emergency in the Mexican population, the instrument used was adapted for the study. The authors acknowledge that their study's findings are restricted to those living in Mexico's northwestern border state, where they had internet, computer, or smartphone access necessary to complete the survey, and where the survey was initially disseminated through a variety of channels related to higher education. To fill these gaps and generalize results, future studies should consider increasing the size of the sample, such as including populations from different places in Mexico and other sociodemographic characteristics that have not been included in this study, such as illiterate people.

## 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 Postgraduate and Research Committee at Universidad Autonoma de Tamaulipas. The

patients/participants provided their written informed consent to participate in this study.

## Author contributions

KV conceived and designed the project, authored and integrated the reviewed drafts of the paper, approved the final draft, and substantially contributed to the interpretation of the data. FP authored and integrated the reviewed drafts of the paper, approved the final draft, and substantially contributed to the interpretation of the data. BZ, CV, IH, and CL authored and reviewed drafts of the paper, approved the final draft, and substantially contributed to the interpretation of the data. All authors contributed to the article and approved the submitted version.

## Funding

This work was supported by the Universidad Autónoma de Tamaulipas by the Postgraduate and Research Committee, Grant Number: 38-UATINVES20.

## 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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frontiers | Frontiers in Public Health

TYPE Original Research
PUBLISHED 13 January 2023
DOI 10.3389/fpubh.2022.1071814



OPEN ACCESS

EDITED BY
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SPECIALTY SECTION
This article was submitted to Public Health and Nutrition, a section of the journal Frontiers in Public Health

RECEIVED 17 October 2022
ACCEPTED 29 December 2022
PUBLISHED 13 January 2023

CITATION
Phulkerd S, Thongcharoenchupong N, Chamratrithirong A, Gray RS, Pattaravanich U, Ungchusak C and Saonuam P (2023) Socio-demographic and geographic disparities of population-level food insecurity during the COVID-19 pandemic in Thailand. *Front. Public Health* 10:1071814. doi: 10.3389/fpubh.2022.1071814



# Socio-demographic and geographic disparities of population-level food insecurity during the COVID-19 pandemic in Thailand

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**Introduction:** This study investigated the prevalence of food insecurity, and the association between socio-demographic and geographic factors and food insecurity in Thailand during the COVID-19 pandemic.

**Methods:** The study extracted data on 5,066 persons age 15 years or older from a nationally-representative sample survey of Thai households, conducted during June-December 2021. The respondents were asked about food insecurity, socio-demographic characteristics, debt, and role of the primary household food provider. Binary logistic regression analysis was used to investigate the association between the variables and food insecurity.

**Results:** Of the total sample, 28.6% had food insecurity. The highest probability of having food insecurity ($p < 0.001$) was observed in persons age 15–29 years, with no formal education, and in the lowest quartile of income. The highest probability of having food insecurity was found among respondents residing in the northeast, which is the poorest and with the least development status among geographic regions in Thailand. Respondents who reported having onerous personal debt and being the main household food provider were 1.4 and 2.3 times as likely to have food insecurity as those with no debt and not being the main food provider, respectively ($p < 0.001$).

**Conclusion:** This suggests that government attention is required in developing policies and strategies to improve food security through addressing the socio-economic determinants, and buffer the negative impact of a national crisis on diets. Investment to improve household income and raise the educational profile of the population is needed. Addressing the regional disparities in food security requires area-specific measures which target the most vulnerable population groups.

KEYWORDS

**food insecurity, socio-demographic characteristics, geographical areas, COVID-19, Thailand**

# 1. Introduction

In 2022, the COVID-19 pandemic has continued to wreak havoc in nearly every country in the world, with more than 520 million confirmed cases and more than six million deaths reported as of May 23, 2022 (1). Among the disastrous health and economic impacts of COVID-19, the pandemic has had profound effects on food security and nutrition of the global population (2). Food security and adequate nutrition were already fragile in many countries before 2020. However, the pandemic has made the situation drastically worse. In 2020, more than 700 million people around the world faced hunger, which was 118 million more people than in 2019. A year later, more than two billion people did not have access to adequate food, which was an increase of 320 million from 2019. Combined with natural disasters, human conflict, and a collapse in global demand for internationally-produced agro-food products, the COVID-19 pandemic has made food insecurity immeasurably worse (2).

Failure to improve food security can lead to many adverse consequences. Mounting evidence points to an association of food insecurity with poverty, poor health, and stunted human development. For example, among Mexican families, being above the poverty line was associated with lower food insecurity (3). Another study found that food insecurity adversely affected growth, cognitive, and behavioral potential of America's poor and near-poor children (4). Previous research also found an association between food insecurity and health consequences in specific population groups, e.g., food insecurity was associated with decreased nutrient intake in children and adults (5, 6); mental health problems and depression (7, 8), diabetes (9), hypertension in adults (10); and depression and anxiety in mothers (11). Food insecurity also affected healthcare utilization and expenditure (12). Furthermore, healthcare utilization and expenditures were likely to increase when household food insecurity increased.

Determinants of food insecurity and the mechanisms through which it impacts on vulnerable households can differ according to physical, social, and economic contexts in which people are living. This includes demographic and geographic contexts which interact in ways already evident elsewhere. In India, a higher percentage of older adults who were hungry did not eat enough food because there were shortages in the household, and this phenomenon was more prevalent in rural than in urban areas (13). In Mexico, vulnerable population (e.g., fishing families) were associated with severity of food insecurity (3). In Iran, a lower employment status and educational level of the household head were significant predictors of food insecurity (14). There is also evidence showing that personal savings, household income, employment status of head of household had a significant association with food insecurity during the COVID-19 pandemic in Iran (15). Similarly, another Iranian study reported arduous economic conditions as important contributors to household food insecurity during the initial COVID-19 lockdown (16). In Canada household food insecurity and the severity of the experience were strongly associated with province or territory of residence (17).

Thailand is among many countries in Southeast Asia which have experienced multiple waves of spread of COVID-19 (18). The 1st wave of Thailand's pandemic started in March 2020, second wave in December 2020, third wave in April 2021, forth wave in June 2021 and fifth wave in January 2022. The Thai government declared and enforced a State of Emergency Decree on 26 March 2020 and curfews between 22:00 and 04:00 (19). The government also announced a number of public health and social measures to control or mitigate the COVID-19, such as lockdowns of various duration and scope, closing of entertainment establishments and sit-down dining, and closures of schools to in-person classroom learning. Access to public spaces was restricted.

There were many socio-economic repercussions of these harsh restrictions, and these measures both directly and indirectly disrupted the food supply chain and consumption of essential nutrients (2). In particular many people in urban areas suddenly had limited access to fresh and nutritious foods. In the year prior to the onset of the Thai pandemic, 39% of Thai households with children under 5 years old had some worries that they would not have enough food to properly feed their child(ren), 25% were unable to eat healthy and nutritious food, and 8% had to skip a meal (20). Among all sample households, 3% were already identified as moderate or severe food-insecure. The poorest Thai households were most likely to suffer from food insecurity, and urban households experienced greater severity of food insecurity than households in rural areas. However, that survey was only conducted with families with a child under 5 years old, and the subsample was unlikely to be representative of the situation of all households nationwide.

Conditions that give rise to population-level food insecurity in Thailand remain poorly understood. As yet, no studies had investigated the prevalence of food insecurity in the Thai population, especially during the COVID-19 pandemic, nor had any studies identified the determinants that affect vulnerability to food insecurity. Unfortunately, combatting food insecurity has not been a priority for public policy intervention in Thailand.

Therefore, the objective of this study was to investigate the prevalence of food insecurity in the Thai population, and socio-demographic and geographic factors associated with food insecurity during the COVID-19 pandemic. Findings of this study should strengthen understanding of how to ensure adequate availability, access, and consumption of nutritious food. The findings at the disaggregated geographical level will allow policymakers and programme planners to visualize which regions or area of residence are most in need of policies and strategies to guarantee the right to secure food. The findings should help guide the way toward accelerated achievement of Sustainable Development Goal 2 (SDG2) — in particular SDG Target 2.1 ("*Ensuring access to safe, nutritious, and sufficient food for all people all year round*") and SDG Target 2.2 ("*Eradicating all forms of malnutrition*") (21).

# 2. Materials and methods

## 2.1. Study design and population

This study used data that were collected in 2021 (during the 3rd and 4th waves of the COVID-19 pandemic in Thailand) from a nationally-representative household survey of the Thai population, namely, "*A Cross-sectional Study on Fruit and Vegetable Eating Behaviors*" (22). For the purpose of this study, a subsample of the dataset was selected for those age 15 years or older.

The survey sampling was conducted by the National Statistical Office (NSO) which applied a multi-stage sampling design. The sampling frame was a hierarchical structure in which households are

TABLE 1 FIES questions for measuring severity of food insecurity.

| Question | Standard label | Severity scale |
|---|---|---|
| [Opening question] *Now I would like to ask you some questions about food. During the last 12 months, was there a time when:* | | |
| Q1 You were worried you would not have enough food to eat? | WORRIED | **Mild food insecurity** (Worrying about running out of food) ↓ **Severe food insecurity** (Experiencing hunger) |
| Q2 You were unable to eat healthy and nutritious food? | HEALTHY | |
| Q3 You ate only a few kinds of foods? | FEWFOODS | |
| Q4 You had to skip a meal? | SKIPPED | |
| Q5 You ate less than you thought you should? | ATELESS | |
| Q6 Your household ran out of food? | RANOUT | |
| Q7 You were hungry but did not eat? | HUNGRY | |
| Q8 You went without eating for a whole day? | WHOLEDAY | |

nested within sampled region, province, district, and enumeration area, respectively. Within each sampled district from nine selected provinces, enumeration areas were randomly chosen from a nationally-representative sampling frame used in the national Population and Housing Census. Twenty households were selected from each enumeration area.

## 2.2. Data collection

Data were collected during June-December 2021 using Qualtrics offline survey application. The survey questionnaire includes items on socio-demographic characteristics, health status, personal debt, and food insecurity. Responses were recorded in the field on a digital device, and then uploaded to Qualtrics as soon as an Internet connection was available. The data collection was carried out by a trained research team.

The questions about food insecurity used the Food Insecurity Experience Scale (FIES), which is experience-based measures of household or individual food security, developed by the Food and Agriculture Organization (FAO) (23). A Thai version of FIES was pretested to evaluate reliability and internal consistency of the questions before actual data collection.

The survey included households in the four geographic regions of Thailand (central, north, northeast, and south) and Bangkok, and included both urban and rural areas in each region. A total sample of 5,066 subjects were included for analysis.

The research team contacted local coordinators such as community leaders and village health volunteers in each study area as liaisons to help the interviewers approach the sampled households. All subjects received a description of the survey and purpose of the study, and written informed consent was obtained prior to the interview.

## 2.3. Outcome variables

Food insecurity was measured through eight questions developed by FAO (Table 1). Each respondent was asked about his or her food-related behavior, and experience associated with increased difficulty in accessing food due to resource constraints. Each question refers to a different experience and represents a different level of severity of food insecurity.

The individual respondent was asked to give a "*yes/no*" response to each question. The questions were analyzed together as a scale (i.e., not as separate questions) to assess a range of severity of food insecurity. A respondent who answered "*yes*" continued to answer the follow-up questions; a respondent answering "*no*" did not need to proceed further with follow-up questions. Response to each question was assigned a potential score of one point. The respondent's score was the sum of the eight FIES questions, with a potential total ranging from zero to eight. The more questions which the respondent answered "*yes*" to, the more severe their food insecurity (i.e., with a higher score). A response of "no" since the first question was coded as "*food secure*." This classification is based on previous literature using FIES (20, 24–27).

Prior to data collection the statistical analysis to assess the internal consistency (reliability) for the set of Thai FIES questions was performed using Cronbach's alpha. Previous literature indicates that an acceptable range of values of alpha is from 0.70 to 0.95 (28, 29). The alpha value of the Thai FIES in this study was 0.89, indicating good reliability.

## 2.4. Independent variables

### 2.4.1. Socio-demographic factors

Socio-demographic variables included the following:

Sex was coded as male and female;

Age was coded as early-working age (15–29 years), middle-working age (30–44 years), late-working age (45–59 years) and older person (60 years or older).

Marital status was coded as married, single, or widowed/divorced/separated.

Educational attainment was coded as currently studying, no formal education/primary not completed, primary school, secondary school, and bachelor's degree or higher.

Income quartile (Q) was based on the median income of the respondents, with Q1 being the lowest income and Q4 being the highest. This variable was coded as Q1 (0–4,999 baht), Q2 (5,000–8,999 baht), Q3 (9,000–14,999 baht), and Q4 (15,000–300,000 baht).

Current occupation was coded as unemployed (people who are not in the labor force, jobless, actively seeking work, available to take a

10.3389/fpubh.2022.1071814

TABLE 2 Characteristics of the sample by prevalence of food security/insecurity ($N = 5,066$).

| Variables | *N* | % of total | Food secure (score = 0) | Food insecure (score = 1–8) | Chi-square (*p*-Value) |
|---|---|---|---|---|---|
| Total | 5,066 | 100.0 | 71.4 | 28.6 | |
| **Sex** | | | | | 65.04*** |
| Male | 2,439 | 48.1 | 76.7 | 23.3 | |
| Female | 2,627 | 51.9 | 66.5 | 33.5 | |
| **Age group** | | | | | 10.29* |
| 15–29 years | 1,053 | 20.8 | 75.0 | 25.0 | |
| 30–44 years | 983 | 19.4 | 71.7 | 28.3 | |
| 45–59 years | 1,848 | 37.5 | 69.5 | 30.5 | |
| 60 years or over | 1,182 | 23.3 | 70.9 | 29.1 | |
| **Marital status** | | | | | 38.55*** |
| Single | 1,157 | 22.8 | 78.7 | 21.3 | |
| Married | 3,214 | 63.5 | 69.2 | 30.8 | |
| Widowed/divorced/separated | 694 | 13.7 | 69.6 | 30.4 | |
| **Place of residence** | | | | | 26.45*** |
| Urban | 2,318 | 45.8 | 75.0 | 25.0 | |
| Rural | 2,748 | 54.2 | 68.4 | 31.6 | |
| **Region of residence** | | | | | 428.92*** |
| Bangkok | 513 | 10.1 | 95.7 | 4.3 | |
| Central | 917 | 18.1 | 82.1 | 17.9 | |
| North | 1,180 | 23.3 | 63.8 | 36.2 | |
| Northeast | 1,119 | 22.1 | 53.4 | 46.6 | |
| South | 1,337 | 26.4 | 76.5 | 23.5 | |
| **Educational attainment** | | | | | 97.63*** |
| Currently studying | 550 | 10.9 | 78.9 | 21.1 | |
| No formal education | 301 | 5.9 | 60.1 | 39.9 | |
| Primary school | 2,019 | 39.9 | 66.5 | 33.5 | |
| Secondary school | 1,732 | 34.2 | 73.2 | 26.8 | |
| Bachelor's or higher degree | 463 | 9.1 | 84.2 | 15.8 | |
| **Income quartile** | | | | | 148.83*** |
| Q1 (0-4,999) | 2,515 | 49.6 | 66.3 | 33.7 | |
| Q2 (5,000-8,999) | 917 | 18.2 | 67.8 | 32.2 | |
| Q3 (9,000-14,999) | 792 | 15.6 | 74.6 | 25.4 | |
| Q4 (15,000-300,000) | 842 | 16.6 | 87.5 | 12.5 | |
| **Occupation** | | | | | 85.92*** |
| Unemployed | 1,927 | 38.0 | 64.7 | 35.3 | |
| Government employee | 189 | 3.7 | 85.7 | 14.3 | |
| Company-hired worker | 350 | 6.9 | 85.4 | 14.6 | |
| Business owner | 900 | 17.9 | 74.6 | 25.4 | |
| Wage laborer | 761 | 15.0 | 64.7 | 35.3 | |
| Farmer | 939 | 18.5 | 66.2 | 33.8 | |

*(Continued)*

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TABLE 2 (Continued)

| Variables | N | % of total | Food secure (score = 0) | Food insecure (score = 1–8) | Chi-square (*p*-Value) |
|---|---|---|---|---|---|
| Total | 5,066 | 100.0 | 71.4 | 28.6 | |
| **Presence of a chronic disease** | | | | | 7.981** |
| Yes | 1,896 | 37.4 | 69.1 | 30.9 | |
| No | 3,170 | 62.6 | 72.8 | 27.2 | |
| **Personal debt** | | | | | 58.46*** |
| Yes | 2,079 | 41.0 | 65.6 | 34.4 | |
| No | 2,987 | 59.0 | 75.5 | 24.5 | |
| **Main food provider in the household** | | | | | 167.49*** |
| Yes | 2,482 | 49.0 | 63.0 | 37.0 | |
| No | 2,584 | 51.0 | 79.5 | 20.5 | |

* Sig. ≤ 0.05, ** Sig ≤ 0.01, *** and Sig ≤ 0.001.

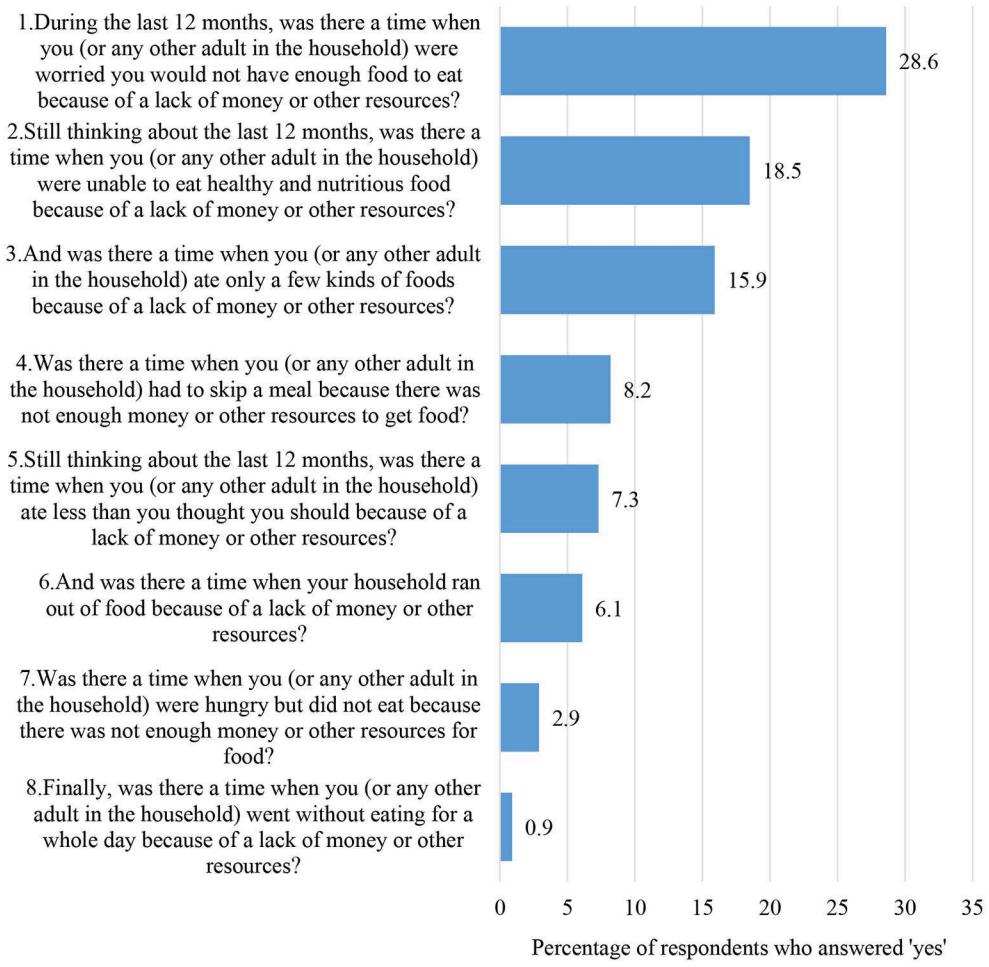


FIGURE 1
Respondents who answered *"yes"* by each of eight FIES questions (%).

job), government employee, company-hired worker, business owner, wage laborer, and farmer.

Personal debt was measured based on data of the NSO Household Socio-economic Survey (2013, 2015, 2017, 2019) and estimation of Bank of Thailand (30). This variable reflects the impact of debt burden on household consumption during the COVID-19pandemic. Debt was coded as "*yes*" (in debt), and "*no*" (without debt).

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TABLE 3 Sample characteristics and food insecurity ($N = 5,066$).

| Variables | Exp (B) | Adjusted OR (95% CI) | |
|---|---|---|---|
| | | Lower | Upper |
| Sex (Reference group = Male) | | | |
| Female | 1.030 | 0.880 | 1.206 |
| Age group (Reference group = 60+ years) | | | |
| 15–29 yrs. | 2.040*** | 1.485 | 2.804 |
| 30–44 yrs. | 1.660*** | 1.279 | 2.156 |
| 45–59 yrs. | 1.162 | 0.956 | 1.413 |
| Marital status (Reference group = Widowed/divorced/separated) | | | |
| Single | 1.248 | 0.979 | 1.591 |
| Married | 1.135 | 0.840 | 1.533 |
| Place of residence (Reference group = Urban) | | | |
| Rural | 1.042 | 0.906 | 1.199 |
| Region of residence (Reference group = South) | | | |
| Bangkok | 0.175*** | 0.110 | 0.279 |
| Central | 0.690** | 0.552 | 0.862 |
| North | 1.724*** | 1.433 | 2.074 |
| Northeast | 2.645*** | 2.197 | 3.183 |
| Educational attainment (Reference group = Bachelor's or higher degree) | | | |
| Currently studying | 1.164 | 0.769 | 1.763 |
| No formal education | 2.702*** | 1.787 | 4.084 |
| Primary school | 1.997*** | 1.435 | 2.779 |
| Secondary school | 1.388* | 1.020 | 1.889 |
| Occupation (Reference group = Wage laborer) | | | |
| Unemployed | 0.546*** | 0.420 | 0.709 |
| Government employee | 0.561* | 0.345 | 0.911 |
| Company-hired worker | 1.085 | 0.735 | 1.601 |
| Own business | 0.898 | 0.705 | 1.144 |
| Farmer | 0.641*** | 0.510 | 0.806 |
| Income quartile (Reference group = Q4) | | | |
| Q1 (0–4,999 baht) | 3.965*** | 2.905 | 5.410 |
| Q2 (5,000–8,999 baht) | 2.331*** | 1.758 | 3.092 |
| Q3 (9,000–14,999 baht) | 1.972*** | 1.490 | 2.610 |
| Indebted (Reference group = No) | | | |
| Yes | 1.365*** | 1.181 | 1.579 |
| Chronic disease (Reference group = No) | | | |
| Yes | 1.060 | 0.909 | 1.236 |
| Main food provider in the household (Reference group = No) | | | |
| Yes | 2.267*** | 1.934 | 2.658 |
| **Cox and snell R2** | **0.155** | | |

* Sig. ≤ 0.05, ** Sig ≤ 0.01, *** and Sig ≤ 0.001.

### 2.4.2. Geographic factors

Place of residence was coded as either rural or urban. Region of residence was coded as either central, north, northeast, south, or Bangkok.

### 2.4.3. Health and food-related factors

Health status and food provision were included in the analysis. The respondents were asked to self-assess their health status. Respondent's health status was coded as "*yes*" (currently have a chronic disease) and "*no*" (no chronic disease). Respondents were also asked whether they are the main food provider in the household, with response coded as "*yes*" or "*no*."

## 2.5. Statistical analysis

This study used descriptive statistics (i.e., frequencies and percentages) in describing prevalence of food insecurity for the set of FIES questions, presence of food insecurity, socio-demographic and geographic factors, and health- and food-related behaviors. To test for statistically-significant associations between food insecurity and respondent characteristics, binary logistic regression analysis was employed, regressing the bi-level individual food insecurity (i.e., having/not having food insecurity) on the socio-demographic and geographic characteristics of the respondents.

Odds ratios (ORs) were calculated, and are presented with a 95% confidence interval (CI). All of the variables were calculated to yield an adjusted odds ratio of food insecurity. The relationship was considered statistically significant if the $p$ value was 0.05 or less (2-tailed). All analyses were conducted using SPSS version 22.

# 3. Results

Table 2 presents prevalence of food insecurity by socio-demographic and geographic characteristics of the sample. Of the total 5,066 respondents, more than one-fourth (28.6%) reported having food insecurity. Groups of the respondents with the highest prevalence of food insecurity were women (33.5%), age 45–59 years (30.5%), married/cohabiting (30.8%), with no formal education (39.9%), with Q1 income (33.7%), and unemployed or wage laborer (35.3%).

People who lived in a rural area (31.6%) and in the northeast region (46.6%) had the highest prevalence of food insecurity. About one-third of the respondents with a chronic disease (30.9%) or onerous debt (34.4%) were experiencing food insecurity. More of the respondents who reported being the primary food provider for the household suffered from food insecurity, compared to those who were not the main food provider. Statistically-significant differences were found in relation to all variables.

## 3.1. Food insecurity by FIES questions

By stratifying level of food insecurity, 28.6% of the respondents felt worried about not having an adequate amount food to eat; 18.5% could not eat enough healthy and nutritious food; 15.9% had limitations in eating several kinds of foods; 8.2% had to skip a meal;

7.3% ate less food than they should; 6.1% ran out of food in the household; 2.9% felt hungry but did not have food to eat; and 0.9% were deprived of food for a whole day (Figure 1).

## 3.2. Socio-demographic and geographic disparities in food insecurity

Table 3 shows results from the binary logistic regression analysis that tested the association between various socio-demographic and geographic factors and food insecurity. The analysis found that socio-demographic factors (i.e., education, occupation, and income) were significantly associated with food insecurity. Respondents who had no formal, primary school, or secondary school education were 2.7, 2.0, and 1.4 times as likely to have food insecurity as those with a bachelor's or higher degree (95% CI 1.787–4.084, 1.435–2.779 and 1.020–1.889, respectively). The *lowest* probability of having food insecurity was observed among people who were unemployed (95% CI 0.510–0.806). The *highest* probability of having food insecurity was observed among people with Q1 income (95% CI 2.905–5.410). The lowest-income group was 4.0 times as likely to have food insecurity compared to those in the highest income group, followed by Q2 (2.3 times) and Q3 (2.0 times) groups, respectively.

By geographic region, the *highest* probability of having food insecurity was found among respondents residing in the northeast region (95% CI 2.197–3.183). Those respondents were 2.7 times as likely to have food insecurity as those residing in the south region. On the other hand, the *lowest* probability of having food insecurity was found among respondents residing in Bangkok (95% CI 0.110–0.279), with 82.5% as less likely to have food insecurity as those in the south region. There was no significant association of place of residence (urban/rural) with food insecurity.

Other associated factors were having onerous, personal debt and being the main food provider of the household. Respondents who reported having debt were 1.4 times as likely to have food insecurity as those with no debt (95% CI 1.181–1.579). Respondents who were the main food provider in the household were 2.3 times as likely to have food insecurity as those who were not the principal food provider (95% CI 1.934–2.658).

# 4. Discussion

Drawing on the data from a nationally-representative sample of the Thai population, this study investigated prevalence of food insecurity in Thailand during the COVID-19 pandemic, and its association with socio-demographic and geographic disparities. To our knowledge, this is the first investigation using a national household survey to measure food insecurity and associated factors at the population level. This study builds upon a previous study by Jankhotkaew et al. (20) with a representative sample of the Thai population, the response to the current health emergency, and an emphasis on the role of socio-demographic characteristics and geography of residence in relation to food insecurity.

In 2021, the prevalence of food insecurity in the Thai population was 28.6% (meaning that they at least worried about not having enough food to eat). This prevalence rate is higher than in many countries using the same measurement tool, e.g., Jordan (24), India (31), and Bangladesh (26). The differing results can be due to variations in demography, culture, and the survey methods used. The present study also found that food insecurity differs by certain socio-demographic characteristics, geographic region, and other factors, in particular, personal indebtedness and being the main food provider in the household.

n terms of socio-demographic disparities, this study found that the younger the population, the higher the food insecurity. That finding is consistent with previous research in young adults (32, 33). This finding could be due to anxiety about not being able to access certain foods, which they could do so easily before the pandemic. In particular, teenagers tend to prefer western "fast food" to traditional food, and the fast food outlets are concentrated in shopping malls, most of which were closed during various waves of the pandemic, or limited to take-out only (34). Even before the advent of COVID-19, there was ample evidence that Thai youth were developing unhealthy eating behaviors, such as overconsumption of cheaper, calorie-dense, nutrient-poor foods, and sugar-sweetened soft drinks (35, 36). Despite Thailand having some of the best fruit and vegetable options of countries around the world, Thai youth are eating less of these nutritious fruits and vegetables (37). During the Thai COVID-19 pandemic various containment measures (e.g., lockdowns) were implemented, and that severely limited consumer access to services, including retail food services and fresh markets.

During COVID-19, millions of Thais suddenly became unemployed or underemployed due to business closures and production slow-downs. However, contrary to expectation, the unemployed portion of the sample in this study had the *lowest* probability of being food insecure. This counter-intuitive finding may be explained by the fact that people who lost jobs returned to the home community, in which the extended family could pool resources and stretch budgets to ensure that everyone in the household got fed. By contrast, employed people were more likely to be in urban areas, and cities and towns were more adversely affected by lockdowns and closures than the rural families, who know how to "*live off the land*." Other research also found an association between being employed during the COVID-19 pandemic and food insecurity (26, 38). During the pandemic, many workers in the service sector could not "work from home" and are generally paid only subsistence wages (39). Thus, they were much more vulnerable to the hardships of COVID-19-related lay-offs or reduction in work hours since they probably had little savings to rely on. Consequently, those who still managed to remain employed were probably living on the margins, and would have had difficulty making ends meet and having enough income for proper nutrition and food sufficiency (40, 41). This study suggests that government attention is required in developing social support policies and systems to improve population food security, health, and wellbeing through addressing the socioeconomic determinants and buffer the impact of a national crisis, especially for vulnerable groups. This action should be done with community and civil organization engagement. This will open up opportunities for people to cope with calamity, improve their economic status, and ultimately improve their food security.

Thai people in the northeastern region had the highest probability of having food insecurity, and those in Bangkok were least likely to having food insecurity. In Thailand, there are significant differences in socio-economic development among the

four geographic regions. The north, northeast, and south lag behind Bangkok and the central region in terms of economic growth and social development (42). The northeast region is especially being left behind, with the lowest gross regional product per capita in 2020, accounting for 86,233 baht per annum, whereas Bangkok and vicinity recorded 436,255 baht per annum per capita (43). In addition, the northeast is a predominantly agriculture-based region, and is largely covered by sandy soil, which is less fertile for cultivation and more prone to drought and flooding (44). Despite overall low food insecurity in Bangkok, people living in slums-more than half, were still hungry but did not eat due to financial constraints (45). Accordingly, the sociodemographic and geographic disparities increase the challenge to equalize food security. That said, modern innovations and advanced technologies in agro-food production and processing are available and needed, but applying those assets also requires a business environment that is conducive to investment in promoting access to healthy food in long-term.

Other factors associated with food insecurity were personal debt and being the main provider of food for the household. The impact of indebtedness on food insecurity has been proven, especially during a pandemic. Previous research found that many people took on extra debt during the COVID-19 (46). Spending on nutritious food is one of the first personal budget items to be cut back on by a debtor (38, 46, 47). The link between being the main food provider of the household and food insecurity may be explained by the added hardship of the person who has to provide sustenance for all other members of the household, especially in large extended families. As noted, the COVID-19 pandemic strained food supply, and the reduced disposable income hampered the household's ability to access and provide a nutritious and balanced diet every day (48, 49). It was also reported elsewhere that people resorted to ultra-processed food and beverage products during times of scarcity, and those foods are often high in fat, sugar, and sodium — though they may have a longer shelf life and create a sensation of being full. Fresh fruits, vegetables, and meats were less available during periods of lockdown, and the more nutritious foods usually require refrigeration to stay fresh (50, 51).

The stress of the main household food provider could aggravate poor eating behaviors, and that may lead to higher risk of food insecurity and worse healthy status later in life. The findings suggest that government action, such as investment in community-based food banks, may be needed to help support nutritious diets for people in need. Improvements in the food supply chain are needed, for example, by shortening the farm-to-pantry process, and promoting consumption of locally-grown food, such as kitchen gardens and local food cooperatives (52, 53).

There are some limitations of this study. First, the study collected data *via* a self-report questionnaire, and response may be subject to recall bias. Second, the data were collected at a single point of time and, thus, it is not possible to draw firm conclusions about the significance and direction of the impact of the COVID-19 on food insecurity. Future research should use a prospective or longitudinal approach to better understand relationships between factors and food insecurity. That would also help forecast longer-term trends in food insecurity in Thailand. Third, other unmeasured factors may be more important determinants of food insecurity (such as food culture and norms specific to each geographic region, or other socio-economic factors). Future studies should expand the number of independent variables in the data collection.

## 5. Conclusions

This study found that food insecurity is still a significant threat in Thailand, with over one-fourth of the population having experienced food insecurity during the COVID-19 pandemic. Food insecurity differs according to various socio-demographic and geographic factors. The findings indicate that food insecurity might be positively affected by age, education, income, and region of residence. The findings suggest that more government attention should be paid to policies and strategies to improve food security through addressing the socio-economic determinants and ways to buffer the impact of a crisis on unhealthy food consumption. Long-term investment in improving incomes and raising the educational profile of the population, especially marginalized groups, are needed. National policy and programs for food security should give priority to those parts of the country which lag behind the other regions. The requisite innovations and advanced technologies in agro-food production and processing already exist. These need to be applied in an enabling and sustainable environment that is conducive to new businesses and investment in healthy food in the long-term.

