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Edited by
Gabriele Nibbio, Chong Chen and Yuka Kotozaki

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Cognitive and mental health improvement under- and post-COVID-19, volume II

Topic editors

Gabriele Nibbio — University of Brescia, Italy

Chong Chen — Yamaguchi University Graduate School of Medicine, Japan

Yuka Kotozaki — Iwate Medical University, Japan

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Table of contents

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Xavier Noel,
Université libre de Bruxelles, Belgium

*CORRESPONDENCE
Gabriele Nibbio
✉ gabriele.nibbio@gmail.com

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Editorial: Cognitive and mental health improvement under- and post-COVID-19, volume II

Gabriele Nibbio[1]*, Yuka Kotozaki[2] and Chong Chen[3]

[1]Department of Clinical and Experimental Sciences, University of Brescia, Brescia, Italy, [2]Department of Hygiene and Preventive Medicine, School of Medicine, Iwate Medical University, Morioka, Iwate, Japan, [3]Division of Neuropsychiatry, Department of Neuroscience, Yamaguchi University Graduate School of Medicine, Ube, Yamaguchi, Japan

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COVID-19, anxiety, depression, posttraumatic growth, resilience, family support, students

Editorial on the Research Topic
Cognitive and mental health improvement under- and post-COVID-19, volume II

The COVID-19 pandemic had an enormous impact on a worldwide level: it was officially declared as a global public health emergency by the World Health Organization from January 30, 2020 to May 5, 2023, totaling more than 777 million documented cases and responsible for >7 million deaths (COVID-19 Cases, 2025).

The pandemic also produced a significant impact on mental health (Moreno et al., 2020; Penninx et al., 2022; Duden et al., 2022; Nibbio et al., 2025). Effects on mental health could be related to the biological effects of SARS-CoV-2, particularly as regards cognitive impairment and persistent fatigue (Ceban et al., 2021; Miskowiak et al., 2021; Galderisi et al., 2023; Corbett et al., 2023; Venkataramani and Winkler, 2022; Global Burden of Disease Long COVID Collaborators et al., 2022), but the widespread and pervasive fear of contagion, the increase in social isolation and the severe and prolonged feelings of loneliness and uncertainty also played a critical role in worsening stress, anxiety and depressive symptoms as well as suicidal ideation (COVID-19 Mental Disorders Collaborators, 2021; Chen et al., 2023; Barlati et al., 2021; Salari et al., 2020; Renaud-Charest et al., 2021). Notably, this situation disproportionately impacted individuals in vulnerable and in marginalized groups (Smith et al., 2020; Barlati et al., 2022; Chen et al., 2024) as well as healthcare workers, which often faced severe levels of stress and burnout (Minelli et al., 2022; Fountoulakis et al., 2023; Leo et al., 2021).

Despite the conclusion of the pandemic emergency, the psychological toll and the lingering effects on mental health persist to this day as significant healthcare issues. In this context, gathering and disseminating evidence as well as developing novel insight in the research field represent objectives of relevance in both a scientific and a societal perspective.

The present Research Topic represents the second volume of a collection of works dedicated to cognitive and mental health improvement during and after the pandemic (Chen et al., 2025) and contains nine different manuscripts.

Five studies investigated psychological outcomes in student samples with the use of dedicated surveys.

Gao et al. surveyed 3,049 vocational students in Sichuan Province, China, and reported high rates of poor mental health, anxiety, depression, and insomnia. High family economic status, low stress from the pandemic, and decreased online activity contributed positively to mental health, while the lack of post-pandemic physical activity, disruptions to education and employment, and deteriorating relationships emerged as negative determinants.

Liu et al. surveyed 1,034 college students in Liaoning Province, China, and reported that perceived COVID-19 stress and negative emotions sequentially mediated the negative relationship between perceived social support and sleep quality, while hope and coping styles moderated the sequential mediating effect.

Zeng et al. surveyed 1,555 college students in Hunan Province, China during the first three months of the pandemic. They observed that better family functioning, measured with the Family APGAR Index, was associated with fewer symptoms of depression, neurasthenia, fear, obsessive-anxiety and hypochondriasis.

Wu surveyed 1,711 college students online in Hebei Province, China and reported that social support positively predicted posttraumatic growth during the pandemic and that belief in a just world and meaning in life mediated the relationship.

Jiang investigated 282 secondary vocational school students in Anhui Province, China and reported that self-efficacy was positively associated with resilience and that emotional intelligence partially mediated this relationship.

Two studies relied on interviews of participants to assess psychological outcomes.

Shahwan et al. interviewed 858 adult Singapore residents, reporting that 22% of the sample showed work burnout while 19% showed personal burnout, with younger participants being more frequently burnt-out. Stress was a risk factor, while social support was a protective factor. Path analysis showed that the relation between social support and burnout was partially explained by resilience.

Zhang and Bian interviewed 10 students of Z University, China, and reported that while participants perceived university closed management as a measure enhancing safety and promoting learning engagement, they also emphasized the adverse effects of the pandemic on their physical health, psychology, and social life.

Two studies investigated psychological outcomes in specific populations.

Chen et al. surveyed 327 individuals during the first year of the pandemic in Shanghai, China. 27.8% and 20.5% of participants reported symptoms of depression and anxiety, respectively. Pre-existing health conditions, lack of medical insurance, concerns about shortages of daily necessities during quarantine, and "guilt and self-blame" emerged as risk factors for both depression and anxiety. Moreover, concerns regarding the impact of the epidemic on studies or work and denial were related to depression, while concerns regarding potential rejection or discrimination from the outside world after quarantine were related to anxiety.

Fu et al. conducted a secondary analysis of the longitudinal data of 3,550 adults aged 60 and older who participated in both the 2016 and 2020 waves of the United States Health and Retirement Survey. They conducted a Latent Profile Analysis and a Transition Analysis and found that 42% of the participants reported personality changes during the pandemic. Higher levels of COVID-19 concern were associated with transitioning to Poor-adjusted from Moderate or Well-adjusted categories, while challenges such as healthcare delays and financial hardships hindered transitions from Poor- to Moderate-adjusted and increased the likelihood of Moderate-adjusted individuals transitioning to Poor-adjusted. Finally, Poor-adjusted individuals who provided help to others were more likely to transition to Moderate-adjusted.

The findings from these original studies shed light on the psychological impact of the pandemic across different populations. Several key patterns emerged.

Firstly, the pandemic and related measures, such as lockdowns, have significantly worsened mental health, as evidenced by diverse assessments across various groups.

Secondly, multiple pathways contribute to these negative effects, including concerns about shortages of daily necessities, disruptions in education and employment, financial hardship, healthcare delays, deteriorating relationships, and reduced physical activity. Understanding these pathways can help mitigate the pandemic's psychological toll.

Third, several risk and protective factors have been identified. Demographic factors, such as younger age, and maladaptive coping strategies, including self-blame and denial, are linked to poorer psychological adaptation. In contrast, environmental and psychological factors—such as social support, socioeconomic stability, resilience, hope, a sense of meaning, self-efficacy, and emotional intelligence—serve as protective buffers.

In conclusion, the present Research Topic provides novel insights into both risk elements and protective factors, informing researchers and clinicians on potential targets to contain the impact of adverse effects and, overall, to strengthen psychological resilience.

Author contributions

GN: Writing – original draft, Writing – review & editing. YK: Writing – original draft, Writing – review & editing. CC: Writing – original draft, Writing – review & editing.

Conflict of interest

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

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EDITED BY
Gabriele Nibbio,
University of Brescia, Italy

REVIEWED BY
Dan-Cristian Dabija,
Babeş-Bolyai University, Romania
Dong Yang,
Krirk University, Thailand
Ana Moreira,
University Institute of Psychological, Social and Life Sciences (ISPA), Portugal
Hui Xu,
McMaster University, Canada

*CORRESPONDENCE
Aoyu Wu
w.ay@foxmail.com

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The relationship of social support to posttraumatic growth in COVID-19 among college students after experiencing campus lockdown: the effects of belief in a just world and meaning in life

Aoyu Wu*

Department of Civil Engineering, Hebei Jiaotong Vocational and Technical College, Shijiazhuang, China

Background: Campus lockdown orders were issued for the purpose of preventing and controlling COVID-19, which resulted in psychological problems among college students. However, the experiences they have during the pandemic may also lead to positive personal changes, including posttraumatic growth (PTG). The current study examined the mediating role of belief in a just world and meaning in life in social support and PTG during the COVID-19 campus lockdown.

Method: An online survey was conducted on 1711 college students in Hebei Province, China. Based on the survey results, a structural equation model was established.

Results: Social support positively predicted PTG. Furthermore, belief in a just world and meaning in life played a mediating role between social support and PTG respectively. Besides, social support could also predict PTG through the multiple serial mediating effect of belief in a just world and meaning in life.

Conclusion: These results indicated mechanisms by which social support influenced PTG, and this provided insights into how to promote post-traumatic growth among university students in the post-pandemic period.

KEYWORDS

COVID-19, campus lockdown, social support, belief in a just world, meaning in life, PTG

Introduction

The global outbreak of COVID-19 in 2020 has had a major impact on people's lives, not only threatening the physical health of individuals, but also impacting people's mental health (1–6). The COVID-19 is considered as a new type of collective trauma (7). Research found that insomnia and posttraumatic stress symptoms are very common among college students, 31.33% and 16.36% of college students are found having depression and anxiety symptoms (8). Changes in living environment and learning patterns, unable to participate in social activities normally, and especially having COVID-19-related viral panic and contagious fear about the epidemic have impacted the mental health of college students greatly (9, 10). In addition to causing negative psychological effects on individuals, traumatic events may also lead to positive changes in their worldview, values, attitudes towards themselves and others, leading to posttraumatic growth (PTG) (11), which is a positive psychological change experienced by individuals after fighting against traumatic events (12). Many researches are currently focused on the negative effects of the pandemic on mental health, however, in the post-pandemic era, it is very relevant for researchers to turn their attention to the potential growth opportunities presented by adversity. Moreover, for the sake of college students' health and well-being, lockdown orders were issued to prevent the epidemic on campus at the beginning of the Fall semester of 2022 in China. Little research is done in the context of campus lockdown, considering the distinctiveness of this policy, it is necessary to conduct research on college students who have experienced campus lockdowns. During the pandemic, whether it is the destruction caused by the epidemic in media reports or the experience of infection, individuals are more likely to reflect on themselves actively, e.g., interpersonal relationships, work, and life status, and think about the meaning of life, which will stimulate the occurrence of posttraumatic growth.