## Data availability statement

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

## Ethics statement

The studies involving human participants were reviewed and approved by the Institutional Review Board of the Institute for Population and Social Research of Mahidol University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## Author contributions

SP: conceptualization, formal analysis, funding acquisition, investigation, methodology, project administration, visualization, writing—original draft preparation, and writing—review and editing. NT: formal analysis, investigation, methodology, and writing—review and editing. AC, RG, and UP: conceptualization, methodology, and writing—review and editing. CU and PS: writing–review and editing. All authors contributed to the article and approved the submitted version.

## Funding

This work was funded by the Thai Health Promotion Foundation (Grant No.: 62-00-0020).

## Acknowledgments

The authors gratefully acknowledge survey participants for taking the time to complete the questionnaire, and the field staff who tirelessly collected data to enable successful completion of the study. The authors would also like to thank the National Statistical Office for constructive comments and assistance during survey sampling and data analysis, and the Institute for Population and Social Research, Mahidol University, for administrative and logistical support.

## 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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## Author disclaimer

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 27 April 2023
DOI 10.3389/fpsyg.2023.1116566



OPEN ACCESS

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RECEIVED 05 December 2022
ACCEPTED 06 April 2023
PUBLISHED 27 April 2023

CITATION
Ausserhofer D, Mahlknecht A, Engl A, Piccoliori G, Pfitscher G, Silbernagl P, Giacomoni F, Pycha R, Lombardo S, Gärtner T, Mian M, Meier H, Wiedermann CJ and Keim R (2023) Relationship between depression, anxiety, stress, and SARS-CoV-2 infection: a longitudinal study. *Front. Psychol.* 14:1116566. doi: 10.3389/fpsyg.2023.1116566



# Relationship between depression, anxiety, stress, and SARS-CoV-2 infection: a longitudinal study

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**Objectives:** We aimed to (1) describe the course of the emotional burden (i.e., depression, anxiety, and stress) in a general population sample during the coronavirus pandemic in 2020 and 2021 and (2) explore the association between emotional burden and a serologically proven infection with SARS-CoV-2.

**Study design:** This longitudinal study involved a sample of community-dwelling persons aged ≥14years from the general population of South Tyrol (Province of Bolzano-Bozen, Northern Italy). Data were collected at two stages over a 1-year period in 2020 and 2021.

**Methods:** Persons were invited to participate in a survey on socio-demographic, health-related and psychosocial variables (e.g., age, chronic diseases, Depression Anxiety Stress Scale, DASS-21), as well as in the serological testing for of SARS-CoV-2-specific immunoglobulins.

**Results:** In 2020, 855 (23.8%) out of 3,600 persons participated; in 2021, 305 (35.7%) out of 855 were tested again. We observed a statistically significant decrease in mean DASS-21 scores for depression, stress, and total scores between 2020 and 2021, yet not for anxiety. Persons with a confirmed SARS-CoV-2-infection between the first and second data collection exhibited increased emotional burden compared to those without SARS-CoV-2-infection. The odds of participants with a self-reported diagnosis of mental disorder for future infection with SARS-CoV-2 was almost four times higher than that of participants without mental disorders (OR:3.75; 95%CI:1.79-7.83).

**Conclusion:** Our findings support to the hypothesis of a psycho-neuroendocrine-immune interplay in COVID-19. Further research is necessary to explore the mechanisms underlying the interplay between mental health and SARS-CoV-2 infections.

KEYWORDS

**COVID-19, SARS-CoV-2, emotional burden, depression, stress, anxiety, longitudinal study**

# 1. Introduction

The association between an infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and emotional disorders such as depression and anxiety post COVID has been shown in several studies, including inpatients (Daher et al., 2021; Tomasoni et al., 2021) and outpatients (Magnúsdóttir et al., 2022), at different time points, i.e., weeks (Halpin et al., 2021; Méndez et al., 2021) and even months after the infection (Hüfner et al., 2022; Kim et al., 2022). A systematic review of eight studies on depressive symptoms 12 weeks after a SARS-CoV-2-infection estimated a prevalence between 11 and 28% (Renaud-Charest et al., 2021). The relatively wide range can be explained by the use of different instruments, differences in acute physical symptom severity, differences in sociocultural background, and/or different recruitment methods (Thye et al., 2022). Moreover, there is increasing evidence on the association between the COVID-19 pandemic and affective symptoms and psychological distress across countries (Brailovskaia et al., 2021), as well as fatigue, loneliness and violent behaviours (Emmelkamp, 2021; Mansueto et al., 2021) and dysfunctional coping strategies, i.e., covid anxiety syndrome (Mansueto et al., 2022).

The high amount of emotional distress in patients with a prior SARS-CoV-2-infection could be due to the infection itself, but we cannot dismiss the possibility that subjects with high depression, anxiety, or stress scores may have had elevated levels before the infection, which in turn might have increased the likelihood of an infection with SARS-CoV-2. Neuroendocrine-immune mechanisms might boost the risk of a SARS-CoV-2 infection and have a negative impact on the course of the following coronavirus disease 19 (COVID-19). However, epidemiological data on the hypothesized interplay between emotional distress and an infection with SARS-CoV-2 are largely missing (Peters et al., 2021). Experimental studies have revealed that pre-existing emotional burden, such as stress or the feeling of loneliness, entails a risk of viral infection and may negatively impact the course of infectious diseases (Cohen et al., 1991; Cole et al., 2011; Cohen et al., 2015; LeRoy et al., 2017; Cohen, 2021). Similarly, high mortality rates after SARS-CoV-2 infection have been observed in patients with schizophrenia (Nemani et al., 2021). Interactions between the brain and immune system, already known from psycho-neuro-immunological research, have been observed in the COVID-19 pandemic (Mehta et al., 2021).

Yet, most studies on the association between COVID-19 and the emotional burden relied on self-reports of prior infection with the SARS-CoV-2 virus only, thus excluding asymptomatic or not diagnosed patients. More importantly, they applied a cross-sectional design, which poses methodological problems in interpreting the results (Renaud-Charest et al., 2021; Hüfner et al., 2022). As studies monitoring immunological and psychological parameters have been urgently called for (Rademacher et al., 2021), longitudinal studies are needed to observe over time changes in emotional burden and the occurrence of SARS-CoV-2 infection to provide more robust evidence on the direction of the association between psychological burden and COVID-19. To explore the association between emotional burden and infection with the SARS-CoV-2 virus, we conducted a longitudinal study over 12 months, measuring depression, anxiety, and stress together with serological testing for an infection with the SARS-CoV-2 virus at two time points during the pandemic.

## 1.1. Objectives

Therefore, we aimed to describe the course of the emotional burden (i.e., depression, anxiety, and stress) in a general population sample during the coronavirus pandemic in 2020 and 2021; and to explore the association between emotional burden and infection with SARS-CoV-2.

# 2. Methods

## 2.1. Study design

This longitudinal study involved a cohort of persons participating in two representative cross-sectional seroprevalence studies in the general population of South Tyrol (Province of Bolzano, Northern Italy). The first data collection took place between July 6 and July 27, 2020, and the second between June 16 and July 9, 2021, revealing an infection-induced seroprevalence of 2.9 and 27.9%, respectively (ASTAT, 2020).

## 2.2. Sample and setting

For the first data collection between June 1 and July 31, 2020 ($t_1$), all community-dwelling persons aged >5 years were eligible to participate in the seroprevalence study. South Tyrol, the Autonomous Province of Bolzano, is part of the Trentino–Alto Adige region in Italy, next to Austria (total population, 534.912), with approximately 70% German-speaking, 25% Italian-speaking inhabitants, and 5% other languages. The Statistical Institute of the Province of Bolzano (Istituto Provinciale di Statistica – Landesinstitut für Statistik) randomly selected study participants from the register of the current resident population in the whole province (ASTAT, 2020). The study sample was stratified by age, sex, and residency. The necessary sample size of 3,600 persons was calculated by the statistical institute based on the current rate of persons testing positive for SARS-CoV-2 and an estimated number of undetected cases. In total, 855 persons aged ≥14 years participated in the first data collection ($t_1$), i.e., survey and serological detection of SARS-CoV-2 infection.

In the second data collection between June 1 and July 31, 2021 ($t_2$), all participants of the first data collection in 2020 ($n = 855$) were eligible for participation. Selected individuals were invited to participate by mail. The invitation letter was sent in German and Italian language and contained (i) all relevant information about the study procedures; (ii) date, time, and location of planned sample-taking (swab test and blood test); and (iii) the URL of the online questionnaire with a personalized password (see below). Informed consent was delivered to and signed by the study participants directly onsite before taking biological samples. From the 855 persons participating in the first data collection 2020 ($t_1$), a total of 305 persons participated in the second data collection in 2021 ($t_2$).

## 2.3. Variables and measures

For this study, data from a participant survey and from the serological test for SARS-CoV-2-specific immunoglobulins were

collected and analyzed. To access the online questionnaire at both time points, a personalized password was delivered with a written invitation letter (see above), which served as a pseudonymization codex throughout the study period. This codex was also applied to the corresponding biological samples to enable a link between the questionnaire results and biological sample results. The online survey was created using SoSci Survey.[1] The questionnaire was additionally provided in paper form at the onsite testing points for those participants who had not completed the online questionnaire.

### 2.3.1. Participant survey

(i) The *socio-demographic and epidemiologic part* of the questionnaire was based on previous national investigations from the Italian Statistical Institute (ISTAT, 2020) and assessed the following information:

- Socio-demographic data: age, sex, place of birth, native tongue, nationality, residence, level of education, current working situation;
- Health-related questions: current health status, current or former occurrence of COVID-19-like symptoms, chronic conditions and pre-existing health problems including mental health, worsening of pre-existing health issues during the pandemic, current medication, previous SARS-CoV-2 swab or antibody test and testing result, and home isolation or hospitalization in case of COVID-19 infection.

(ii) The *psychologic part* assessed behavioral habits and burdens during the pandemic, as well as emotional risk factors with potential negative impact on the immune system. Depression, anxiety, and stress were measured with the Depression Anxiety Stress Scale (DASS-21) in the German (Nilges and Essau, 2015) and Italian (Bottesi et al., 2015) versions. The scale has shown good psychometric properties (Antony et al., 1998). The DASS-21 consists of 21 items, with seven items for each subscale. Subjects were asked to score each item on a 4-point Likert scale ranging from 0 ('did not apply to me at all') to 3 ('applied to me very much'). According to the classification provided from S Lovibond and P Lovibond (Lovibond and Lovibond, 1993), we calculated the percentages of as "high" or "severe" emotional burden according to the following cut-offs: DASS-21-total sore (≥60 points), depression (≥21 points), anxiety (≥15 points) and stress (≥26 points).

As the emotional burden, including depression is strongly associated with fatigue, we aimed to control for this potential confounding variable and measured fatigue using the Fatigue Severity Scale (FSS) (Krupp et al., 1989). This 9 items questionnaire investigates the severity of fatigue in various situations during the previous week on a 7-point Likert scale, where 1 indicates strong disagreement and 7 indicates strong agreement. The final score is defined as the mean value. The scale was validated with different patient cohorts both in the German (Valko et al., 2008) and the Italian language (Ottonello et al., 2016) showing good psychometric properties.

As social behavior was greatly affected during the pandemic (e.g., lockdown, quarantine), which might be associated with both, emotional burden and the occurrence of SARS-CoV-2 infection, we considered social network size and diversity as control variables, measured with the social network index (SNI) (Cohen et al., 1997). More diverse social network was associated in prior research with greater resistance against upper respiratory illness (Cohen et al., 1997). The SNI measures participation in 12 types of social relationships (spouse, parents, parents-in-law, children, other close family members, close neighbors, friends, workmates, schoolmates, fellow volunteers, members of groups without religious affiliation, and religious groups) and the number of persons in contact per relationship. One point was assigned for each type of relationship (highest possible score = 12) when respondents indicated that they spoke (in person or over the phone) to persons in that relationship at least once every 2 weeks. Moreover, participants indicated the number of people for each relationships to which they spoke at least once every 2 weeks to calculate the total number of network members for each participant (Cohen et al., 1997).

Sleep is closely linked to mental health and well-being. While poor sleep quality and sleep disturbances have been shown to be associated with a range of mental health problems (Blackwelder et al., 2021), as well the stress, anxiety and depression during the pandemic (Franceschini et al., 2020), improved sleep quality leads to better mental health outcomes (Scott et al., 2021). We aimed to control for sleep quality in our analyses and measured sleep duration as the self-reported mean hours of sleep per night during the last month, and sleep quality was assessed using a single item on a 3-point Likert scale (i.e., poor, moderate, or very good).

### 2.3.2. Detection of SARS-CoV-2 infection

The testing procedures and analyses of the biological samples were planned and coordinated by the local representative of the National Health Service (Servizio Sanitario Nazionale) in collaboration with the research team. The personnel who conducted the on-site testing received instructions and a checklist of all procedures from the study group. For the detection of SARS-CoV-2-specific immunoglobulins, blood tests for the quantitative determination of IgM and IgG antibodies (without differentiation) based on the nucleocapsid (N) antigen by means of Elecsys® Anti-SARS-CoV-2 assay (Roche Diagnostics) were applied, considering a cut-off index for a SARS-CoV-2 infection ≥1.0.[2] The biological samples were tagged with the individual pseudonymization codex (corresponding to the codex of the questionnaire) and transported to the analysis laboratory of the Central Hospital of Bolzano – Bozen. Serological results were communicated to the study participants according to the standard operating procedures and transferred to the research team in a pseudonymized form at the end of data collection.

1 www.soscisurvey.com

2 https://diagnostics.roche.com/global/en/products/params/elecsys-anti-sars-cov-2.html, accessed June 19, 2022.

## 2.4. Ethical aspects

The study was approved by the responsible ethics committee of Bolzano on 28/05/2020 (approval number 52-2020) and the amendment on 22/04/21 (approval number 51-2021). All study procedures were in accordance with the 1964 Helsinki Declaration and its amendments, European Union General Data Protection Regulation (679/2016), and Italian Data Protection Law (196/2003). All study participants provided written informed consent before their inclusion.

## 2.5. Statistical analyses

Descriptive statistics (e.g., frequencies, means, and SDs) were calculated to describe the measured variables. To explore differences on categorical and non-normally distributed continuous variables between the characteristics of participants in $t_1$ and $t_2$ and participants in $t_1$ only, chi-square and Mann–Whitney U tests were performed. Student's t-tests were applied for continuous variables that were normally distributed according to Kolmogorov–Smirnov test to explore differences in emotional burden (DASS-21 scale) between 2020 and 2021 and between persons with and without confirmed SARS-CoV-2 infection for participants in $t_1$ and $t_2$. To explore the associations between emotional burden and SARS-CoV-2 infection, regression analyses were performed. First, four multiple linear regression models were computed with confirmed SARS-CoV-2 infection and other sociodemographic variables as independent variables, and changes in depression, anxiety, and stress levels (DASS-21 total score and depression, stress, and anxiety subscales) between 2020 and 2021 as dependent variables. Similarly, a binary logistic regression model was used to explore the association between depression, anxiety, and stress in 2020 (independent variables) and the confirmed SARS-CoV-2 infection in 2021 (dependent variable). Major potentially confounding variables, including psychosocial and health-related factors (e.g., social network, sleep quality, and fatigue), were included in the regression analyses. All data analyses were performed using the IBM SPSS Statistics (version 27). A $p$ value of less than 0.05 was considered significant.

# 3. Results

In the 2020 data collection, out of a total of 3,600 invitations, 855 persons (23.8%) participated in both the survey and serological detection of SARS-CoV-2-specific immunoglobulins. In the 2021 data collection, 305 (35.7%) of the 855 persons participated. Table 1 shows the characteristics of the study participants at both time points. Compared to the first data collection in 2021, women, persons aged 45 or older and Italian citizens were more likely to participate in the second data collection.

## 3.1. Emotional burden in 2020 and 2021

Among the cohort members, less than 5% had high or very high DASS-21 depression (2020:3.0% vs. 2021:4.0%), anxiety (2020:3.3% vs. 2021:3.6%), stress (2020:3.9% vs. 2021:2.2%), and total scores (2020:3.3% vs. 2021:2.6%) at both time points. As summarized in Table 2, we observed a statistically significant decrease in the mean DASS-21 depression, stress, and total scores between 2020 and 2021, but not for anxiety. Participants with a confirmed SARS-CoV-2 infection had significantly higher DASS-21 depression, anxiety, stress, and total scores in 2021 than those without confirmed SARS-CoV-2 infection (see Table 3).

In the subgroup of 67 subjects that in 2021 were above the cut-off for normal DASS-21 depression scores (>9 points), 34 out of 39 subjects with a confirmed SARS-CoV-2 infection between 2020 and 2021 had shown normal DASS-21 depression scores in 2020, while this was the case in only 8 out of 28 subjects without SARS-CoV-2 infection. Thus, the risk of developing relevant depressive symptoms after SARS-CoV-2 infection for unremarkable subjects was 3.05 times higher compared to non-infected subjects.

## 3.2. Association between SARS-CoV-2 infection and emotional burden

As reported in Tables 4–6, evidence of SARS-CoV-2 infection was associated with an increase in depression, anxiety, and stress levels, as well as with an overall worsening of emotional well-being (DASS-21-total score; Table 7). More precisely, in subjects tested positive for SARS-CoV-2 specific antibodies we observed a higher increase in depression, anxiety, and stress levels compared to those without SARS-CoV-2 infection after adjusting for major socio-demographic and health-related (e.g., age, chronic diseases, and vaccination against COVID-19), as well as psychosocial and individual factors (e.g., social network, sleep quality, fatigue).

## 3.3. Association between emotional burden and SARS-CoV-2 infection

Data did not provide proof of an association between higher depression, anxiety, and stress levels (DASS-21) in seronegative subjects in 2020 and confirmed SARS-CoV-2-infection in 2021. In contrast, the odds of people with a self-reported diagnosis of mental disorder in 2020 for a future infection with SARS-CoV-2 in 2021 was almost four times higher than that of people without any prior self-reported mental disorder. Moreover, subjects reporting a higher number of sleep hours had lower odds for SARS-CoV-2 infection (see Table 8).

# 4. Discussion

This longitudinal study revealed a significant decrease in depression and stress levels (as measured by the DASS-21) in the general population of South Tyrol (Northern Italy) between the coronavirus pandemic in 2020 and 2021. Moreover, a previous SARS-CoV-2 infection resulted in a negative impact on emotional burden (i.e., depression, anxiety, and stress levels). The risk of developing relevant depressive symptoms after infection was more than three times higher than that in non-infected subjects. While the emotional burden itself, as measured with the DASS-21, was not an explanatory

TABLE 1 Characteristics of study participants in 2020 ($n$=855) and comparison between study participants in 2020 ($t_1$) and 2021 ($t_2$) ($n$=305) and study participants in 2020 ($t_1$) only ($n$=550).

| Variables | Total sample in 2020 ($n$=855) | | Study participants in 2020 ($t_1$) and 2021 ($t_2$) ($n$=305) | | Study participants in in 2020 ($t_1$) only ($n$=550) | | $p^{\#}$ |
|---|---|---|---|---|---|---|---|
| Sex, $n$ – % | | | | | | | |
| Female | 448 | 52.4 | 174 | 57.0 | 251 | 49.0 | 0.026* |
| Male | 407 | 47.6 | 131 | 43.0 | 261 | 51.0 | |
| Age, $n$ – % | | | | | | | |
| 14–20 years | 33 | 4,0 | 6 | 2.0 | 26 | 5.1 | <0.001* |
| 21–44 years | 263 | 32.0 | 72 | 23.6 | 189 | 36.9 | |
| 45–65 years | 341 | 41.5 | 152 | 49.8 | 189 | 36.9 | |
| 66 years and older | 184 | 22.4 | 75 | 24.6 | 108 | 21.1 | |
| Native tongue, $n$ – % | | | | | | | |
| German | 534 | 71.3 | 199 | 71.8 | 312 | 71.4 | 0.305 |
| Italian | 160 | 21.4 | 64 | 23.1 | 88 | 20.1 | |
| Ladin | 23 | 3.1 | 7 | 2.5 | 16 | 3.7 | |
| Other | 32 | 4.3 | 7 | 2.5 | 21 | 4.8 | |
| Citizenship, $n$ – % | | | | | | | |
| Italian | 812 | 95.0 | 301 | 98.7 | 479 | 93.6 | 0.001* |
| other | 43 | 5.0 | 4 | 1.3 | 33 | 6.4 | |
| Educational level, $n$ – % | | | | | | | |
| Below Highschool | 384 | 51.3 | 137 | 49.5 | 225 | 51.5 | 0.597 |
| Highschool or higher | 365 | 48.7 | 140 | 50.5 | 212 | 48.5 | |
| Employment, $n$ – % | | | | | | | |
| Employed (including housewife) | 545 | 73.0 | 202 | 72.9 | 318 | 73.1 | 0.243 |
| Unemployed/job seekers | 15 | 2.0 | 2 | 0.7 | 12 | 2.8 | |
| Retired | 150 | 20.1 | 60 | 21.7 | 83 | 19.1 | |
| Student | 37 | 5.0 | 13 | 4.7 | 22 | 5.1 | |
| Household, $n$ – % | | | | | | | |
| Living alone | 105 | 12.8 | 273 | 89.5 | 439 | 85.7 | 0.120 |
| Living with partner/family | 715 | 87.2 | 32 | 10.5 | 73 | 14.3 | |
| Social Network | | | | | | | |
| Number of people, Median – IQR | 13 | 12 | 13 | 12 | 12 | 11 | 0.170 |
| Network diversity, Median – IQR | 7 | 3 | 7 | 3 | 7 | 3 | 0.181 |
| Overall good or very good health status, $n$ – % | 673 | 89.9 | 253 | 91.3 | 391 | 89.5 | 0.415 |
| 1 or more chronic diseases | 59 | 19.3 | | | | | |
| Diagnosed mental disorder (e.g., depression and/or anxiety) | 26 | 3.0 | 5 | 1.6 | 19 | 3.7 | 0.090 |
| Sleep hours, Median – IQR | 7 | 1 | 7 | 1 | 7 | 1 | 0.279 |
| Sleep quality | | | | | | | |
| Poor | 69 | 8.5 | 27 | 8.3 | 42 | 8.3 | 0.899 |
| Medium | 495 | 60.9 | 187 | 60.7 | 308 | 60.7 | |
| Very Good | 249 | 30.6 | 90 | 31.0 | 157 | 31.0 | |
| Confirmed infection with SARS-CoV-2 | | | | | | | |
| Yes | 31 | 3.7 | 60 | 20.0 | NA | NA | |
| No | 800 | 96.3 | 240 | 80.0 | NA | NA | |
| Vaccinated against COVID-19 in 2021 | | | | | | | |
| Yes | NA | NA | 246 | 80.7 | NA | NA | |
| No | NA | NA | 59 | 19.3 | NA | NA | |
| DASS-21 Depression, Mean – SD | 3.8 | 5.8 | 4.2 | 6.5 | 3.6 | 5.5 | 0.204 |
| DASS-21 Anxiety, Mean – SD | 2.6 | 4.4 | 2.8 | 4.6 | 2.5 | 4.2 | 0.334 |
| DASS-21 Stress, Mean – SD | 6.1 | 6.9 | 6.4 | 7.5 | 5.9 | 6.6 | 0.324 |
| DASS-21 Total, Mean – SD | 12.5 | 15.4 | 13.4 | 16.8 | 12.1 | 14.6 | 0.232 |

[#]Chi-square test, Mann–Whitney-U test or Student's $t$-test, NA, not assessed. *Statistically significant.

TABLE 2 Summary statistics for the DASS-21 study participants ($t_1$ and $t_2$) and comparison between 2020 and 2021 ($n$=305).

| Variables | 2020 | | 2021 | | *T(p)* # |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| DASS-21 Depression (0–42) | 4.19 | 6.49 | 3.44 | 6.58 | −2.21(0.028)* |
| DASS-21 Anxiety (0–42) | 2.87 | 4.64 | 2.48 | 4.63 | −1.50(0.148) |
| DASS-21 Stress (0–42) | 6.48 | 7.46 | 5.13 | 7.10 | −3.64(<0.001)* |
| DASS-21 Total (0–126) | 13.54 | 16.82 | 11.04 | 16.79 | −2.95(0.003)* |

Scores on the DASS-21 items were multiplied by 2 to calculate the subscale and total scores, producing a maximum of 42 points and 126 points, respectively. #Student's *t*-tests. *Statistically significant.

TABLE 3 Comparing depression, anxiety and stress (DASS-21) for study participants ($t_1$ and $t_2$) between those with and without confirmed SARS-CoV-2 infection in 2021 ($n$=305).

| Variables | SARS-CoV-2 infection (positive anti-nucleocapsid test) $n$=61 | | No SARS-CoV-2 infection (negative anti-nucleocapsid test) $n$=241 | | *T(p)* # |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| DASS-21 Depression (0–42) | 5.68 | 7.81 | 2.82 | 6.22 | 2.58(0.012)* |
| DASS-21 Anxiety (0–42) | 3.79 | 5.58 | 2.16 | 4.41 | 2.06(0.043)* |
| DASS-21 Stress (0–42) | 7.16 | 7.89 | 4.66 | 6.93 | 2.35(0.021)* |
| DASS-21 Total (0–126) | 16.63 | 19.22 | 9.64 | 15.98 | 2.51(0.014)* |

Scores on the DASS-21 items were multiplied by 2 to calculate the subscale and total scores, producing a maximum of 42 points and 126 points, respectively. #Student's *t*-tests. *Statistically significant.

TABLE 4 Multiple linear regression analyses showing the association between confirmed SARS-CoV-2-infection and changes in depression (DASS-21 depression subscale) between 2020 and 2021 ($n$=305).

| Variables | *B* | Beta | SE | 95%CI | | *p* |
|---|---|---|---|---|---|---|
| | | | | *LL* | *UL* | |
| SARS-CoV-2 infection (2021) (reference: no infection) | 2.52 | 0.16 | 0.88 | 0.80 | 4.25 | 0.004* |
| Age (in years) | −0.02 | −0.05 | 0.03 | −0.08 | 0.04 | 0.488 |
| Sex (reference: male) | 1.34 | 0.10 | 0.76 | −0.15 | 2.83 | 0.078 |
| Native tongue (reference: German) | −0.15 | −0.02 | 0.54 | −1.21 | 0.90 | 0.778 |
| Employment | 0.49 | 0.08 | 0.41 | −0.31 | 1.30 | 0.226 |
| Educational level (reference: below high school) | −0.19 | −0.02 | 0.74 | −1.65 | 1.27 | 0.797 |
| Vaccinated against COVID-19 (reference: yes) | 0.09 | 0.01 | 0.77 | −1.42 | 1.60 | 0.904 |
| One or more chronic diseases (reference: no disease) | 4.04 | 0.11 | 2.16 | −0.23 | 8.31 | 0.063 |
| Diagnosed mental disorder (reference: no mental disorder) | −0.25 | −0.02 | 0.89 | −2.00 | 1.49 | 0.774 |
| Sleep – Hours | −0.20 | −0.04 | 0.36 | −0.91 | 0.50 | 0.572 |
| Sleep-- Quality | 0.37 | 0.03 | 0.69 | −0.10 | 1.73 | 0.597 |
| Social Network – Diversity | −0.30 | −0.07 | 0.36 | −1.02 | 0.42 | 0.414 |
| Social Network – Number of people | 0.09 | 0.12 | 0.06 | −0.02 | 0.21 | 0.114 |
| Fatigue (FSS) | 1.24 | 0.27 | 0.32 | 0.62 | 1.87 | <0.001* |
| DASS-21 Depression 2020 | −1.28 | −0.65 | 0.18 | −1.63 | −0.93 | <0.001* |
| DASS-21 Anxiety 2020 | 0.19 | 0.07 | 0.22 | −0.23 | 0.62 | 0.371 |
| DASS-21 Stress 2020 | 0.05 | 0.03 | 0.16 | −0.27 | 0.37 | 0.762 |

SE, standard error; CI, confidence interval; *LL*, lower limit; *UL*, upper limit. $R^2 = 0.38$, $F(17, 226) = 8.10$, $p < 0.001$. *Statistically significant.

factor for infection with SARS-CoV-2, subjects with a self-reported diagnosed mental disorder were more likely to be infected prospectively.

The COVID-19 outbreak in 2020, with shocking images of army trucks transporting coronavirus victims in Lombardy (Italy), the implementation of transmission and protection measures (i.e., lockdown, social distancing), together with a fear of contracting COVID-19, uncertainty of the future, and financial instability, had a negative impact on the population's emotional burden (WHO, 2022), especially among younger adults and women (Kunzler et al., 2021; Ma et al., 2021; Prati and Mancini, 2021; Racine et al., 2021; Schelhorn et al., 2021; Robinson et al., 2022). A systematic review by Santomauro et al. (2021) estimated a global increase in major depressive disorder

TABLE 5 Multiple linear regression analyses showing the association between confirmed SARS-CoV-2-infection and changes in anxiety (DASS-21 anxiety subscale) between 2020 and 2021 ($n$=305).

| Variables | *B* | Beta | SE | 95%CI | | *p* |
|---|---|---|---|---|---|---|
| | | | | *LL* | *UL* | |
| SARS-CoV-2 infection (2021) (reference: no infection) | 1.25 | 0.12 | 0.59 | 0.03 | 0.09 | 0.035* |
| Age (in years) | 0.01 | 0.04 | 0.02 | 0.57 | −0.03 | 0.570 |
| Sex (reference: male) | 0.10 | 0.01 | 0.51 | 0.85 | −0.90 | 0.846 |
| Native tongue (reference: German) | 0.11 | 0.02 | 0.36 | 0.77 | −0.60 | 0.769 |
| Employment | 0.29 | 0.07 | 0.27 | 0.28 | −0.24 | 0.283 |
| Educational level (reference: below high school) | 0.32 | 0.04 | 0.49 | 0.52 | −0.66 | 0.523 |
| Vaccinated against COVID-19 (reference: yes) | −0.40 | −0.04 | 0.51 | 0.44 | −1.40 | 0.435 |
| One or more chronic diseases (reference: no disease) | 2.79 | 0.11 | 1.44 | 0.05 | −0.05 | 0.054 |
| Diagnosed mental disorder (reference: no mental disorder) | 0.57 | 0.05 | 0.60 | 0.35 | −0.62 | 0.345 |
| Sleep – Hours | 0.42 | 0.11 | 0.24 | 0.08 | −0.06 | 0.084 |
| Sleep - Quality | 0.16 | 0.02 | 0.46 | 0.73 | −0.75 | 0.734 |
| Social Network – Diversity | −0.24 | −0.08 | 0.24 | 0.33 | −0.72 | 0.329 |
| Social Network – Number of people | 0.08 | 0.16 | 0.04 | 0.04 | 0.00 | 0.040* |
| Fatigue (FSS) | 1.09 | 0.34 | 0.21 | 0.00 | 0.67 | <0.001* |
| DASS-21 Depression 2020 | −0.05 | −0.04 | 0.12 | 0.67 | −0.29 | 0.668 |
| DASS-21 Anxiety 2020 | −1.22 | −0.67 | 0.14 | 0.00 | −1.51 | <0.001* |
| DASS-21 Stress 2020 | 0.11 | 0.09 | 0.11 | 0.31 | −0.11 | 0.313 |

SE, standard error; CI, confidence interval; *LL*, lower limit; *UL*, upper limit. $R^2 = 0.41$, $F(17, 226) = 9.09$, $p < 0.001$. *Statistically significant.

by 27.6% and anxiety disorders by 25.6% due to the COVID-19 pandemic. Similar to previous longitudinal survey studies (Mata et al., 2021), we observed patterns of habituation over time with decreasing depression and stress and stable anxiety levels. Although we did not observe an association between vaccination and SARS-CoV-2 infection or emotional burden in our data, the decrease in depression and stress levels might be related to the introduction of safe and effective vaccines against COVID-19., as a national study of U.S. adults revealed (Koltai et al., 2022).

The findings from our study confirm the elevated risk of developing new and relevant depressive, anxiety, and stress symptoms after a serologically confirmed infection with SARS-CoV-2, even after controlling for potentially confounding variables such as fatigue, and support to the hypothesis of a psycho-neuroendocrine-immune interplay in COVID-19. Both a (sub)chronic inflammatory response and cytokine storm might be involved in the immediate manifestation of neuropsychiatric symptoms in individuals with COVID-19 infections (Debnath et al., 2020). Previous clinical research on long COVID or post COVID conditions described the various long-term effects and mental health issues in both hospitalized patients with severe COVID-19 illness (Michelen et al., 2021; Chen et al., 2022; Houben-Wilke et al., 2022) and non-hospitalized patients with mild clinical illness (Graham et al., 2021; Han et al., 2022). In addition, psychological mechanism, such as personality (e.g., lower emotional stability) and dysfunctional coping strategies (i.e., COVID anxiety syndrome) could have a moderating effect of an infection with SARS-CoV-2 on psychological symptoms (Nikčević and Spada, 2020; Mansueto et al., 2021). However, the negative impact of SARS-CoV-2 infection on mental health should therefore be highlighted more clearly in COVID-19 campaigns to inform the general population. Individuals after COVID-19, especially those with previous mental health issues, could profit from a systematic screening for mental burden from healthcare professionals (e.g., general practitioners, nurses) to identify those individuals in need for psychological and psychiatric support, e.g., stress-reducing interventions to improve resilience, with the objective to improve mental health and to reduce the likelihood for developing mental disorders after a SARS-CoV-2 infection.