"What doesn't kill you makes you stronger", thus spoke Nietzsche. Seizing opportunities in times of crisis and promoting growth is a desirable vision for people, but turning danger into opportunity requires certain conditions. Posttraumatic growth (PTG) refers to the positive psychological changes that individuals experience after experiencing traumatic situations or events (12). The Theory of Crises and Personal Growth (13) believes that environmental factors are the key affecting whether individuals could gain growth or not after trauma, and social support, which refers to the material and spiritual assistance a person gained from social relationships such as family, relatives, friends, and organizations (14), is an important environmental factor. The Model of Thriving Through Relationships (15) believes that the reason for individuals to experience Posttraumatic Growth is due to having a strong social support system. Good interpersonal relationships can provide individuals with a safe atmosphere, facilitate the expression of negative emotions, and enable them to be accepted and comforted promptly, which is beneficial for individuals to devote more energy to coping with crisis events, encouraging individuals to actively think about traumatic events and reduce psychological distress. Therefore, this theory believes that social support can not only promote individuals to discover their potentials to cope with difficulties, but also help them reflect on crisis events and construct their cognition actively, discover the meaning behind traumatic events, and achieve post-traumatic growth. Besides, from the perspective of Resource Conservation Theory (16), social support is a social resource owned by individuals that provides material security and enables individuals to obtain psychological support when under pressure, thereby promoting posttraumatic growth. Numerous studies have shown that social support can predict posttraumatic growth significantly (17–19). On this basis, this study proposes H1: Social support positively predicts posttraumatic growth among college students.

The purpose of the present study is to explore the mechanism of social support on PTG in the context of COVID-19 epidemic by establishing a structural equation model to examine the mediating role of belief in a just world and meaning in life in the relationship between social support and PTG.

The mediating role of belief in a just world

The theory of belief in a just world holds that people need to believe that the world they live in is stable and orderly, with predictable outcomes, and that they will be treated fairly without becoming victims of unforeseeable disasters. This provides people with a sense of security and control. Only under this premise can people have confidence in the future and pursue long-term goals with the belief that they will eventually get what they deserve (20). Therefore, researchers consider belief in a just world to be an important psychological resource. During the COVID-19 epidemic, quarantine became the most common coping measure, and social deprivation would affect individuals' belief in a just world significantly (21). At this time, effective social support could provide individuals with a safe environment and coping resources (19, 22–24), and buffer the psychological impact of the epidemic, increasing individuals' belief in a just world level (18, 25, 26). Individuals with high belief in a just world have strong emotional regulation abilities (21, 27), which helps to maintain a good level of mental health and improve well-being in life. According to the Posttraumatic Growth Model (12), an individual's perception of the world is an important predictor of posttraumatic growth. After experiencing disaster events, individuals' beliefs in a just world often change (28). Individuals with high belief in a just world tend to have higher levels of trust in interpersonal and social organizational relationships mostly and have a more positive attitude towards the future (29). Positive perceptions of the world can increase confidence in the face of injustice (27), and buffer the negative effects of traumatic events, which promotes posttraumatic growth (28). Therefore, we hypothesize that the belief in a just world may have a mediating effect between social support and posttraumatic growth accordingly. On this basis, this study proposes H2: Belief in a just world plays a mediating role between social support and posttraumatic growth among college students.

The mediating role of meaning in life

Meaning in life refers to an individual's perception and awareness of human beings and the nature of their existence, as well as those things that they consider important, including the two dimensions of presence of meaning and search for meaning (30). According to the Shattered Assumptions Theory of Posttraumatic Growth (31) traumatic events can shatter assumptions about oneself and the world, making it necessary to rethink the meaning of life. When the meaning in life is reconstructed, individuals would form a new understanding of themselves and the world, and the new hypothesis towards the world begins to emerge. After experiencing a traumatic event, support and encouragement from others are important sources of meaning in life (32). Social support helps to reconstruct the meaning of traumatic events, and view adversity from a positive perspective, through which individuals could explore psychological resources to cope with difficulties and establish a basic understanding of themselves and the world. What's more, new life goals that individuals striving for will be set (33). Research has shown that social support provides a warm and receptive psychological atmosphere that allows people to confide in others when they are in pain, thereby promoting their sense of meaning and hope facing adversity (34). Therefore, social support is positively correlated with meaning in life significantly (32, 35). Moreover, individuals who experience the meaning of life in the face of difficulties are more likely to experience posttraumatic growth (36–39). In view with the above, we hypothesize that social support may influence posttraumatic growth through meaning in life. On this basis, this study proposes H3: Meaning in life plays a mediating role between social support and posttraumatic growth among college students.

The multiple serial mediating role of belief in a just world and meaning in life

An effective social support system provides people with a safe psychological atmosphere, alleviates psychological impact when facing difficulties, and helps maintain a high belief in a just world. According to the Meaning-Making Model (40), beliefs constitute the core schema interpreting life experiences which are an important foundation to develop unique and stable life meaning experiences for individuals. Beliefs in a just world can guide people to conduct more positive self-evaluation and provide internal motivations to pursue long-term goals, helping them experience a higher sense of meaning in life (41) (42). When individuals witness or experience severe injustice, such that they are unable to maintain their belief in a just world, they may believe that the world is fundamentally random, and nothing goes around comes around. This may lead them to give up on long-term goals and seek immediate short-term goals, or simply giving them all up (20), reducing the sense of meaning in life. In addition, meaning of life enables individuals to recognize the value of their own existence, have a higher sense of self-efficacy, maintain a positive attitude in the face of difficulties (43), and strive to achieve goals in adversity. These positive changes in worldview, values, and attitudes about self and interpersonal relationships may indicate one's posttraumatic growth in the face of adversity. Therefore, we can infer that social support may have a positive effect on the belief in a just world when facing difficulties, and individuals with a higher belief in a just world have a higher sense of life meaning by rethinking themselves and the world, which is conducive to the formation of posttraumatic growth. On this basis, this study proposes H4: Belief in a just world and meaning in life mediate the relationship between social support and posttraumatic growth among college students through their chain mediating effect.

To sum up, this study proposes the following hypothesis, and the conceptual model is presented in Figure 1:

H1: Social support positively predicts posttraumatic growth among college students.

H2: Belief in a just world plays a mediating role between social support and posttraumatic growth among college students.

H3: Meaning in life plays a mediating role between social support and posttraumatic growth among college students.

H4: Belief in a just world and meaning in life mediate the relationship between social support and posttraumatic growth among college students through their chain mediating effect.

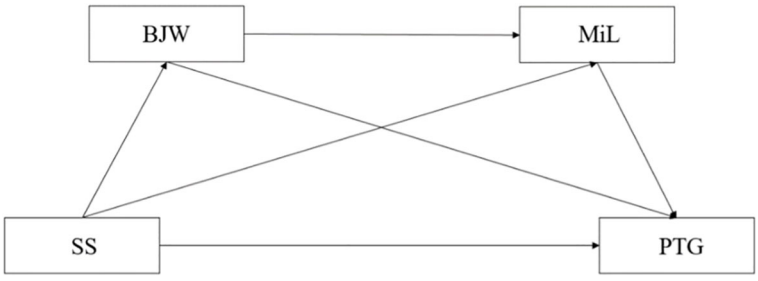

FIGURE 1
Conceptual model; SS, social support; BJW, belief in a just world; MiL, meaning in life.

Method

Participants

An online questionnaire survey was conducted on 1711 college students (mean age = 19.89 years old, *SD* = 2.36, range = 18-24 years old), among which 1047 males (61.2%) and 664 females (38.8%) participated, including undergraduate and vocational colleges with 51 majors offered, in Hebei Province between March 7th and 15th, 2023. There were 847 freshmen (51.1%), 697 sophomores (40.7%), 73 juniors (4.3%), and 67 seniors (4.0%) participated in the survey. It is worth mentioning that the students were all quarantined at school during the fall semester of 2022.

Measures

Perceived social support scale

The Perceived Social Support Scale (PSSS) was compiled by Zimet et al. (44) and the Chinese version was revised by Jiang Qianjin (45). The revised scale consists of 12 items arising from three groups, namely family, friend, and significant others. Participants answered these using a 7-point Likert scale ranging from 1 (completely disagree) to 7 (completely agree). The total score reflects the overall level of social support perceived by the individual, and greater score indicates a higher level of perceived social support. The Cronbach's alpha was 0.96 in the present study. Factor loading of every item is > 0.4, and AMOS was used to conducted Confirmatory Factor Analysis (CFA) on the questionnaire and the results showed that the model fit is well, indicating the validity of the tools is acceptable: χ^2/df = 1.92, CFI = 0.91, TLI = 0.92, RMSEA = 0.069, SRMR = 0.06. The original data was organized in Stata/MP13.1, and average variance extracted (AVE) and composite reliability (CR) are calculated using Excel 2013 (46). AVE and CR on family support are 0.49 and 0.7, AVE and CR on friend support are 0.55 and 0.83, and AVE and CR on other support are 0.48 and 0.79, indicating the validity of the tools is acceptable.

Belief in a just world scale

Belief in a just world scale developed by Zhou Chunyan (20) was used. The scale consists of 17 items, including two lie detection items, which were rated on a 6-point Likert scale ranging from 1 (completely disagree) to 6 (completely agree). The total score reflects the level of belief in a just world, and greater score indicates a higher level of belief in a just world. The Cronbach's alpha for the total scale was 0.94 in the present study. Factor loading of every item is > 0.4, and AMOS was used to conducted CFA on the questionnaire and the results showed that the model fit is well, indicating the validity of the tools is acceptable: χ^2/df = 2.05, CFI = 0.91, TLI = 0.90, RMSEA = 0.075, SRMR = 0.08. The original data was organized in Stata/MP13.1, and average variance extracted (AVE) and composite reliability (CR) are calculated using Excel 2013 (46). AVE and CR on self-present are 0.44 and 0.67, AVE and CR on others-future are 0.45 and 0.67, AVE and CR on other-present are 0.36 and 0.61, and AVE and CR on self-future are 0.47 and 0.78 respectively, indicating the validity of the tools is acceptable.

Meaning in life questionnaire

The present study used the Meaning in Life Questionnaire (MLQ) compiled by Steger, Frazier, Oishi, and Kaler (30) and translated by Liu and Gan (47). The questionnaire consists of two subscales: the search for meaning and the presence of meaning with a total of nine items. Participants respond to the items on a 7-point Likert scale ranging from 1 (absolutely untrue) to 7 (absolutely true). Greater score indicates higher presence and search, and the Cronbach's alpha was 0.86 for the total scale in the current study. Factor loading of every item is > 0.4, and AMOS was used to conducted CFA on the questionnaire and the results showed that the model fit is well, indicating the validity of the tools is acceptable: χ^2/df = 1.91, CFI = 0.92, TLI = 0.91, RMSEA = 0.069, SRMR = 0.06. AVE and CR on search for meaning are 0.45 and 0.78, and AVE and CR on presence of meaning are 0.51 and 0.79 respectively, indicating the validity of the tools is acceptable.

Posttraumatic growth inventory

PTG was assessed using the Posttraumatic Growth Inventory (PTGI) developed by Tedeschi and Calhoun (11) and revised by Wang and Wu (48). There are a total of 22 items, including five subscales, namely personal strength, new possibilities, relating to others, appreciation of life, and spiritual change. It was scored on a 6-point Likert scale from 0 (no change) to 5 (experienced this change to a very great degree). The Cronbach's alpha was 0.97 for this scale in our sample. Factor loading of every item is > 0.4, and AMOS was used to conducted CFA on the questionnaire and the results showed that the model fit is well, indicating the validity of the tools is acceptable: χ^2/df = 1.94, CFI = 0.95, TLI = 0.93, RMSEA = 0.06, SRMR = 0.06. AVE and CR on personal strength are 0.51 and 0.79 respectively, AVE and CR on new possibilities are 0.47 and 0.78 respectively, AVE and CR on relating to others are 0.45 and 0.76 respectively, AVE and CR on appreciation of life are 0.55 and 0.83 respectively, AVE and CR spiritual change are 0.49 and 0.79 respectively, indicating the validity of the tools is acceptable.