Although depression, anxiety, and stress levels in 2020 were not predictive for an infection with SARS-CoV-2 within the following 12 months, our analyses revealed that people with a diagnosed mental disorder were more likely to be infected with SARS-CoV-2. This is in contrast to a recent WHO policy brief stating that there is no consistent evidence that people living with mental disorders are more susceptible to COVID-19 (WHO, 2022). While one meta-analysis found an increased risk of COVID-19 in people with pre-existing mood disorders, anxiety, and attention-deficit hyperactivity disorder, another meta-analysis comparing people with and without pre-existing mood disorders found no evidence of increased susceptibility to COVID-19 (Ceban et al., 2021; Liu et al., 2021). Further longitudinal research is necessary to explore whether and what types of pre-existing mental disorders are independent risk factors for SARS-CoV-2 infection, more severe COVID-19 and subsequent negative outcomes, including hospitalization and mortality, while including psychological variables like personality, coping stile and resilience as possible moderating variables. To reduce the risk of developing severe illness or complications from COVID-19, healthcare providers should advise and support individuals with pre-existing mental health conditions to take extra precautions to reduce their risk of exposure to SARS-CoV-2, as well as to improve

TABLE 6 Multiple linear regression analyses showing the association between confirmed SARS-CoV-2-infection and changes in stress (DASS-21 stress subscale) between 2020 and 2021 ($n$=305).

| Variables | *B* | Beta | SE | 95%CI | | *p* |
|---|---|---|---|---|---|---|
| | | | | *LL* | *UL* | |
| SARS-CoV-2 infection (2021) (reference: no infection) | 1.71 | 0.10 | 0.84 | 0.05 | 3.37 | 0.044* |
| Age (in years) | 0.01 | 0.02 | 0.03 | −0.04 | 0.06 | 0.712 |
| Sex (reference: male) | 1.54 | 0.11 | 0.73 | 0.11 | 2.97 | 0.035* |
| Native tongue (reference: German) | 0.43 | 0.04 | 0.52 | −0.59 | 1.44 | 0.407 |
| Employment | 0.35 | 0.05 | 0.39 | −0.42 | 1.13 | 0.368 |
| Educational level (reference: below high school) | −0.52 | −0.04 | 0.71 | −1.92 | 0.88 | 0.463 |
| Vaccinated against COVID-19 (reference: yes) | −0.78 | −0.06 | 0.73 | −2.22 | 0.66 | 0.287 |
| One or more chronic diseases (reference: no disease) | 0.90 | 0.02 | 2.08 | −3.20 | 5.01 | 0.665 |
| Diagnosed mental disorder (reference: no mental disorder) | 1.52 | 0.09 | 0.86 | −0.17 | 3.20 | 0.077 |
| Sleep – Hours | −0.24 | −0.04 | 0.35 | −0.92 | 0.44 | 0.489 |
| Sleep – Quality | −0.34 | −0.03 | 0.66 | −1.64 | 0.97 | 0.611 |
| Social Network – Diversity | 0.04 | 0.01 | 0.35 | −0.65 | 0.74 | 0.899 |
| Social Network – Number of people | 0.09 | 0.12 | 0.05 | −0.02 | 0.20 | 0.094 |
| Fatigue (FSS) | 2.22 | 0.45 | 0.30 | 1.62 | 2.81 | <0.001* |
| DASS-21 Depression 2020 | −0.06 | −0.03 | 0.17 | −0.39 | 0.28 | 0.740 |
| DASS-21 Anxiety 2020 | 0.10 | 0.04 | 0.21 | −0.31 | 0.50 | 0.633 |
| DASS-21 Stress 2020 | −1.31 | −0.71 | 0.16 | −1.62 | −1.01 | <0.001* |

SE, standard error; CI, confidence interval; *LL*, lower limit; *UL*, upper limit. $R^2 = 0.50$, $F(17, 228) = 13.20$, $p < 0.001$. *Statistically significant.

TABLE 7 Multiple linear regression analyses showing the association between confirmed SARS-CoV-2-infection and changes in depression, anxiety and stress levels (DASS-21 total score) between 2020 and 2021 ($n$=305).

| Variables | *B* | Beta | SE | 95%CI | | *p* |
|---|---|---|---|---|---|---|
| | | | | *LL* | *UL* | |
| SARS-CoV-2 infection (2021) (reference: no infection) | 5.60 | 0.15 | 1.98 | 1.65 | 9.47 | 0.006* |
| Age (in years) | 0.01 | 0.01 | 0.06 | −0.12 | 0.13 | 0.924 |
| Sex (reference: male) | 2.96 | 0.10 | 1.72 | −0.42 | 6.35 | 0.086 |
| Native tongue (reference: German) | 0.31 | 0.01 | 1.21 | −2.07 | 2.69 | 0.798 |
| Employment | 1.22 | 0.08 | 0.92 | −0.59 | 3.03 | 0.186 |
| Educational level (reference: below high school) | −0.58 | −0.02 | 1.68 | −3.89 | 2.73 | 728 |
| Vaccinated against COVID-19 (reference: yes) | −1.27 | −0.04 | 1.74 | −4.70 | 2.15 | 0.463 |
| One or more chronic diseases (reference: no disease) | 7.70 | 0.09 | 4.87 | −1.89 | 17.30 | 0.115 |
| Diagnosed mental disorder (reference: no mental disorder) | 1.68 | 0.04 | 2.02 | −2.31 | 5.66 | 0.408 |
| Sleep – Hours | −0.07 | −0.01 | 0.81 | −1.67 | 1.54 | 0.933 |
| Sleep – Quality | 0.31 | 0.01 | 1.57 | −2.78 | 3.39 | 0.844 |
| Social Network – Diversity | −0.45 | −0.04 | 0.83 | −2.08 | 1.18 | 0.589 |
| Social Network – Number of people | 0.27 | 0.15 | 0.13 | 0.01 | 0.52 | 0.042 |
| Fatigue (FSS) | 4.66 | 0.43 | 0.72 | 3.25 | 6.08 | <0.001* |
| DASS-21 Depression 2020 | −1.41 | −0.30 | 0.41 | −2.20 | −0.60 | 0.001* |
| DASS-21 Anxiety 2020 | −0.95 | −0.15 | 0.48 | −1.90 | 0.01 | 0.051 |
| DASS-21 Stress 2020 | −1.12 | −0.28 | 0.37 | −1.86 | −0.39 | 0.003* |

SE, standard error; CI, confidence interval; *LL*, lower limit; *UL*, upper limit. $R^2 = 0.44$, $F(17, 222) = 10.24$, $p < 0.001$. *Statistically significant.

TABLE 8 Binary logistic regression analyses showing the association between depression, anxiety and stress (DASS-21) in 2020 and confirmed SARS-CoV-2-infection in 2021 (*n*=305).

| Variables | OR | SE | 95%CI | | *p* |
|---|---|---|---|---|---|
| | | | *LL* | *UL* | |
| DASS-21 Depression 2020 | 0.99 | 0.09 | 0.83 | 1.18 | 0.896 |
| DASS-21 Anxiety 2020 | 0.94 | 0.10 | 0.77 | 1.14 | 0.521 |
| DASS-21 Stress 2020 | 0.98 | 0.08 | 0.84 | 1.13 | 0.737 |
| Age (in years) | 0.96 | 0.01 | 0.94 | 0.99 | 0.009* |
| Sex (reference: male) | 1.07 | 0.38 | 0.51 | 2.25 | 0.864 |
| Native tongue (reference: German) | 1.21 | 0.25 | 0.74 | 1.97 | 0.451 |
| Employment | 0.71 | 0.21 | 0.47 | 1.08 | 0.112 |
| Educational level (reference: below high school) | 0.76 | 0.36 | 0.38 | 1.55 | 0.455 |
| Vaccinated against COVID-19 (reference: yes) | 1.81 | 0.36 | 0.88 | 3.69 | 0.105 |
| One or more chronic diseases (reference: no disease) | 1.37 | 0.96 | 0.21 | 9.02 | 0.746 |
| Diagnosed mental disorder (reference: no mental disorder) | 3.75 | 0.38 | 1.79 | 7.83 | <0.001* |
| Sleep – Hours | 0.68 | 0.18 | 0.48 | 0.96 | 0.028* |
| Sleep - Quality | 1.38 | 0.35 | 0.69 | 2.73 | 0.360 |
| Social Network - Diversity | 0.79 | 0.19 | 0.55 | 1.13 | 0.198 |
| Social Network - Number of people | 1.03 | 0.03 | 0.97 | 1.09 | 0.313 |
| Fatigue (FSS) | 1.22 | 0.15 | 0.92 | 1.63 | 0.171 |

OR, odds ratio; SE, standard error; CI, confidence interval; *LL*, lower limit; *UL*, upper limit. *Statistically significant.

health behaviors to strengthen the immune system (e.g., nutrition, physical activity and stress reduction measures) (Ingram et al., 2020; Fazia et al., 2022).

Interestingly, our data showed that higher sleep duration was associated with lower odds for SARS-CoV-2 infection. Sleep is a key factor in maintaining overall health and immunity and sleep disorders are a common feature of mental health problems that have been more frequently observed during the COVID-19 pandemic. Evidence suggests that obstructive sleep apnea is an independent risk factor for severe COVID-19 (Strausz et al., 2021). While sleep problems were found to be associated with higher levels of psychological distress during the COVID-19 pandemic (Alimoradi et al., 2021), we did not observe an association between sleep quality and duration and emotional burden in our study. Given that COVID-19 is a respiratory illness that can cause severe illness and complications, it is important to understand the role of sleep in the immune response to the virus. Further investigations are required to explore whether our finding might be related to specific shift-working professions that suffer from sleep deprivation and are therefore at higher risk for infection (e.g., healthcare professionals).

## 4.1. Strengths and limitations

The strengths of our study are the longitudinal design and the selection of a representative sample from the general population. Moreover, an infection with SARS-CoV-2 was confirmed using a SARS-CoV-2-specific immunoglobulin blood test and did not rely on self-reports. This study has several limitations that must be considered. As the participation/response rate in both data collections was below the expected 40–50% (Guo et al., 2016), the findings need to be interpreted in light of a possible participation bias. Although most participants reporting increased depression, anxiety and stress levels at the second data collection (June–July 2021) were most likely infected during the second and third waves in fall/winter 2020/2021, we were unable to determine the exact timing of the infection and therefore to prove the chronicity of emotional burden after an infection with SARS-CoV-2. Given the time period of this longitudinal study, the findings and conclusions are limited to infections with SARS-CoV-2 variants alpha and delta, although recent research found similar neurological and psychiatric outcomes during the delta and omicron waves (Taquet et al., 2022). As diagnosed mental disorders were self-reported, we cannot exclude that participants' responses were affected by the pandemic (e.g., political situation, pandemic management) leading to an over- or underreporting.

# 5. Conclusion

This longitudinal study included a sample from the general population of South Tyrol (Northern Italy) participating in two data collections during the coronavirus pandemic in 2020 and 2021. Data confirmed the negative impact of SARS-CoV-2 infection on depression, anxiety, and stress levels. While emotional burden itself was not associated with an infection with SARS-CoV-2, persons with a previously diagnosed mental disorder were more likely to be infected. Psychological and psychiatric support, for example, stress-reducing interventions, may improve the resilience and immune defense of individuals with diagnosed mental disorders and help restore mental health after SARS-CoV-2 infection. Further research is necessary to explore whether and (what types of) mental disorders are independent risk factors for SARS-CoV-2 infection, more severe

COVID-19 and subsequent negative outcomes, including hospitalization and mortality.

## Data availability statement

Data will be made available from the corresponding author upon request.

## Ethics statement

The studies involving human participants were reviewed and approved by Ethics committee of Bolzano on 28/05/2020 (approval number 52-2020) and the amendment on 22/04/21 (approval number 51-2021). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## Author contributions

AM, AE, GP, MM, HM, RK, and DA developed the idea for the study. SL, TG, CW, AM, AE, GP, MM, HM, RK, GeP, PS, FG, and DA contributed to the concept, design, and data collection. GeP, PS, FG, RP, SL, TG, MM, DA, AM, AE, GP, and RK contributed to the analysis and interpretation of the data. DA, CW, and RK contributed to the drafting of the manuscript. All authors contributed to the critical revision of the manuscript and approved the final version.

## Funding

The study was funded by the local representatives of the National Health Service (Azienda Sanitaria dell'Alto Adige/Südtiroler Sanitätsbetrieb – ASDAA/SABES).

## Acknowledgments

The authors thank Tomas Somadossi for the proofreading of the manuscript.

## Conflict of interest

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

## Publisher's note



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frontiers | Frontiers in Psychology

TYPE Brief Research Report
PUBLISHED 18 May 2023
DOI 10.3389/fpsyg.2023.1115322



OPEN ACCESS

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RECEIVED 03 December 2022
ACCEPTED 19 April 2023
PUBLISHED 18 May 2023

CITATION
Pena-Shaff J, Heckart A, Mannion C and Barry K (2023) Caregivers' anxiety and perception of their children's wellbeing: a year into the COVID-19 pandemic.
*Front. Psychol.* 14:1115322.
doi: 10.3389/fpsyg.2023.1115322



# Caregivers' anxiety and perception of their children's wellbeing: a year into the COVID-19 pandemic

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The COVID-19 pandemic and related social restrictions disrupted family routines affecting millions of youths and their caregivers worldwide. This study explored the relationship between caregivers' anxiety and their children's emotional states 1year after COVID-19, as well as differences between caregivers' perceptions of their children's emotional states and reality. Sixty-eight caregiver-child pairs completed an online survey between March 31 and May 31, 2021. Our analysis showed positive correlations between caregivers' anxiety and children's wellbeing, worries about children's use of time, and a variety of negative emotional states in their children. Caregivers' anxiety about their children's wellbeing was negatively correlated with their children's perceptions of self-control. Caregivers' anxiety about their personal wellbeing was negatively correlated with children's feelings of busyness and positively associated to their children's fear. Caregivers' perception of COVID-19 as a challenging experience was positively associated with some of their children's negative emotions. Overall, caregivers were accurate about children's emotional experiences in the previous 3months with some exceptions: their children felt lonelier and more worried about schoolwork and grades than their caregivers realized. These findings will help researchers and practitioners further explore the sources of caregivers' anxiety and their relationship with children's emotions and stress management as countries move toward a new normal.

KEYWORDS

**COVID-19 pandemic, youth parents' anxiety, children's emotional states, children's coping, psychological wellbeing**

## 1. Introduction

Research has revealed the large impact the COVID-19 pandemic and its related life changes has had on family routines, affecting millions of youths and their caregivers worldwide including striking effects on mental health due to prolonged fear and health measures, like social distancing (Jin et al., 2022). This study focused on caregivers' (those taking parental roles), and youths' (ages 9–18 years) perceptions of their psychological wellbeing 20 months after COVID-19 social restrictions were first enforced in the United States.

The first known infections of the severe acute respiratory syndrome SARS-CoV-2 causing the coronavirus disease (COVID 19) were identified in Wuhan, Hubei, China, in 2019. In January 2020, the extent of the epidemic in China became apparent to the world as images of this region's lockdown appeared (Katella, 2021). Soon after, cases were identified in the Philippines, Europe, and the United States. By March 2020, most of the world shut down, with

countries closing their borders, schools, and workplaces. People were required to wear masks, social distance, and work/learn from home (Katella, 2021). Adults with children reported an increase in stress and anxiety in all aspects of daily life (American Psychological Association, 2020). In addition to significant levels of stress related to the disease, caregivers also worried about their children's schooling, the long-term impacts on their social–emotional development and mental health, and about keeping their children occupied during the pandemic (American Psychological Association, 2020). Based on a 2020 APA report, caregivers' anxiety was related to their children's overall wellbeing and development, and their activities during lockdowns.

## 1.1. Caregivers' anxiety and their children's psychological wellbeing

Disruptions in school and workplace, in addition to COVID-19 fears, have been associated with stressors to children, their caregivers, and the overall family (American Psychological Association, 2020). In addition, confinement of caregivers for a long time without opportunities to pursue personal interests and goals increased conflict and tensions at home for many (Mohler-Kuo et al., 2021). Several studies report on the increased levels of anxiety, depression, and perceived stress in caregivers during the pandemic (American Psychological Association, 2020; Spinelli et al., 2020; Wu et al., 2020; Mohler-Kuo et al., 2021). Wu et al. (2020) found that parents, particularly those with middle or high school children, reported high levels of depression, anxiety, and perceived stress, especially if there were family conflicts. Spinelli et al. (2020) reported that household chaos during the pandemic affected parents' stress levels. Mohler-Kuo et al. (2021) found that caregivers, particularly mothers, reported higher levels of stress due to the need to "take on greater family or work responsibilities" (p. 6). This study also reported a higher-than-expected level of children's internet use which also could cause friction between children and their caregivers.

We found only two studies addressing the relationship between caregivers' anxiety and stress related to COVID-19 and their children's psychological wellbeing. Schabus and Eigl (2021) in a sample of Austrian youth found that children of higher-anxiety parents worried more about themselves or loved ones getting sick than did those of lower-anxiety parents. In addition, Kerr et al. (2021) found that among caregivers with at least one child aged 12 years or younger, there was a positive correlation between caregivers' psychological impacts/parental burnout and their perceptions of their children's stress behaviors. In addition, there was a negative correlation between these and their children' positive behaviors. It is important to further explore the relationship between caregivers' anxiety and their children's emotional states and coping skills to deal with difficult situations such as those brought about by the COVID-19 pandemic.

## 1.2. Youth psychological wellbeing during COVID-19

Immediately after the pandemic began, several studies investigated how the quarantine and social disruptions psychologically affected youth (Orgilés et al., 2000; Buzzi et al., 2020; Liu et al., 2020; Schabus and Eigl, 2021; Tang et al., 2021; Jin et al., 2022). These studies report increased rates of loneliness (Orgilés et al., 2000; Schabus and Eigl, 2021), boredom (Orgilés et al., 2000), fear (Orgilés et al., 2000; Buzzi et al., 2020; Jin et al., 2022), irritability and anger (Orgilés et al., 2000; Schabus and Eigl, 2021), anxiety sensitivity (Jin et al., 2022), and depression (Schabus and Eigl, 2021; Tang et al., 2021). For example, Buzzi et al. (2020) found, in an impromptu study among youth in Italy, that the COVID-19 outbreak had impacted not only youth emotions and lifestyle but also their relationships with parents and peers. Likewise, Orgilés et al. (2000) study on the psychological impact of the COVID-19 social restrictions in children and adolescents in Italy and Spain, found that parents perceived changes in their children's emotional states such as increased boredom, difficulty concentrating, nervousness, loneliness, and worries since social restrictions were imposed. These problems seemed to be exacerbated by difficult family dynamics and higher caregiver stress levels. Schabus and Eigl (2021) study with Austrian children and adolescents presented "an alarming picture of psychosocial health among children and adolescents, highlighting the acute need for action" (p. 9) due to increased feelings of fury, anger, loneliness, and sadness. Due to the abrupt life changes and fears of the pandemic, psychological effects on the wellbeing of caregivers and children are unsurprising. However, humans, and particularly children and adolescents, are highly resilient and able to adapt to changes in their routines and life situations.

## 1.3. Youth coping and resilience during COVID-19's social restrictions

Some research evidence from early in the pandemic suggests that children's and adolescents' psychological wellbeing improved as they became used to the changes in social life brought about by COVID-19. Liu et al. (2020) reported that residents of Wuhan, China, experienced an increase in post-traumatic stress symptoms (PTSS) due to the psychological trauma of COVID-19. However, they also stated that adolescents were less likely to develop mental health disorders than adults and were more likely to bounce back after experiencing negative events related to the pandemic. Similarly, Yang et al. (2020) found that although COVID-19-related trauma had a significant impact on the mental health of high school students in Wuhan, those with higher levels of resilience and positive emotion regulation had overall better mental health than those who did not. Likewise, Commodari and La Rosa (2020) in a survey with Italian youths, who had very strict quarantine rules between March and May 2020, found that even though many reported negative feelings during those months, they also reported new routines such as exercise and engaging in new hobbies that helped them cope. Youth who followed strict personal protective measures and avoided going out in public to reduce their chances of contracting COVID-19, used social media, and talked about COVID-19 with family and friends, felt better equipped to deal with the social changes imposed by the pandemic (Baloran, 2020).

As Yang et al. (2020) stated, positive emotion regulation and resilience interrupted or reduced the psychological trauma youth experienced during the COVID-19 pandemic, helping protect their mental health. Therefore, understanding how youth dealt with difficult situations can help practitioners develop training and interventions to promote resilience and positive coping strategies to ameliorate or prevent negative mental health outcomes from traumatic life disruptions.

When we began to design our study, most of the published studies came from China or European countries (e.g., Spain, Italy, and Austria). To our knowledge, there were very few published studies, if any, with youth from the United States. In addition, most studies reporting on youth's psychological wellbeing look either at youth's self-reports or reports from their parents' perceptions. Based on the experience of one of this study's authors, we became intrigued by how attuned caregivers were to their children's emotional states as well as the relationship between caregivers' anxiety and their children's emotional experiences. Previous studies used data collected during the first 6 months after social restrictions began. However, as children and adolescents are highly resilient and adapt more easily than adults to new situations, their psychological state could be different after 20 months. Caregivers and their youth might have begun adapting to their new work, school, and family routines, possibly reducing the mental health impact of the COVID-19 pandemic. In addition, by March 2021, vaccines were becoming available in the United States, and some schools began to offer in-person classes, either full time or in hybrid form, with many of them still following safety measures such as mask-wearing and social distancing. Study Purpose and Research Questions.

The purpose of this study was to explore the relationship between caregivers' anxiety and their children's emotional states and coping strategies nearly 1 year after the COVID-19 pandemic social disruptions began in the United States. We also explored differences between caregivers' perceptions of their children's emotions and how their children felt. The following questions guided our study:

1. Was there a relationship between caregivers' perceived anxiety and their children's emotional states?
2. Was there a relationship between caregivers' perceived anxiety and how their children dealt with difficult or challenging situations?
3. Were there differences between caregivers' perceptions of their children emotional states and their children's emotional states?

# 2. Methodology

## 2.1. Participants

Caregivers participating in the study were 18 years old or older with at least one child between the ages of 9 and 18 years. A total of 156 caregivers accessed the survey; 122 completed it. Participants who did not complete the survey were excluded from the study. Some participants provided information for more than one child between the required ages. In those cases, and if child-caregiver were matched, they were counted as two participants. The caregivers' survey provided a link to the youths' questionnaire. Caregivers were invited to share the link with their children if they consented to participate in the study. They were also directed to include a personal code to share with their children to allow researchers to pair caregivers with their respective children. One-hundred and twenty-five youth accessed their survey. Before beginning the survey, they were also asked for their consent to participate. Of these, 99 completed most of the survey questions. Researchers were able to pair 68 of these youth with their respective caregivers. We used these caregiver-youth pairs for the analyses. Table 1 presents the sample demographics.

## 2.2. Measures

We developed two surveys (one for caregivers and one for their children) based on the available literature at the time related to the psychological impact of COVID-19 quarantine and social restrictions in China and several European countries were published shortly after the pandemic began (Orgilés et al., 2000; Commodari and La Rosa, 2020). These studies explored the psychological effects within the first 6 months of social restriction. We used Qualtrics to design the online questionnaires. The online surveys conformed to the recommended standards for conducting internet surveys by following the Checklist for Reporting Results of Internet E-Surveys (CHERRIES): The study was approved by our IRB, participants included gave consent after reading the survey cover letter, etc. Participants were recruited through local advertisement, Facebook accounts, and the use of the snowball sampling technique. Surveys were anonymous. Once caregivers completed the survey, they had the opportunity to add their email to be included in a raffle for a $ 100 Visa card. If they accepted to participate in the raffle, the link took them to another URL to maintain anonymity. The surveys were available between the period of March 31 and May 31, 2021.The caregivers' survey included a total of 71 items, most of them in Likert-scale form, with four open-ended questions. Caregivers' survey used a simplified version of the survey used by Orgilés et al. (2000) examining the psychological impact of the COVID-19 quarantine in youth from Spain and Italy. The survey included five sections: (1) caregivers' sociodemographic information and their children's ages 9–18 years; (2) COVID-19 perceived levels of risk; (3) caregivers' perceived levels of anxiety; (4) caregiver's perceptions of how the COVID-19 restrictions in the previous 2 months were affecting their children's emotional wellbeing and how they thought their children were dealing with difficult situations; and (5) caregivers' coping methods and social support systems during the previous 2 months.

The youth survey consisted of 64 items, most of them in Likert-scale or dichotomous responses addressing their experiences during the 2 months before the survey. The survey also included two open-ended questions. The survey included the following sections: (1) their emotions and behaviors during the previous 2 months; (2) relationships and social support experienced; (3) their way of dealing with difficult situations; and (4) demographics. The sections about feelings and dealing with difficult situations presented Likert-scale items matching those on the adult survey. Youth selected the answers that best reflected their emotional states; caregivers selected the answers that best reflected their perceptions of their children's emotional states.

## 2.3. Data analysis

The 12 items from the COVID-19 caregivers anxiety scale were subjected to principal component analysis (PCA) using SPSS Version 21. Inspection of the correlation matrix revealed the presence of many coefficients of 0.3 or above. The Kaiser-Meyer-Oklin value was 0.744, exceeding the recommended value of 0.6 (Kaiser, 1974) and Bartlett's test of Sphericity reached statistical significance (<0.001), supporting the factorability of the correlation matrix. Principal components analysis revealed three components with eigenvalues at or above 1, explaining 33.6, 16, and 11.7% of the variance, respectively. These

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TABLE 1 Caregivers' and (Child) demographics ($N$=68).

| Variable | % | Variable | % |
|---|---|---|---|
| *Relationship to child* | | *Racial identification* | |
| Mother | 65 | White | 74 (71) |
| Father | 31 | Black | 19 (18) |
| Stepparent | 2 | Native American/Alaskan Native | 4 (4) |
| Other (grandparent; foster parent) | 2 | Asian/Asian American | 1 (2) |
| *Sex* | | Other | 2 (2) |
| | | *Ethnicity* | |
| Female | 62.8 (38) | Non-Hispanic | 75 (75) |
| Male | 35.5 (57) | Hispanic | 18 (22) |
| Prefer not to say | (5) | Missing | 8 (3) |
| *Age range* | | *Education level* | |
| 26–30 | 3 | Highschool or GDE | 3 |
| 31–35 | 28 | Some college, no degree | 14 |
| 36–40 | 24 | Trade or technical training | 4 |
| 41–45 (*Mdn*) | 15 | Associate degree | 6 |
| 46–50 | 15 | Bachelor's degree | 21 |
| 51–55 | 13 | Master's or higher degree | 44 |
| 56–60 | 3 | Missing | 8 |
| *Marital status* | | *Partner's education* | |
| Single or never married | | Highschool or GDE | 4 |
| Married or domestic | 1 | Some college, no degree | 13 |
| Partnership | | Trade or technical training | 5 |
| Divorced | 97 | Associate degree | 15 |
| | | Bachelor's degree | 23 |
| | | Master's or higher degree | 27 |
| | 2 | It is just me | 4 |
| | | Missing | 8 |
| *Employment status* | | *Approximate household income* | |
| Employed | 72.5 | <$39,999 | 9 |
| Self-employed | 10 | $40,000 to $49,999 | 6 |
| Homemaker | 8 | $50,000 to $59,999 | 7 |
| Student | 2 | $60,000 to $69,999 | 3 |
| Unemployed | <1 | $70,000 to $79,999 | 7 |
| Missing | 6.5 | $80,000 to $89,999 | 9 |
| | | $90,000 to $99,999 | 8 |
| | | $100,000 to $149,999 | 16 |
| | | $150,000 or more | 26 |
| | | Missing | 8 |
| *Area of residence* | | Type of home | |
| Rural | 19 | Apartment | 22 |
| Urban | 26 | Duplex | 7 |
| Suburban | 54 | House | 69 |
| | | Other | 1 |
| *Number of children aged 9–18* | | *Children mode of schooling* | |

*(Continued)*

TABLE 1 (Continued)

| Variable | % | Variable | % |
|---|---|---|---|
| One | 71 | Homeschooling | 6 |
| Two | 22 | Hybrid | 39 |
| Three | 6 | 100% in-person | 12 |
| Four or more | 1 | 100% remote | 42 |
| *Caregivers working from home* | | | |
| Yes | 57 | | |
| No | 12 | | |
| Hybrid | 31 | | |

three components were retained. Oblimin rotation was performed to aid in the interpretation of these components. The rotation showed several strong loadings with all variables but one loading on only one component. The interpretation of these three components makes sense [Factor 1. caregivers' anxiety related to their child(ren) overall development and wellbeing; Factor 2. caregivers' anxiety related to their personal finances, mental and physical health, and health of other family members, not their children; and Factor 3. caregivers' anxiety related to their children's use of time]. There was a weak or non-existent positive correlation between the three factors (Factor 1 and 2, $r = 0.21$; Factor 1 and 3, $r = 0.024$; Factor 2 and 3, $r = 0.067$).

Caregivers' anxiety related to (1) their children's development and wellbeing (*Child Wellbeing Anxiety*), (2) their personal finances, mental and physical health (*Personal Anxiety*), and (3) anxiety about how children were using their time at home (*Child Time-Use Anxiety*). We conducted correlations between these anxiety factors and children's emotional states and how children dealt with difficult situations in the previous 2 months. Youth questions about their emotional states were measured using a 5-point Likert scale ranging from 1 (never) to 5 (always). For example, youth were asked "In the last 2 months, how often have you felt scared." Ten items related to youth emotional states.

For 68 of these parents-child dyads, we calculated 86 correlations between different variables related to caregiver anxiety and youth emotional states. According to Faul et al.'s (2007) software for power analyses, a sensitivity power analysis showed that an $N$ of 68 provides 80% power to detect a correlation of $r = \pm 0.33$, $p < 0.05$, two-tailed. With a Bonferroni adjustment to the $p$-value for 76 correlations between different variables ($p = 0.00066$), $N$ of 68 provides 80% power to detect a difference between two between-subjects conditions of $r = \pm 0.48$, $p < 0.00066$, two-tailed.

For 66 of these parents and 66 children, we also calculated 36 correlations between different variables. According to Faul et al.'s (2007) software for power analyses, a sensitivity power analysis showed that an $N$ of 66 provides 80% power to detect a correlation of $r = \pm 0.34$, $p < 0.05$, two-tailed. With a Bonferroni adjustment to the $p$-value for 36 correlations between different variables ($p = 0.00139$), $N$ of 66 provides 80% power to detect a difference between two between-subjects conditions of $d = \pm 0.467$, $p < 0.00139$, two-tailed.

Paired-sample t-tests were conducted to explore mean differences between how caregivers perceived their children's emotional states and how their children experienced them. As in the youth survey, the caregivers' survey included 11 items using a Likert scale asking them "In the last 2 months, how often has this child felt scared, happy, etc."

According to Faul et al.'s (2007) software for power analyses, a sensitivity power analysis showed that 68 parent–child dyads achieve 80% power to detect a difference between two between-subjects conditions of $d = \pm 0.345$, $p < 0.05$, two-tailed. With a Bonferroni adjustment to the $p$-value for 11 paired-samples $t$-tests ($p = 0.0045$), 68 parent–child dyads achieve 80% power to detect a difference between two between-subjects conditions of $d = \pm 0.460$, $p < 0.0045$, two-tailed.

# 3. Results

## 3.1. Demographics

Table 1 provides details on the sample demographics. Participants came from 19 states in the United States, predominantly from the Northeast (New York and Massachusetts) and California. The sample was mostly suburban or urban and most lived in houses, not apartments. Almost all caregivers said their children had opportunities to play or be outside during the pandemic.

Caregivers (female = 62.8%) were between the ages of 26 and 60 years (*Median* for age was 3, which corresponds to ages 41–45 years), mostly White (24% identified as Black/African American, Native American, or Asian), non-Hispanic (19% identified as Hispanic). Most participants were married or in a domestic partnership. About 75% of the participants or their partners had at least some college credit and a yearly household income of $80,000 or more. About 70% of participants and their partners were employed for wages or salary, and only about 10–12% were self-employed. The youth sample (Female = 34%; Male = 63%, nonbinary = 3%) were between 9 and 17 years old ($M = 13.6$; $SD = 2.4$).