Procedure and date analysis

The statistical analyses were performed using SPSS 24.0 and Amos 24.0. Firstly, we used Harman's single factor test to determine if there is a common method bias (49). Factor analysis was conducted on all items, and a total of 7 factors with eigenvalues > 1 were selected. The variation explained by the first factor was 30.2%, less than the critical value of 40%, indicating that there was no significant common method bias in this study. Afterwards, descriptive and correlation analysis were conducted. On this basis, a structural equation modeling method (50) was used to examine the mediating role of belief in a just world and meaning in life between social support and posttraumatic growth, after controlling gender, place of origin, and income as covariates.

Results

Discrepancy test and correlation analysis of various variables

The results show that there was no significant difference in grade and whether the only child or not among the variables. Tables 1, 2 show the differences in gender, origin, and income level among the variables. From Table 1, the gender difference in the belief in a just world and post traumatic growth is significant, with female students having significantly higher scores in the belief in a just world than male students; and the posttraumatic growth score of males is significantly higher than that of females. In addition, there were significant differences in social support, belief in a just world, and sense of life significance among students from different regions of origin. College students from urban areas scored significantly higher on these three variables than college students from rural areas. There are significant differences in social support, belief in a just world, and meaning in life at the income level. Students from middle-income families have significantly higher scores in social support, belief in a just world, and meaning in life than students from low and high income families.

Table 3 shows the mean scores, standard deviations, and correlation matrices for each variable. The Pearson correlation analysis indicates that social support, belief in a just world, meaning in life, and posttraumatic growth are positively inter-correlated among one another.

Testing for the mediation effects

The PROCESS v4.2 macro program was used for the mediation analysis, repeated sampling 5000 times from the original date to calculate the 95% CI. If the 95% CI of the standardized path coefficient does not contain 0, it indicates that the mediating effect is significant (51). The results show that after controlling for gender, place of origin, and income level, the overall fit model fit is within an acceptable range (χ^2/df = 8.63, CFI = 0.98,TLI = 0.97, RMSEA = 0.067), and the model is presented in Figure 2.

The results show that the effect of social support on PTG was significant (direct effect = 0.31, 95% CI: 0.267, 0.356), while that on belief in a just world and meaning in life were significant mediators between social support and PTG (total indirect effect = 0.15, 95% CI: 0.111, 0.194). And the mediating effect is partial. To be specific, belief in a just world played a mediating role between social support and PTG (indirect effect = 0.08; 95% CI: 0.040, 0.114); meaning in life played a mediating role between social support and PTG (indirect effect = 0.03, 95% CI: 0.019, 0.048); belief in a just world and meaning in life played a serial mediating role between social support and PTG (indirect effect = 0.04, 95% CI: 0.028, 0.060). None of the bootstrapped 95% CI includes zero, confirming the mediating effect of belief in a just world and meaning in life. Furthermore, in the relationship between social support and PTG, the mediating effect of belief in a just world was significantly greater than that of meaning in life (the mediating effect of belief in a just world minus the mediating effect of meaning in life = 0.05; 95% CI: 0.003, 0.100). These results illustrate that belief in a just world and meaning in life play a mediating role between social support and PTG. Moreover, compared to meaning in life, belief in a just world had a more substantial relation on social support to PTG of college students after COVID-19 campus lockdown.

Discussion

The purpose of the present study is to explore the mechanism of social support on PTG in the context of COVID-19 epidemic by establishing a structural equation model to examine the mediating role of belief in a just world and meaning in life in the relationship between social support and PTG.

The results of the study showed that social support could positively predict PTG, which was consistent with previous studies (18, 19, 25). From the perspective of the Model of Thriving through Relationships, social support, as an important personal resource, provides individuals with a safe atmosphere and creates an environment to alleviate negative emotions facing difficulties, which is beneficial to view the current adversity from a positive perspective, thereby promoting the development of PTG. The study further investigated the mediating effect between social support and PTG and found that both the belief in a just world and meaning in life can play a mediating role.

We found that social support could promote post-traumatic growth by positively predicting the belief in a just world, which was consistent with previous research (18, 52–54). As a public health emergency of international concern, the COVID-19 disrupted people's routines. Continuous quarantine and isolation have

TABLE 1 Analysis of differences in gender and origin among various variables.

	Gender			Origin		
	Male	Female		Urban	Rural	
	(*n*=1047)	(*n*=664)	*t*	(*n*=434)	(*n*=1277)	*t*
SS	5.23 ± 1.68	5.23 ± 1.08	0.89	5.38 ± 1.17	5.18 ± 1.12	3.13***
BJW	4.11 ± 0.98	4.25 ± 0.76	3.33**	4.24 ± 0.92	4.13 ± 0.89	2.18*
MiL	4.98 ± 1.10	4.89 ± 0.97	1.71	5.04 ± 1.08	4.92 ± 1.04	2.15*
PTG	4.25 ± 1.02	4.12 ± 0.95	2.56**	4.22 ± 1.04	4.20 ± 0.98	0.32

*p<0.05,**p<0.01,***p<0.001; SS, social support; BJW, belief in a just world; MiL, meaning in life.

TABLE 2 Analysis of differences in income levels among various variables.

	Income levels			
	Low-income (*n*=1369)	Middle-income (*n*=277)	High-income (*n*=65)	F
SS	5.18 ± 1.12	5.44 ± 1.14	5.38 ± 1.30	6.57**
BJW	4.12 ± 0.89	4.33 ± 0.89	4.17 ± 1.51	5.95**
MiL	4.91 ± 1.03	5.12 ± 1.04	4.92 ± 1.39	4.38**
PTG	4.18 ± 0.98	4.31 ± 0.96	4.28 ± 1.30	2.01

**p<0.01; SS, social support; BJW, belief in a just world; MiL, meaning in life.

TABLE 3 Descriptive results and correlation analysis between variables.

Variables	M	SD	1	2	3	4
1. SS	5.23	1.14				
2. BJW	4.16	0.90	0.63**			
3. MiL	4.95	1.05	0.47**	0.55**		
4. PTG	4.20	0.99	0.43**	0.46**	0.43**	

n=1711; **p<0.01; SS, social support; BJW, belief in a just world; MiL, meaning in life.

reduced the sense of control and security that individuals felt. As for college students in their youth who cannot have a normal campus life, the deprivation of interpersonal relations reduced their belief in a just world. To prevent the epidemic on campus, China had adopted measures of lockdowns even in campus without outbreaks. This measure had protected the safety of staff's lives, but it had also harmed the psychological well-being of students to some extent (55). Strict lockdowns prevented college students from engaging in normal social interactions with people outside of their own school (56), and they may feel treated unjustly. People were unable to control their own lives. The sense of absurdity when order was broken could easily make people feel that life is meaningless, and their sense of meaning was reduced (57). Afterwards, China had adjusted its policies in a timely manner based on the development of COVID-19, and no longer imposed strict lockdowns on campus. Staff were able to come in and go out of schools normally. The restoration of social interaction and life order allowed people to rebuild meaning in life, which facilitate PTG (19). Nowadays, in the post-pandemic era, the order of life is gradually being restored and college students value interpersonal relationships even more (58). With a good social support system, college students begin to reconstruct their understanding of the world. Moreover, normal social interaction makes college students feel supported and cared for by others, which helps to maintain and improve the quality of existing interpersonal relationships, thereby obtaining a higher sense of social support (59). To sum up, in warm and receptive psychological environment like this, the psychological impact of the epidemic on college students can be alleviated, which helps to rebuild belief in a just world. The positive understanding of the world can promote the development of PTG. This result validates the Posttraumatic Growth Model (12).

Moreover, the study showed that social support could promote PTG by enhancing meaning in life of college students. Specifically, encouragement and support from others are important sources for individuals to have higher level of meaning in life when experiencing difficulties. Previous studies have also found that maintaining the

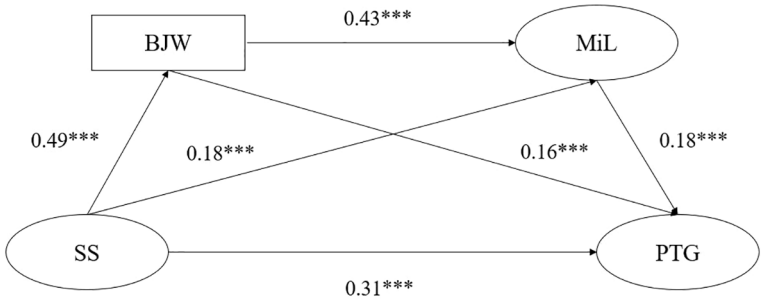

FIGURE 2
Proposed mediation model. ***p<0.001.

meaning in life in adversity helps individuals face challenges with a more positive mindset. During the pandemic, meaning in life felt by college students played a crucial role in their psychological growth. According to the Shattered Assumptions Theory of Posttraumatic Growth, the things that happened pandemic may break college students' original understanding of the world, causing them to lose the sense of control over themselves, others, or the world, and even the meaning in life as a result (60). In the post pandemic era, normal social interactions enable college students to feel that they have more social support. And the warm interpersonal environment can divert their attention from past negative experiences, encouraging individuals to pay attention to positive information. In this way, college students gradually regain a sense of control over their lives, so they set and strive for new goals, which will reshape their meaning in life. Besides, the meaning in life can also help college students discover the positive connotations behind disasters, which enables them to gain hope and face life with a grateful attitude. From the past experiences, college students learn to explore their potential when facing difficulties, thereby achieving PTG.

Our results also confirmed that social support played a positive role in predicting PTG through a chain mediating effect of belief in a just world and meaning in life. In the post-pandemic period, college students with high social support experience more psychological warmth, providing a safe environment and coping resources, which enables them to have a high belief in a just world even in a disordered life. The strength that college students leads them to recognize and reassess the difficult situation they are facing actively, through which helps them construct meaning in life, and see adversity as an opportunity to stimulate their own growth, namely PTG.

In all, through this study, we found that the impact of social support on PTG can be achieved through the belief in a just world and meaning of life. The research integrated the Model of Thriving Through Relationships (15) and the Shatter Assumptions Theory (31) effectively, which has enlightening significance for the study of the mechanism of PTG. In addition, this study also provided some inspiration for the well-being of college students after the epidemic. To promote PTG of college students who have experienced adversity in real life, social support should be provided to individuals. For example, during school lockdown and quarantine, school staff should provide enough help to college students. And timely attention ought to be paid to college students with prominent emotional fluctuations. In particular, staff need to help students establish trust in themselves and the world and make them realize the meaning of life to avoid losing faith in life during adversity. What's more, this study suggests that except for focusing on alleviating negative psychological problems among college students affected by the epidemic, a positive belief in the world should be established as well. To maintain the meaning in life and people's well-being, the policy makers should take people's need for the belief in a just world into account. To achieve PTG, college students ought to master the ability to explore the strength faced with problems and learn to overcome difficulties.

However, this study also has some limitations. This study adopted a cross-sectional study design and cannot discuss the changes and causal relationships between variables over time. Some researchers believe that PTG can be individual' coping strategies when facing traumatic events, which may fade after a period (61). So future research can follow-up this group to further confirm incidence of PTG and the long-term mechanism of social support on it. Besides, compared to other countries, China's policies had their own distinctive characteristics, so the experiences of Chinese college students during the epidemic is unique as well, and it is necessary to verify the model's generalizability in cross-cultural scenarios.

Conclusions

Through the research on the relationship between social support, belief in a just world, meaning in life and posttraumatic growth of college students who had experienced school lockdown during COVID-19 pandemic, the following conclusions are drawn: Social support can not only directly promote PTG, but also through belief in a just world and the meaning in life. It can also be promoted through the serial mediation effect of belief in a just world and meaning in life.

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 humans were approved by The ethics committee of Hebei Jiaotong Vocational and Technical College. 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. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

AW: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The author declares 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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EDITED BY
Yuka Kotozaki,
Iwate Medical University, Japan

REVIEWED BY
Agata Ewa Chudzicka-Czupała,
SWPS University of Social Sciences and Humanities, Poland
Maria Jose Gonzalez-Olmo,
Rey Juan Carlos University, Spain

*CORRESPONDENCE
Qianqian Zhang
2625809032@qq.com
Liang Chen
chenlfly@126.com

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What can we learn about stress and sleep from COVID-19 pandemic—perspective from the theory of preventive stress management

Fang Liu[1], Weijie Liang[1], Hanqi Li[1], Yuyang Li[1], Yue Zhang[1], Lei Ding[1], Qianqian Zhang[1]* and Liang Chen[2]*

[1]College of Teacher Education, Ningbo University, Ningbo, Zhejiang, China, [2]Research Center for Psychological Development, University of Science and Technology Liaoning, Anshan, Liaoning, China

Background: The COVID-19 pandemic has presented unique challenges to individuals worldwide, with a significant focus on the impact on sleep. However, the precise mechanisms through which emotional and cognitive variables mediate this relationship remain unclear. To expand our comprehensive understanding of variables, the present study utilizes the Preventive Stress Management theory, to test the relationship between perceived social support and sleep quality, as well as the effect of perceived COVID-19 stress, hope, negative emotions and coping styles.

Methods: Data were collected in March 2022 from 1,034 college students in two universities located in Liaoning Province, China, using an online survey platform regarding perceived social support, perceived COVID-19 stress, sleep quality, hope, negative emotions and coping styles. The moderated mediation model were conducted using Process macro program (Model 6) and the syntax in SPSS.

Results: The results revealed perceived COVID-19 stress and negative emotions sequentially mediated the negative relationship between perceived social support and sleep quality. Furthermore, hope and coping styles were found to moderate the sequential mediating effect.

Conclusion: The present study sheds light on the pathways that affect sleep quality among college students during the COVID-19 pandemic. Findings highlight the protective roles played by positive social and personal resources, such as perceived social support, hope, and effective coping styles, against sleep problems. These insights have important implications for the development of targeted interventions to improve sleep outcomes during this challenging time.

KEYWORDS

COVID-19 pandemic, perceived social support, coping tendency, hope, stress, sleep quality

1 Introduction

The COVID-19 pandemic has had profound health impacts globally, one of which is the significant rise in sleep issues. This concern has garnered considerable attention from researchers, with multiple studies highlighting the strong link between perceived stress from the pandemic and compromised sleep quality (1–3). Furthermore, certain investigators have delved into the potential mechanisms underlying this association

(4, 5). However, a gap remains in the literature, as these studies often overlook the theoretical perspectives that could offer deeper insights into the intricate relationships among these variables.

The Theory of Preventive Stress Management (TPSM) (6–8) provides a comprehensive framework for understanding how perceived stress and its effects can be reduced during a pandemic outbreak. This theory outlines three distinct stages: stress generation, stress response, and consequences. By applying different preventive measures at each stage, we can effectively mitigate perceived stress, the stress response, and its consequences. These measures can be grouped into primary, secondary, and tertiary prevention (9, 10). Applying TPSM to the COVID-19 pandemic, primary prevention aims to intervene in COVID-19-related stressors, focusing mainly on the causes of stress; secondary prevention aims to intervene in stress responses, focusing mainly on individual actions and coping; and tertiary prevention aims to intervene in the final outcomes of stress, such as treating poor COVID-19 outcomes. In the present study, we focus on primary and secondary prevention, specifically examining how perceived social support, coping styles, and trait hope can counteract perceived COVID-19 stress.

According to TPSM, stressors are defined as physiological and psychological needs that triggers stress responses in individuals (6, 9, 11). This diverges from the conventional conception of stressors as merely stimulus events. Rather, it aligns with the initial assessment of stimulus events in cognitive appraisal theory (12). According to this theory, individuals determine whether a stimulus event affects them or not, and if it is perceived as harmful, it is considered a stressor. Hence, stressors are actually perceived stress. Perceived stress can be affected by two levels of factors; first, the frequency and intensity of the stimulus event, the more frequently the stimulus event occurs and the greater the intensity, the higher the level of stress perceived by the individual; and second, individual differences, evaluations of the stimulus event may vary from person to person, and for the same stimulus event, some people may perceive stress, while others may not, or there may be a level of difference.

During the COVID-19 pandemic, perceived COVID-19 stress among college students may stem from the following areas: academic (concerns about grades, rankings, and the future), health (concerns and fears about illness), interpersonal (difficulty achieving social closeness and may worry about friends or family), financial (debt and expenses), and family life (e.g., worrying about missing every phone call from parents) (13). Many of these aspects can be mitigated by social support. For example, family support will go a long way in directly alleviating financial stress, while help from classmates and friends may go a long way in alleviating difficulties in academic and interpersonal areas. In addition, support from others implies information about the good status of others, which alleviates individuals' worries about others. Therefore, we propose Hypothesis 1a: Perceived social support is negatively related to perceived COVID-19 stress.

Besides social support, personal traits, such as trait hope, can also influence how people perceive stress. According to Snyder's hope theory (14, 15), hope is a cognitive structure with two aspects: pathway thinking and agency thinking (15, 16). Pathway thinking is thinking about strategies to achieve a goal; for a highly hopeful person pursuing a specific goal, path thinking means identifying a feasible path and having confidence in that path. Agency thinking, on the other hand, is the motivational component of hope, which represents an individual's ability to use his or her own path to reach a desired goal (15). Stress arises when a particular situation threatens to reach a goal (17). In the case of the COVID-19 pandemic, pandemic may threaten college students' achievement of academic goals, interpersonal goals, thus causing stress. However, not all individuals will experience the same stress, hope theory suggests that individuals with high trait hope may be less likely to perceive these obstacles as stressful compared to individuals with low trait hope (15). In a COVID-19-related study, Gallagher et al. (18) also found that higher trait hope was associated with greater sense of wellbeing and perceived emotional control, as well as lower levels of anxiety and perceived COVID-19 stress, additionally, trait hope had an indirect effect on all outcomes through perceived emotional control. Therefore, we propose Hypothesis 1b: Trait hope is negatively associated with perceived COVID-19 stress.

In addition, trait hope may also amplify the role of social support. High hopefuls have a positive bias (15) and therefore may overestimate the effectiveness of treatment (19). As for the effect on perceived stress, overestimating the effectiveness of social support may contribute to reducing perceived COVID-19 stress. Therefore, we propose Hypothesis 1c: Trait hope will interact with social support to amplify the effect of social support on perceived stress.

TPSM posits that perceived stress leads to two types of responses (6). One is eustress, which is a positive, healthy response that leads to motivation and challenge (e.g., scientific pressure may stimulate a researcher's potential); the second is distress, which is a negative response that may result from a lack of stimulation (e.g., boredom), or it may result from a stress response that is too frequent, intense, or prolonged (e.g., anxiety). In current study, we focus on distress and use negative affect as measured by the Depression Anxiety Stress Scale (DASS-21). This scale is a self-reported questionnaire containing 21 questions designed to measure the extent of three negative affective states: depression, anxiety, and stress. Subscale of depression focuses on low mood, motivation, and self-esteem, and subscale of anxiety focuses on physiological activation, perceived panic, and fear, while subscale of stress focuses on tension and irritability (20). Thus, this scale provides a more comprehensive description of the symptoms of distress.

A large number of studies have now validated the positive correlation between perceived COVID-19 stress and negative emotions [e.g., (21–27)]. In addition, according to cognitive appraisal theory, assessing events as harmful leads to negative emotional responses (12). Therefore, we propose Hypothesis 2a: Perceived COVID-19 stress is positively correlated with negative emotions.

According to TPSM, the higher the perceived stress, the more likely an individual is to use passive coping rather than active coping (6, 28), and therefore, an individual's stress response can be moderated through secondary prevention. Secondary prevention focuses on several positive coping strategies, including emotion regulation and cognitive behavioral therapy (e.g., relaxation techniques, meditation techniques, hypnosis, and biofeedback training), faith and religion-based practices, emotional expression,

exercise and wellness programs (6, 9, 14). Therefore, the role of coping styles may be consistent with secondary prevention.

At a more specific mechanistic level, the moderating effect of coping styles between perceived COVID-19 stress and negative emotions can be explained by cognitive appraisal theory. Cognitive appraisal theory suggests that individuals have three levels of appraisal of stimulus events. Among them, a primary appraisal is the individual's assessment of the relationship between the stimulus event and their interests, which is directly related to the perceived stress level. Secondary evaluation is the individual's assessment of the regulation and control of their response behavior, which is mainly related to whether people can control the stress events and the degree of control. When individuals assess their resources as insufficient or uncontrollable, individuals will experience negative emotions. Tertiary evaluation refers to the individual's assessment of the effectiveness and appropriateness of their emotional and behavioral responses. Negative emotions may arise when individuals perceive that their behavior is not effective enough (12). In this context, active and passive coping styles may have three opposite effects: first, active coping styles may increase an individual's resources, while passive coping styles do not; second, active coping styles may make individuals more inclined to assess stressors as controllable, while the opposite is true for passive coping styles; and third, active coping styles are more likely to be perceived as effective, whereas passive coping styles are not. These disparities underscore the critical role of coping styles in mediating the relationship between perceived stress and negative emotions. Therefore, we propose Hypothesis 2b: Coping styles can play a moderating role between perceived COVID-19 stress and negative emotions.

The TPSM suggests that when we experience distress, it can cause various behavioral, psychological, and medical problems (9). One of the psychological problems often associated with distress is sleep disturbance (6). There has been much literature exploring the relationship between negative emotions and sleep. For instance, Baglioni et al. (29) reviewed the connection between emotions and insomnia and identified different models of insomnia. In essence, when our thoughts are active, our emotions become heightened, and our body becomes activated, making it difficult to fall asleep (29). Empirical evidence suggests that this basic model is reliable [e.g., (30, 31)] and has been well-observed in the COVID-19 pandemic [e.g., (1, 27, 32–34)]. Therefore, we propose Hypothesis 3: Negative emotions are positively associated with poor sleep quality. However, the tertiary interventions mainly refer to therapeutic interventions for symptom consequences, which were beyond the scope of this study.