## 3.2. Caregivers' anxiety and their children's emotional states

Table 2 presents the correlational analysis results and descriptive statistics between caregivers' anxiety (Child Wellbeing Anxiety, Personal Anxiety and Child Time-Use Anxiety) and youth emotional states. Our analysis showed that caregivers' anxiety related to their children's development and wellbeing was positively and moderately correlated with youth feeling lonely ($r = 0.49$, $p < 0.01$), scared ($r = 0.46$, $p < 0.01$), hopeless or sad ($r = 0.45$, $p < 0.01$), lonely ($r = 0.44$, $p < 0.01$), angry and bored ($r = 0.42$, $p < 0.01$), and nervous ($r = 40$, $p < 0.01$). There were also positive but weaker correlations between caregivers'

TABLE 2 Correlation between caregivers' anxiety and youth emotional states.

| Variable | Mean | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Child Wellbeing Anxiety | 16.7 | 2.11 | 1 | | | | | | | | | | | |
| 2. Personal Anxiety | 19.3 | 3.01 | 0.10 | 1 | | | | | | | | | | |
| 3. Child Time Use Anxiety | 9.5 | 2.3 | 0.265* | 0.040 | 1 | | | | | | | | | |
| *Youth reported emotional states* | | | | | | | | | | | | | | |
| 4. Rushed | 2.7 | 1.1 | 0.32** | −0.20 | 0.41** | 1 | | | | | | | | |
| 5. Stressed about school | 2.7 | 1.3 | 0.21 | −0.36** | 0.30* | 0.70** | 1 | | | | | | | |
| 6 Worried about grades | 2.9 | 1.4 | 0.39** | 0.01 | 0.47** | 0.68** | 0.56** | 1 | | | | | | |
| 7. Bored | 2.9 | 1.3 | 0.42** | −0.01 | 0.45** | 0.69** | 0.53** | 0.64** | 1 | | | | | |
| 8. Lonely | 2.7 | 1.4 | 0.49** | −0.06 | 0.41** | 0.73** | 0.51** | 0.61** | 0.74** | 1 | | | | |
| 9. Scared | 2.5 | 1.4 | 0.46** | 0.25* | 0.41** | 0.66** | 0.39** | 0.65** | 0.71** | 0.74** | 1 | | | |
| 10. Nervous | 2.7 | 1.3 | 0.40** | 0.06 | 0.37** | 0.64** | 0.55** | 0.72** | 0.67** | 0.68** | 0.80** | 1 | | |
| 11. Angry | 2.5 | 1.1 | 0.42** | −0.01 | 0.38** | 0.73** | 0.55** | 0.66** | 0.68** | 0.73** | 0.77** | 0.75** | 1 | |
| 12. Hopeless/sad | 2.6 | 1.3 | 0.45** | −0.10 | 0.39** | 0.74** | 0.63** | 0.69** | 0.64** | 0.79** | 0.76** | 0.82** | 0.77** | 1 |
| 13. Happy | 2.7 | 1.2 | 0.05 | −0.12 | −0.26* | −0.39** | −0.35** | −0.21 | −0.46** | −0.33** | −0.27* | −0.36** | −0.48** | −0.31* |

**$p < 0.01$ level (2-tailed); *$p < 0.05$ level (2-tailed); $N = 68$.





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TABLE 3 Correlation between caregivers' anxiety and youth perceptions of how they dealt with difficult situations.

| Variable | Mean | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Child Wellbeing Anxiety | 16.7 | 2.1 | 1 | | | | | | | |
| 2. Personal Anxiety | 19.4 | 3.0 | 0.11 | 1 | | | | | | |
| 3. Child Time Use Anxiety | 9.5 | 2.3 | 0.29* | 0.53 | 1 | | | | | |
| 4 Find different ways to make themselves feel better when things do not go their way | 3.0 | 0.4 | −0.15 | −0.02 | −0.04 | 1 | | | | |
| 5 Can grow as a person by dealing with difficult situations | 3.0 | 0.5 | −0.02 | −0.21 | 0.07 | 0.41** | 1 | | | |
| 6 Look for new ways to deal with difficult situations | 2.9 | 0.4 | −0.13 | −0.06 | −0.05 | 0.25* | 0.49** | 1 | | |
| 7 Can control emotional reactions | 2.6 | 0.7 | −0.34** | 0.17 | −0.12 | 0.15 | 0.30* | 0.24 | 1 | |
| 8 Only sets goals that they know can achieve without help | 2.7 | 0.6 | −0.05 | 0.03 | 0.10 | 0.25* | 0.20 | 0.30* | 0.36** | 1 |
| 9 Asks friends, teachers, or family when needing help | 2.9 | 0.6 | −0.11 | 0.25* | −0.07 | 0.23 | 0.33** | 0.40** | 0.33** | 0.06 |

**$p < 0.01$ (2-tailed); *$p < 0.05$ level (2-tailed), $N = 66$.

Child Wellbeing Anxiety and their children being worried about their grades ($r = 0.39$, $p < 0.01$) and feeling rushed ($r = 0.32$, $p < 0.01$). Caregivers' Child Time-Use Anxiety during the past 2 months was positively correlated with most youth negative emotions and weakly but negatively correlated with their children's sense of happiness ($r = -264$, $p < 0.05$). Caregivers' Personal Anxiety was negatively correlated with their children being worried about school ($r = -0.36$, $p < 0.01$) but positively correlated with their children feeling scared ($r = 0.25$, $p < 0.05$). With a Bonferroni adjustment to the value of p ($r = \pm$ 0.483, $p < 0.00066$, two-tailed), only correlations between caregivers' anxiety related to their children's development and wellbeing and children's loneliness remained significant.

## 3.3. Caregivers' anxieties and how their youth dealt with difficult situations

Table 3 presents the correlational analysis results and descriptive statistics between the factors that drove caregivers' anxiety (Child Wellbeing Anxiety, Personal Anxiety, and Child Time Use Anxiety) and youth perceptions on how they dealt with difficult situations. Our analysis showed that caregivers' Child Wellbeing Anxiety negatively correlated with youth perception of self-control ($r = -0.35$, $p < 0.01$); in addition, caregivers' Personal Anxiety was positively associated with their youth asking friends, teachers, and family for help if needed ($r = 0.25$, $p < 0.05$). These results, however, were underpower, as only anything above 0.467 remained significant with a Bonferroni adjustment.

## 3.4. Differences between caregivers' and their youth's perceptions of youth emotions

Table 4 shows the results of the paired sample t-tests conducted to examine differences in caregivers' perceptions of their children's emotional states and their children's actual emotional states. We found statistically significant differences in perceptions for how worried or stressed children felt about schoolwork ($t = -3.64$, $p < 0.001$, *Cohen's* $d = 0.90$) and how bored ($t = -3.44$, $p < 0.001$, *Cohen's* $d = 1.06$) children felt in the previous 2 months. This suggests that children felt more worried about schoolwork and were more bored than caregivers realized. In addition, caregivers perceived their children to be less rushed ($t = -2.43$, $p < 0.05$, *Cohen's* $d = 0.75$), less worried about grades ($t = -2.20$, $p < 0.05$, *Cohen's* $d = 0.88$), and less lonely ($t = -2.06$, $p < 0.05$, *Cohen's* $d = 1.06$) than they were. Overall, youth in our sample were more worried about schoolwork and their grades and felt more rushed, lonely, and bored than their caregivers perceived them to be. The percentage of youth who often or always experienced negative emotions was higher than what their caregivers perceived (Table 4).

# 4. Discussion

We explored the relationship between caregivers' anxiety and their children's emotional states and how youth dealt with difficult situations 20 months after the COVID-19 pandemic social disruptions began in the United States. In addition, we explored differences between caregivers' perceptions of their children's emotions and how their children felt.

First, we found that caregivers' anxiety related to their children's development and wellbeing was positively and moderately correlated with some negative emotions experienced by their children such as feeling scared, sad, lonely, angry, bored, and nervous, and to a lesser but still significant degree to their children being worried about their grades and feeling rushed. Caregivers' anxiety over how children spent their time (e.g., screen time) over the previous 2 months was also correlated with most negative emotions in their children and weakly but negatively correlated with their children's sense of happiness. Caregivers' anxiety about their own personal matters negatively correlated with children being worried about school but positively correlated with their children feeling scared. It is possible that caregivers' anxiety about their children's wellbeing increased if they perceived them experiencing negative emotions such as fear and sadness. Likewise, it is possible that seeing their children

TABLE 4 Differences between caregivers' and youth perceptions of youth emotional states.

| Variables | Caregivers' perceptions of child emotional state (*N*=68) | | | Youth emotional states (*N*=68) | | | Paired-t |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | Often/Always % | *M* | *SD* | Often/Always % | |
| Rushed | 2.49 | 1.02 | 15 | 2.71 | 1.15 | 22 | −2.43* |
| Stressed about schoolwork | 2.26 | 1.06 | 22 | 2.66 | 1.32 | 38 | −3.64** |
| Worried about grades | 2.69 | 1.25 | 31 | 2.92 | 1.41 | 37 | −2.20* |
| Bored | 2.5 | 1.11 | 28 | 2.94 | 1.35 | 33 | −3.44** |
| Lonely | 2.46 | 1.15 | 19 | 2.72 | 1.36 | 26 | −0.206* |
| Fearful | 2.46 | 1.16 | 16 | 2.49 | 1.38 | 16 | −0.270 |
| Anxious | 2.68 | 1.13 | 27 | 2.74 | 1.35 | 29 | −0.541 |
| Angry | 2.51 | 1.13 | 18 | 2.50 | 1.127 | 16 | 0.148 |
| Sad | 2.43 | 1.08 | 17 | 2.57 | 1.30 | 24 | −1.344 |
| Happy | 2.78 | 1.03 | 36 | 2.66 | 1.17 | 28 | 1.09 |

**$p < 0.01$ (2-tailed); *$p < 0.05$ level (2-tailed).

spending too much time playing video games or on social media and not enough on school-related work made them anxious about how they were spending their time. These issues could also cause conflicts, exacerbating anxiety in the caregivers and negative emotions in their children. As such, youth negative emotions could also be the result of caregivers' increased anxiety about their children's emotions and their use of time and the conflict that could arise from such interactions. It was interesting to see that caregivers' anxiety related to their personal matters was inversely correlated with their children feeling worried about school. Since causation cannot be assumed, it is impossible to draw conclusions on whether caregivers could focus more on their personal matters because their kids were focused on their studies or whether their children could be more relaxed if their caregivers were not focusing on their schoolwork. Our findings support earlier evidence on the relationship between caregivers' anxiety and their children's psychological wellbeing during the early stages of the pandemic. Several studies (e.g., Spinelli et al., 2020; Kerr et al., 2021; Schabus and Eigl, 2021; Suzuki and Hiratani, 2021; Joo and Lee, 2022) have reported the indirect association of COVID-19 parental stress and their children's internalizing and externalizing behavioral problems. Frustration related to quarantine or social distancing, living with others in confined spaces with restricted social networks, drastic disruptions in daily routines, and increased parenting demands, particularly on mothers, have been associated with parents' mental health and behaviors predicting children's outcomes (Joo and Lee, 2022). However, our study revealed that not all types of caregiver anxiety positively associated with their children's negative emotional states. Still, we can see the dynamic relationship between youth's psychological wellbeing and caregivers' anxiety as it relates to their children's development, wellbeing, and use of time.

We also found that caregivers' anxiety related to their children's development and wellbeing negatively correlated with youth perceptions of self-control. As caregivers' anxiety over their children's wellbeing increased, their children's sense of self-control decreased or vice versa. Again, causality cannot be established. We know from earlier studies that the abrupt changes in daily routines brought about by the pandemic increased caregivers' anxiety levels as children's schooling moved online and many caregivers had to either work from home or had to leave their children alone while they risked their lives as essential workers (American Psychological Association, 2020). Many caregivers worried about their children's schooling and academic prospects (American Psychological Association, 2020). Living in a confined space over a long period of time could have increased tensions and undermined youth's feelings of self-control over their lives and futures. However, caregivers' personal-related anxiety was positively associated with their youth asking friends, teachers, and other family members for help if needed. This also shows youth proactive behaviors when dealing with difficult situations. To our knowledge, ours is the first study focusing on the relationship between caregivers' sources of anxiety and how their children dealt with difficult situations during the COVID-19 pandemic.

Overall, caregivers were very perceptive of their children's emotional experiences in the previous 2 months with some exceptions: their children felt lonelier, more worried about schoolwork and grades than their caregivers realized. The pandemic social restrictions, as other studies have shown, had a substantial impact on youth emotional states and caregivers were attuned to their children's emotional changes. This finding is important for researchers and practitioners, as many surveys during the COVID-19 pandemic were directed at caregivers or at youth only. Examining the differences between caregivers' perceptions of their children's emotional states and youth's actual emotional states could be used to further assess, and predict, children's psychological health.

Almost 1 year after the pandemic, the impact of social restrictions was still raw, even though the U.S. had eased these restrictions and many children were attending school in person, to some degree. As our results show, at least one fourth of children between the ages of 9 and 18 years were experiencing worries and negative emotions often or always. These are alarming numbers that call for urgent interventions and further screening to see if, as school and family routines return to pre-pandemic times, the negative emotional state

of our youth decreases. In addition, school closures during the COVID-19 pandemic have implications related to schooling after the pandemic. For example, Commodari and La Rosa (2021) discuss the association of distance learning during the pandemic with students' distress related to homework, difficulty organizing their study time, focusing on studying, and worries about their future career options. These areas of distress and school-related difficulties will need to be addressed by schools as students return to in-person school. They might also generate new sources of stress as students may feel ill prepared to assume the pre-pandemic learning expectations. This need for support in school is emphasized in the study conducted by Dudovitz et al. (2022) with results suggesting deficits in child wellbeing being related to peer problems, prosocial skills, and the need for learning support and mental wellness. School closures during the COVID-19 pandemic also have implications relating to dietary and sleep habits of children and adolescents, disrupting their routine, which can make it difficult in their schooling after the pandemic (Segre et al., 2021).

Based on the results obtained, we recommend follow up studies to determine whether the negative emotional state of our youth has changed since the return to in-person schooling. In addition, future studies should address areas of distress and school-related difficulties in post-pandemic schooling by potentially implementing interventions to decrease these areas for students. Interventions could consist of a required work-based learning class or an allotted time each school day as a study period. A work-based learning class would allow students to explore career goals, abilities, and interests, which could help students who are worrying about their future career options. An allotted study period would allow students to get a jumpstart on homework, extra help from teachers or other students, and be a time to relax during the school day.

Our study had some limitations. First, it used a convenience sampling approach as the pandemic was still ongoing. Although we advertised through local venues, our sample was recruited mostly using a snowball sampling technique, which led to a sample that was mainly educated, suburban, and middle class. Second, in trying to pair caregivers with their children, we ended up having a small sample of these dyads, making it more difficult to generalize the results to the population. As mentioned in our results, some of our results were underpower after conducting Bonferroni's adjustments. Lastly, due to the short period available to capture the reality of caregivers and their children, we developed our survey *ad hoc*, using questions from studies in Europe and China, not standardized scales that have higher validity and reliability. Regardless, our study provides further evidence on the effects of the COVID-19 pandemic on youth's mental health and psychological wellbeing and caregivers' sources of anxiety and how these two relate. Our results align with results from other studies (e.g., Segre et al., 2021) regarding the psychological effects of the COVID-19 in children and their caregivers and highlight the short-and-long-term impact of this life disruptions to learning and wellbeing.

## Data availability statement

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

## Ethics statement

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

## Author contributions

JP-S led the design of the questionnaire, organized the survey, conducted all statistical analyses, and completed the manuscript. AH, CM, and KB carried out the literature searches and manuscript preparation and wrote the first draft of the literature review, methods, and discussion. JP-S, AH, CM, and KB carried out manuscript editing. All authors approved the final version of the manuscript.

## Funding

This study was funded by Ithaca College.

## 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/fpsyg.2023.1115322/full#supplementary-material

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 14 June 2023
DOI 10.3389/fpsyg.2023.1169845



OPEN ACCESS

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RECEIVED 20 February 2023
ACCEPTED 23 May 2023
PUBLISHED 14 June 2023

CITATION
Zheng F, Xiong H, Jin Y and Zhang M (2023) Exploring the relationship between unemployment perception and health during COVID-19: a comparative study of rural and urban adults in China.
*Front. Psychol.* 14:1169845.
doi: 10.3389/fpsyg.2023.1169845



# Exploring the relationship between unemployment perception and health during COVID-19: a comparative study of rural and urban adults in China

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**Introduction:** The COVID-19 pandemic has significantly impacted global economies and individual health. This study uses data from the China Family Panel Data (CFPS) in 2018 (before the pandemic) and 2020 (during the pandemic) to a) estimate the relationships between the perceived risk of unemployment and individuals' mental health, physical health, and health behaviors; and b) explore the variations of these relationships between rural and urban adults in China.

**Methods:** Ordinary linear regression models or Logit models are employed, depending on the nature (continuous vs. discrete) of the dependent variables.

**Results:** We find that the perceived risk of unemployment was statistically and positively associated with the risk of depression, and the association was greater for rural adults than for urban adults. Rural-urban variations were observed in various dimensions. For rural adults, the perceived risk of unemployment was statistically and negatively associated with life satisfaction, the probability of gaining weight and becoming obese, the probability of having adequate sleep, and computer-based screen time. These associations were statistically insignificant for urban adults. On the other hand, the perceived risk of unemployment was statistically and negatively associated with self-rated very-good-to-excellent health condition and health-compromising behaviors (e.g., smoking and drinking) for urban adults; but such associations were statistically insignificant for rural adults.

**Discussion:** These findings suggest that rural and urban adults exhibited different psychological and behavioral responses to the unemployment risk during the COVID-19 pandemic. Public policies aiming to improve health and employment should be strategically designed to address the unique needs of urban and rural populations.

KEYWORDS

**unemployment perception, psychological wellbeing, health, rural and urban adults, China**

## Introduction

The COVID-19 pandemic has been an ongoing global public health crisis, causing more than 600 million confirmed infection cases with over 6 million deaths worldwide (WHO, 2023). Governments have implemented various policies, including social distancing, isolations, travel restrictions, lockdowns, and masking mandates, to curtain the spread. The pandemic has seriously affected the world's economic and political conditions (Chen G. et al., 2022; Fang et al., 2022a,b). The economic impacts have been globally unprecedented—more than 90% of countries worldwide had a negative GDP growth in 2020, a much higher

percentage than that in World War I and II as well as the 2008 economic recession (World-Bank, 2022). Economic downturns or even recessions increased unemployment worldwide (Che et al., 2020; Galea and Abdalla, 2020; Su et al., 2022) and led to a poor employment outlook (Aucejo et al., 2020; Le and Nguyen, 2021).

The relationships between economic condition and health outcomes vary by the type and severity of economic slump, cultural backgrounds, geographic aggregation, and population groups (Ruhm, 2000, 2005; Janet et al., 2015; Alam and Bose, 2022; Belotti et al., 2022). Some studies find that higher unemployment rates during business cycle fluctuations are associated with better health outcomes, such as lower mortality risk, reduced smoking, and decreased obesity prevalence. This association is attributed to the decreased opportunity cost of time, which encourages people to invest more time in maintaining and improving their health (Ruhm, 2000, 2005). Others find that sharp and severe economic shocks, such as the 2008 economic recession, can have detrimental effect on health outcomes. These effects may include a decline in self-reported health status, an increase in substance use, and a higher prevalence of cardiovascular diseases-related morbidity. (Janet et al., 2015; De and Segura-Escano, 2021; Belotti et al., 2022).

Unlike economic downturns and recessions in the past, the economic downturn during the COVID-19 pandemic was caused by an unprecedented public health crisis. Job insecurity along with economic downturns and health shocks is expected to affect mental health and psychological wellbeing during the pandemic (Ganson et al., 2021; Gong et al., 2022; Sun et al., 2022). However, very few studies have provided comprehensive evaluations on how individuals' psychological wellbeing, physical health, and health behaviors were affected by job insecurity during the pandemic.

Since the first infected case was reported in December 2019, China has implemented strict lockdown measures such as the "zero-COVID" policy through extensive testing, contact tracing, and quarantine apparatus (Normile, 2021; Wang et al., 2021). Several studies have found that the pandemic elevated the level of stress and anxiety across different age cohorts in China (Hu et al., 2021; Chen B. et al., 2022; Yang et al., 2022). On the other hand, although China had the lowest GDP growth rate[1] (2.2%) and the highest unemployment rate[2] (4.2%) in 2020 in the last decade, it was one of the very few countries having positive GDP growth during the pandemic (World-Bank, 2022). Yet, no study has investigated the relationships between perceived job insecurity and a broad spectrum of health status among Chinese adults.

In China, rural–urban disparities and inequalities have been predominant in many socioeconomic perspectives, such as income, infrastructure, health services, fertility, mortality, education, and social security system (Goodkind, 2011; Xie and Zhou, 2014; Bragg et al., 2017; Chan and Wei, 2019; Che et al., 2020). The rural populations, especially rural-to-urban migrant workers, were more vulnerable to economic shocks during the pandemic (Che et al., 2020; Wang et al., 2021). However, no studies have explored the potential differences in the relationship between the perceived risk of unemployment and health outcomes/behaviors between urban and rural adults in China. This study fills the gap in literature by exploring the rural–urban variations in such relationships.

Using the China Family Panel Data (CFPS) in 2018 (before the pandemic) and 2020 (during the pandemic), we find that a higher perceived risk of unemployment was found to be statistically associated with lower life satisfaction and an increased risk of depression. This is evidence of rural–urban disparities in the relationships between employment risk and health outcomes from various perspectives. The association of unemployment risk with life satisfaction was found to be statistically significant and negative for rural adults but statistically insignificant for urban adults. Similar patterns were found for health outcomes (whether gained weight or became obese) and health behaviors (computer-based screen times and having adequate sleep). On the other hand, the association between unemployment risk and health outcomes (self-reported very-good/excellent health condition) and health-compromising behaviors (smoking and drinking) were found to be statistically significant and negative for urban adults, but statistically insignificant for rural adults.

This study expands the emerging literature by investigating the relationships between unemployment risk triggered by an unprecedented health crisis and individual health outcomes, which differs from the previous studies focusing on economic downturns in business fluctuation cycles or by economic shocks (e.g., the great recession in 2008) (Ruhm, 2000, 2005; Burgard and Kalousova, 2015; Janet et al., 2015; Alam and Bose, 2022). Our empirical results based on nationally representative data show that Chinese adults who perceived their job as insecure were less satisfied with their lives and more likely to experience depression. Rural and urban adults might respond to and cope with job insecurity differently and thus experience differentiated health impacts—decreased probability of gaining weight and less computer-based screen time for rural adults and reduced smoking and drinking for urban adults.

This study contributes to the literature on social inequality. Previous studies show that individuals with low income or socioeconomic status, limited skills, poor health, or limited access to healthcare are more susceptible to unemployment and more likely to experience adverse mental health outcomes during the COVID-19 pandemic (Banks et al., 2020; Che et al., 2020; Gong et al., 2022). Our study is the first to present rural–urban variations on comprehensive health outcomes and behaviors affected by unemployment risk during the pandemic for Chinese adults. Our findings suggest that public policies aimed to improve health outcomes and behaviors impacted by job insecurity during the COVID-19 pandemic should be tailored to target urban and rural populations specifically.

## Literature overview of economic downturns and health outcomes

### Economic downturns and health outcomes

How could macroeconomic conditions affect individual health outcomes? The theoretical foundation can be traced back to

1 The GDP growth rate in China from 2011 to 2020 is 9.55%, 7.86%, 7.77%, 7.43%, 7.04%, 6.85%, 6.95%, 6.75%, 5.95%, and 2.24%, respectively. https://data.stats.gov.cn/easyquery.htm?cn=C01. Last access was on 14 February 2023.

2 The annual unemployment rates in urban China from 2011 to 2020 are 4.1%, 4.1%, 4.1%, 4.1%, 4.1%, 4.0%, 3.9%, 3.8%, 3.6%, and 4.2%, respectively. https://data.stats.gov.cn/easyquery.htm?cn=C01. Last access was on 14 February 2023.

Grossman (1972)'s seminal work on health production modeling. An economic downturn potentially leads to unemployment, income loss, and wage decrease, affecting an individual's resource reallocation for health production. On the one hand, a wage decrease leads to a lower opportunity cost of time. Therefore, individuals would increase time spent in health-promising activities (e.g., more physical activity and cooking healthier food) due to the substitution effect. On the other hand, due to the income effect, job loss and income/wage decrease make people less affordable for healthy foods and health-promising activities. Furthermore, people may seek health-comprising activities, such as substance use, to deal with increased stress or anxiety resulting from adverse labor market outcomes.

Since the substitution and income effects on health outcomes are in opposite directions, whether the net impact is positive or not is an empirical issue. Ruhm et al. provide empirical evidence supporting the "healthy life in hard times" hypothesis (Ruhm, 2000, 2003, 2005; Ruhm and Black, 2002; Gerdtham and Ruhm, 2006). They find pro-cyclical associations between unemployment and healthy lifestyles: a higher unemployment rate is associated with a lower probability of mortality, obesity, and acute and chronic illness (Ruhm, 2000, 2003, 2005; Ruhm and Black, 2002; Gerdtham and Ruhm, 2006). Others find that job insecurity leads to poor health outcomes (Charles and DeCicca, 2008; Browning and Heinesen, 2012; Cygan-Rehm et al., 2017; Lenhart, 2017). A higher unemployment rate correlates with weight gain (Böckerman et al., 2007; Latif, 2014), increased tobacco and alcohol consumption (Dávalos et al., 2012), and higher morbidity of cardiovascular diseases (Belotti et al., 2022). Given that the relationship between economic downturns and health outcomes is an empirical issue depending on the trade-off between the substitution and income effects, further research is needed in various contexts and among different population groups.

## COVID-19 pandemic and health outcomes

The COVID-19 pandemic has significantly changed people's lifestyles and psychological wellbeing. Blanchflower and Bryson (2022) report that anxiety and depression for U.S. adults reached a peak in 2020 and then declined in 2021 and 2022 using the Household Pulse Survey data collected by the U.S. Census Bureau. A meta-analysis based on 71 studies covering 146,139 adults, including Chinese, Japanese, Italian, American, Turkish, Indian, Spanish, Greek, and Singaporean populations, shows that many people suffered from anxiety (32.6%), depression (27.6%), and insomnia (30.3%) during the pandemic (Liu et al., 2021). The elderly, low-income households, and ethnic minorities were more vulnerable to the pandemic as they experienced poor mental health and higher mortality (Proto and Quintana-Domeque, 2021; Whitehead et al., 2021).

The COVID-19 pandemic also led to changes in individual health-promising and compromising behaviors. Individuals may increase substance use to cope with elevated anxiety or depression (Rehm et al., 2020; Rodriguez et al., 2021). Bremner (2020) finds that sales of alcoholic beverages in the U.S. increased by 55% in the week ending 28 March 2020, compared with the same week in 2019. Increased alcohol consumption during the pandemic was also found in Canada (NANOS-Research, 2020). Two studies for England population during the lockdown offer mixed results: Jackson et al. (2021) find reduced alcohol consumption using the monthly cross-sectional survey among the adult population, while Kim et al. (2020) report increased alcohol consumption among people with alcohol use disorders and relapse for those who were previously abstinent. In terms of smoking, some studies find that people smoked more during the pandemic (Gendall et al., 2021; Guignard et al., 2021; Reynolds et al., 2021; Jackson et al., 2022). In contrast, others find that people were more likely to attempt to quit or successfully quit smoking (Jackson et al., 2021; Kayhan Tetik et al., 2021; Carreras et al., 2022).

Engaging in physical activity and maintaining healthy food-related behaviors are crucial for positive health outcomes. People may decrease their physical activity levels and increase sedentary time due to restrictions on public gatherings, closures of sports and entertainment facilities, and isolations and lockdowns (Naughton et al., 2021; Wedig et al., 2021). In contrast, people may increase their physical activity levels at home with a more flexible schedule during the pandemic (Ai et al., 2021; Mutz et al., 2021). The lockdown policies caused significant disruptions in food availability and accessibility (Niles et al., 2020; Ribeiro-Silva et al., 2021). A dramatic reduction in food expenditure was observed in rural areas or low- or middle-income countries (Mahmud and Riley, 2021; Wang et al., 2021). People who felt insecure about their job and food may shift their food consumption to ultra-processed foods, increasing the risk of weight gain (Adams et al., 2020; Pryor and Dietz, 2022).

Studies have demonstrated the association between job insecurity and poor mental health during the COVID-19 pandemic (Gong et al., 2022). Individuals losing their job during the pandemic were reported to have a higher risk of depression and anxiety than their employed peers in different countries, including the U.S. (Mcdowell et al., 2021), South Africa (Posel et al., 2021), and Spain (de Miquel et al., 2022). Bakkeli (2021) finds that worries and uncertainties regarding job security emerged as a significant predictor of lower life satisfaction during the COVID-19 pandemic. Overall, very few studies have investigated how job insecurity affected individuals' health and wellbeing during the COVID-19 pandemic and no such analysis for China.

We fulfill the gap in literature by investigating (a) the relationships between the perceived risk of unemployment and health outcomes (e.g., psychological wellbeing, physical health, and health behaviors) of Chinese adults; and (b) how the relationships differed between urban and rural adults.

## Data and key variables

This study uses the China Family Panel Studies (CFPS) data collected in 2018 (before the COVID-19 pandemic) and 2020[3] (during the COVID-19 pandemic). The CFPS is a biennial longitudinal survey launched in 2010 by the Institute of Social Science Survey (ISSS) of Peking University, China (Xie and Hu, 2014). It collects a rich set of information from a nationally

3 The 2020 CFPS was conducted from July to December 2020. Due to the lockdowns and mobility restrictions, about 88.5% of the participants were surveyed by telephone.

representative household sample in 31 provinces and autonomous regions/cities in China. This study uses the 2020 CFPS data for the analysis and leverages the 2018 CFPS data to control for the pre-pandemic socioeconomic status, psychological wellbeing, and health outcomes. We excluded the observations in Ningxia, Hainan, Qinghai, Inner Mongolia, and Tibet from the analysis as each province had <10 observations. We only keep observations who were 18–70 years in 2020. The total sample for the analysis is 9,308, including 6,925 rural adults and 2,383 urban adults.

This study also leverages the Oxford COVID-19 Government Response Tracker (OxCGRT)[4] to control policy measures. OxCGRT created government policy indices for many countries, including China. We use two policy indicators, the stringency index and the economic support index. The stringency index measures the strictness of "lockdown style" policies that restrict individual behaviors and movements. The economic support index measures the supportive degree of economic policies, such as income support and debt relief. The 2020 CFPS participants were assigned the stringency index and economic support index based on their province of residence and the month when they completed their survey.

## Perceived unemployment risk

The variable of interest is the perceived risk of unemployment. Previous studies often use the state-level unemployment rate as a proxy for macroeconomic conditions (Ruhm, 2000, 2005; Janet et al., 2015; Triaca et al., 2020). We use the unemployment risk perceived by each individual to measure job insecurity during the COVID-19 pandemic for the following two main reasons. First, the state-level unemployment rate could capture neither individual heterogeneity on job security nor the effects of job insecurity on health outcomes, especially during the pandemic. For example, even among individuals who remained employed during the pandemic, there was significant perception of job insecure due to the increased occurrence of business closures and layoffs. This perception led to behavioral changes towards health shocks. Second, the official unemployment rate released by the Chinese government was likely to be underestimated as many rural-to-urban migrant workers would return home during the pandemic, and their employment status may not be appropriately recorded on time (Che et al., 2020). The 2020 CFPS participants were asked to answer the following question: "What is the probability you think that you will lose your job within the next 12 months as your companies may close down or lay off employees (0–100%)?" As shown in Table 1, the average perceived risk of unemployment risk was 20.8%; and it was statistically higher for rural adults (21.3%) than for urban adults (19.1%).

4 OxCGRT has collected systemic information on government policy measures to tackle COVID-19 worldwide. Detailed information on data construction and codebook can be found at https://www.bsg.ox.ac.uk/research/COVID-19-government-response-tracker. Last access was on 10 February 2023.

## Health status: psychological wellbeing and physical health

We use both life satisfaction and depression risk to measure the psychological wellbeing of adults. The 2020 CFPS participants were asked to answer the following question: "How do you rate your life satisfaction on a scale from one (not satisfied at all) to five (extremely satisfied)?" We create a binary variable for life satisfaction that equals one if the participant chose a scale of 4 or 5; and zero otherwise. The CFPS adopted eight questions according to the Center for Epidemiology Studies Depression (CES-D scale) (Radloff, 1977). The CFPS provides a depression scale by summing the answer to these eight questions, where each question scores from one to four. We standardize the depression scale to have a mean of zero and a standard deviation of one. A higher value of the depression risk suggests a higher probability of being depressed.

Based on the available information in the CFPS, we use weight status and self-rated health status to measure physical health. The participant's body mass index (BMI) is calculated based on their self-reported weight and height. A binary variable is created to indicate obesity status: it equals one if BMI is equal to or greater than 28; and zero otherwise[5] (Pan et al., 2021). We also create the other binary variable indicating whether the participants gained weight in 2020 compared with 2018. The participants were also asked to rate their health status on a scale from one (excellent health) to five (poor health). A binary variable is created to indicate an excellent or very good health status if a scale of one or two was chosen.

Table 1 presents summary statistics of the key dependent variables measuring health outcomes for all the sample, rural adults, and urban adults during the pandemic (2020) and before the pandemic (2018), respectively. Compared with urban adults, rural adults had significantly lower life satisfaction (0.685 vs. 0.708), a higher depression risk (0.076 vs. −0.124), a significantly higher probability of having self-rated very good-to-excellent health condition (0.333 vs. 0.283), and a lower obesity risk (0.086 vs. 0.114). No statistically significant difference was found in the probability of gaining weight between rural and urban adults. Qualitatively similar rural–urban differences were found for psychological wellbeing and physical health in 2018.

## Health behaviors

We investigate both health-promising activities (e.g., physical activity) and health-compromising behaviors (e.g., inadequate sleep, screen time, and substance use). The CFPS participants were asked to answer the following question: "How often do you participate in physical activities in the last 12 months, excluding walking or biking to work?" We create a categorical variable to measure the weekly frequency of physical activities. It would equal zero if they chose "less than one time per week," one for "1–2 times per week," two for "3–4 times per week," three for "5–6 per

5 According to the working group on obesity and health industry standard (WS/T 428-2013) in China, Chinese people with BMI equal to or greater than 28.0 kg/m$^2$ are defined as obese (Pan et al., 2021).

10.3389/fpsyg.2023.1169845

TABLE 1 Summary statistics of perceived unemployment risk and health wellbeing in both 2018 and 2020.

| Variable | Full sample | | Rural sample | | Urban sample | | Mean difference[a] |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | |
| **Variable of interest** | | | | | | | |
| Perceived risk of unemployment (0–1) | 0.208 | 0.288 | 0.213 | 0.292 | 0.191 | 0.274 | 0.023*** |
| **Health wellbeing in 2020** | | | | | | | |
| Life satisfaction (satisfied = 1, otherwise = 0) | 0.691 | 0.462 | 0.685 | 0.464 | 0.708 | 0.455 | −0.023** |
| Risk of depression | 0.025 | 1.000 | 0.076 | 1.017 | −0.124 | 0.932 | 0.200*** |
| Self-rated health status (very good/excellent = 1, otherwise = 0) | 0.320 | 0.467 | 0.333 | 0.471 | 0.283 | 0.451 | 0.049*** |
| Weight gain from 2018 to 2020 (yes = 1, no = 0) | 0.415 | 0.493 | 0.416 | 0.493 | 0.413 | 0.493 | 0.003 |
| Obesity status (obese = 1, otherwise = 0) | 0.093 | 0.290 | 0.086 | 0.280 | 0.114 | 0.318 | −0.028*** |
| Weekly frequency of physical activities | 0.894 | 1.443 | 0.718 | 1.351 | 1.407 | 1.571 | −0.689*** |
| Daily digital screen time using mobile phones (hours) | 2.008 | 2.694 | 1.692 | 2.486 | 2.924 | 3.043 | −1.233*** |
| Daily digital screen time using computers (hours) | 0.641 | 1.842 | 0.409 | 1.529 | 1.315 | 2.417 | −0.906*** |
| Inadequate sleep (sleeping hours <7 h = 1, otherwise = 0) | 0.207 | 0.405 | 0.195 | 0.396 | 0.240 | 0.427 | −0.044*** |
| Smoking (daily number of cigarettes smoked) | 4.653 | 8.419 | 4.868 | 8.631 | 4.028 | 7.739 | 0.840*** |
| Drinking (weekly frequency ≥3 times = 1, otherwise = 0) | 0.147 | 0.354 | 0.149 | 0.357 | 0.139 | 0.346 | 0.010 |
| **Health wellbeing in 2018** | | | | | | | |
| Life satisfaction (satisfied = 1, otherwise = 0) | 0.688 | 0.464 | 0.677 | 0.468 | 0.719 | 0.450 | −0.042*** |
| Risk of depression | −0.003 | 0.990 | 0.042 | 1.006 | −0.136 | 0.928 | 0.179*** |
| Self-rated health condition (very good/excellent = 1, otherwise = 0) | 0.309 | 0.462 | 0.319 | 0.466 | 0.281 | 0.449 | 0.039*** |
| BMI | 23.32 | 3.395 | 23.23 | 3.381 | 23.59 | 3.423 | −0.356*** |
| Obesity status (obese = 1, otherwise = 0) | 0.091 | 0.287 | 0.085 | 0.279 | 0.107 | 0.309 | −0.021*** |
| Weekly frequency of physical activity frequency | 1.295 | 1.625 | 1.210 | 1.624 | 1.544 | 1.602 | −0.334*** |
| Daily digital screen time (hours) | 1.264 | 1.690 | 1.107 | 1.602 | 1.722 | 1.849 | −0.615*** |
| Inadequate sleep (sleeping hours <7 h = 1, otherwise = 0) | 0.205 | 0.403 | 0.202 | 0.402 | 0.212 | 0.409 | −0.010 |
| Smoking (daily number of cigarettes smoked) | 4.941 | 8.876 | 5.214 | 9.164 | 4.150 | 7.929 | 1.064*** |
| Drinking (weekly frequency ≥3 times = 1, otherwise = 0) | 0.166 | 0.372 | 0.171 | 0.376 | 0.151 | 0.359 | 0.019** |
| **No. of observations** | 9,308 | | 6,925 | | 2,383 | | |

[a]"Mean difference" represents the mean comparison of each variable between rural and rural adults based on t-tests.
*p < 0.1.
**p < 0.05.
*** p < 0.01.

week," and four for "seven times or above per week." The 2020 CFPS participants were also asked to separately report their daily digital online hours using either mobile devices or computers in 2020, while the 2018 participants were asked to report their total weekly digital online hours for leisure using either mobile devices or computers. We create the daily digital online screen time in 2018 to control sedentary behavior before the pandemic. We also created variables measuring digital time using mobile phones and computers in 2020 separately. The participants were asked to report their sleeping hours on a typical day.[6] Blanchflower and Bryson (2021) reported that a higher unemployment rate is associated with a higher probability of lacking sleep (<7 h). We create a binary variable indicating inadequate sleep if the participant reported sleeping <7 h on a typical day. The participants were also asked to answer two questions about substance use: "How many cigarettes did you consume daily in the last month?" and "Did you drink at least three times per week in the last month?" The number of cigarettes smoked daily in the last month is used as one of the outcome variables. We also create a binary variable indicating whether drinking at least three times per week in the last month.

As shown in Table 1, compared with the pre-pandemic level, the CFPS participants had a much lower frequency of physical activities and longer digital screen time during the pandemic. Digital screen time using mobile phones was much longer than digital screen time using computers in 2020: 2.008 hours vs. 0.641 hours per

6 We excluded the CPFS participants who reported more than 15 h of sleep a day.

day. Furthermore, compared with urban adults, rural adults had a significantly lower frequency of physical activities (0.718 vs. 1.407), shorter digital screen time using mobile phones (1.692 hours vs. 2.924 hours per day) and computers (0.409 hours vs. 1.315 hours per day), a smaller probability of inadequate sleep (0.195 vs. 0.240), and more cigarettes smoked daily (4.868 vs. 4.028). No statistical difference in drinking behavior was found between rural and urban adults in 2020.

## Control variables

We control for several sets of factors in the regression analyses. First, we control for health outcomes and psychological wellbeing in the pre-pandemic period using the 2018 CFPS data. Specifically, we include annual household income (10,000 Yuan), household net assets (10,000 Yuan), total liquid assets consisting of bank savings and brokerage accounts (10,000 Yuan), and whether at least one family member was a migrant worker in 2018. These covariates reflect economic/financial status and migrants' experience before the pandemic. Second, we control for personal, household, and regional characteristics in 2020. Personal characteristics include age, age squared, and sex, belonging to the Han ethnic group or not, education level, marital status, ever being diagnosed with any chronic diseases or not, and self-rated interpersonal relationship on a scale from 1 (extremely poor) to 10 (extremely good). We also include two labor market outcome variables, a dummy variable indicating the major job type (non-agricultural vs. agricultural), and whether the participant was self-employed in non-agricultural sectors. We also include economic and financial variables: whether covered by medical insurance or not, whether having retirement plans, personal income in the past 12 months (10,000 Yuan)[7], and self-rated relative income status (below, around, and above the average in one's neighborhood). Household characteristics consist of the number of children under 16 years and the number of family members. Regional characteristics include self-rated neighborhood medical services and the monthly average of new COVID cases at the province level in the last 3 months before the interview month for each observation. We also control for two OxCGRT policy indicators at the province level: the stringency index and the economic support index, in the month when the CFPS participant was interviewed. Province-fixed effects are also included.

Table 2 shows that the CFPS participants were 44.10 years on average, more males (55.5%) than females, and the majority belonged to the Han ethnic group (92.5%) and were married (84.2%). About one-third had up to 6 years of schooling (elementary school), one-third completed junior high school, 16.5% completed high school, and 17.1% received associated degrees or above. About 12.7% of the participants had been diagnosed with chronic diseases. About 60.7% worked mainly in the non-agricultural sectors, and 10.6% were self-employed in non-agricultural business. The participants had an average score of 7.08 in a 10-point scale for the self-rated interpersonal relationship. Before the pandemic, on average, the participant households had ~100,200 Yuan for annual household income, 773,000 Yuan for household net assets, and 71,520 Yuan for household liquid assets. During the pandemic, the average personal annual income was 39,310 Yuan; 63.6% had retirement plans; and 91.4% had medical insurance. At the regional level, 60.9% of the participants considered their neighborhood medical services satisfactory; the monthly new COVID cases reported in the residing province was 1.236; the monthly stringency index and economic support index at the province level were 49.48 and 37.62 in a 100-point scale in 2020.

7 Ideally, we would like to control household income in 2020 as it is one of the most important factors for health wellbeing. Unfortunately, CFPS has not released the data on household income and wealth in 2020.

# Estimation methodology

We examine the relationships between the perceived risk of unemployment and the psychological wellbeing, health status, and health behaviors of the CFPS participants controlling for confounding factors at the personal, household, and regional levels. Ordinary linear regression (OLS) models or logit models are employed depending on the nature (continuous vs. discrete) of the dependent variables.

$$H_{ip}^{2020} = \alpha + \beta Unemployment_{ip} + \gamma E_{ip}^{2018} + \delta X_{ip}^{2020} + \theta H_{ip}^{2018} + \lambda_p + \mu_{ip} \quad (1)$$

The variable of interest, $unemployment_{ip}$, indicates the perceived risk of unemployment in 2020 by individual $i$ residing in province $p$. The dependent variable, denoted by $H_{ip}^{2020}$, is one of the health outcomes. Due to the concern of potential serial correlations, we control for health outcomes in 2018 indicated by $H_{ip}^{2018}$. We also control for the family's financial and economic status in 2018, denoted by $E_{ip}^{2018}$, including annual household income, net household assets, household liquid assets, and whether ever having a migrant worker in the family. Those variables reflect family financial strength and migrating experience, and they are expected to affect health outcomes in 2020. $X_{ip}^{2020}$ is a vector of control variables representing personal, household, and regional characteristics in 2020. Equation (1) also includes province-fixed effects denoted by $\lambda_p$ and error term denoted by $\mu_{ip}$.

# Results

We present the OLS coeffects of key independent variables for health outcomes measured by a continuous variable (i.e., depression risk, weekly frequency of physical activities, digital screen time using mobile devices or computers, and daily number of cigarettes smoked). For the health outcomes measured by a binary variable, including life satisfaction, self-rated very good-to-excellent health condition, weight gain, obesity status, having inadequate sleep, and drinking at least three times per week in the last month, we present the marginal effects of key independent variables based on the corresponding logit model estimation.

## Psychological wellbeing

We first investigate the relationship between the perceived risk of unemployment and psychological wellbeing (e.g., life

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TABLE 2 Summary statistics of control variables.

| Variable | Surveyed year | Full sample | | Rural sample | | Urban sample | | Mean difference[a] |
|---|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | Mean | SD | |
| **Personal characteristics** | | | | | | | | |
| Age | 2020 | 44.10 | 12.63 | 44.73 | 12.95 | 42.27 | 11.47 | 2.455*** |
| Age squared | 2020 | 2,104 | 1,134 | 2,168 | 1,167 | 1,918 | 1,010 | 249.8*** |
| Male (male = 1, female = 0) | 2020 | 0.555 | 0.497 | 0.558 | 0.497 | 0.547 | 0.498 | 0.011 |
| Ethnicity (Han = 1, otherwise = 0) | 2020 | 0.925 | 0.263 | 0.917 | 0.276 | 0.950 | 0.219 | −0.033*** |
| Highest education level | 2020 | | | | | | | |
| At most elementary schools (yes = 1, no = 0) | | 0.333 | 0.471 | 0.332 | 0.471 | 0.337 | 0.473 | −0.006 |
| Completed junior high school (yes = 1, no = 0) | | 0.330 | 0.470 | 0.328 | 0.469 | 0.337 | 0.473 | −0.009 |
| Completed high school (yes = 1, no = 0) | | 0.165 | 0.371 | 0.169 | 0.375 | 0.154 | 0.361 | 0.016* |
| Had an associate degree or above (yes = 1, no = 0) | | 0.171 | 0.377 | 0.171 | 0.377 | 0.172 | 0.378 | −0.001 |
| Marital status (marriage = 1, otherwise = 0) | 2020 | 0.842 | 0.365 | 0.847 | 0.360 | 0.827 | 0.378 | 0.020** |
| Diagnosed with chronic diseases (yes = 1, no = 0) | 2020 | 0.127 | 0.333 | 0.130 | 0.337 | 0.118 | 0.323 | 0.0120 |
| Self-employed in non-agricultural business (yes = 1, no = 0) | 2020 | 0.106 | 0.308 | 0.102 | 0.302 | 0.120 | 0.325 | −0.019** |
| Major job type (non-agricultural = 1, agricultural = 0) | 2020 | 0.607 | 0.488 | 0.515 | 0.500 | 0.874 | 0.332 | −0.359*** |
| Having retirement plans (yes = 1, no = 0) | 2020 | 0.636 | 0.481 | 0.613 | 0.487 | 0.703 | 0.457 | −0.090*** |
| Having medical insurance (yes = 1, no = 0) | 2020 | 0.914 | 0.281 | 0.915 | 0.279 | 0.910 | 0.287 | 0.005 |
| Self-rated interpersonal relationship scale (1–10) | 2020 | 7.081 | 1.816 | 7.102 | 1.874 | 7.021 | 1.636 | 0.082* |
| Personal income in the last 12 months (10,000 Yuan) | 2020 | 3.931 | 3.694 | 3.347 | 2.787 | 5.629 | 5.183 | −2.282*** |
| Self-rated income status in the neighborhood | 2020 | | | | | | | |
| Below average | | 0.273 | 0.446 | 0.274 | 0.446 | 0.271 | 0.444 | 0.004 |
| Around average | | 0.519 | 0.500 | 0.501 | 0.500 | 0.569 | 0.495 | −0.068*** |
| Above average | | 0.208 | 0.406 | 0.224 | 0.417 | 0.160 | 0.367 | 0.064*** |
| **Family characteristics** | | | | | | | | |
| No. of children under 16 years | 2020 | 1.310 | 1.357 | 1.406 | 1.392 | 1.031 | 1.207 | 0.375*** |
| No. of household members | 2020 | 4.175 | 2.009 | 4.295 | 2.067 | 3.828 | 1.787 | 0.467*** |
| Annual household income (10,000 Yuan) | 2018 | 10.02 | 17.17 | 8.22 | 11.32 | 15.24 | 27.25 | −7.025*** |
| Net assets (10,000 Yuan) | 2018 | 77.30 | 170.0 | 53.68 | 139.6 | 145.9 | 223.6 | −92.26*** |
| Liquid assets (10,000 Yuan) | 2018 | 7.152 | 20.885 | 4.565 | 13.641 | 14.670 | 32.976 | −10.11*** |
| Family members ever being migrant workers (yes = 1, no = 0) | 2018 | 0.462 | 0.499 | 0.537 | 0.499 | 0.244 | 0.430 | 0.293*** |
| **Regional characteristics** | | | | | | | | |
| Perception of neighborhood medical services (good/very good = 1, otherwise = 0) | 2020 | 0.609 | 0.488 | 0.595 | 0.491 | 0.650 | 0.477 | −0.056*** |
| Monthly new COVID cases at the province level | 2020 | 1.236 | 2.774 | 1.001 | 2.434 | 1.921 | 3.494 | −0.920*** |
| Monthly stringency index at the province level | 2020 | 49.48 | 8.137 | 48.68 | 8.038 | 51.81 | 7.973 | −3.137*** |
| Monthly economic support index at the province level | 2020 | 37.62 | 13.18 | 38.21 | 13.41 | 35.92 | 12.34 | 2.290*** |
| No. of observations | | 9,308 | | 6,925 | | 2,383 | | |

[a]"Mean difference" represents the mean comparison of each variable between rural and urban adults by t-tests.

*$p < 0.1$.

**$p < 0.05$.

***$p < 0.01$.

TABLE 3 Regression results on the associations between the perceived risk of unemployment and psychological wellbeing.

| | Life satisfaction | | | Depression risk | | |
|---|---|---|---|---|---|---|
| | Full sample | Rural | Urban | Full sample | Rural | Urban |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Perceived unemployment risk | −0.316*** (0.090) | −0.330*** (0.103) | −0.257 (0.191) | 0.305*** (0.031) | 0.325*** (0.037) | 0.243*** (0.062) |
| Life satisfaction in 2018 | 1.205*** (0.053) | 1.133*** (0.061) | 1.444*** (0.110) | | | |
| Depression risk in 2018 | | | | 0.434*** (0.009) | 0.437*** (0.011) | 0.416*** (0.019) |
| $R^2$ | | | | 0.286 | 0.287 | 0.288 |
| Pseudo $R^2$ | 0.202 | 0.205 | 0.212 | | | |
| Control | Y | Y | Y | Y | Y | Y |
| No. of observations | 9,308 | 6,925 | 2,383 | 9,308 | 6,925 | 2,383 |

This table presents the estimated coefficients of the perceived unemployment risk on life satisfaction and the risk of depression. Standard errors are shown in parentheses.
*p < 0.1.
**p < 0.05.
***p < 0.01.
The control variables at the individual level in 2020 are age, age squared, gender, belonging to the Han ethnic group or not, education level, marital status, ever being diagnosed with chronic diseases or not, being self-employed in non-agricultural sectors or not, major job type (non-agricultural vs. other), covered by medical insurance or not, having retirement plans or not, self-rated interpersonal relationship scale, personal annual income (10,000 Yuan), and self-rated income status. We also control for the following family characteristics: the number of children under 16 years and the number of household members in 2020 as well as annual household income (10,000 Yuan), net assets (10,000 Yuan), liquid financial assets (10,000 Yuan), and life satisfaction (Columns 1–3) and depression risk (Columns 4–6) in 2018. The regional characteristics we control for are the perceived neighborhood medical services, the number of monthly new COVID cases, and the monthly stringency index and economic support index at the province level. All regressions include the province-fixed effects.

satisfaction and depression risk) during the COVID-19 pandemic and summarize the results in Table 3. For the national sample, the perceived risk of unemployment was significantly associated with life satisfaction (Column 1) and depression risk (Column 4). A higher unemployment risk was found to be associated with lower life satisfaction and an escalated risk of depression. Table 3 also shows rural–urban variations — the association between the perceived unemployment risk and depression risk was statistically significant for both rural and urban adults and greater in magnitude for rural adults than for urban adults. On the other hand, the unemployment risk was only significantly associated with decreased life satisfaction for rural adults ($P <$ 1%), but no statistically significant association was found for urban adults. The results indicate that compared with urban adults, rural adults were more vulnerable to unemployment risk and exposed to greater adverse impacts on their psychological wellbeing during the pandemic.

## Physical health status

We further investigate the effects of the perceived unemployment risk on the self-reported physical health status and summarize the results in Table 4. The perceived risk of unemployment was only negatively associated with the self-rated very-good-to-excellent health condition for urban adults, and the associations stayed negative but statistically insignificant for the national sample and rural adults (Columns 1–3). The differences in the relationship between unemployment risk and self-rated physical health could potentially attributed to the urban–rural differences in their awareness of physical health. Urban adults might be more health cautious and sensitive to their physical health than rural adults, while rural adults might have lower healthcare utilization (Ying et al., 2020).

Obesity is a public epidemic in high-income countries and has become a rising public health issue for low-income countries (Janet et al., 2015; Triaca et al., 2020). We examine the association between the perceived risk of unemployment and the following two weight measures: whether gained weight in 2020 compared to the 2018 level and whether being obese or not in 2020. Columns (4)–(9) show that a higher perceived risk of unemployment was statistically associated with a lower probability of gaining weight or being obese for the full sample and rural adults ($P <$ 5%), but no statistically significant associations were found for urban adults.

Overall, the results show the rural–urban differences in the relationships between the perceived risk of unemployment and physical health outcomes. A higher perceived risk of unemployment was significantly associated with poor self-reported physical health for urban adults, but the relationship was statistically insignificant for rural adults. On the other hand, a higher unemployment risk was significantly associated with a lower probability of gaining weight and being obese for rural adults; but the relationships were statistically insignificant for urban adults.

## Health behaviors

Health-promising and compromising behaviors are important factors in the health production function (Grossman, 1972). Based on literature and available information on CFPS, we examine

TABLE 4 Regression results on the associations between the perceived risk of unemployment and physical health.

| | Self-rated health condition | | | Weight gain | | | Obesity | | |
|---|---|---|---|---|---|---|---|---|---|
| | Full sample | Rural | Urban | Full sample | Rural | Urban | Full sample | Rural | Urban |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Perceived unemployment risk | −0.130 (0.090) | −0.093 (0.102) | −0.356* (0.200) | −0.180** (0.078) | −0.210** (0.089) | −0.064 (0.165) | −0.426** (0.179) | −0.454** (0.211) | −0.497 (0.356) |
| Self-rated health status in 2018 | 1.560*** (0.052) | 1.534*** (0.060) | 1.675*** (0.109) | | | | | | |
| BMI in 2018 | | | | −0.137*** (0.007) | −0.136*** (0.008) | −0.147*** (0.015) | | | |
| Obesity status in 2018 | | | | | | | 4.327*** (0.104) | 4.431*** (0.126) | 4.276*** (0.200) |
| Pseudo $R^2$ | 0.174 | 0.175 | 0.183 | 0.0422 | 0.0430 | 0.0581 | 0.433 | 0.441 | 0.437 |
| Control | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| No. of observations | 9,308 | 6,925 | 2,383 | 9,308 | 6,925 | 2,383 | 9,308 | 6,861 | 2,349 |

This table presents the estimated coefficients of the perceived unemployment risk on physical health. Standard errors are shown in parentheses.
*p < 0.1.
** p < 0.05.
*** p < 0.01.
We include self-rated health condition in 2018 (Columns 1–3), BMI in 2018 (Columns 4–6), and obesity status in 2018 (Columns 7–9) as additional covariates. The other covariates are the same as those in Table 3. All regressions include the province-fixed effects.

TABLE 5 Regression results on the associations between the perceived risk of unemployment and physical activity and screen time.

| | Weekly frequency of physical activities | | | Digital online screen time | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Using mobile phones | | | Using computers | | |
| | Full sample | Rural | Urban | Full sample | Rural | Urban | Full sample | Rural | Urban |
| | (1) | (2) | (3) | (4) | (5) | (6) | (4) | (5) | (6) |
| Perceived unemployment risk | −0.071 (0.050) | −0.061 (0.055) | −0.011 (0.113) | −0.104 (0.079) | −0.113 (0.084) | −0.030 (0.198) | −0.164*** (0.060) | −0.140** (0.058) | −0.130 (0.168) |
| Weekly frequency of physical activities in 2018 | 0.213*** (0.009) | 0.186*** (0.010) | 0.276*** (0.020) | | | | | | |
| Digital online screen time using mobile phones and computers in 2018 | | | | 0.401*** (0.015) | 0.360*** (0.018) | 0.475*** (0.031) | 0.087*** (0.011) | 0.038*** (0.012) | 0.174*** (0.026) |
| $R^2$ | 0.140 | 0.092 | 0.163 | 0.367 | 0.366 | 0.312 | 0.235 | 0.214 | 0.216 |
| Control | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| No. of observations | 9,308 | 6,925 | 2,383 | 9,308 | 6,925 | 2,383 | 9,308 | 6,925 | 2,383 |

This table presents the estimated coefficients of the perceived unemployment risk on physical activity patterns. Standard errors are shown in parentheses.
*p < 0.1.
** p < 0.05.
***p < 0.01.
We include weekly frequency of physical activities (Columns 1–3) and daily digital online screen time using mobile phones and computers in 2018 (Columns 4–9) as additional covariates. The other covariates are the same as those in Table 3. All regressions include the province-fixed effects.

health-promising behaviors such as physical activity and health-compromising behaviors such as inadequate sleep, substance use, and digital screen time.[8]

Three indicators are used to measure physical activities: (1) weekly frequency of physical activities in the last 12 months, (2) daily hours spent on screen time using mobile phones, and (3) daily hours spent on screen time using computers. Table 1 shows that digital screen time using mobile phones was more predominant than that using computers for Chinese adults. The previous studies document that Chinese mobile users spent more time on digital screen time using mobile phones during the pandemic than the pre-pandemic level: 5.7 h in 2020 vs. 4.3 h in 2018 (Thomala, 2022), as people would spend more time to search information through the Internet when facing uncertainties (Fang et al., 2019).

8 Dietary behavior is also a critical lifestyle component and affects health status. Unfortunately, the 2020 CFPS does not collect detailed dietary-related information.

As shown in Table 5, no statistically significant relationships were found between the perceived risk of unemployment and the weekly frequency of physical activities (Columns 1–3) and digital screen time using mobile phones (Columns 4–6) for both rural and urban adults. The perceived risk of unemployment was negatively and significantly associated with digital screen time using computers for rural adults, but the association was statistically insignificant for urban adults (Columns 7–9).

The rural–urban variations of the associations between the perceived unemployment risk and inadequate sleep or substance use were quite intriguing (Table 6). A higher perceived risk of unemployment was significantly associated with an increased probability of inadequate sleep (<7 h per day) for the full sample ($P < 10\%$) and rural adults ($P < 1\%$), while such a relationship was statistically insignificant for urban adults. On the other hand, the perceived unemployment risk played a significant and negative role in smoking and drinking behaviors for urban adults, but not for rural adults. In China, smoking and drinking are more prevalent among males than females. The CFPS2020 data show that the average number of cigarettes smoked daily was 8.24 for males and only 0.17 for females; and the percentage for drinking at least three times a week was 24.61% for males and only 2.30% for females. We re-estimate the results for males only and present the results in Table A1. The results for male adults were qualitatively similar to the main results—the associations between the perceived risk of unemployment and substance use were statistically significant and negative for urban male adults but statistically insignificant for rural male adults.

## Discussion

This study contributes to the ongoing discussion on the relationships between economic conditions and health outcomes by uncovering the associations between the perceived risk of unemployment and a broad spectrum of health outcomes for Chinese adults during the COVID-19 pandemic. Our descriptive statistics in Table 1 show that urban adults had a lower risk of depression than rural adults, which is consistent with previous studies (Zhang et al., 2012, 2022). We find that rural adults in China were more vulnerable than urban adults when they perceived their jobs as insecure. The perceived risk of unemployment was significantly and negatively associated with depression risk, and the correlation was greater for rural adults than for urban adults. The association between unemployment risk and life satisfaction was statistically significant and negative for rural adults but insignificant for urban adults. Our findings, to a great extent, are consistent with recent studies showing that the fear of COVID-19 infection, job insecurity, and loss of employment income were associated with aggravated life satisfaction during the pandemic (Bakkeli, 2021; Mahmud and Riley, 2021; Satici et al., 2021). Our results can be potentially explained by the much higher unemployment rate for rural migrant workers than for urban workers as well as for people with lower education levels or unprofessional skills (Che et al., 2020). Although the Chinese government has implemented various economic stimulus policies during the pandemic, a few of them specifically targeted the rural population (Wang et al., 2021). One policy implication of our findings is to call for more economic stimulus policies to improve job opportunities for rural adults to improve their wellbeing.

We also find that a higher perceived risk of unemployment was significantly associated with a lower probability of having better self-rated health for urban adults ($P < 10\%$), but not for rural adults. Several factors can potentially explain this. First, urban adults in China in general are more health cautious than rural adults, which is partly reflected by much lower self-reported very-good-to-excellent health status for urban adults than rural adults (see Table 1). Second, rural and urban adults generally have different living environments. The living environment for urban residents is more populated and denser, while rural residents have larger living spaces augmented by their indoor spaces, yards, and farms. Although non-farm activities were restricted during the lockdown period for urban adults, rural adults could still maintain some of their agricultural production activities. Therefore, rural adults were likely to keep their routine farm work or physical activities, even though their non-farm work was unsecured.

An increasing number of empirical studies offer mixed results on the relationship between economic conditions and weight-related health outcomes (Cawley, 2015). Ruhm (2000) used Behavioral Risk Factor Surveillance System (BRFSS) data from 1987 to 1995 and found that an increase in the state unemployment rate in the U.S. was associated with reduced obesity, increased physical activities, and improved diet (measured by daily grams of fat consumed). Similarly, a decrease in employment rates was found to reduce the risk of obesity, especially severe obesity based on the BRFSS data in 1987–2000 (Ruhm, 2005). Triaca et al. (2020) also report similar results for Brazilian pollution in 2006–2014: an increase in unemployment rates significantly reduced the probability of being overweight, obese, and severely obese. However, positive associations between the unemployment rate and weight measures were reported in a Finnish cohort (Böckerman et al., 2007) and among African-American men in metropolitan statistical areas in the U.S. (Charles and DeCicca, 2008). The divergent findings suggest considerable heterogeneity in the effects of unemployment on weight-related health outcomes across gender, region, urbanicity, and socioeconomic status (Cawley, 2015). This study expands this growing literature by exploring rural and urban variations on the associations between the perceived risk of unemployment and weight measures during the COVID-19 pandemic. We find that rural adults in China were less likely to gain weight and be obese if they perceived their job as insecure, while the association was not statistically significant for urban adults.

The relationships between unemployment risk and health behaviors found in this study are quite interesting. Ruhm (2000) reports increased physical activities as the unemployment rate went up in the business fluctuation cycles. One possible reason was that decreased opportunity cost of leisure time during economic downturns would encourage people to spend more time in physical activities. However, this study finds no statistically significant relationship between unemployment risk and physical activities for both rural and urban adults in China. The insignificant relationships could result from the lockdown policies during the pandemic: urban adults may face restricted

TABLE 6 Regression results on the associations between the perceived risk of unemployment and inadequate sleep and substance use.

| | Inadequate sleep | | | Substance use | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Smoking | | | Drinking | | |
| | Full sample | Rural | Urban | Full sample | Rural | Urban | Full sample | Rural | Urban |
| | (1) | (2) | (3) | (4) | (5) | (6) | (4) | (5) | (6) |
| Perceived unemployment risk | 0.183* (0.094) | 0.287*** (0.109) | −0.170 (0.191) | −0.078 (0.179) | 0.127 (0.218) | −0.605** (0.287) | −0.070 (0.128) | 0.019 (0.145) | −0.505* (0.284) |
| Inadequate sleep in 2018 | 1.315*** (0.059) | 1.278*** (0.069) | 1.441*** (0.113) | | | | | | |
| No. of cigarettes smoked daily in 2018 | | | | 0.715*** (0.007) | 0.686*** (0.008) | 0.818*** (0.011) | | | |
| Drink at least three times weekly in 2018 | | | | | | | 2.348*** (0.075) | 2.274*** (0.087) | 2.669*** (0.159) |
| $R^2$ | | | | 0.671 | 0.647 | 0.777 | | | |
| Pseudo $R^2$ | 0.0927 | 0.0938 | 0.103 | | | | 0.335 | 0.342 | 0.352 |
| Control | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| No. of observations | 9,308 | 6,925 | 2,383 | 9,308 | 6,925 | 2,383 | 9,308 | 6,925 | 2,378 |

This table presents the estimated coefficients of the perceived unemployment risk on inadequate sleep and substance use. Standard errors are shown in parentheses.
*p < 0.1.
**p < 0.05.
***p < 0.01.
We include whether having inadequate sleep in 2018 (Columns 1–3), the daily number of cigarettes smoked in 2018 (Columns 4–6), and whether drinking at least three times per week in 2018 (Columns 7–9) as additional covariates. The other covariates are the same as those in Table 3. All regressions include the province-fixed effects.

access to sports/entertainment facilities. An Uganda study found that rural households spent more time on agricultural farming or livestock production to make up for the decline or even loss of non-farm income during the COVID-19 lockdown (Mahmud and Riley, 2021). Similarly, rural Chinese adults, especially rural-to-urban migrants, would increase their labor supply to farm work, if they perceived their non-agricultural job unsecured, declined, or even lost. This could be a possible explanation for the statistically insignificant association between job insecurity and physical activities for rural adults, even though the opportunity cost of time was reduced.

The heterogeneous associations between unemployment risk and health behaviors between rural and urban adults suggest that they might have responded to or coped with the pandemic-driven unemployment risk differently. The perceived risk of unemployment was significantly and positively associated with inadequate sleep for rural adults, but the relationship was statistically insignificant for urban adults. Unemployment risk was statistically and negatively associated with substance use for urban adults, but the relationships were statistically insignificant for rural adults. Our finding on inadequate sleep for rural adults is similar to the finding in Blanchflower and Bryson (2021), where an increased unemployment rate was reported to associate with poor sleep quality for the U.S. and European populations. Inadequate sleep was also found to significantly correlate with the increased risk of depression (Zhai et al., 2015). Our finding on inadequate sleep for rural adults is also consistent with what we found on psychological wellbeing: rural adults who perceived an increased risk of unemployment were more likely to have inadequate sleep, experience depression, and have lower life satisfaction.

Previous studies have found that consumption of alcohol and cigarettes increased due to mental stress in economic downturns despite decreased income (Charles and DeCicca, 2008; De and Segura-Escano, 2021; Alam and Bose, 2022). Our results are quite different in the context of the COVID-19 pandemic. Health concerns could be one of the reasons to explain such a difference. The WHO has stated that tobacco smoking[9] and alcohol disorders[10] would put people at high risk of developing severe COVID-19 symptoms. Urban adults in China might reduce their smoking and drinking due to health concerns, though job insecurity might impose significant pressure on them. Another explanation for decreased smoking is the concern about second-hand smoking to their family members during the COVID-19 lockdown (Cai and Zhou, 2022). Such concern might not play a significant role in rural adults as they had greater living spaces and more open areas (yards and farms). Furthermore, the concern of job insecurity along with lockdown policies might reduce business gatherings for the social network, where alcohol and cigarette consumption frequently occurred. It could be another possible explanation for reduced substance use for urban adults during the pandemic.

There are several limitations in this study. First, we face measurement bias as job insecurity and health outcomes were self-reported. Second, although we control for the pre-pandemic economic and health status in 2018 as well as policy measures

9 https://www.who.int/news/item/11-05-2020-who-statement-tobacco-use-and-COVID-19. Last accessed on 6 February 2023.

10 https://www.euro.who.int/__data/assets/pdf_file/0010/437608/Alcohol-and-COVID-19-what-you-need-to-know.pdf. Last accessed on 6 February 2023.

upon the COVID-19 pandemic in 2020, our empirical analyses were based on the cross-sectional data, making it challenging to pin down the causal effects of job insecurity on health outcomes. Therefore, this study is likely to be plagued by omitting variable problems and/or collinearity between job insecurity and the control variables. Third, we only investigate the short-term effects of the perceived unemployment risk on health outcomes and behaviors, as the latest released CFPS data were collected from July to December 2020. Chinese government kept the stringent mobility restrictions and lockdown policies, also known as the "zero-COVID" policy, until the end of 2022. Future investigations are merited when China removed the "zero-COVID" policy in early 2023.