Although numerous studies have examined the association between perceived stress and sleep quality during the COVID-19 pandemic, as well as the individual impacts of social support, personal traits, and coping styles, there remains a dearth of research that integrates these variables within a unified theoretical framework. Drawing upon the TPSM model, the present study provides a conceptual framework that explains the roles played by perceived social support, trait hope, and coping styles in the triadic relationship between perceived COVID-19 stress, emotions, and sleep quality (Figure 1 illustrates the conceptual framework). First, we posit that perceived social support and trait hope can directly reduce perceived COVID-19 stress, which in turn reduces negative emotions and sleep disturbances, which is ultimately expressed as a chain mediation. Second, we argue that hope amplifies the effects of social support on perceived COVID-19 stress. Finally, we argue that active coping styles reduce the effects of perceived stress on negative emotions, whereas passive coping styles amplify the effects of perceived stress on negative emotions.

2 Measures and methods

2.1 Participants

The participants were selected randomly from two universities located in Liaoning Province. A total of 1,034 university students participated in the study. All students were ranging from the first to third grades at the University of Science and Technology Liaoning. The data collection employed an online survey in March 2022. To ensure data uniqueness and validity, a unique electronic measurement network link was provided, limiting participants to submit only one survey per IP address. Following the exclusion of invalid questionnaires (including straight-lining and non-differentiation response patterns, as well as questionnaires with missing values), the final analysis included 980 participants (630 men and 350 women) aged between 17 and 29 years ($M = 19.43$, $SD = 1.14$). Written informed consent was obtained from all students and their affiliated universities. The study design was approved by the Human Research Ethics Committee of local university of the corresponding author. Table 1 provided the demographic profiles of the participants.

Based on our planned statistical analyses, we calculated the required sample size. In view of the fact that there seemed not a completely suitable estimation method in a two-stage moderated mediation model (35), we refer to previous studies and utilized the Monte Carlo Power Analysis for Indirect Effects technique developed by Schoemann et al. (36) to determine the minimum sample size needed for this study. With guidance from correlations and standard deviations from previous studies (5, 37, 38), and assuming 80% power in a two-stage mediation model, we calculated a minimum requirement of 650 participants. Given that our sample size far exceeds 650, we believe that the sample size should be sufficient.

2.2 Measures

2.2.1 Perceived COVID-19 stress

Perceived COVID-19 stress was evaluated by the COVID-19 Stress Questions (21). This questionnaire comprises eight items, such as "How likely is it that you could become infected with the COVID-19 virus?". The items range from 1 (not at all) to 4 (very much). Higher scores indicate higher levels of perceived COVID-19 stress. ($\alpha = 0.81$).

2.2.2 Negative emotions

Negative emotions were evaluated by the short form of Depression, Anxiety and Stress Scale (DASS-21) (39). The scale comprises three subscales: depression (seven items, e.g., "I felt that

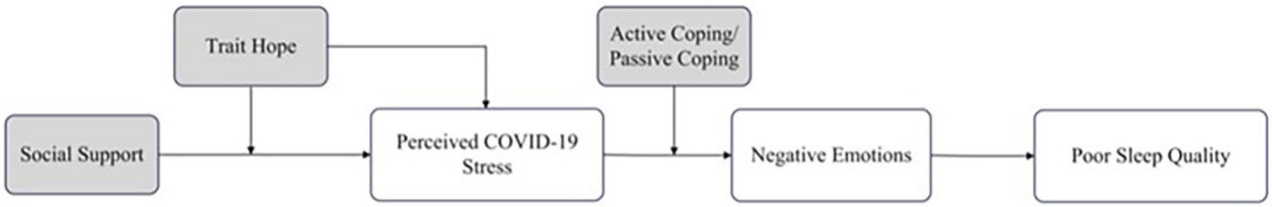

FIGURE 1
Conceptual framework of the relationship among perceived COVID-19 stress, negative emotions, poor sleep quality, perceived social support, trait hope, and coping styles.

TABLE 1 Descriptive statistics and correlation coefficient matrix ($N = 980$).

	1	2	3	4	5	6	7	8	9
1. Gender	–								
2. Age	−0.181***	–							
3. PCOS	0.010	−0.017	–						
4. NE	−0.066*	0.033	0.503***	–					
5. PSQI	0.022	0.082*	0.305***	0.531***	–				
6. PSS	0.099**	−0.096**	−0.132***	−0.254***	−0.201***	–			
7. TH	0.062	−0.045	−0.076*	−0.182***	−0.195***	0.466***			
8. ACS	0.081*	−0.059	0.051	−0.157***	0.123***	0.486***	0.647***	-	
9. PCS	−0.052	−0.017	0.133***	0.234***	0.125***	0.033	0.228***	0.340***	
M	–	19.430	2.310	11.670	3.299	59.760	22.201	1.847	1.395
SD	–	1.139	0.576	12.604	2.638	14.887	4.095	0.570	0.605

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Gender is coded as a categorical variable (male = 0, female = 1).
PCOS, perceived COVID−19 stress; NE, negative emotions; PSQI, Pittsburgh Sleep Quality Index; PSS, perceived social support; TH, trait hope; ACS, active coping style; PCS, passive coping style; M, Means; SD, Standard deviation.

life was meaningless"), anxiety (seven items, e.g., "I was worried about situations in which I might panic and make a fool of myself"), and stress (seven items, e.g., "I was intolerant of anything that kept me from getting on with what I was doing"). The items range from 0 (never) to 3 (always). Higher scores indicate higher levels of negative emotions experienced by the participants. ($\alpha = 0.97$).

2.2.3 Poor sleep quality

Poor sleep quality was evaluated by the Chinese version of the Pittsburgh Sleep Quality Index (PSQI) (40). The scale consists of 19 items that encompass seven factors: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. PSQI scores range from 0 to 21, with higher scores indicating poorer sleep quality ($\alpha = 0.88$).

2.2.4 Perceived social support

Perceived social support was evaluated by the Multidimensional Perceived Social Support Scale (MSPSS) (41). This scale comprises three subscales: family (four items, e.g., "My family really try to help me"), friends (four items, e.g., "My friends really try to help me"), and significant others (four items, e.g., "There is a special person who is around when I am in need"). The items range from 1 (definitely disagree) to 7 (definitely agree). Higher scores indicate higher levels of perceived social support ($\alpha = 0.97$).

2.2.5 Trait hope

Trait hope was evaluated by the Trait Hope Scale (14). This scale comprises two subscales: pathways thinking (four items, e.g., "I can think of many ways to get out of jams"), and agency thinking (four items, e.g., "I energetically pursue my goals"). The items range from 1 (definitely false) to 4 (definitely true). Higher scores indicate higher levels of trait hope ($\alpha = 0.88$).

2.2.6 Coping styles

Coping styles were evaluated by the Simplified Coping Style Questionnaire (SCSQ) (42). The SCSQ comprises 20 items separated into passive (eight items, e.g., "I try to forget the whole thing") and active coping styles (12 items, e.g., "I could try to look on the bright side of things") (42). The items range from 0 (never) to 3 (always), with higher scores indicating greater active/passive coping. ($\alpha = 0.91, 0.93, 0.85$ for total score, active coping, passive coping, respectively).

2.2.7 Statistical analysis

We employed ordinary least squares (OLS) regression models to test the effects of interested variables on perceived COVID-19 stress, negative emotions and poor sleep quality. Then we ran a serial mediation model (using model 6 in SPSS PROCESS macro v 4.2) (43) to explore the proposed mediation relationship. Finally, we employed a conditional moderated mediation analysis to examine the moderating role of trait hope and coping styles in the mediation process (using syntax in SPSS), the syntax was "process y=ZPSQI/m=ZCS ZDASS/x=ZPSSS/w=Zhope/Z=CT/cov= age gender/conf=95.0/boot=5000/plot=1/moments=1/total=1/ bmatrix=1,1,1,1,1,1/wmatrix=1,1,1,1,1,1/zmatrix=1,1,1,1,1,1.". The standardization was applied to all variables of interest in the analysis due to the presence of interaction terms. We controlled for age and gender in the subsequent analysis. The figure s in the text were produced using sangerbox.com, Excel.

3 Results

Table 1 presents descriptive statistics and correlations for each variable. In the first step, we ran regression analyses to test hypotheses initially. The results of the OLS regression are presented in Supplementary Table S1–S3 (see Figures 2–5 for more details). The results suggested that: First, those who perceive more social support were likely to perceive less COVID-19 stress (B = −0.137, SE = 0.036, $p < 0.001$); and people with high trait hope were likely to gain more benefits from perceived social support (B = −0.066, SE = 0.022, $p = 0.003$); Second, those who perceived more COVID-19 stress were likely to experience higher negative emotions (B = 0.437, SE = 0.027, $p < 0.001$); Those who employed more active coping styles were likely to experience lower negative emotions (B = −0.228, SE = 0.028, $p < 0.001$) and gain negative emotions from perceived COVID-19 stress (B = −0.071, SE = 0.025, $p = 0.005$); Those who employed more passive coping styles were likely to experience higher negative emotions (B = 0.258, SE = 0.028, $p < 0.001$) and gain higher negative emotions from perceived COVID-19 stress (B = 0.141, SE = 0.026, $p < 0.001$); Then those who experienced higher negative emotions were likely to experience poorer sleep quality (B = 0.533, SE = 0.027, $p < 0.001$); Those who were older were likely to experience poorer sleep quality (B = 0.068, SE = 0.024, $p = 0.005$); Girls were likely to experience poorer sleep quality compared to boys (B = 0.149, SE = 0.057, $p = 0.009$). Next, to explore whether here is a serial mediation (perceived social support → perceived COVID-19 stress → negative emotions → poor sleep quality), we ran mediation analyses using the model 6 in SPSS PROCESS macro v 4.2 (43). The bootstrapping method was used to estimate the indirect effects ($N = 5{,}000$).

The results are illustrated in Figure 5. As observed, we found that perceived social support could affect poor sleep quality in three ways: Ind3: more perceived social support → less perceived COVID-19 stress → lower negative emotions → poorer sleep quality [B = −0.022, SE = 0.010, 95% CI: (−0.042, −0.003)]; Ind2: more perceived social support → lower negative emotions → poorer sleep quality [B = −0.048, SE = 0.018, 95% CI: (−0.084, −0.015)]; Ind1: higher perceived social support → poorer sleep quality [B = −0.045, SE = 0.032, 95% CI: (−0.108, 0.018)]. These results indicated that perceived social support affect poor sleep quality by many ways, and the strongest way may be that perceived social support makes people experience negative emotions less. And the effect of perceived COVID-19 stress on poor sleep quality was total mediated by negative emotions.

Finally, we explored the moderating role of trait hope and coping styles on each path of the mediation process. Though, from the regression analyses, it is already known that trait hope could moderate the effect of perceived social support on perceived COVID-19 stress, and the coping styles could moderate the effect of perceived COVID-19 stress on negative emotions, we did not know whether they have a moderating effect on other paths, and how these moderating effects influence the final outcome. To analysis the moderating effect on each path, we employed conditional process analyses using the SPSS syntax with PROCESS macro (43) for 2 conditional moderators. As process only allow two moderators, we transformed active coping style and passive coping style into coping tendency, which is determined by "$Z_{activecoping} - Z_{passivecoping}$" (44). The higher the value of this indicator, the more inclined the individual is to use active coping styles. Although this may result in the loss of some information characteristics, we could get a rough result, and some articles had employed this indicator (44).