We envision future research in several directions. First, we focus on the rural–urban variation as we were inspired by the predominant rural–urban disparities in various socioeconomic conditions in China. It would be interesting to investigate the differences in the relationships between job insecurity and health outcomes by other socioeconomic factors. For example, given that females and males have different attitudes toward economic uncertainties and responsibilities within families (Fang et al., 2020; Shepherd, 2022), they would have different psychological and behavioral responses (e.g., health outcomes and parenting styles) to unemployment risk. Second, we provide a comprehensive picture of the associations between job insecurity and health outcome and behaviors for rural and urban adults in China during the COVID-19 pandemic. Yet, the study cannot address the causal relationship and offer explorations on potential mechanisms due to the lack of data. Future research is merited to explore the potential causal relationship between job insecurity and health outcome and mechanisms through which job insecurity can affect health outcomes during the COVID-19 pandemic when data become available.

## Conclusion

This study investigates the associations between the perceived risk of unemployment and psychological wellbeing, physical health, and health behaviors among Chinese adults during the COVID-19 pandemic and explores the rural–urban variation in such associations. We find that a higher perceived risk of unemployment was statistically associated with lower depression risk and aggravated life satisfaction, and such correlation was greater for rural adults than urban adults. A negative and statistically significant association was observed between the perceived unemployment risk and self-rated health conditions for urban adults, but the relationship was statistically insignificant for rural adults. Rural adults who perceive their job as insecure were more likely to have inadequate sleep, reduce compute-screen time, and less likely to gain weight and be obese. We also find that the perceived unemployment risk was significantly and negatively associated with health-compromising behaviors (smoking and drinking) for urban adults, but not for rural adults. These findings imply that rural and urban adults had different psychological and behavioral responses to the unemployment risk that was tightly related to the pandemic. Public policies aimed to improve health and employment should be designed from different angles targeting urban and rural populations.

## Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: CFPS official website: https://www.isss.pku.edu.cn/cfps/en/index.htm.

## Ethics statement

The studies involving human participants were reviewed and approved by Peking Univeristy. The patients/participants provided their written informed consent to participate in this study.

## Author contributions

FZ: conceptualization, funding acquisition, writing—reviewing and editing, and supervision. HX: data analysis, validation, and writing—original draft. YJ: supervision, methodology, and writing—reviewing and editing. MZ: data analysis, writing—original draft, and writing—reviewing and editing. All authors contributed to the manuscript and approved the submitted version.

## Funding

This work was funded by the National Natural Science Foundation of China (Grant numbers: 72203223 and 71873139).

## 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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10.3389/fpsyg.2023.1169845

# Appendix

TABLE A1 Regression results on the associations between the perceived risk of unemployment and substance use for males only.

| | Substance use | | | | | |
|---|---|---|---|---|---|---|
| | Smoking | | | Drinking | | |
| | Full sample for male adults | Rural male sample | Urban male sample | Full sample for male adults | Rural male sample | Urban male sample |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Perceived unemployment risk | −0.145<br>(0.316) | 0.261<br>(0.383) | −1.165**<br>(0.520) | −0.014<br>(0.018) | 0.001<br>(0.021) | −0.071*<br>(0.038) |
| No. of cigarettes smoked daily in 2018 | 0.714***<br>(0.009) | 0.684***<br>(0.011) | 0.819***<br>(0.015) | | | |
| Drink at least 3 times weekly in 2018 | | | | 0.304***<br>(0.007) | 0.300***<br>(0.008) | 0.314***<br>(0.014) |
| $R^2$ | 0.576 | 0.543 | 0.727 | | | |
| Pseudo $R^2$ | | | | 0.233 | 0.236 | 0.271 |
| Control | Y | Y | Y | Y | Y | Y |
| No. of observations | 5,169 | 3,865 | 1,304 | 5,169 | 3,865 | 1,302 |

This table presents the estimated coefficients (margin effect) of the perceived unemployment risk on substance use just for the male sample. Standard errors are shown in parentheses.
*$p < 0.1$.
**$p < 0.05$.
***$p < 0.01$.
We include whether having the daily number of cigarettes smoked in 2018 (Columns 1–3), and whether drinking at least three times per week in 2018 (Columns 4–6) as additional covariates. The other covariates are the same as those in Table 3. All regressions include the province-fixed effects.

frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 26 September 2023
DOI 10.3389/fpsyg.2023.1256240



OPEN ACCESS

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RECEIVED 10 July 2023
ACCEPTED 08 September 2023
PUBLISHED 26 September 2023

CITATION
Bahk Y-C, Jung D and Choi K-H (2023) Social distancing policy and mental health during COVID-19 pandemic: an 18-month longitudinal cohort study in South Korea. *Front. Psychol.* 14:1256240. doi: 10.3389/fpsyg.2023.1256240



# Social distancing policy and mental health during COVID-19 pandemic: an 18-month longitudinal cohort study in South Korea

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**Background:** Despite the effectiveness of social distancing policies in preventing the spread of Coronavirus Disease 2019 (COVID-19), their impact on mental health remains a concern. Longitudinal studies investigating the psychological effects of social distancing are limited.

**Methods:** Longitudinal data on psychological variables were collected eight times between May 2020 and November 2021 through online surveys in South Korea.

**Results:** The participants in the study reported a worsening of depressive and anxiety symptoms, suicide risk, and psychological distress with increasing levels of social distancing. Specifically, during the third wave, when social distancing levels peaked, the highest levels of depression, anxiety, and psychological distress were observed, and the second-lowest levels of vitality were reported. Furthermore, psychological risk factors, such as depressive symptoms, anxiety symptoms, and suicidal risk, were closely associated with vitality levels in daily life.

**Discussions:** During the pandemic, although social distancing helped prevent the spread of COVID-19, it also led to increased depression, anxiety, suicide risk, psychological distress, and decreased vitality. Engagement at a personal level in fundamental daily activities is important to cope with psychological distress. Our results indicate that commitment to fundamental daily activities and following routines is an important protective factor against psychological distress, notwithstanding COVID-19.

KEYWORDS

**COVID-19, depressive symptoms, anxiety symptoms, psychological distress, vitality, social distancing**

## 1. Introduction

Coronavirus disease 2019 (COVID-19), which originated in Wuhan in December 2019, rapidly spread throughout China and across many other countries, causing an outbreak of infectious pneumonia (Wang et al., 2020a). The World Health Organization (WHO) declared the COVID-19 outbreak a global health emergency (Mahase, 2020). The first case of infection in South Korea was reported in January 2020 (Gralinski and Menachery, 2020), and more than

27,098,734 confirmed cases and over 30,506 deaths were reported by November 2022 (Coronavirus Disease-19, Republic of Korea, 2022).

Since the beginning of the COVID-19 outbreak in South Korea, the Korean government has made vigilant and timely efforts to prevent its spread, including public education, hand washing, social distancing, wearing face masks, and IT-enhanced screening and self-checking systems. Despite the impressive management of COVID-19 in South Korea, its proliferation continues not only in South Korea but also worldwide. Previous studies have shown extensive economic and psychosocial effects of epidemics on society and public health (Siu and Wong, 2004; Cheung et al., 2008; Sim et al., 2010). In particular, although mental health issues such as depression, anxiety, and suicidal risk increase with the long-term spread of infectious diseases (Nickell et al., 2004; Tsang et al., 2004; Sim et al., 2010; Van Bortel et al., 2016), the likelihood of obtaining psychological services decreases (Kavoor, 2020). Additionally, lockdown, which is one of the most effective preventive methods, is a major risk factor (e.g., social withdrawal, familial conflicts) for mental health issues (O'Connor and Nock, 2014; John et al., 2018; Brooks et al., 2020). In South Korea, the social distancing system was introduced on May 16, 2020, and the levels of social distancing were adjusted by the Korean government until April 17, 2022. The stages of social distancing were flexibly adjusted according to the number of daily confirmed cases and were a major policy measure undertaken to prevent the spread of COVID-19 in the community. The social distancing system imposed mandatory restrictions on people and facilities according to its levels. At social distancing level 1, people were required to wear masks; at level 1.5, events with more than 100 people were prohibited; at level 2, specific facilities (such as pubs) were prohibited, and the business hours of various facilities (such as restaurants) were also restricted; and at level 2.5, gatherings of more than four people were prohibited with work-from-home recommendations, and so on. Thus, the restrictions imposed increased with the increase in the level of social distancing. Although the social distancing system was effective in preventing the spread of COVID-19, there have been concerns regarding the psychological impact of social distancing. However, few longitudinal studies have examined the psychological impact of social distancing systems.

The prolonged impact of COVID-19 has led to reduced social and economic activities, growing concerns about its direct and indirect effects on mental health through the economic hardship it has caused (Holmes et al., 2020). Since the beginning of the COVID-19 outbreak, several studies around the world have reported the various psychological effects of pandemic. Wang et al. (2020b) examined the psychological effects during the early period of COVID-19 in China and demonstrated that 32.1, 16.5, and 28.8% of participants experienced mild-to-severe psychological distress, moderate-to-severe depressive symptoms, and moderate-to-severe anxiety symptoms, respectively. Moghanibashi-Mansourieh (2020) assessed anxiety levels among the Iranian population during the early period of COVID-19 and found that 19.1% of the participants had experienced severe anxiety. In another study on Iranian participants, Jahanshahi et al. (2020) found that 61.1% experienced mild psychological distress at the beginning of COVID-19. Moccia et al. (2020) examined the psychological distress during the early phase of COVID-19 in Italy and reported that 18.6% of the participants had experienced moderate-to-severe psychological distress. Studies with healthy Italian participants conducted at the beginning of the COVID-19 pandemic also reported that participants' depression, anxiety, and obsessive-compulsive symptoms worsened compared to before the lockdown (Mariani et al., 2020, 2021). Another comparative study of Italian college students before and after COVID-19 found that clinical symptoms such as depressive, anxiety, and psychotic symptoms increased significantly after pandemic (Cerutti et al., 2022, 2023). Factors such as reduced social interaction, heightened loneliness, fears of disease transmission, and increased uncertainty have could lead to elevated levels of depression, anxiety, and psychological distress (Fiorillo and Gorwood, 2020; Fountoulakis et al., 2021). These concerns are substantiated by numerous prior studies (Czeisler et al., 2020; Xiong et al., 2020). Additionally, concerns have been raised about increased suicide risk influenced by various psychological and environmental factors (Sher, 2020). Notably, the increase in unemployment linked to the COVID-19 crisis showed a significant correlation with an increase in suicide risk (Gratz et al., 2020).

In addition to the transversal studies conducted in the early phase of COVID-19, research on the effects of COVID-19 on mental health is ongoing. Gopal et al. (2020) conducted a web-based survey of 159 participants during the first two months (March to May 2020) of the lockdown in India that revealed a significant increase in stress, depression, and anxiety symptoms. Salfi et al. (2020) investigated 2,701 Italian participants during the lockdown period (March to April 2020) and found changes in the pattern of mental health problems such as sleep problems and depressive and anxiety symptoms between men and women over time. Specifically, women displayed severe mental health problems since the initial period of the lockdown, whereas men showed a pattern of worsening mental health problems over time. In a survey of 14,393 participants conducted before COVID-19 and in April, May, and June 2020 in the United Kingdom, Daly et al. (2022) reported that the prevalence of mental health problems slightly diminished from April to June, though it was still high compared to before COVID-19. Kikuchi et al. (2020) investigated the psychological distress of 2,400 participants in Japan during the community transmission phase of COVID-19 (February to April 2020) and found a significant increase in severe psychological distress. Taken together previous studies, social distancing policies had a negative impact on mental health (Marroquín et al., 2020). Women and young age group were found to be more vulnerable in terms of mental health (Xiong et al., 2020; Cerutti et al., 2022). Furthermore, unemployment had adverse effects on psychological well-being (Escudero-Castillo et al., 2023), and individuals who experienced job loss were identified as more susceptible to depression (Posel et al., 2021).

There is growing concern about the long-term psychological impact of COVID-19 as the pandemic persists (Pierce et al., 2020; Power et al., 2020). This assessment can be performed utilizing longitudinal data, which can track changes in mental health and related factors during the COVID-19 pandemic. However, to the best of our knowledge, longitudinal studies focusing on the psychological impact of COVID-19 are limited. To date, most studies have focused on the initial few months of lockdown, with the majority of the current research focusing on the limited sample. This study is designed to investigate the long-term psychological impact of social distancing in the general Korean adult population

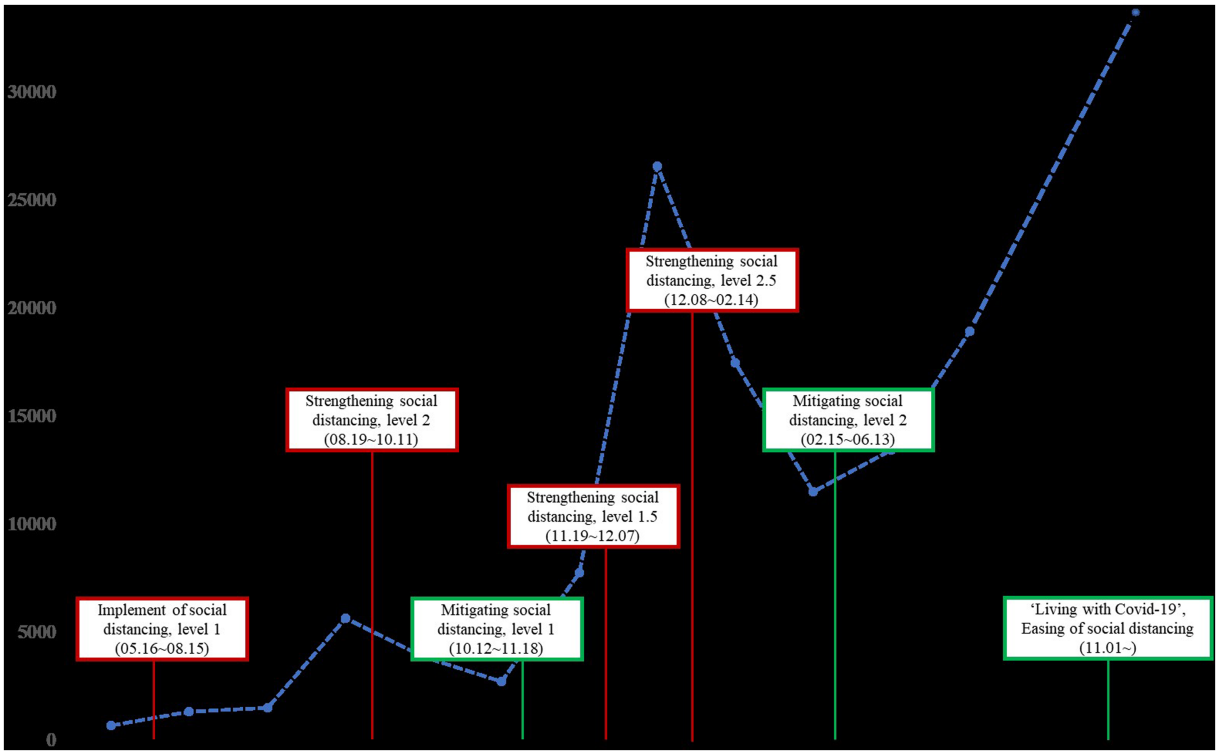


FIGURE 1
National epidemic trend of the COVID-19 outbreaks in South Korea from May 2020 to November 2021.

during COVID-19 and its risk factors. It was conducted through eight longitudinal data collections over a period of 11 months, from May 2020, when the social distancing system began, to April 2021. A follow-up data collection was done in November 2021 (Figure 1). Data were collected on average every two months but also occasionally at one-month intervals to account for environmental changes, such as sudden changes in social distancing levels.

In addition, we aimed to investigate the importance of maintaining a primary routine in daily life. Recognizing the rapidly changing societal and personal environments during the pandemic, the WHO has advised maintaining regular daily routines as a guideline for maintaining mental health (World Health Organization, 2020). This emphasis on sustaining primary daily routines is known to act as a protective factor against acute stress (Goodwin et al., 2020; Hou et al., 2020). Therefore, we investigated whether maintaining a regular routine remained effective among the general Korean adult population.

Based on the previous studies, the hypotheses formulated for this research are as follows:

> *H1*: As the stages of social distancing increase, mental health will be deteriorated.
>
> *H2*: During the COVID-19 period, women will experience greater psychological vulnerability compared to men.
>
> *H3*: Young people will be more psychologically vulnerable during the COVID-19 period than other age groups.
>
> *H4*: Individuals who have experienced job loss will be more psychologically vulnerable than those whose employment status remained unchanged.
>
> *H5*: Individuals who exhibited higher levels of engagement in daily activities during the COVID-19 period will experience better mental health.

## 2. Methods

### 2.1. Participants and study procedure

A longitudinal Internet panel survey was designed to assess the psychological impact of the COVID-19 pandemic in South Korea. This longitudinal study was conducted from May 8, 2020 (the first wave) to November 28, 2021 (the follow-up). A week was allocated for each survey to ensure maximum participation. Participants received rewards of 1,500 KRW (about 1.12 USD) for each survey. The target population was the Korean adult population aged 18 and above. Based on the gender, age, and regional distribution of the Korean population, we conducted stratified random sampling, a method of extracting samples that align with the composition proportions of the population. The participants were recruited through a research company. A total of 1,167 representative Korean participants participated in the first (May 2020), 936 in the second (July 2020), 842 in the third (September 2020), 765 in the fourth (November 2020), 704 in the fifth (December 2020), 650 in the sixth (February 2021), 603 in the seventh (April

2021) waves, and 513 in the follow-up (November 2021) data collection. The participants were aged 18 and above, could read and write in Korean, and were residents of South Korea. No other exclusion criteria were applied. Participation in the survey was voluntary; however, to encourage participation, monetary rewards were handed out for responding to each survey. The survey was conducted on an online platform. This study was approved by the local Institutional Review Board. All the respondents provided informed consent.

## 2.2. Measures

### 2.2.1. COVID-19 peritraumatic distress index

The COVID-19 Peritraumatic Distress Index (CPDI) was used to assess the level of stress induced by COVID-19. It is a 24-item self-reported questionnaire designed to assess the frequency of psychological distress, including anxiety, depression, specific phobias, cognitive changes, avoidance and compulsive behavior, physical symptoms, and loss of social functioning (Qiu et al., 2020). It consists of stress, seeking for information factors (Jiménez et al., 2021). Items are rated on a 5-point Likert scale (0 = never, 1 = occasionally, 2 = sometimes, 3 = often, and 4 = most of the time), and the total score ranges from 0 to 100. The CPDI was originally developed in Chinese. Jahanshahi et al. (2020) translated the index into English, and later into Persian. The English version of the index was translated into Korean by researchers using the back-translation method (Lee and Kim, 2023). The internal consistency of the CPDI is high (Cronbach's $\alpha = 0.93$) and its content validity has been verified by the psychiatrists at the Shanghai Mental Health Center (Qiu et al., 2020).

### 2.2.2. COVID-19 preventive behavior scale

The COVID-19 Preventive Behavior Scale (CPBS) was used to detect pandemic-related preventive behaviors during the COVID-19 pandemic. The CPBS was developed based on a previous study that examined the relationship between psychological factors and pandemic-related behaviors (Oosterhoff and Palmer, 2020). The constructed items were based on COVID-19 prevention and control guidelines unveiled by the Korean government. It consists of compliance with hygiene recommendations and social distancing. The eight-item scale was rated on a 5-point Likert scale (0 = never, 4 = most of the time). In this study, the CPBS indicated high internal consistency (Cronbach's $\alpha = 0.88$).

### 2.2.3. Mental health screening for depressive disorders

The Mental Health Screening for Depressive Disorders (MHS:D) is a brief screening assessment tool designed to detect depressive symptoms in the Korean population. The 12-item scale was rated on a 5-point Likert scale (0 = never, 4 = most of the time). The MHS:D was preliminarily validated and revealed a statistically significant positive correlation with the Center for Epidemiologic Studies Depression Scale (CES-D), Patient Health Questionnaire-9 (PHQ-9), and Beck Depression Inventory-II (BDI-II) (Yoon et al., 2018). A high internal consistency for the Korean sample was established in this study (Cronbach's $\alpha = 0.94$). Factor analysis revealed a one-factor structure for depressive disorders (Park et al., 2022). MHS:D has been utilized before in a study related to the COVID-19 pandemic in South Korea (Bahk et al., 2020).

### 2.2.4. Mental health screening for anxiety disorders

The Mental Health Screening for Anxiety Disorders (MHS:A) is a 10-item self-reported questionnaire designed to assess anxiety levels. The items were rated on a 5-point Likert scale (0 = never, 4 = most of the time). The total score ranged from 0 to 40. The internal consistency of the scale was high (Cronbach's $\alpha = 0.96$). Factor analysis revealed a one-factor structure for anxiety disorders (Kim et al., 2018). The MHS:A was previously used in a study related to the COVID-19 pandemic in South Korea (Bahk et al., 2020).

### 2.2.5. Mental health screening tool for suicide risk

The Mental Health Screening Tool for Suicide Risk (MHS:S) is a succinct index comprising four items designed to assess suicidality. The items are rated on a 5-point Likert scale (0 = never, 4 = most of the time). Its reliability and validity were robust in the Korean population (Yoon et al., 2020). The Cronbach's alpha for the MHS:S in this research was 0.89. The MHS:S has been previously employed in previous studies on the COVID-19 pandemic in South Korea (Bahk et al., 2020).

### 2.2.6. Engagement in daily activity scale

The Engagement in Daily Activity Scale was used to assess the level of vitality in daily activities. This five-item scale was developed to evaluate the quality of daily life using five routine activities (sleep, eating, physical activity, socializing, and learning). Items are rated on a 5-point Likert scale (1 = never, 5 = most of the time). The Cronbach's alpha for the EDAS was 0.77. This scale has been employed in past studies on the COVID-19 pandemic in South Korea (Bahk et al., 2020).

## 2.3. Statistical analysis

The statistical analyses were conducted using SPSS Version 22 and R Version 4.2.1. A descriptive statistic was utilized to assess baseline and psychological characteristics. A linear mixed-effects model was used to examine changes in psychological variables (e.g., severity of depressive symptoms, anxiety symptoms, suicide risk, and psychological distress due to COVID-19). The model was fitted to quantify the assessments. Dependent variables were continuous and were fitted using a linear mixed-effects model. Gender, age, job loss experience, and vitality in daily life (divided into three groups based on the EDAS score: low group = less than one standard deviation from the mean, normal group = within one standard deviation, and high group = more than one standard deviation from the mean) were used as group variables (level 2 units). In longitudinal data, individual responses are nested within participants, which implies that each participant is a level 2 unit. Therefore, random intercepts were used instead of fixed intercepts to capture subject effects. Multiple imputation was used to estimate missing values. We used a statistical model corrected for multiple comparisons according to the Bonferroni procedure ($p < 0.05$/number of comparisons) to minimize the likelihood of type I statistical errors.

TABLE 1 Baseline characteristics of measures.

| | 1st wave ($N$ = 1,167) | | | |
|---|---|---|---|---|
| | Min. | Max. | Mean/N | SD/% |
| Demographic characteristics | | | | |
| Age | 20 | 69 | 44.37 | 12.95 |
| Gender ($N$ of Female) | | | 573 | 49.1 |
| Education level (year) | 6 | 18 | 15.32 | 2.00 |
| Marital status | | | | |
| Single | | | 414 | 35.5 |
| Married | | | 687 | 58.9 |
| Divorced | | | 37 | 3.2 |
| Other | | | 29 | 2.5 |
| Other factors | | | | |
| Decrease in Household income | | | 198 | 17.0 |
| Job loss during COVID-19 | | | 74 | 6.3 |
| COVID-19 confirmed | | | 4 | 0.3 |
| Psychological variables | | | | |
| MHS:D | 0 | 50.63 | 8.77 | 10.54 |
| MHS:A | 0 | 45.96 | 7.97 | 9.72 |
| MHS:S | 0 | 16.00 | 1.11 | 2.65 |
| CPDI | 0 | 86.50 | 20.30 | 15.39 |
| CPBS | 0 | 32 | 20.35 | 7.09 |
| EDAS | 5 | 25 | 15.35 | 3.78 |

MHS:D, Mental Health Screening for Depressive Disorders; MHS:A, Mental Health Screening for Anxiety Disorders; MHS:S, Mental Health Screening Tool for Suicide Risk; CPDI, COVID-19 Peritraumatic Distress Index; CPBS, COVID-19 Preventive Behavior Scale; EDAS, Engagement in Daily Activity Scale.

# 3. Results

## 3.1. Baseline characteristics

The baseline characteristics of the study participants are shown in Table 1. There were 573 (49.1%) women and 594 (50.9%) men among the total participants ($n$ = 1,167). The mean age of the participants was 44.37 (SD = 12.95), and the mean years of education were 15.32 (SD = 2.00). A total of 198 (17.0%) participants reported their earnings to have decreased during the COVID-19 period, and 74 (6.3%) reported losing their jobs during this period. Four participants reported being diagnosed with COVID-19. A total of 397 (34%) participants reported experiencing at least mild depressive symptoms, and 366 (31.3%) reported experiencing at least mild anxiety symptoms. A total of 312 (26.7%) participants were classified into the suicide risk group, and 237 (20.3%) reported experiencing at least mild psychological distress due to COVID-19.

## 3.2. Psychological characteristics

Table 2 demonstrates the changes in psychological characteristics during the survey period (May 2020 to November 2021). In general, psychological variables worsened with an increase in the social distancing level, and improved when the social distancing level was mitigated or maintained. Depressive symptoms peaked at 9.94 (10.73) in September 2020, when social distancing first entered level 2.5, and 324 (38.4%) participants reported experiencing at least mild depressive symptoms during that time. Anxiety symptoms and psychological distress were also highest at 9.33 (10.11) and 23.10 (17.68), respectively; 330 (39.1%) and 265 (31.4%) participants, respectively, indicated experiencing at least mild anxiety symptoms and psychological distress during the same period. Suicide risk peaked at 1.3 (2.81) in February 2021, when the social distancing level was again strengthened to level 2. During this period, 196 (30.1%) participants were classified in the suicide risk group.

## 3.3. Linear mixed-effects model

A linear mixed-effects model was used to examine the changes in psychological variables over time and the effects of gender, age, job loss, and vitality on daily life. Significant changes were observed in depressive symptoms, anxiety symptoms, and psychological distress during the COVID-19 period (see Supplementary Tables S1–S4). Depressive and anxiety symptoms and psychological distress peaked in September 2020, when the social distancing level first entered level 2.5. The gender differences for anxiety symptoms and psychological distress were deemed significant. Women reported higher levels of anxiety

TABLE 2 Changes in psychological characteristics during COVID-19.

| | May 2020 (*N* = 1,167) | July 2020 (*N* = 936) | Sep 2020 (*N* = 842) | Nov 2020 (*N* = 765) | Dec 2020 (*N* = 704) | Feb 2021 (*N* = 650) | April 2021 (*N* = 603) | Nov 2021 (*N* = 513) |
|---|---|---|---|---|---|---|---|---|
| Average confirmed cases during the survey period | 25.33 | 42.12 | 212.14 | 113.11 | 1016.37 | 474.88 | 654.00 | 3,223.75 |
| Level of social distancing during the survey period | 1 | 1 | 2.5 | 1 | 2.5 | 2 | 2 | - |
| | Mean(SD)/*N*(%) | | | | | | | |
| MHS:D | 8.77 (10.54) | 8.65 (10.71) | 9.94 (10.73) | 8.60 (9.98) | 9.50 (10.36) | 9.35 (10.50) | 8.51 (9.83) | 7.52 (9.85) |
| Experiencing at least mild depressive symptoms | 397 (34%) | 302 (32.2%) | 324 (38.4%) | 252 (32.9%) | 280 (39.7%) | 242 (37.2%) | 210 (34.8%) | 134 (26.1%) |
| MHS:A | 7.97 (9.72) | 8.37 (10.02) | 9.33 (10.11) | 8.46 (9.73) | 8.91 (10.31) | 8.82 (10.17) | 8.33 (9.5) | 7.2 (9.62) |
| Experiencing at least mild anxiety symptoms | 366 (31.3%) | 311 (33.2%) | 330 (39.1%) | 259 (33.8%) | 249 (35.3%) | 226 (34.7%) | 212 (35.1%) | 136 (26.5%) |
| MHS:S | 1.11 (2.65) | 1.24 (2.83) | 1.28 (2.83) | 1.21 (2.79) | 1.19 (2.71) | 1.3 (2.81) | 1.14 (2.63) | 0.95 (2.6) |
| Classified as a risk group for suicide | 312 (26.7%) | 250 (26.7%) | 237 (28.1%) | 202 (26.4%) | 193 (27.4%) | 196 (30.1%) | 162 (26.8%) | 111 (21.6%) |
| CPDI | 20.3 (15.39) | 20 (16.81) | 23.1 (17.68) | 20.29 (17.63) | 22.77 (18.03) | 20.86 (17.13) | 19.61 (16.59) | - |
| Experiencing at least mild psychological distress | 286 (24.5%) | 248 (26.4%) | 265 (31.4%) | 197 (25.7%) | 231 (32.8%) | 183 (28.1%) | 145 (24%) | - |
| CPBS | 20.35 (7.09) | 18.5 (7.23) | 22.19 (6.82) | 19.26 (6.93) | 22.33 (6.62) | 21.22 (6.76) | 20.46 (6.42) | 20.97 (5.64) |
| EDAS | 15.35 (3.78) | 15.21 (3.87) | 14.94 (3.73) | 15.06 (3.82) | 14.88 (3.56) | 14.99 (3.64) | 15.39 (3.73) | - |

MHS:D, Mental Health Screening for Depressive Disorders; MHS:A, Mental Health Screening for Anxiety Disorders; MHS:S, Mental Health Screening Tool for Suicide Risk; CPDI, COVID-19 Peritraumatic Distress Index; CPBS, COVID-19 Preventive Behavior Scale; EDAS, Engagement in Daily Activity Scale.

symptoms and psychological distress than men during the COVID-19 period. However, no significant gender differences were observed in the patterns of change over time (see Supplementary Figure S1). The differences according to age were established as significant for depressive and anxiety symptoms, suicide risk, and psychological distress. Participants in their 20s and 30s reported significantly higher levels of depressive and anxiety symptoms, suicide risk, and psychological distress than those aged over 60 years. However, there was no significant age-related difference in the pattern of change over time (see Supplementary Figure S2). Significant differences according to job loss were affirmed for depressive and anxiety symptoms. Participants who experienced job loss during COVID-19 reported significantly higher levels of depressive and anxiety symptoms than those who did not experience job loss (see Supplementary Figure S3). The levels of vitality in daily life led to significant differences in depressive and anxiety symptoms, suicide risk, and psychological distress. Participants with low levels of vitality in daily life reported significantly higher levels of depressive and anxiety symptoms, suicide risk, and psychological distress than those with normal or high levels of vitality (see Supplementary Figure S4).

## 4. Discussion

This study investigated the long-term psychological impact of social distancing levels during COVID-19 and its risk factors on the general Korean adult population. The results revealed that psychological characteristics, such as depressive and anxiety symptoms, suicide risk, and psychological distress, worsened as the level of social distancing increased. These psychological characteristics improved when social distancing was mitigated or maintained.

The results of this study suggest that the strengthening of social distancing levels is associated with worsening mental health. The highest levels of depression, anxiety, and psychological distress, and the second-lowest level of vitality were reported in the third wave, when social distancing was first strengthened to a level of 2.5. Additionally, in the fifth wave, when social distancing was again strengthened to level 2.5, the second-highest levels of depression, anxiety, and psychological distress and the lowest level of vitality were observed. These results indicate that increasing levels of social distancing have a significant impact on people's mental health. Although these effects are initially strong, with gradual adaptation, they lessen in intensity. These results were consistent with those of previous studies (Pierce et al., 2020; Smith et al., 2020; Bendau et al., 2021; Evans et al., 2021) and suggest that changes in social distancing should be considered cautiously. Particularly, it is advisable to maintain the same level of social distancing for a longer time rather than making frequent changes, which can be beneficial for mental health.

The current study found existence of gender and age differences in psychological variables. Specifically, women reported significantly higher levels of anxiety symptoms and psychological distress than men. However, there were no significant gender differences in symptoms of depression or suicide risk. These results are similar to those of previous studies that reported women's mental health as being more vulnerable during the COVID-19 period, although these psychological factors vary between countries (Pieh et al., 2020; Pierce et al., 2020; O'Connor et al., 2021; Wickens et al., 2021). One possible

hypothesis could be that women tend to pay more attention to threats (McClure, 2000; Tan et al., 2011). COVID-19 has come to people as a health threat, and women are likely to have experienced relatively high anxiety and stress.

Furthermore, participants in their 20s and 30s showed higher levels of depression and anxiety symptoms, suicide risk, and psychological distress than those aged over 60 years. These results are consistent with previous studies showing that young people are more sensitive to psychological distress caused by social distancing such as the COVID-19 lockdown (Glowacz and Schmits, 2020; Huang and Zhao, 2020) and are suggestive of the greater impact of social distancing on young people due to COVID-19. Therefore, more attention should be paid to the psychological health of youth during the COVID-19 pandemic. Additionally, during COVID-19, economic activity was suspended or restricted worldwide and people who experienced job loss increased as flexible work arrangements also increased. Those who experienced job loss during COVID-19 showed higher level of depression and anxiety than those who did not experience. This is in line with job loss study during COVID-19 in other country (Posel et al., 2021).

Our results also highlight the linkage of psychological risk (i.e., depressive symptoms, anxiety symptoms, and suicidal risks) to vitality levels in daily life. Although social distancing has adverse effects on mental health, it is an inevitable choice for preventing community transmission. It should be noted that the COVID-19 pandemic diminished the opportunity to access mental health services and antidepressant activities (e.g., socialization, work, and goal-directed behaviors) due to prolonged quarantines or social distancing. We found that, despite COVID-19, engagement in routine daily activities (e.g., healthy diets and sleep) functioned as a protective factor against psychological distress. Unlike other disasters, COVID-19 leads to isolation in individuals, depriving them of everyday routines such as attending social gatherings and parties, hanging out with friends, and going to the gymnasium. This is a major contributing factor, which makes it difficult to overcome the psychological impact of COVID-19. Thus, maintaining daily routines (e.g., getting adequate sleep, taking a bath, exercising at home) and identifying possible pleasurable activities (e.g., reading a book, watching a movie, listening to music), and increasing reduced social activity through active use of online platforms should play an important role in alleviating psychological distress (Reich, 2006; Dekel et al., 2016; Polizzi et al., 2020).

To overcome the psychological impact of COVID-19, changes in the social environment and policy support are also needed to complement the personal approach. For example, the provision of most mental health services is done in a traditional, face-to-face manner. However, in the COVID-19 pandemic, this traditional approach is no longer sufficiently distributed. There is an increasing need to transform mental health services into online or telehealth modes, which requires the development of related technologies, policies, clinician training, and clinical guidelines. Additionally, psychological interventions tailored to the epidemic situation should be examined and disseminated. The psychological influence of social policies such as social distancing should be taken into consideration while formulating policies. For example, stepwise and slow changes in the stages of social distancing will have fewer adverse psychological effects than immediate and large changes. Therefore, it is necessary to provide people with sufficient time to adapt to the change. In addition, there is a need for support measures for groups with vulnerability to pandemic. This study found that women and young people were particularly vulnerable to the psychological impacts of COVID-19. Follow-up research is needed on the cause analysis of groups vulnerable to COVID-19, and it is also necessary to establish extensive support measures for the vulnerable.

## 4.1. Limitations of this study

The present study has some limitations. First, since the current data were obtained from a general Korean sample, the findings cannot be generalized to specific clinical populations. Second, the results were obtained from Koreans dwelling in South Korea, which limits generalization to other countries with different government policies, cultures, and so on. International collaborative studies are further needed to better understand the psychological impact of COVID-19 and develop effective preventive approaches for mental health issues. Third, there are various restrictions according to the social distancing level, but these restrictions, which can adversely affect the psychological characteristics of individuals, were not examined in the study. Finally, the drop-out rate of participants was not low. The present study was conducted in the form of an online panel survey for a total of 18 months, and it is considered that the long period of participation in the study, the form of an online survey, and the small rewards are related to high drop-out rates. We performed a statistical analysis to replace the missing values. However, analysis of the causes of high drop-out rates could not be performed, and there is a possibility that factors such as high drop-out rates and rewards have caused bias that we did not consider.

Despite these limitations, this study is the first to investigate the long-term psychological effects of social distancing in the general Korean adult population during COVID-19. This study examined the changes in psychological variables according to the level of social distancing during the COVID-19 epidemic, and showed that changes in the level of social distancing can lead to deteriorating psychological variables. The study offers suggestions for moderating psychological deterioration during COVID-19. In particular, maintaining a high level of vitality in daily life (*adequate sleep, regular eating, daily physical activity,* etc.) at a personal level can act as a protective factor for psychological influence during the COVID-19 pandemic. Furthermore, policy support, such as the provision of psychological services to vulnerable groups, such as young people, is also considered necessary. Mental health experts should strive to provide mental health services that minimize the psychological impact of COVID-19. Finally, COVID-19 is likely to persist; therefore, additional long-term follow-up studies are needed to investigate its psychological effects.

# Data availability statement

The datasets presented in this article are not readily available because the data set belongs to Korea University SMI laboratory and is accessible to relevant researchers. Requests to access the datasets should be directed to Y-CB, pyc215@gmail.com.

# Ethics statement

The studies involving humans were approved by Korea University Institutional Review Board. The studies were conducted in accordance

with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

Y-CB: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. DJ: Formal analysis, Methodology, Software, Visualization, Writing – review & editing. K-HC: Conceptualization, Funding acquisition, Project administration, Supervision, Validation, Writing – review & editing.

## Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2017S1A5B6053101), a grant from the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number: HI21C0268), and the MSIT (Ministry of Science and ICT), Korea, under the ITRC (Information Technology Research Center) support program (IITP-2023-2018-0-01405) supervised by the IITP (Institute for Information & Communications Technology Planning & Evaluation).

## Acknowledgments

We would like to thank Editage (www.editage.co.kr) for English-language editing.

## Conflict of interest

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

## Publisher's note



## Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1256240/full#supplementary-material

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 20 November 2023
DOI 10.3389/fpsyg.2023.1215463



OPEN ACCESS

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RECEIVED 02 May 2023
ACCEPTED 27 October 2023
PUBLISHED 20 November 2023

CITATION
Omiya T, Sankai T, Miyazaki A, Abe Y and Deguchi NK (2023) Transitions in sense of coherence among middle-aged women raising adolescents before and during the COVID-19 pandemic.
*Front. Psychol.* 14:1215463.
doi: 10.3389/fpsyg.2023.1215463



# Transitions in sense of coherence among middle-aged women raising adolescents before and during the COVID-19 pandemic

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**Objective:** A longitudinal study was conducted among Japanese women raising adolescents to determine how the COVID-19 pandemic has affected their sense of coherence (SOC) and to provide suggestions for supporting them.

**Methods:** The SOC scores of 138 pairs of middle-aged women and their children (junior high school students) were compared at two time points: 2019 (before the pandemic, T1) and 2020 (during the pandemic, T2).

**Results:** Overall, the women's SOC did not change, whereas the adolescents' SOC increased. In contrast, 44% of the women's SOC scores decreased during the pandemic; no differences were detected between the SOC maintenance and increase group (G1) and the SOC decrease group (G2) in mental health, subjective physical health, social capital, and job status, and the child variables were not related. Multiple regression analysis of G1 and G2 with SOC at T2 as the dependent variable showed that for G2, at T1, having good mental and physical health conditions, a rich social capital, and having a job were positively associated with SOC during the pandemic.

**Conclusion:** Middle-aged Japanese women, who often work as informal workers, are easily laid off and are involved in care work. Thus, the change in their socioeconomic status due to the pandemic may have been severe. Given the long-term social impact of the pandemic, it is necessary to consider support for women, including economic and social support such as employment and building human connections.

KEYWORDS

**adolescents, COVID-19, job security, longitudinal study, middle-aged women, pandemic, sense of coherence, social capital**

## 1 Introduction

The novel coronavirus disease (COVID-19) has caused serious stress in Japanese society. Following the declaration of a state of emergency on 7 April 2020, the government imposed various restrictions on economic activities and human flow. People drastically restricted their interactions with intimate ones in the name of social distancing and even changed

their behaviour and social norms (Sugawara et al., 2022). The pandemic has also exacerbated health risk factors and chronic loneliness and has had various effects on individuals (Kikuchi et al., 2020; Lal et al., 2022).

As COVID-19 is an infectious disease, healthcare, food services, and hospitality industries, where interpersonal work is a mainstay, have been forced to cease or downsize their operations. In Japan, these jobs are primarily held by women as non-regular employees. Therefore, it is possible that women were most directly affected socially by the COVID-19 pandemic. Sakuragi et al. (2022) found that during the pandemic, the time women spent on housework and childcare increased compared to that of men. They pointed out that this increase may be related to the fact that women who worked informally lost their jobs due to the pandemic and that their husbands and children became homebound. In terms of mental health as well, Khan et al. (2022) indicated that during the pandemic, women were lonelier than men, especially middle-aged women, and older men were the loneliest. Koda et al. (2022) conducted a detailed data analysis on approximately 21,000 people reported in national suicide statistics from January 2020, when the first COVID-19 cases were identified in Japan, to May 2021. The analysis demonstrated that cases had increased, especially among women. The reasons were family problems, such as "child-rearing problems," "marital discord," and "fatigue from nursing care."

In Japan, schools were closed nationwide in March 2020 because of COVID-19. Children were suddenly indoors 24 h a day for nearly 3 months. Moreover, COVID-19 made it difficult for people to receive medical and welfare services. Koda et al. (2022) suggested that fixed gender roles within Japanese society, where mothers assume childcare and caregiving roles, may contribute to the COVID-19 pandemic-related distress for women because of changes in their lives. The World Economic Forum (2022) also noted that the cost-of-living crisis had an unduly large impact on women, given the loss of the labour market due to the pandemic and the ongoing lack of care infrastructure. Owing to the pandemic, it is expected that many women and children will remain in poor economic, physical, and mental conditions. Therefore, support for them is an urgent priority.

Regarding the impact of the pandemic on children, a study examined how the "zest for life" of junior high school students attending a public school changed before and during the pandemic. Omiya et al. (2021) used sense of coherence (SOC) as an indicator of "zest for life" and conducted longitudinal assessments with 150 students in two schools to examine changes before and during the pandemic. The results demonstrated that although the overall SOC increased after the pandemic occurred, approximately 40% of the students continued to have a low SOC and displayed a lack of vitality or other such negative outcomes. It is possible that a certain number of adolescent children as well as middle-aged and older mothers of adolescents had lower SOC after pandemic onset.

Sense of coherence as a stress-coping skill is a core concept of the health generation theory proposed by health sociologist Antonovsky (1979, 1987). It is the ability to face stressful situations and circumstances and not only cope with them successfully but even transform them into sources of growth. SOC comprises three subconcepts: comprehensibility (confidence that predictions and explanations are possible), manageability (confidence that coping resources are always available), and meaningfulness (confidence that what happens is worth engaging with) (Yamazaki and Togari, 2011). Previous studies have demonstrated that SOC changes with life events in middle-aged and older women. The life course diverges in various ways after life events such as marriage, pregnancy, and childbirth. Yamazaki and Togari (2017) found no variation in SOC scores among middle-aged women regarding life course characteristics (e.g., single or married, housewife or working, and with or without children) and that SOC scores were relatively stable in mature age.

However, the pandemic seems to have had a negative impact on the SOC of Japanese women, who are considered the most vulnerable due to their precarious social status. In addition, women's middle age coincides exactly with the adolescent child-rearing period, and this period also just corresponds to menopause, which is a time when mental and physical health problems are more likely to occur (Adachi, 2021). According to the Cabinet Office (2015), the middle-aged group comprises those aged 35–64 years, however, there is no consensus regarding the age range of those who are considered middle-aged. Further, middle-aged women are often in a difficult position as an increasing number of them are non-regular employees, they are in a precarious social position, and have limited opportunities for career advancement. The pandemic exacerbated this situation and further burdened these women. Such significant social changes have likely brought about changes in their SOC (Antonovsky, 1996). In particular, as with children, it is necessary to clarify the characteristics of the groups whose SOC has declined, to help improve the support for these populations during the ongoing pandemic.

This study aimed to capture changes in coherent sensory SOC before and during the pandemic among adolescents and middle-aged women who are raising the adolescents, and to identify the differences in and factors related to SOC, especially between the groups whose SOC decreased and those whose SOC increased. Additionally, this study aimed to present implications for providing support for middle-aged women during and after the COVID-19 pandemic.

## 2 Materials and methods

### 2.1 Participants

The sample comprised 138 students from two public junior high schools (A and B junior high schools) around the Tokyo area and their parents (mothers) who agreed to participate in the study. The baseline survey was conducted in the spring (March–April) of 2019 (before the pandemic; Time 1: T1), and the second survey was conducted from July to September of 2020 (Time 2: T2), after Japan declared a state of emergency due to the pandemic (declared at the end of February 2020). Most schools in Japan were closed for approximately 3 months, after which, students began attending school. Identification numbers (IDs) were matched between parents and students (children), and pairs whose data matched twice were included in the analysis.

### 2.2 Ethical considerations

As junior high students are minors, the survey was first explained in writing to their parents. Only those students who signed a consent form after obtaining handwritten consent from

their parents were given the survey. Students were informed in writing, and their willingness to participate was confirmed by setting up a checkbox to indicate whether they agreed to participate in the survey. We also explained that participation in the survey was voluntary, that not participating in the study would not put them at a disadvantage, and that the participants are free to withdraw at any time. As this was a longitudinal study, each student was assigned a random six-digit personal ID number to manage the participant data. For parent–child data matching, a common parent–child number was assigned to each pair in addition to the individual ID number. However, these ID numbers were not personally identifiable, and anonymity was maintained throughout the study. Documents linking the personal ID number to the student's name were maintained by one person at each school and locked in an archive so that individuals could not be identified based on their responses. Questionnaires were distributed to the students, which they answered. The students took the parent questionnaire home, for their parents to complete; the completed parent questionnaires were enclosed in sealed envelopes and delivered to the schools by the students. This study was conducted in accordance with the principles of the Declaration of Helsinki. This study was approved by the Medical Ethics Review Board of the University of Tsukuba (approval number: 1,343, approval date: 30 January 2019).

In a previous study (Omiya et al., 2021), we analysed the data from the child's perspective. Conversely, in the current study, the data are analysed mainly from the parent's perspective. However, the data for both studies were obtained simultaneously and analysed from different perspectives.

## 2.3 Methods

### 2.3.1 SOC, a variable common to mother and child

The shortened Japanese version of the SOC scale, containing 13 items rated on a five-point scale, was used to measure SOC – a variable that is common to both mothers and children. Its reliability and validity have been verified by Togari and Yamazaki (2005). The scale has been widely used in Japanese national sample surveys and studies pertaining to high school students (Togari et al., 2012; Omiya et al., 2020, 2022). The SOC scale consists of three subscales: comprehensibility, manageability, and meaningfulness. The SOC scores were calculated for both parents and children at T1 and T2. The Cronbach's alpha coefficients for the SOC ranged from 0.82–0.87 and 0.78–0.89 for mothers and children, respectively.

### 2.3.2 Mothers

Regarding the variables examined at T1 and T2, mothers were asked about their age and marital status (married/unmarried, separated, or bereaved) as basic attributes. Previous research has demonstrated that SOC is associated with economic and relational wealth in the community (Koda et al., 2022), so we asked whether participants had a job at T1 (yes or no).

### 2.3.3 Mental health inventory

This scale was used to measure mental health at T1 and T2. Yamazaki et al. (2005) translated the mental health inventory (MHI) developed by Berwick et al. (1991) into Japanese and validated it for use in Japanese populations. It is a 5-item tool (ranging from "always" to "never") used to assess mental health problems, particularly depression, in the past month. Examples of items include "I was quite nervous" and "I was depressed and couldn't help it." Higher scores indicate better mental health. Cronbach's alphas were 0.84 and 0.82 for both T1 and T2.

### 2.3.4 Subjective physical health

We evaluated the participants' subjective physical health by asking them questions regarding eight physical complaints (headache, stomach ache, insomnia, palpitations, vertigo, constipation/diarrhoea, body pain, and irritability), as suggested by Ben-Sira (1982). Measurements were taken at T1 and T2. The responses ranged from 1 "always" to 4 "never." The higher the score, the better their subjective physical health. Cronbach's alpha was 0.81 on this scale.

### 2.3.5 Variable assessed only at T1: social capital

In a comparative study of SOC across regions, Tsuno and Yamazaki (2012) pointed out that reciprocal human relationships in the community are important factors for SOC. Especially during childcare, mothers' perceptions of residents' interactions with each other, such as rich human interactions and safe neighbourhoods, may be deeply related to SOC formation and change. Mothers' perception of their neighbourhood was evaluated using Togari et al.'s (2015) scale, which comprises 6 items rated on a 5-point scale. Examples of the items include "The area where I live is very safe" and "We help each other." The scale's Cronbach's alpha coefficient was 0.80.

### 2.3.6 Measurement items for adolescents at T2

Adolescence has been described as a period of "storm and stress" (Hall, 1907), with the storm implying a decreased level of self-control and stress implying increased sensitivity at this stage of life. Considering the impact of the COVID-19 outbreak on this phase of life, we felt it necessary to examine the stress of children and its impact on their families (parents) during the pandemic. In this study, stress related to academic performance, friendship stress and family relationship stress was measured at T2 using the "Life-Related Stress Scale for High School Students," which was developed by Ishida et al. (2017) and tested for reliability and validity. For academic performance stress, a 5-item, four-point scale was used, with higher scores indicating higher levels of stress about studying and grades. Friendship stress was assessed using a 5-item, four-point scale, and family relationship stress was assessed using a 4-item, four-point scale. Cronbach's alpha coefficients were 0.88, 0.91, and 0.84, respectively.

## 2.4 Analysis

The sum of SOC scores at T1 and T2 were calculated for the 138 eligible mothers and their children. For the mothers, total scores at T1 and T2 were also calculated for the mental health inventory and subjective physical health. Corresponding *t*-tests were performed to determine differences in scores at the two-time points.

Next, based on previous studies (Omiya et al., 2021), we divided the mothers into two groups. Mothers were classified based on their

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TABLE 1 Measured variables at T1 and T2 and comparison analysis results for each timeline.

| Items | T1 2019, before pandemic occurred | T2 2020, during pandemic | | Range, notes |
|---|---|---|---|---|
| | Average (SD) | Average (SD) | Paired *t*-test *p*-Value | |
| **Mothers** | | | | |
| Sense of coherence (SOC) | 42.6 (6.9) | 42.8 (6.8) | 0.687 | Range: 13–65 |
| Mental health inventory (MHI) | 18.9 (3.1) | 18.6 (3.0) | 0.170 | Range: 5–25, higher scores indicate good mental health |
| Subjective physical health | 23.9 (4.4) | 23.4 (4.1) | 0.095 | Range: 8–32, higher scores indicate good health |
| Employment status | | | | |
| Employed, *n* (%) | 110 (79.7%) | 114 (82.6%) | – | |
| Unemployed, *n* (%) | 28 (20.3%) | 24 (17.4%) | – | |
| Social capital | 21.1 (3.7) | – | – | Range: 6–30, higher is preferable |
| **Children** | | | | |
| Sense of coherence (SOC) | 40.9 (6.7) | 42.8 (7.8) | 0.002 | Range: 13–65 |
| Academic performance stress | – | 9.2 (3.5) | – | Range: 5–20, higher scores indicate more experience |
| Friendship stress | – | 5.7 (1.8) | – | Range: 5–20, higher scores indicate more experience |
| Family relationships stress | – | 5.9 (2.7) | – | Range: 4–16, higher scores indicate more experience |

Where the number of people did not match the total, it was a missing value.

total SOC score at T2 minus their total SOC score at T1 (T2-T1). If the result of the subtraction was zero or positive, the group was classified as "Group 1" (G1), the SOC maintenance and increase group, and if the result was negative, the group was classified as "Group 2" (G2), the SOC decrease group.

As a comparison between G1 (56.0%) and G2 (44.0%), *t*-tests and cross-tabulated $\chi^2$ tests were performed for baseline age and marriage as maternal variables. *t*-Tests were conducted for continuous variables and $\chi^2$ tests for all other variables. The same was conducted for social capital, where only T1 was measured. For children, *t*-tests were also conducted for T1 and T2 SOC total scores and for academic, friends, and family stress scores.

Pearson's correlation coefficients were calculated for G1 and G2, mainly to establish the strength of association of the parent–child SOC score in T2 in a cross-sectional manner. Correlation coefficients with the parent's T2 SOC total score and the child's T2 SOC total score were calculated for the parent and child variables measured at T2. For social capital, correlation coefficients were calculated in the same way to examine inputs to the multiple regression analysis.

To explore the variables that influence the T2 maternal SOC score, multiple regression analysis was performed for each of the G1 and G2 groups using the forced entry method, with the T1 maternal variable as the explanatory variable and the T2 maternal SOC total score as the dependent variable. Based on the results of the analysis of the variables up to this point, we noted that the child variable was not well related to the mother's SOC; therefore, we used the mother-only T1 variable as the explanatory variable. The explanatory variables were MHI, subjective physical health, social capital, and job status (yes = 1, no = 1), with age and marital status as control variables. Absolute correlations between independent variables were rejected.

## 3 Results

The difference between T1 and T2 scores is shown in Table 1. The results of the corresponding *t*-tests showed that the only variable that differed significantly between T1 and T2 was the child's total SOC score. Children's scores increased significantly from T1 to T2 ($p = 0.002$).

Table 2 shows the comparative results of G1 and G2. *t*-Tests were conducted to compare groups, and no significant differences were detected in age, marital status, MHI, subjective physical health, or social capital for the mothers, except for the criterion SOC-related scores. For meaningfulness, a subscale of SOC, a score of 14.2 points was noted at T2, both for G1 and G2, and no significant difference was detected between the groups. For comprehensibility, scores of 16.8 for G1 and 15.5 for G2 were noted, with a significant *p*-value of 0.016 between the two groups at T2. For manageability, G1 scored 13.0 and G2 scored 11.5 at T2. The difference between the two groups was statistically significant at $p < 0.001$. No item was statistically significant ($p < 0.05$) between the two groups for the T2 child measurement variables.

The results of the correlation analysis of variables associated with the SOC of T2 are shown in Table 3. Two variables were significantly correlated with the mother's total SOC score at T2 for G1: MHI ($r = 0.571$, $p < 0.01$) and subjective physical health ($r = 0.432$, $p < 0.01$). For G2, MHI ($r = 0.641$, $p < 0.01$) and subjective physical health ($r = 0.488$, $p < 0.01$) as well

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TABLE 2 Score comparison results for each group.

| Items | Group 1 | Group 2 | *t*-Test *p*-Value |
|---|---|---|---|
| | *n* = 77 | *n* = 61 | |
| | Average score (SD) | | |
| **Mothers** | | | |
| Basic characteristics in baseline | | | |
| Age (SD) | 45.5 (4.59) | 44.6 (4.34) | 0.217 |
| Married | 67 (87.0) | 56 (91.8) | 0.369 ($\chi^2$-test) |
| Never married, separated, or bereaved | 10 (13.0) | 5 (8.2) | |
| **T1 (2019)** | | | |
| Sense of coherence (SOC) total score | 40.3 (6.5) | 45.4 (6.4) | 0.010 |
| Meaningfulness | 13.4 (2.4) | 15.0 (2.5) | <0.001 |
| Comprehensibility | 15.5 (3.0) | 17.2 (2.9) | <0.001 |
| Manageability | 11.3 (2.3) | 13.3 (2.5) | <0.001 |
| Mental health inventory (MHI) (range 5–25) | 18.4 (3.3) | 19.4 (3.2) | 0.065 |
| Subjective physical health (range 8–32) | 23.6 (4.7) | 24.4 (4.1) | 0.280 |
| Social capital (range 6–30) | 20.9 (3.9) | 21.2 (3.4) | 0.570 |
| Employed, *n* (%) | 61 (79.2) | 49 (80.3) | 0.872 ($\chi^2$-test) |
| Unemployed, *n* (%) | 16 (20.8) | 12 (19.7) | |
| **T2 (2020)** | | | |
| Sense of coherence (SOC) total score | 44.1 (6.9) | 41.1 (6.3) | 0.000 |
| Meaningfulness | 14.2 (2.3) | 14.2 (2.4) | 0.604 |
| Comprehensibility | 16.8 (3.4) | 15.5 (3.1) | 0.016 |
| Manageability | 13.0 (2.6) | 11.5 (2.6) | <0.001 |
| Mental health inventory (MHI) (range 5–25) | 18.9 (2.7) | 18.4 (3.1) | 0.281 |
| Subjective physical health (range 8–32) | 23.8 (4.1) | 23.1 (4.2) | 0.314 |
| Employed, *n* (%) | 60 (77.9) | 51 (83.6) | 0.518 ($\chi^2$-test) |
| Unemployed, *n* (%) | 17 (22.1) | 10 (16.4) | |
| **Children (students)** | | | |
| SOC total score, T1 (range: 13–65) | 40.4 (6.3) | 42.0 (7.1) | 0.198 |
| SOC total score, T2 (range: 13–65) | 42.6 (7.9) | 44.3 (7.5) | 0.215 |
| Academic performance stress, T2 (range: 5–20) | 9.3 (3.6) | 8.2 (3.4) | 0.069 |
| Friendship stress, T2 (range: 5–20) | 5.7 (1.9) | 5.4 (0.9) | 0.234 |
| Family relationships stress, T2 (range: 4–16) | 6.4 (3.1) | 5.8 (2.4) | 0.244 |

G1 is the mothers' SOC increase/maintain group and G2 is the mothers' SOC decrease group.

as social capital ($r$ = 0.330, $p$ < 0.01) showed a significant positive correlation. None of the child variables were significantly correlated. Correlation coefficients for children's SOC scores at T2 also showed no significant correlation with mothers' measured scores in both groups, and except for G2 friendship stress, children's T2 SOC was negatively associated only with children's own stress-related variables ($r$ = −0.563 to −0.293, $p$ < 0.05 to 0.01).

For G1 and G2, multiple regression analysis was performed with T2's total maternal SOC score as the dependent variable. The explanatory variables were the measured variables at T1, and we aimed to examine the effect of T1 on T2 SOC. Table 4 presents the results. For G1, the significant items were MHI (β = 0.379, $p$ = 0.001) and subjective physical health (β = 0.301, $p$ = 0.005). The total adjusted $R^2$ was 0.378.

For G2, significant positive associations were found for MHI (β = 0.386, $p$ = 0.001) and subjective physical health (β = 0.380, $p$ = 0.001) as well as social capital (β = 0.300, $p$ = 0.006) and having a job (β = 0.213, $p$ = 0.046). The adjusted $R^2$ was 0.463. No multicollinearity was observed in both groups based on VIF values.

## 4 Discussion

This study is considered noteworthy as it is the first, to the best of our knowledge, to examine adolescents' and their mothers' stress-coping skills before and during the COVID-19 outbreak.

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TABLE 3 Correlation coefficient with SOC total score of the two groups.

| Measurement items at T2 | Group 1 $n$ = 77 | | Group 2 $n$ = 61 | |
|---|---|---|---|---|
| | Correlation coefficient ($r$) | | Correlation coefficient ($r$) | |
| | With mothers' SOC total score (T2) | With children's SOC total score (T2) | With mothers' SOC total score (T2) | With children's SOC total score (T2) |
| **Mothers'** | | | | |
| SOC score in 2020 | – | 0.036 | – | 0.170 |
| Mental health inventory (MHI) | 0.571** | 0.063 | 0.641** | 0.230 |
| Subjective physical health | 0.432** | 0.080 | 0.488** | 0.250 |
| Social capital, data in T1 | 0.205 | −0.026 | 0.330** | −0.021 |
| **Children's** | | | | |
| SOC score in 2020 | 0.036 | – | 0.170 | – |
| Academic performance stress | −0.059 | −0.563** | −0.042 | −0.367** |
| Friendship stress | −0.125 | −0.293* | 0.050 | −0.240 |
| Family relationships stress | −0.038 | −0.437** | 0.165 | −0.325* |

G1 is the mothers' SOC increase/maintain group and G2 is the mothers' SOC decrease group. *$p < 0.05$, **$p < 0.01$.

## 4.1 Overall SOC score

Antonovsky, who proposed the core concept of SOC, stated that SOC is stable in adulthood and gradually increases with age. Thus, there was no change in SOC scores over the approximate one-year span of this study (Antonovsky and Sagy, 1986; Antonovsky, 1987, 1996). However, the increase in SOC for adolescents may have been due to the reopening of schools after the first emergency declaration issued in Japan and the ensuing simultaneous school closures. The fact that adolescents' SOC scores increased regardless of the group to which their parents belonged suggests that school life significantly impacts adolescents. It can also be inferred that the SOC scores of the parents and their children were not significantly related.

Moreover, approximately 40% of the mothers' scores decreased. Interestingly, of the three components of SOC, there was no decline in meaningfulness, suggesting that the score decline in G2 was due to the other two components: comprehensibility and manageability. According to Yamazaki and Togari (2011), comprehensibility is "the ability to predict, to some extent, the various events one encounters daily and explain what those events are like." The literature on stress-coping skills suggests that the key to improving comprehensibility is to foster consistent experiences. As mentioned earlier, the COVID-19 pandemic has changed society, causing a shift in daily lifestyles. As it would have been for anyone, the pandemic would still have been difficult for women to predict or explain. The government issued a state of emergency declaration and a request to close schools in Japan. Three months later, they were lifted despite the ongoing COVID-19 pandemic. We surmise that this would not have been a confusing and inconsistent experience for women.

Manageability is "the confidence that one is capable of using the coping resources (people, goods, tools, and thinking skills) necessary to overcome the events of daily life." Moreover, to enhance this, "a balanced load experience that is neither too much nor too little" is considered valuable (Yamazaki and Togari, 2011). For many mothers who manage family life, a situation where a child cannot attend school may have been too sudden and burdensome. It is also conceivable that they may have experienced a situation where they could not find any means of coping at all, such as the lack of coping resources – for example, facilities to take care of their children, cram schools, and neighbours – and they had to go to work. In Japan, many children disrupt their lifestyles during school vacations by turning their days and nights upside down or becoming immersed in their smartphones. If the cause or trigger were school closures due to the COVID-19 pandemic, parents might not have been able to find an effective solution. These experiences may have lowered manageability.

In Japan, under the Infection Control Act, the treatment for COVID-19 has changed since May 2023, and COVID-19-related restrictions are loosening (Infectious Disease Subcommittee of the Health Sciences Council, 2023). However, it is possible that the damage caused by the pandemic, which lasted for three years, negatively impacted women, a socially vulnerable group. These trends should be monitored in future studies.

## 4.2 Comparison between the two groups and multiple regression analysis results

The two groups were compared; however, no significant differences were detected. The authors asked the participants (mothers) about their employment status, considering the possibility of economic damage related to COVID-19. We expected these to have some relationship; however, we found no difference between the two groups. General anxiety about daily life, life changes, or a sense of self-efficacy due to the COVID-19 pandemic may have made a difference rather than something more direct, such as a specific event. The results in **Tables 1–3** also suggest that for parents and children, the relationship between them would be very weak, even for SOC and other variables. It has been previously suggested that school life, in which adolescents spend most of

10.3389/fpsyg.2023.1215463

TABLE 4 Factors related to mothers' SOC (T2) of the two groups.

| Mothers' variables in T1 | Group 1 ($n$ = 77) | | | | | | Group 2 ($n$ = 61) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $T$ score | Coefficient β | $p$-Value | Standard error | 95% CI | VIF | $T$ score | Coefficient β | $p$-Value | Standard error | 95% CI | VIF |
| Age | 2.022 | 0.204 | 0.047 | 0.175 | 0.005 to 0.703 | 1.094 | 1.515 | 0.162 | 0.136 | 0.151 | −0.074 to 0.533 | 1.210 |
| Marital status (married = 1, others = 0) | −0.974 | −0.098 | 0.333 | 2.229 | −6.621 to 2.278 | 1.081 | 1.794 | 0.203 | 0.079 | 2.414 | −0.515 to 9.177 | 1.354 |
| Mental health inventory (MHI) | 3.447 | 0.379 | 0.001 | 0.239 | 0.347 to 1.301 | 1.302 | 3.463 | 0.386 | 0.001 | 0.211 | 0.308 to 1.156 | 1.317 |
| Subjective physical health | 2.888 | 0.301 | 0.005 | 0.179 | 0.159 to 0.873 | 1.171 | 3.686 | 0.380 | 0.001 | 0.154 | 0.258 to 0.876 | 1.128 |
| Social capital | 0.350 | 0.036 | 0.728 | 0.186 | −0.306 to 0.436 | 1.161 | 2.866 | 0.300 | 0.006 | 0.183 | 0.157 to 0.892 | 1.163 |
| Employment status (employed = 1, unemployed = 0) | −0.854 | −0.085 | 0.396 | 1.661 | −4.735 to 1.897 | 1.055 | 2.046 | 0.213 | 0.046 | 1.594 | 0.062 ot 6.461 | 1.152 |
| $R$ | | | | 0.615 | | | | | 0.721 | | | |
| $R^2$ | | | | 0.378 | | | | | 0.520 | | | |
| Total adjusted $R^2$ | | | | 0.322, $p < 0.001$ | | | | | 0.463, $p < 0.001$ | | | |

G1 is the mothers' SOC increase/maintain group and G2 is the mothers' SOC decrease group. All explanatory variables (of mothers) were measured at T1. Age and marital status are control variables.

their time, especially more than the parent–child relationship, is associated with SOC (Omiya et al., 2022). Thus, support for both the parent and child need to be considered.

Multiple regression analysis revealed that the significantly associated factors differed between the two groups. This section will mainly discuss the group with lower SOC (G2) to provide suggestions to support the women in the G2 condition. The MHI and subjective physical health scores pertain to the subjective health of mind and body, respectively, with higher scores indicating better mental and physical health. Many studies have reported strong positive associations or causal relationships between the variables related to the relationship between SOC and mental and physical health. As expected, the results were interesting: the coefficient β for social capital was lower than the coefficients β for MHI and subjective physical health, but the $p$-value scores were considered sufficient to be significant.

Several studies have pointed out the relationship between social capital and SOC (Larm et al., 2016; van Sint Fiet et al., 2022). SOC assumes a self that exists with people and the surrounding environment and attempts to measure the degree of trust in one's environment and the people in one's life. In other words, SOC has a high affinity for social mechanisms based on trust, norms, and networks, which are characteristics of social capital, as proposed by the political scientist Putnam (2000).

The reason social capital has a significant positive association only in G2 must be interpreted. Social capital refers to the relationship between people in the community, including cooperation and interaction, mutual support, and a sense of security. The relationship between the community and SOC has been pointed out in the past (Tsuno and Yamazaki, 2012); for example, it has been reported that building mutually beneficial relationships in the community is related to SOC (Fukuda and Fukuda, 2022). In G2, warm connection, security, and support in the community as social capital may have acted as a coping resource, even when the family was disrupted, or the child became unstable due to the effects of the COVID-19 pandemic. For people in G2, peace of mind and a sense of de-isolation due to the richness of social capital may have been a relief. It is also possible that the richness of social capital improved SOC through manageability.