The general results are illustrated in Figure 5, only the significant moderating effects were plotted. As observed, except for the two moderating effects that we originally assumed, we found that people with higher trait hope could gain more negative emotions from perceived COVID-19 stress. We also found that coping tendency could aggregate the direct effect of perceived social support on poor sleep quality, those who prefer to use active coping styles were likely to gain better sleep quality from perceived social support. The bootstrap results for the moderated mediation effects were shown in Table 2 (direct effect) and Supplementary Table S4, S5 (Table 2 describes the overall effect of trait hope and coping style on the process from perceived social support to sleep quality, while Supplementary Table S4, S5 describe the effect of trait hope and coping style on the stage process from perceived social support to perceived stress, and perceived stress to negative emotion.). The plots of interaction effects were shown in Supplementary Figures S1–S3.

The results of the conditional effects of perceived social support on poor sleep quality via four pathways at different levels (−1 SD, mean, and +1 SD) of trait hope and coping tendency are included in Table 2. We found complex results. In the direct effects of social support on poor sleep quality, the effect was significant only when the coping tendency was at a high level and the trait hope was at mean or high levels. In the direct effect 2 (higher perceived social support → lower negative emotions → poorer sleep quality), we found that the effect could be significant when both trait hope and coping tendency were at a low level, and the effects was always significant when trait hope was at a high level. In the indirect effect 3 (higher perceived social support → less perceived COVID-19 stress → lower negative emotions → poorer sleep quality), we found that only when both trait hope and coping tendency were at mean or high levels, the effects could be significant.

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TABLE 2 Conditional effects of perceived social support on poor sleep quality through perceived COVID-19 stress and negative emotions at different levels of trait hope and coping tendency.

Trait hope level and coping tendency level	Effect	Boot SE	LLCI	ULCI
Direct effect				
Low (−1 SD) trait hope and low (−1 SD) coping tendency	0.055	0.040	−0.023	0.133
Low (−1 SD) trait hope and mean coping tendency	−0.024	0.038	−0.098	0.050
Low (−1 SD) trait hope and high (+1 SD) coping tendency	−0.103	0.056	−0.212	0.006
Mean trait hope and low (−1 SD) coping tendency	0.034	0.041	−0.046	0.115
Mean trait hope and mean coping tendency	−0.045	0.032	−0.108	0.018
Mean trait hope and high (+1 SD) coping tendency	−0.124	0.047	−0.216	−0.032
High (+1 SD) trait hope and low (−1 SD) coping tendency	0.014	0.052	−0.088	0.116
High (+1 SD) trait hope and mean coping tendency	−0.066	0.039	−0.143	0.012
High (+1 SD) trait hope and high (+1 SD) coping tendency	−0.135	0.047	−0.237	−0.052
Indirect effect 1				
Low (−1 SD) trait hope and low (−1 SD) coping tendency	−0.002	0.005	−0.014	0.007
Low (−1 SD) trait hope and mean coping tendency	−0.003	0.006	−0.018	0.006
Low (−1 SD) trait hope and high (+1 SD) coping tendency	−0.005	0.010	−0.032	0.012
Mean trait hope and low (−1 SD) coping tendency	−0.003	0.006	−0.017	0.008
Mean trait hope and mean coping tendency	−0.005	0.004	−0.014	0.002
Mean trait hope and high (+1 SD) coping tendency	−0.007	0.007	−0.024	0.004
High (+1 SD) trait hope and low (−1 SD) coping tendency	0.001	0.012	−0.027	0.023
High (+1 SD) trait hope and mean coping tendency	−0.003	0.008	−0.020	0.012
High (+1 SD) trait hope and high (+1 SD) coping tendency	−0.006	0.009	−0.026	0.010
Indirect effect 2				
Low (−1 SD) trait hope and low (−1 SD) coping tendency	−0.047	0.025	−0.102	−0.003
Low (−1 SD) trait hope and mean coping tendency	−0.040	0.023	−0.088	0.001
Low (−1 SD) trait hope and high (+1 SD) coping tendency	−0.032	0.031	−0.101	0.023
Mean trait hope and low (−1 SD) coping tendency	−0.055	0.025	−0.106	−0.007
Mean trait hope and mean coping tendency	−0.048	0.018	−0.084	−0.015
Mean trait hope and high (+1 SD) coping tendency	−0.041	0.022	−0.088	−0.002
High (+1 SD) trait hope and low (−1 SD) coping tendency	−0.061	0.031	−0.122	−0.001
High (+1 SD) trait hope and mean coping tendency	−0.055	0.022	−0.099	−0.012
High (+1 SD) trait hope and high (+1 SD) coping tendency	−0.048	0.021	−0.094	−0.009
Indirect effect 3				
Low (−1 SD) trait hope and low (−1 SD) coping tendency	−0.008	0.017	−0.040	0.027
Low (−1 SD) trait hope and mean coping tendency	−0.008	0.012	−0.033	0.015
Low (−1 SD) trait hope and high (+1 SD) coping tendency	−0.006	0.010	−0.029	0.014
Mean trait hope and low (−1 SD) coping tendency	−0.026	0.018	−0.061	0.012
Mean trait hope and mean coping tendency	−0.022	0.010	−0.042	−0.003
Mean trait hope and high (+1 SD) coping tendency	−0.016	−0.010	−0.037	0.001
High (+1 SD) trait hope and low (−1 SD) coping tendency	−0.044	0.026	−0.095	0.009
High (+1 SD) trait hope and mean coping tendency	−0.037	0.014	−0.066	−0.009
High (+1 SD) trait hope and high (+1 SD) coping tendency	−0.028	0.011	−0.052	−0.009

Direct effect, perceived social support → poor sleep quality; Indirect effect 1: perceived social support → perceived COVID-19 stress → poor sleep quality; Indirect effect 2: perceived social support → negative emotions → poor sleep quality; Indirect effect 3: perceived social support → perceived COVID-19 stress → negative emotions → poor sleep quality.

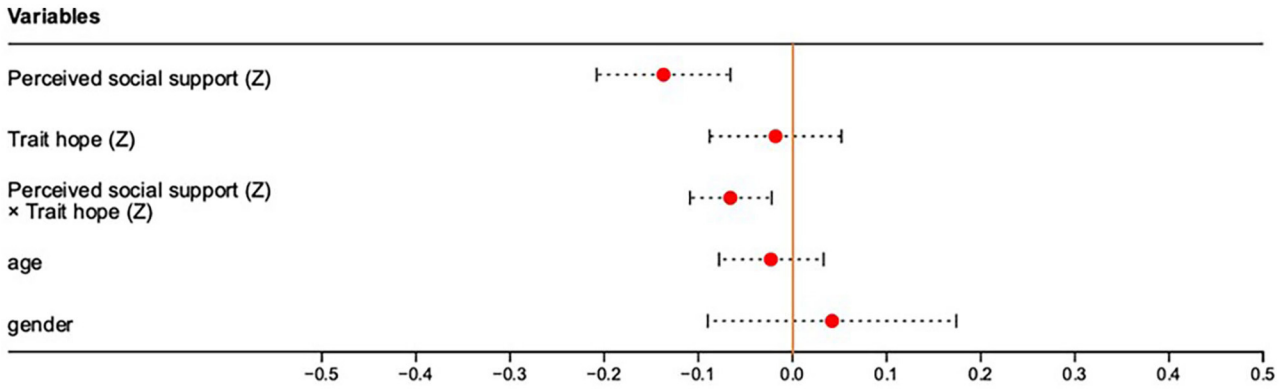

FIGURE 2
Regression plot of the Perceived social support (Z), Trait hope (Z), Perceived social support (Z) × Trait hope (Z), age and gender predicting Perceived COVID-19 stress (Z). (Z) is the result after standardization.

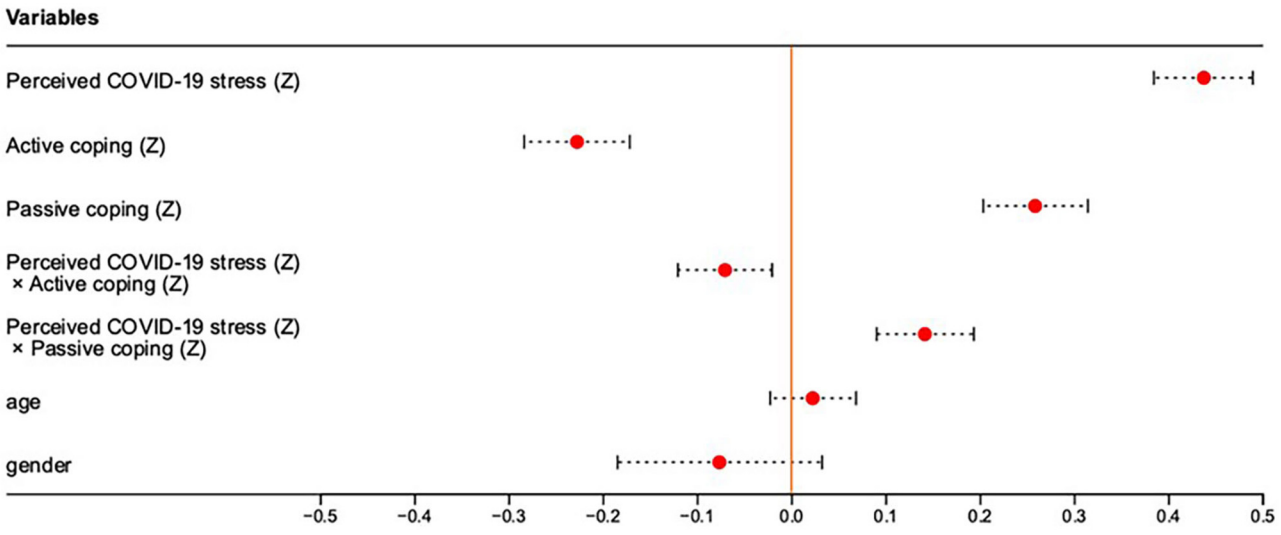

FIGURE 3
Regression plot of the Perceived COVID-19 stress (Z), Active coping (Z), Passive coping (Z), Perceived COVID-19 stress (Z) × Active coping (Z), Perceived COVID-19 stress (Z) × Passive coping (Z), age and gender predicting Negative emotions (Z). (Z) is the result after standardization.