For women in G2, employment was also positively and significantly associated with SOC scores; as noted earlier, the economic hardship caused by the COVID-19 pandemic was extremely damaging, especially for women working informally in Japan. Therefore, it is plausible that having a job and being able to earn money, regardless of whether they are employed full time or part time, would have led to a certain degree of economic security. The link between SOC and job availability has been mentioned previously (Volanen et al., 2004; Feldt et al., 2005). SOC may be associated not only with the value of money itself but also with the social value of one's activities and a sense of contribution through work. It is also possible that the work may have strongly affected the participants' sense of place in the context of reduced social interaction.

Thus, it is possible that the items that were significantly associated with SOC in G2 were tangible and intangible, providing important support for the difficulties that middle-aged women were likely to face, such as loneliness, helplessness, and economic insecurity caused by the COVID-19 pandemic. Therefore, it is possible that not only financial or tangible means of support but

also the creation of relationships and networks that enable small interactions (i.e., small talk or chatting), as well as events and interventions that foster relationships, may provide women with the required support (Pasek et al., 2017; Nowicki et al., 2020).

### 4.3 Limitations

Although we targeted mothers with children attending junior high school and obtained cooperation from two junior high schools, the data are limited as few parent–child pairs were available at both time points. Therefore, caution is required when generalising the results. Although, regrettably, it is no longer possible to obtain matching data from before the pandemic, we believe it is necessary to accumulate research from a long-term perspective by designing longitudinal studies and conducting analyses related to SOC with a focus on middle-aged women. We are convinced that such a focus will have implications for the SOC theory, stress theory, midlife support, and support for menopausal women.

As presented in Table 2, there were no significant differences between the two groups. Although not included in the text or the tables, the participants were asked to answer 20 items regarding life events after the onset of the pandemic (e.g., divorce, need for nursing care, and company bankruptcy). There was no difference between the two groups in this regard. Differences may have been observed for some items not included in this study. However, on the three subscales of the SOC component, differences were found between the two groups regarding comprehensibility and manageability. For example, it is important to clarify which specific items related to these two subscales differed between the two groups in the interviews to provide clues for providing support. In addition, the participants were biased in that they were highly aware of and interested in the issues and agreed to participate in this type of study. Those who did not respond to the survey were more likely to experience problems; thus, further research is required.

## 5 Conclusion

In Japan, often, women are non-regular employees and engage in care work such as housework, childcare, and nursing care, placing them in a socially vulnerable position. We considered the possibility that the COVID-19 pandemic might have impacted women raising adolescent children. We followed changes in the SOC of 138 parent–child pairs using SOC scores as an indicator to clarify the impact of the pandemic. Overall, there was no change in the scores of middle-aged mothers before and during the pandemic, whereas the scores of their children (junior high school students) increased. However, 44% of mothers had lower SOC scores than before the pandemic, with particularly significant declines in comprehensibility and manageability scores among the SOC components. For example, anxiety about uncertain prospects may be associated with lower SOC; in the group with declining SOC, perceived high social capital and employment may have contributed to stable SOC. Conversely, the results suggest that among middle-aged women raising adolescents in the community, maintaining social interactions is much more important, such as living in a community where they can casually talk and communicate. Work is also important for economic security. Simultaneously, having places to spend their time outside the home setting, where they feel safe, is also important. Further research is required to investigate these long-term implications.

## Data availability statement

The datasets presented in this article are not readily available because it contains data on minors and we do not have permission to share the data from the middle school and parents who cooperated with the survey. Requests to access the datasets should be directed to TO, toomiya-tky@umin.ac.jp.

## Ethics statement

This study was conducted in accordance with the Declaration of Helsinki and approved by University of Tsukuba's medical ethics review board approved this research (approval number: 1,343, approval date 30 January 2019: 1343-1, 10 June 2020). Informed consent was obtained from all the participants involved in the study. Upon the minors' participation in the study, we obtained their parents' handwritten signatures. The students (junior high school students) were then allowed to express their willingness to participate in the study on their own. The authors provided a written statement from the authors that they would not be disadvantaged in any way if they did not participate in the study or if they dropped out of the study.

## Author contributions

TO and ND contributed to the conception, methodology, coordination of the survey participants, and in the refinement of the questions to capture the characteristics of the target population. TO wrote the entire manuscript. AM and TS contributed to the discussions and provided important inputs regarding manuscript editing and conference presentations. YA provided important advice on variable adjustment and analysis and contributed to the presentation and interpretation of the results. All authors contributed to the manuscript revision, read, and approved the submitted version.

## Funding

This study was supported by JSPS KAKENHI (grant numbers 21K11077 and 17K01798).

## Acknowledgments

We would like to thank the mothers, students, and teachers who participated in this study. Editage assisted with the English editing of the manuscript (www.editage.jp).

## 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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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 21 December 2023
DOI 10.3389/fpsyg.2023.1246996



OPEN ACCESS

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RECEIVED 25 June 2023
ACCEPTED 08 December 2023
PUBLISHED 21 December 2023

CITATION
Phutong P and Thaithae S (2023) Social support, health literacy and anxiety among pregnant women during coronavirus 2019 pandemic in Thailand.
*Front. Psychol.* 14:1246996.
doi: 10.3389/fpsyg.2023.1246996



# Social support, health literacy and anxiety among pregnant women during coronavirus 2019 pandemic in Thailand

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**Background:** The ongoing coronavirus disease 2019 (COVID-19) pandemic continues to have a significant impact. Pregnant women are particularly vulnerable to its effects, which may increase their anxiety levels. This study aims to investigate anxiety levels in pregnant women during the COVID-19 pandemic in Thailand and to identify factors predicting such anxiety.

**Methods:** The researchers collected data through an online questionnaire from November 2021 to May 2022. The sample included 404 pregnant women. The questionnaire consisted of personal information, health literacy related to COVID-19, social support, and anxiety related to COVID-19. The content validity of the questionnaire were verified by three experts, with content validity indices of 0.87, 0.80, and 0.87 for each domain, respectively. The reliability of the questionnaire were 0.96 for health literacy, 0.95 for social support, and 0.96 for anxiety. Moreover, in-depth telephone interviews were also conducted with pregnant women. The data were analyzed using descriptive statistics, stepwise multiple regression, and content analysis.

**Results:** Group of 404 pregnant women were studied, and the results showed that pregnant women had a high level of health literacy regarding COVID-19 and pregnancy (mean = 96.36, SD = 14.23) and social support level on a high level (mean = 83.99, SD = 11.34). Most of them were concerned about anxiety related to COVID-19 infection and pregnancy on a moderate level (mean = 47.78, SD = 11.49). The factors predicting the anxiety of pregnant women during the COVID-19 outbreak in Thailand included health literacy related to COVID-19 ($\beta = 0.468$) and social support ($\beta = 0.283$), with a prediction rate of 32.80% ($R^2 = 0.328$) with statistical significance ($p < 0.05$).

**Conclusion:** This study revealed the anxiety level of pregnant women during the COVID-19 outbreak in Thailand, which was moderate. Health literacy about COVID-19 and social support can predict the anxiety level of pregnant women.

KEYWORDS

**anxiety, pregnant woman, COVID-19, social support, health literacy**

## Introduction

Coronavirus Disease 2019 (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus. The initial case emerged on December 1, 2020, in Wuhan, the capital of Hubei province, China. Swiftly escalating, the virus proliferated globally, resulting in a surge of infected individuals and casualties. The World Health Organization (WHO) declared the coronavirus 2019 a global pandemic on March 11, 2021 (Cucinotta and Vanelli, 2020; Ansariniya et al., 2021). The most significant symptom is sudden respiratory failure, which can lead to difficulty breathing or pneumonia. However, most cases exhibit mild to moderate symptoms, such as fever, runny nose, cough, sore throat, headache, body aches, fatigue, loss of smell, nausea, vomiting, or diarrhea (Boddington et al., 2021). Severe symptoms occur in elderly patients and those with underlying medical conditions, such as diabetes, heart disease, respiratory disease, cancer, and pregnant women (Centers for Disease Control and Prevention, 2021). Although the risk of infection in pregnant women is similar to that of the general population, there is a higher chance of severe symptoms compared to non-pregnant women. The rapid progression and failure of the respiratory system may be due to changes in physiology and alterations in the immune system during pregnancy.

Aside from the impact on the health of pregnant women, COVID-19 infection also affects pregnancy outcomes. It leads to preterm birth at a rate of 19–49%, premature rupture of membranes at a rate of 19%, and fetal distress due to hypoxia at a rate of 43% (Almeida et al., 2020). Moreover, there is an increased incidence of stillbirths during the pandemic, from 2.38 per 1,000 births to 9.31 per 1,000 births (Khalil et al., 2020). Most of the research, around 70%, indicates that neonates contract COVID-19 from the environment after delivery, but transmission from mother to fetus during pregnancy is also possible (Centeno-Tablante et al., 2021). The World Health Organization (2020) recommends that mothers can continue to breastfeed their infants, with appropriate precautions and guidance from healthcare professionals on proper practices and the associated risks and benefits. Neonates with COVID-19 exhibit similar symptoms to adults, including fever (44%), gastrointestinal abnormalities (36%), respiratory abnormalities (52%), pulmonary abnormalities (64%), and neurological symptoms (18%) (Raschetti et al., 2020).

During the outbreak of COVID-19 in Thailand, the Ministry of Public Health implemented a policy to modify prenatal care services by reducing the duration of care and limiting certain activities such as parent school and reducing the number of prenatal visits to hospitals to minimize the risk of exposure to the virus (Ministry of Public Health, 2020b). Previous studies show that fetal wellbeing and daily lives restrictions are the greastest concern for pregnant women (Akgor et al., 2021). Social distancing measures, seen as a pivotal strategy in curbing the virus's spread, led to a substantial reduction in outdoor activities, hindering physical exercise. Pregnant women, especially in high-prevalence areas, refrained from leaving their homes, even temporarily distancing from their spouses. The shutdown of transportation systems compounded challenges. Job layoffs surged, escalating unemployment rates and diminishing family incomes (Nowacka et al., 2021). Consequently, accessing antenatal care became increasingly inconvenient, reflecting the multifaceted impact of these measures (Bivia-Roig et al., 2020). However, this policy may have unintended consequences, such as reducing social support for pregnant women, including emotional support, appraisal support, informational support, and instrumental support (House, 1981), which may increase anxiety levels in pregnant women. A study conducted in Iran on 300 pregnant women who were not infected with COVID-19 found that 51.30% of them had a high level of anxiety related to the COVID-19 outbreak during their pregnancy (Mehdizadehkashi et al., 2021). A study conducted in the United States also found that pregnant women experienced high levels of anxiety during the COVID-19 outbreak and were more anxious about childbirth during the pandemic (Moyer et al., 2020). This is consistent with another study conducted in Thailand on 403 pregnant women during the first COVID-19 outbreak, which found that anxiety levels were significantly higher in pregnant women compared to those who were pregnant before the outbreak (Thongsomboon et al., 2020).

Based on the studies, social support is related to anxiety levels in pregnant women during the COVID-19 pandemic (Hocaoglu et al., 2020; Hamzehgardeshi et al., 2021). Moreover, it has been found that social support is negatively connected to anxiety levels in pregnant women during the COVID-19 pandemic (Azene et al., 2020; Kassaw and Pandey, 2020). This is significant given that COVID-19 is a new and rapidly spreading infectious disease, and information about the disease, particularly the COVID-19 vaccine, is not yet clear. Accessing and understanding accurate information for appropriate pregnancy care may be challenging. In Turkey, a study found that a higher level of health literacy about COVID-19 was significantly associated with lower levels of anxiety ($p < 0.05$) (Ugras et al., 2021).

The high level of anxiety may have an impact on pregnant women, pregnancy, and the fetus, such as vaginal bleeding, miscarriage, preterm delivery, and low birth weight (Hoyer et al., 2020; Nodoushan et al., 2020). Therefore, the researchers conducted a study to investigate the predictors of anxiety levels in pregnant women during the COVID -19 pandemic, in order to provide information for developing guidelines to reduce anxiety during the outbreak of COVID-19 or other similar emerging infectious diseases in the future.

## Objectives

1 To investigate anxiety levels among pregnant women during the outbreak of COVID-19.
2 To identify predictive factors for anxiety levels among pregnant women during the outbreak of COVID-19.
3 To conduct an in-depth exploration of social support, health literacy, and anxiety levels among pregnant women during the outbreak of COVID-19.

## Methods

The research conducted in this study included a mixed methods approach to investigate maternal anxiety and predictive factors of anxiety in pregnant women during the COVID-19 pandemic. The research proposal has been approved by Kuakarun Faculty of Nursing Institutional Review Board, Navamindradhiraj University, and Institutional Review Board Faculty of Medicine Vajira Hospital, as well as Bangkok Metropolitan Administration Human Research Ethics Committee.

## Population and sample group

The population in this study consists of pregnant women residing in Thailand, aged 18 years and older, in all stages of pregnancy, without any pregnancy complications, and with the ability to use a Google Form. The sample group for quantitative data collection includes pregnant women during the COVID-19 pandemic outbreak period. The sample size was determined using G*Power software, based on Cohen's (1992) calculation principle, with a power (1-β) of 0.95 and alpha value of 0.05. The sample group size was set to be 385 individuals, and an additional 10% were added to account by the researchers, resulting in a final sample group size of 424 individuals. Purposive sampling was used to select the sample group between November 2021 to May 2022, and the complete response rate was 404 individuals, or 95.28%.

## Measurements

Tools used for data collection include questionnaires which are divided into five parts as follows:

**Part 1:** Personal information includes age, education level, residential address, household income, employment status, pregnancy history, and complications during pregnancy.

**Part 2:** The measurement of health literacy about COVID-19 and pregnancy is adapted from the health knowledge and health behavior questionnaire for working-age population from the Department of Health Service Support, Ministry of Public Health (2020a). It is a Likert scale with 5 levels and consists of 24 items. The scores range from 24 to 120, and the scores are categorized according to Best's (1977) criteria. Scores between 24–56 indicate low knowledge, scores between 57–89 indicate moderate knowledge, and scores between 90–120 indicate high knowledge.

**Part 3:** The measurement of social support is an assessment of social support that the researchers developed based on the theoretical concept of social support by House (1981). It is a Likert scale with 5 levels and consists of 20 items. The scores range from 20 to 100 and are categorized according to Best's (1977) criteria. Scores between 20–47 indicate low social support, scores between 48–75 indicate moderate social support, and scores between 76–100 indicate high social support.

**Part 4:** The measurement of anxiety related to COVID-19 infection and pregnancy: Data was collected using an adapted version of the Modified Pregnancy-Related Anxiety Scale (PRAS) (Moyer et al., 2020), which is a Likert scale with five levels and 15 items, scoring between 15 and 75 points. The scoring criteria for the modified PRAS was based on Best's (1977) criteria, where scores between 15–35 indicate low anxiety, scores between 36–56 indicate moderate anxiety, and scores between 57–75 indicate high anxiety.

**Part 5:** In-depth interviews were conducted using open-ended questions created by the researchers. The interviews were conducted with 20 pregnant women, covering topics as following:

How do you feel anxious about COVID-19 infection and pregnancy?

What factors contribute to increasing your anxiety?

What factors contribute to reducing your anxiety?

The researchers conducted the quality testing of the questionnaire by having three experts to evaluate the content validity index (CVI) of the questionnaire. The CVI values for the health literacy about COVID-19 and pregnancy, social support and anxiety related to COVID-19 and pregnancy were 0.87, 0.80, and 0.87, respectively. Then, the revised questionnaire was tried out on a sample of 30 pregnant women with characteristics similar to the target population to assess the reliability using Cronbach's alpha coefficient. The health literacy about COVID-19 and pregnancy, social support and anxiety related to COVID-19 and pregnancy of the questionnaire had Cronbach's alpha coefficients of 0.96, 0.95, and 0.96, respectively.

## Data collection

The research was conducted in two phases as follows:

### Phase 1: quantitative research

The objective of this phase was to investigate predictors of anxiety among pregnant women during the outbreak of the COVID-19 infection. The research was conducted using a questionnaire consisting of personal information, social support assessment, health literacy assessment, and anxiety assessment. The research project was promoted and distributed through an online platform, specifically a Facebook group comprising pregnant women, such as "Group of pregnant women talk" and "Group of newly mother talk".

### Phase 2: qualitative research

In this phase, in-depth interviews were conducted through video call to obtain rich and detailed data. The interviews were carried out using a set of open-ended questions developed by the researchers. The sample for this phase was selected through simple random sampling from volunteers who expressed their interest in Phase 1 to participate in Phase 2 of the research. The introduction and interview were made as scheduled, and participants were informed about the objective of the interviews conducted through VDO calls and were requested for audio recording consent. Once the participants agreed to take part in the research project, the interviews were conducted using the open-ended questions developed by the researchers. Each interview lasted between 15 to 20 min, and a total of 20 individuals were interviewed.

## Statistical analysis

Data analysis was conducted using packaged computer programs as follows:

1. Analysis of personal data, health literacy regarding COVID-19 and pregnancy, social support, and anxiety related to COVID-19 infection and pregnancy was performed using descriptive statistics, mean, and standard deviation.
2. Analysis of data from in-depth interviews was conducted using content analysis.
3. Analysis of personal factors, health literacy regarding COVID-19 and pregnancy and social support to predict the anxiety related to COVID-19 infection and pregnancy was performed using stepwise multiple regression analysis, with a significance level set at 0.05.

# Results

## Personal data

The data of the sample group consisting of 404 individuals was analyzed. The majority of the participants, 280 individuals (69.31%) were between the ages of 20 and 34, while 351 individuals (86.88%) were married. Regarding educational attainment, 132 individuals (32.67%) had completed junior high school. In terms of residency, 314 individuals (77.72%) lived in urban areas, and 224 individuals (55.46%) resided in areas at high risk of COVID-19 infection. In terms of monthly family income, 223 individuals (55.20%) reported an income range of 10,000 to 20,000 baht, and 193 individuals (47.77%) had stable employment and income. Furthermore, 201 individuals (49.75%) were in their third trimester of pregnancy (28–40 weeks). In terms of perceptions about the effectiveness of COVID-19 vaccines, 187 individuals (46.29%) believed that the vaccines offered moderate protection against COVID-19. A total of 253 individuals (62.62%) had previously been infected with COVID-19, and 331 individuals (81.93%) had close contacts who were infected. Additionally, 328 individuals (81.19%) had undergone quarantine for COVID-19 surveillance. The majority, 149 individuals (36.88%), had not yet received the COVID-19 vaccine.

## Anxiety related to COVID-19 infection and pregnancy

Anxiety related to COVID-19 infection and pregnancy was predominantly at a moderate level, ranging from 36 to 56 on the anxiety scale (mean = 47.78, SD = 11.49). Interviews revealed that pregnant women experienced anxiety in five areas: their own health status, the health of their fetus, the safety of their older child, the safety of their spouse, and the process of childbirth and hospital stay. The following quotes from pregnant women's interviews illustrate their concerns:

> "I worry about getting infected and concern about myself, the baby, and my eldest child, especially about my husband because he goes out the most."
>
> "I am afraid of getting infected because pregnant women have a weaker immune system and are more susceptible. I am afraid of giving birth without anyone to accompany because visitors are not allowed due to COVID-19. If I am away, there will not be anyone to take care of my older child."
>
> "I'm afraid of getting infected with COVID-19 before giving birth. What if something happens? I'm afraid I'll have to undergo a surgery, and I worry if someone gets infected, they will have to undergoes surgery only. And I worry about giving birth method and they will not allow any relatives to accompany."

In addition, interviews also revealed that factors contributing to increased anxiety among pregnant women include working suspension and loss of income, traveling outside, household members working or providing services outside, the need to interact with people, having pre-existing medical conditions, being in close proximity to individuals infected with the COVID-19 virus, and exposure to alarming news about the severity of the COVID-19 infection. The following are examples of interviews conducted with pregnant women:

> "Watching news makes me more anxious. There are also reports of dying, even pregnant women. It make us scared, so we try not to watch the news too much."
>
> "The environment makes us more stressed. If people around us get infected, we become even more fearful. We do not know which places have the virus, and we are afraid of touching contaminated surfaces or accidentally open our masks."

Factors that contribute to reducing anxiety include receiving support from family members, practicing strict personal protective to prevent infection, having a small number of family members, and residing in rural areas or non-high risk areas. The following are examples of interviews with pregnant women:

> "When I'm not in the city and return to my hometown in the rubber trees plantation, I feel less stressed because I do not have to interact with people."
>
> "I'm glad to have my mother's help. She buys food for me and assists me with financial matters when my resources are insufficient."

## Health literacy regarding COVID-19 and pregnancy

Pregnant women have the health literacy related to the coronavirus disease 2019 (COVID-19) and pregnancy in a high level, ranging between 60 and 120 (mean = 96.36, SD = 14.23). From interviews, it was found that pregnant women seek information on their own and compare it with their friends or family members. They also consult healthcare professionals to confirm information at times. The following excerpts from interviews with pregnant women illustrate this:

> "I search for knowledge on the internet because it's easier. However, if something seems strange, I will ask the doctor when I visit the hospital because their explanation is more understandable and reliable."
>
> "I watch the news during dinner with my family. We discuss it together, and if there's something I do not understand, I can ask others for answers. It makes me feel more at ease than being stressed by watching it alone."
>
> "At first, I was hesitant to get vaccinated because my siblings who gave birth earlier told me that breastfeeding might be affected. I was afraid I would not have enough breast milk for my baby. However, as I read information on pages, my understanding improved, so I decided to get vaccinated."

TABLE 1 Health literacy regarding COVID-19 and pregnancy, social support and anxiety related to COVID-19 infection and pregnancy.

| Data | Mean | S.D. | Level |
|---|---|---|---|
| Health Literacy regarding COVID-19 and pregnancy | 96.36 | 14.23 | High |
| Social support | 83.99 | 11.34 | High |
| Anxiety related to COVID-19 infection and pregnancy | 47.78 | 11.49 | Moderate |

TABLE 2 Variable analysis of predicting factors of anxiety related to COVID-19 infection and pregnancy using stepwise multiple regression.

| Predicting factors | *B* | S.E. | *β* | *t* | *p*-value |
|---|---|---|---|---|---|
| Health literacy regarding COVID-19 infection | 0.378 | 0.033 | 0.468 | 11.365 | 0.000 |
| Social support | 0.287 | 0.042 | 0.283 | 6.875 | 0.000 |

Constant = 108.294; $R = 0.573$; $R^2 = 0.328$; Adjusted $R^2 = 0.325$; $F$ 97.997; $p < 0.05$.

## Social support

Pregnant women receive significant social support (mean = 83.99, SD = 11.34) reporting high levels of support. From interviews, it was found that pregnant women receive support from their spouses, parents, friends, colleagues, and medical personnel. This support encompasses various aspects, including childcare assistance, provision of food, financial aid, household items, information sharing, assistance with activities, and emotional encouragement, as the following interviews:

> "A nurse from the public health service center came to my house, provided blood tonic, reminded me, and gave me encouragement. They advised me to take good care of myself during pregnancy so that the baby would be healthy. My partner also take cares of some heavy housework."
>
> "My partner goes out and buys things for us since I cannot go out. When we run out of essentials, my partner buys them, and the supplies last for about a week."
>
> "People around me try not to go outside for my sake. They help finding necessary items, while my mother prepares food for me. I bring food from home to eat during work hours. I do not buy and eat outside food. During lunchtime, I have a lunchbox at the office instead."

Data of health literacy regarding COVID-19 and pregnancy, social support and anxiety related to COVID-19 infection and pregnancy are presented in Table 1.

## Predicting factors of anxiety related to COVID-19 infection and pregnancy

From the preliminary test of agreement, it was found that the variables exhibited appropriate relationships for non-multicollinearity analysis based on the examination of Tolerance and VIF values, with Tolerance = 0.98 and VIF = 1.01, which passed the preliminary agreement. Considering the Durbin-Watson value, which is 1.83, it passed the preliminary agreement for non-autocorrelation. Multiple regression analysis using all three independent variables revealed that two of them significantly predicted anxiety related to COVID-19 and pregnancy at a statistically significant level of 0.05. Specifically, the health literacy regarding COVID-19 infection (HL) ($\beta = 0.468$) and social support (SS) ($\beta = 0.283$) together accounted for 32.80% of the variance in anxiety ($R^2 = 0.328$). The results are presented in Table 2.

# Discussion

A majority of pregnant women experience moderate levels of anxiety, consistent with a study conducted by Ilska et al. (2022), which found that pregnant women during the COVID-19 pandemic had moderate levels of anxiety. This may be attributed to the government's campaign to practice preventive measures based on the DMHTT principles. Statistical reports on the number of infections and deaths caused by COVID-19 have raised awareness among pregnant women about the importance of taking precautions. Healthcare services have implemented policies such as reducing hospital visits to minimize the infection, utilizing telemedicine, providing prenatal care through mail delivery of medications, and deploying volunteer healthcare workers for community support. Screening for COVID-19 risk factors for individuals entering communities has also been intensified, leading to moderate levels of anxiety among pregnant women.

However, interviews with pregnant women have revealed additional factors contributing to their anxiety. Firstly, the uncertainty of the disease as it is a newly emerged illness. Secondly, pregnant women express concerns about their family members, particularly their husbands who have to leave the house for work and manage various tasks on their behalf. Furthermore, they worry about their older children attending school and the potential for them to contract the virus and spread it to pregnant women or other family members. These concerns align with the previous studies (Yan et al., 2020; Ding et al., 2021; Wang et al., 2022), which have found that increased risk perception among pregnant women leads to greater self-protective behaviors. It is evident that pregnant women take more precautions during the pandemic compared to before their pregnancy, such as wearing double-layered face masks, frequently washing hands, and minimizing outdoor activities. Conversely, when pregnant women perceive a higher risk, it results in increased anxiety levels.

Furthermore, in the context of Thailand, pregnant women who experience pregnancy-related symptoms, upon arriving at the hospital, will undergo a COVID-19 screening. If there is a risk of infection, they will be isolated until test results come back negative. All pregnant women undergo COVID-19 testing, and if no infection

is detected, they will be admitted to the labor room and receive regular medical care from doctors and nurses. However, for cases where COVID-19 infection is confirmed, pregnant women are required to stay in a separate, specifically designed negative-pressure delivery room. Husbands or relatives are not allowed to visit, and communication is facilitated through video call. Isolated care is provided by doctors and nurses. After delivery, the newborn is separated from the mother and kept in a separate room. In cases requiring cesarean section, disposable equipment is used, leading to increased expenses. These factors contribute to heightened anxiety levels among pregnant women. The research also found that the majority of the study sample resided in densely populated urban areas, where the prevalence of COVID-19 infections was higher compared to rural areas. This further increases the anxiety levels among pregnant women residing in urban areas, particularly in Bangkok, the capital city of Thailand, which has recorded more infections than any other province. These findings align with the study by Shangguan et al. (2021), which reported higher anxiety levels regarding COVID-19 infection among pregnant women residing in urban areas compared to rural areas.

According to the research findings, there is a high level of health literacy regarding COVID-19 infection and pregnancy. This knowledge can predict the level of anxiety experienced by pregnant women during the period of COVID-19 outbreaks. Pregnant women exhibit a high level of health literacy regarding COVID-19 infection and pregnancy because of easy access to various sources of information, predominantly through LINE and Facebook applications. In the context of Thailand, the general population has a 77.8% access rate to online social media (Kemp, 2022). Other sources of information include television programs and informative posters found in various locations, which are provided by government agencies in Thailand to disseminate diverse knowledge. The main methods for receiving news and information are through online platforms. Additionally, the government regularly presents news and guidelines on COVID-19 infection and practices through television broadcasts. However, some pregnant women report that excessive exposure to news has led to increased anxiety. This finding is consistent with the previous studies indicated that excessive news consumption can contribute to heightened anxiety (Wang et al., 2022). Health literacy is a crucial factor that enables pregnant women to stay well-informed and reduce their anxiety levels. The research findings demonstrate that knowledge regarding the health literacy of COVID-19 infection can predict the level of anxiety among pregnant women during periods of COVID-19 outbreaks. This is consistent with studies conducted in Japan and Vietnam, which found that pregnant women with higher health knowledge had lower levels of anxiety (Luong et al., 2021).

Furthermore, it has been found that social support for pregnant women during the COVID-19 pandemic is high. This is because the majority of Thai society consists of extended families, where family members have close relationships and a constant concern for each other. Additionally, pregnant women are viewed as individuals who should receive special care. In normal circumstances without disease outbreaks, family members often take good care of pregnant women as a norm. Moreover, Thailand's healthcare system has a strong primary care system, with community health volunteers residing in the same communities as pregnant women, providing close care. This allows pregnant women to seek trusted advice and counseling. Consistent with previous research, it has been found that social support can predict the level of anxiety experienced by pregnant women during the COVID-19 pandemic (Khoury et al., 2021). Pregnant women in Thailand receive social support in four dimensions, as proposed by House's (1981) social support theory. These dimensions include emotional support, where family members provide encouragement, love, understanding, and reduce anxiety for pregnant women. Appraisal support involves receiving positive feedback from family members when pregnant women take good care of themselves. Informational support involves family members and friends assisting in finding news and information, aligning with interview data indicating that pregnant women have an interest in searching for information and have good access to information sources. However, when pregnant women receive a large amount of COVID-19 related information or news for an extended period, it can lead to increased anxiety. Pregnant women choose to receive information through family members or friends to help filter out violent content and provide practical guidance. Instrumental support involves mothers and husbands providing meals or purchasing food, as well as providing daily necessities and items for childbirth preparation. Additionally, healthcare personnel in the public health service deliver prenatal vitamins and other necessary medications to the homes of pregnant women or send them by mail. These factors contribute to the low levels of anxiety experienced by pregnant women in Thailand.

## Conclusion and implication

Pregnant women's anxiety levels during the COVID-19 pandemic are at a moderate level. Predictive factors include health literacy and social support. Therefore, it is necessary to promote health knowledge among pregnant women, particularly through online sources, and provide support from family members and healthcare professionals. Furthermore, it is recommended to use health literacy and social support as guiding principles to develop a model of prenatal care for future implementation.

This study's outcomes offer valuable insights applicable to prenatal care in high-prevalence areas of COVID-19 infection. The methodological rigor, exemplified by a robust sample size, enhances the study's credibility. The use of standardized questionnaires assessing health literacy about COVID-19 and pregnancy, social support, and anxiety related to COVID-19 infection and pregnancy establishes a replicable framework for future research in analogous domains. The explicit delineation of tools and methodology contributes to the further scholarly utility of this study. The results of the study can be utilized in similar context countries.

## Limitations

This research exhibits some limitations that warrant consideration. Notably, the absence of a comparative analysis with non-pregnant cohorts restricts a comprehensive understanding of the broader population. The reliance on an online platform for data collection introduces a potential bias, as participants with greater data accessibility may possess elevated health literacy, potentially skewing concern levels downward. Moreover, the predominantly urban

residence of volunteers may not be representative of pregnant women in rural settings lacking internet-connected mobile phones. These nuanced limitations underscore the need for cautious interpretation but also contribute to the study's transparency.

### Suggestions

Subsequent investigations should adopt a comparative approach, evaluating the concerns of pregnant women against those of diverse population segments. Additionally, comparisons between urban and rural pregnant cohorts, as well as those with and without internet access, would offer valuable insights.

Furthermore, elevating health literacy on COVID-19 among pregnant women involves enhancing their online information access and critical analysis skills. Healthcare personnel should actively bolster social support by offering guidance to families caring for pregnant women and fostering clear communication to mitigate anxiety. The recruitment and training of Village Health Volunteers (VHV) is pivotal for localized care, especially during lockdowns, ensuring effective support for pregnant women.

## Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found in the article/supplementary material.

## Ethics statement

The studies involving humans were approved by 1. Kuakarun Faculty of Nursing Institutional Review Board, Navamindradhiraj University (KFN14/2021) 2. Institutional Review Board Faculty of Medicine Vajira Hospital (COA 152/2564) 3. Bangkok Metropolitan Administration Human Research Ethics Committee (E013h/64_EXP). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

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

## Funding

This research was funded by Navamindradhiraj University Research Fund.

## Acknowledgments

The authors would like to thank Navamindradhiraj University Research Fund for a research grant allocated. The authors would also like to thank the pregnant women for their times and participation.

## Conflict of interest

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

## Publisher's note



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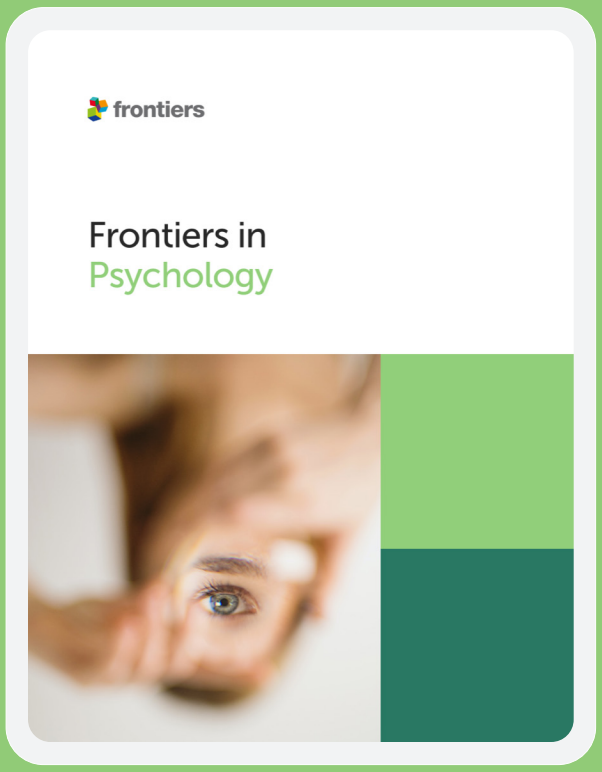


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