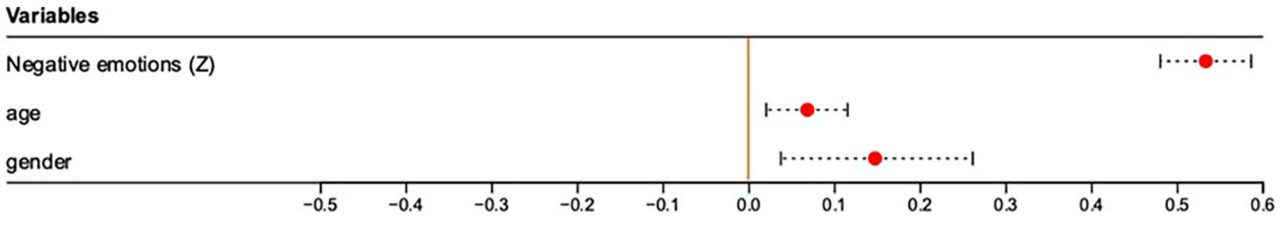

FIGURE 4
Regression plot of the Negative emotions (Z), age and gender predicting Poor sleep quality (Z). (Z) is the result after standardization.

4 Discussion

4.1 Main findings

Previous studies have explored the possible mechanism in the relationship between perceived stress and sleep in the COVID-19 pandemic, however few studies have integrated the above variables. Based on the TPSM framework, current study explored the possible protective factors in relationship between perceived stress and sleep in the COVID-19 pandemic. Results indicated that high levels of perceived social support, trait hope, and coping style would decrease the

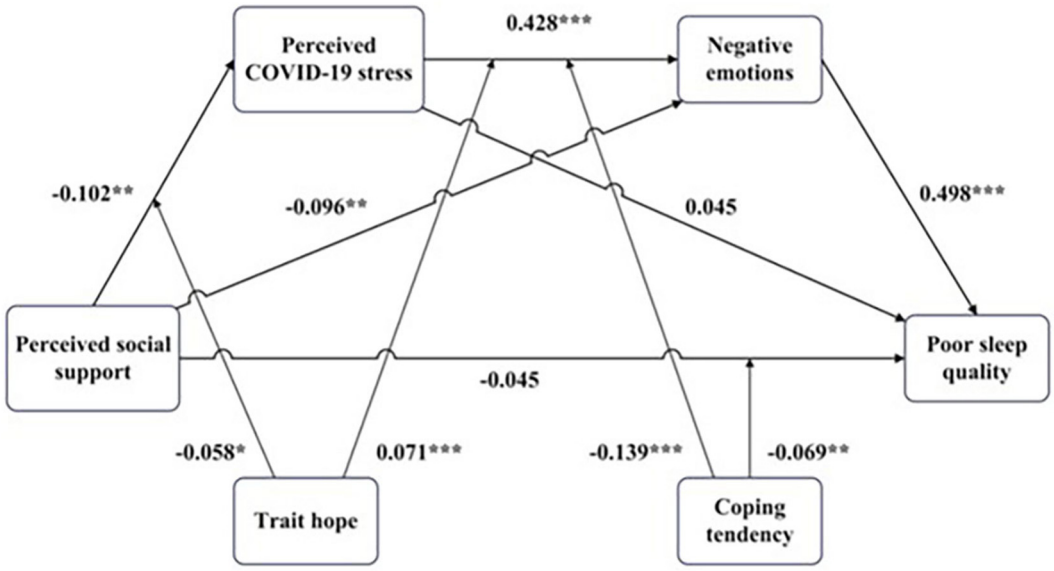

FIGURE 5
Illustrated moderated mediation of perceived social support, perceived COVID-19 stress, negative emotions, poor sleep quality, trait hope, and coping tendency. Bootstrap resample = 5,000. Statistical controls include age, gender. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

negative effect of perceived COVID-19 stress on sleep during the pandemic.

Results showed that high levels of perceived social support can effectively reduce individual's perceived COVID-19 stress, and then reduce negative emotions and poor sleep quality, which is consistent with H1 a, H1 c, H2 a, and H3. In addition, we found that trait hope moderated the path from perceived social support to perceived COVID-19 stress, and coping styles moderated the path from perceived COVID-19 stress to negative emotions, which was consistent with H1b and H2b. However, our results did not support H1b, that is, we found that trait hope does not directly reduce perceived stress. Finally, when the focus shifted to the final impact of these moderating effects on poor sleep quality, the results showed that perceived social support could significantly reduce poor sleep quality only when trait hope was at a moderate or higher level and individuals were not inclined to use passive coping styles; the two exceptions are that when individuals with low trait hope and high trait hope tend to use negative strategies, perceived social support can also reduce poor sleep quality by directly reducing negative emotions.

From the perspective of TPSM, perceived social support can reduce perceived COVID-19 stress due to others can directly help deal with stressors. For example, economic support from families can directly reduce economic stress, and help from classmates and teachers can directly reduce academic stress (6, 9, 11). Our results also showed a certain boundary condition, that is, the influence of trait hope and coping style: people with high trait hope may amplify the perceived effectiveness of others' help. On the contrary, people with low trait hope may feel that the help from others is inefficient or ineffective. The individual's coping style is mainly used to reduce the negative stress response. Active coping styles can reduce the response of perceived stress to negative emotions, while passive coping styles are the opposite, which is consistent with the previous results (44).

However, we also found that high levels of perceived social support can directly reduce negative emotions and poor sleep quality, which may suggest that there are other mediating factors. One possibility is that perceived social support not only offsets perceived COVID-19 stress but also facilitates effective coping, which in turn motivate positive emotions. This can also explain why coping styles can moderate the direct path because active coping can promote and amplify responses to positive factors (45). Positive emotions not only offset negative emotions but also have their unique roles, such as increasing psychological resources (34) and promoting tolerance and patience (46).

We also found that in the path from perceived COVID-19 stress to negative emotions, high levels of trait hope amplify the effect of perceived COVID-19 stress on negative emotions, regardless of coping style. This showed that when an individual with high trait hope has perceived COVID-19 stress, will produce more negative emotions. This can be explained by the hope theory. If an individual perceives stress, it means that the current situation is beyond control to a certain extent, and people with high trait hope may have higher expectations of the situation. When expectations are broken, the individual's psychological state will weaken (47). However, the hope theory also holds that even if hopeful people find their hopes dashed, they will not be defeated, but try another effective strategy to pursue their goals. As a result, hopeful people re-actively think when faced with obstacles (15), while low hopeful people tend to be frustrated and lethargic when faced with obstacles, especially in terms of behavior. As reflected in this article, the hopefuls are more likely to adopt active coping styles than their

counterpart (see Table 1). Active coping styles will reduce the impact of perceived stress on negative emotions. Therefore, present results may reflect the dynamic pattern of high trait hope in coping with stress.

Finally, our results support the framework provided by TPSM, and we verify the role of perceived social support as primary prevention and the role of coping style as secondary prevention. This largely illustrates the importance of classical theory in clarifying the relationship between variables. The framework provides beneficial insights, which give a comprehensive relationship between variables. Even if the current study is only a cross-sectional study, it can provide a lot of valuable information.

4.2 Practical implications

Current findings are particularly important in the context of public health, showing the different roles of external support and internal response in responding to public health crises, and revealing the unique impact of individual differences in these processes. First, in the discussion of the COVID-19 pandemic, some articles have argued that the COVID-19 pandemic is uncontrollable for the general public (48), and subsequently may argue that perceived stressors are also unpredictable; however, in reality, only a portion of people's perceived stress stems from the fear of getting sick, and much more is the fear of the social, economic, and economic consequences derived from the COVID-19 pandemic. much more from concerns about social, economic, and academic aspects derived from the COVID-19 pandemic (13), the latter of which can offset by social support or otherwise. Second, hope is an important factor influencing the role of perceived social support on perceived stress. Although trait hope is measured in this paper, hope can also be state-based, and triggering state hope may elicit similar effects as trait hope. Since hope is goal-oriented, figuring out ways to evoke goals in life may help combat stress (49, 50), so individuals can de-stress by being committed to work-study (51), and the government can reduce feelings of hopelessness by providing opportunities in future. Finally, coping styles are also an important part of mitigating the consequences of stress, with positive coping styles helping to reduce an individual's stress response, while negative coping styles do the opposite. For example, when faced with a disaster, the public media could promote positive coping styles to help people deal with the current difficulties.

4.3 Limitations and future directions

This study is not without limitations. First, the reliance on cross-sectional data limits our understanding of the causal relationship between variables. For example, once stress is recognized and starts affecting emotions and sleep, even if the original stressors is removed, the sleep issues that have already emerged might result in continued stress, negative emotions, ineffective coping styles, and future sleep disturbances (52, 53). Failing to focus on any of these factors can prevent problems from being fully resolved. This is where the importance of TPSM lies. Unfortunately, current study involves neither tertiary interventions nor longitudinal research. Future studies can consider exploring these directions. Additionally, fluctuating variables over time could be captured more effectively using diary methods or experience sampling. Second, while this paper focuses on applying and expanding TPSM during the COVID-19 pandemic, there are other theories worth exploring for insights as outlined in Bhattacharjee et al.'s review (54). Future research can integrate theories to discuss the relationship between variables in depth. Third, the absence of positive emotions in both measurements and theoretical frameworks may affect the interpretation of the results. Positive emotions have unique roles beyond just offsetting negative emotions, as they can enhance resilience and transform negatives into positives (55). Future research could integrate positive emotions into frameworks for a comprehensive understanding. Fourth, factors such as stamina and fatigue may play a significant role in the relationship between sleep quality and perceived stress (56). Future research can consider including these variables. Finally, as college students served as the study's primary demographic, it is important to determine whether the results could be applied to people of different ages. Future research could validate the results by including participants from a broader range of ages. Moreover, as all information in this study was sourced from participants' subjective reports, there is a risk of reporting bias. Future research may take this into account by gathering information from various sources to increase the objectivity of the measurements.

5 Conclusion

This study employed the TPSM to examine the integration of perceived COVID-19 stress, negative emotions, poor sleep quality, and related resilience variables during the COVID-19 pandemic. Results suggested that perceived social support effectively alleviated perceived COVID-19 stress, negative emotions, and poor sleep quality. Furthermore, trait hope not only enhanced the positive effects of perceived social support, but enhanced the negative effects of perceived COVID-19 stress in situations where individuals already perceived stress. Additionally, active coping styles attenuated the transition from perceived COVID-19 stress to negative emotions, whereas passive coping styles had the opposite effect.

Data availability statement

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

Ethics statement

The studies involving humans were approved by College of Teacher Education, Ningbo University. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this

study was provided by the participants' legal guardians/next of kin.

Author contributions

FL: Writing – original draft, Writing – review & editing. WL: Writing – original draft. HL: Writing – original draft. YL: Writing – original draft. YZ: Writing – review & editing. LD: Writing – review & editing. QZ: Writing – review & editing. LC: Writing – review & editing.

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Conflict of interest

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

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2024.1383966/full#supplementary-material

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Yuka Kotozaki,
Iwate Medical University, Japan

REVIEWED BY
Valeria Saladino,
University of Cassino, Italy
Morteza Taheri,
University of Tehran, Iran

*CORRESPONDENCE
Zihao Zeng
z.zihao@vu.nl

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Chinese college students' mental health during the first three months of the COVID-19 pandemic: the protective role of family functioning

Zihao Zeng[1,2,3]*, Karen Holtmaat[1,2], Irma M. Verdonck-de Leeuw[1,2,4,5] and Sander L. Koole[1]

[1]Department of Clinical, Neuro and Developmental Psychology, Vrije Universiteit Amsterdam, Amsterdam, Netherlands, [2]Amsterdam Public Health, Mental Health, Amsterdam, Netherlands, [3]School of Educational Science, Hunan Normal University, Changsha, China, [4]Cancer Center Amsterdam, Treatment and Quality of Life, Amsterdam, Netherlands, [5]Department Otolaryngology-Head and Neck Surgery, Amsterdam UMC, Vrije Universiteit Amsterdam, Amsterdam, Netherlands

Background: Various psychological theories suggest that a supportive family environment protects the mental health of young adults during stressful life events. However, evidence is limited regarding the protective role of family support during a major public health crisis.

Objective: To examine the role of family functioning on mental health among Chinese college students during first stage of the COVID-19 pandemic.

Methods: Between January–March 2020, 1,555 college students (44% female, on average 19 years old) from five Chinese universities participated. Participants rated their family functioning on the Family APGAR Index and their mental health on the Psychological Questionnaires for Emergent Events of Public Health, measuring depression, neurasthenia, fear, obsessive-anxiety and hypochondriasis.

Results: Better family functioning was associated with having fewer psychological symptoms. In addition, we identified three mental health profiles related to the severity across the psychological symptoms: Low-level, medium-level and high-level symptom clusters. Latent profile analysis showed that as family function improved, students were, respectively, 16 to 24% more likely to be in the low-level symptom group, compared to being in the medium symptom group or the high-level symptom group.

Conclusion: These results support the notion that family support may act as a psychological buffer for young adults during a large-scale public health crisis like the COVID-19 pandemic.

KEYWORDS

COVID-19 pandemic, latent profile analysis, depression, neurasthenia, fear, obsessive-anxiety, hypochondriasis

Introduction

The COVID-19 pandemic was a major public health emergency from 2019 to 2023, not only because of the virus' effects on physical health, but also because the psychological threat of the pandemic and its accompanying public health measures invoked high levels of chronic life stress. This, in turn, led to global increases in mental health problems, including increased prevalence of anxiety and depression disorders (1, 2). Especially during the early stages of the pandemic, the eyes of the world were directed toward China, that the pandemic had started there. Given China's large population and the fact that China was the epicenter of the COVID-19 pandemic, understanding its public health situation at this moment in time is of particular significance. The purpose of the present study was to investigate Chinese college students' mental health during the first 3 months of the pandemic in China (January–March 2020) and to address the potential protective role of family functioning therein.

Life during the COVID-19 pandemic presented unique challenges for young adults worldwide, including Chinese college students. There were widespread concerns regarding the risk of contracting the virus and its potential impact on physical health (3–6). Additionally, daily routines were significantly disrupted by extensive public health measures aimed at curbing the spread of the virus, such as mask-wearing, social distancing, and the closure of public spaces like shops, schools, and restaurants. Adjusting to these changes was particularly stressful for the general population and young adults alike (7, 8). Young adults typically face elevated risks of psychological issues due to their lower levels of psychological maturity and distress tolerance (9). Furthermore, young adulthood represents a crucial developmental period characterized by rapid shifts in personality functioning (10). Persistent challenges in coping with stress during young adulthood may therefore lead to enduring vulnerabilities to mental and physical health conditions throughout the lifespan (11, 12).

Several strands of evidence highlight the heightened coping challenges faced by young adults during the COVID-19 pandemic. In a systematic review and meta-analysis involving 13,247 nursing students, Mulyadi et al. (13) found elevated rates of mental health issues, including depression (52%), fear (41%), anxiety (32%), stress (30%), and sleep disorders (27%) amidst the pandemic. Similarly, an international study encompassing over 134,000 college students across 28 countries revealed various COVID-19-related concerns among students, such as fear of virus transmission within their social circles, increased loneliness, reduced motivation, disrupted sleep patterns, and symptoms of anxiety and depression (14). Furthermore, a survey examining the mental health status of 3,881 college students during the initial 3 months of the pandemic in Guangdong, China, documented incidence rates of clinical depression and anxiety at 21 and 26%, respectively (15).

Despite the pervasive challenges posed by the COVID-19 pandemic, it appears that certain young adults were adapting effectively to their new life situation. One key resource in this regard may be the social support network of young adults, particularly their family. Family functioning encompasses the social and structural aspects of the overall family environment, including interactions and relationships within the family (16). Effective family functioning provides various psychological benefits, such as promoting secure attachment (17), enhancing a sense of belonging (18), and offering ample opportunities for social–emotional support (19). Moreover, within Chinese culture, the family holds paramount importance as one of the foundational social institutions, with traditional Chinese philosophy emphasizing harmony within the family as a fundamental virtue (20). Consequently, family functioning may exert a more pronounced influence on the mental health of Chinese adolescents (21).

In line with this perspective, a young adults' healthy development is closely linked to strong family functioning (22–24). Children raised in well-functioning families are less prone to mental health issues compared to those from dysfunctional family environments (25). Moreover, research involving 988 adolescents (aged 11–17 years) in Monteria public schools found that better family functioning was associated with improved mental and physical health outcomes (26). Finally, a meta-analysis of 8,646 children revealed a negative association ($r = -0.22$) between family function and post-traumatic stress disorder (27), suggesting that family function can protect children's mental health against excessive stress.

In view of the aforementioned findings, family functioning may have a protective role when people are dealing with major public health threats such as the COVID-19 pandemic. Generally speaking, in the aftermath of natural or human-made disasters, children tend to display better mental health when they are in a more (versus less) supportive family environment (28). More directly to the point, research among a sample of 135 Latinx adolescents found that better family resilience was associated with improved mental and physical health outcomes during the COVID-19 pandemic (29). A study on Puerto Rican adolescents in the U.S. also found that family financial stress had an impact on COVID-19 pandemic related mental health (30). Finally, a study of 1,254 Chinese university students in the Shanghai region (an 8-h drive to Wuhan, where the pandemic started) observed that family cohesion was negatively associated with adverse stress consequences during the third month of the COVID-19 pandemic (31).

In the present study, we sought to gain more insight into the potentially protective role of family functioning for Chinese young adults during the initial stages of the COVID-19 pandemic. Specifically, we investigated family function among a sample of more than 1,500 Chinese university students: (1) during the first 3 months of the COVID-19 pandemic; (2) in a Chinese region (Hunan) close (i.e., a 2-h drive) to the region from where COVID-19 first broke out (Wuhan); and (3) including a comprehensive and well-validated measure of mental health as our primary outcome variables. The present study thus goes beyond prior published studies (31, 32) that were conducted somewhat later in time, in regions farther removed from the epicenter of the pandemic, and did not include direct measures of mental health. In line with prior research, we hypothesized that better (rather than worse) family functioning would be positively associated with mental health. A second, more exploratory, objective of the present study was to use latent profile analysis within a regression mixture model to identify mental health subgroups within the sample of Chinese college students (33).

Methods

Design, participants and procedure

A cross-sectional study was conducted among students attending five different universities in China. These universities were randomly

selected from Hunan Province (central China) and were all higher research universities. Participants could be included if they were (1) current university students, and (2) native Chinese speakers. All measurements were carried out with written informed consent from the universities and participants. The questionnaire was distributed to the students electronically, and all responses were anonymized to ensure confidentiality. During the COVID-19 pandemic the Hunan Agricultural University ethics committee conducted a fast-track ethical approval of studies related to the pandemic, including the present study. The study was conducted consistent with the principles of the Helsinki declaration regarding research with human subjects (34).

We used G-Power 3.1 software to identify the required sample size. To achieve a statistical power of 80%, a small effect size (0.01) and an alpha at 0.05, the required sample size was 1,199.

Instruments

Sociodemographic questionnaire

We included sociodemographic variables that were found to be associated with mental health among college students in prior literature (35). We assessed sex, whether the participant was an only child, family location and monthly family income. Family location was categorized as *major city, medium city, county town* and *countryside*. Monthly family income was categorized from *below € 400* to *over € 2,500*.

Mental health

To evaluate participants' mental health, we employed the original Psychological Questionnaire for Emergent Events of Public Health (PQEEPH). Originally developed during the 2003 SARS epidemic (36), this questionnaire has demonstrated strong reliability and validity in previous studies and is well-suited for assessing individuals' psychological responses to sudden public health crises (37, 38). The PQEEPH comprises five subscales: depression (e.g., less energy than before; six items), neurasthenia (e.g., very concerned about any symptoms you may have; five items), fear (e.g., fear that you and your family may be infected; six items), obsessive-anxiety (e.g., unable to control excessive fear and nervousness; five items), and hypochondriasis (e.g., symptoms associated with a sudden public health event cause you to that suspect you that have been infected, two items). Responses to items were scored on a four-point scale ranging from 0 ("never") to 3 ("always"). Subscale scores were calculated by summing relevant item scores and dividing by the number of items. In this study, the aggregate PQEEPH index exhibited high internal consistency, with a Cronbach's α of 0.91. For individual subscales, Cronbach's α values ranged from 0.67 to 0.87, indicating satisfactory reliability for scientific research purposes.

Family functioning

The Family APGAR index, initially developed by Smilkstein (39), underwent adaptation and translation into Chinese by Zhang (40). Subsequent research demonstrated the scale's robust reliability and validity among Chinese college students (41, 42). Comprising five items, the scale aims to assess various facets of family functioning, encompassing adaptation, partnership, growth, affectation, and resolve. Responses are recorded on a three-point scale ranging from 0 ("never") to 2 ("always"). In this study, the Cronbach's α coefficient for the Family APGAR index was calculated to be 0.90, indicating high internal consistency.

Statistical analyses

Due to the reliance on self-reported data, there exists a potential concern regarding common method bias. To address this issue, we assessed common method bias using Harman's one-way method and confirmatory factor analysis, as recommended by Jordan and Troth (43). Furthermore, we examined the association between family functioning and mental health using Pearson correlation coefficients.

Latent profile analysis identifies cohesive latent classes or subgroups within heterogeneous data samples. To evaluate the adequacy of the latent profile model, various statistical metrics were assessed. Firstly, entropy values were scrutinized, with a threshold of $\geq$0.80 indicating a 90% accuracy in assigning individuals to their respective clusters, while values <0.65 suggested elevated classification errors (44). Secondly, the Bayesian Information Criterion (BIC) was utilized, with lower values indicating improved model fit as it promotes parsimony (45). Akaike's Information Criterion (AIC) was also examined to support the chosen model. Additionally, the significance of the Lo-Mendeel-Rubin (LMR) and Bootstrap-Lo-Mendeel-Rubin (BLMR) values aided in determining the optimal number of latent classes, with these indices indicating that a solution with 'k' clusters significantly outperforms a 'k – 1' cluster model (46). Following the selection of the best-fitting model, an ANOVA was employed to assess potential differences among the mental health clusters identified in this model. In the final step of the regression mixture model, family functioning was examined in relation to the identified mental health clusters. Specifically, a logistic mixture model regression analysis was conducted to determine whether family functioning predicts membership in the clusters.

Statistical analyses were conducted using SPSS Version 27.0 (IBM, United States) and SPSS Amos software Version 26.0 (IBM, United States). Latent Profile Analysis was performed using Mplus 7.0. A significance level of $p < 0.05$ was utilized for all analyses.

Results

Study population

In total, questionnaires of 1,555 students were collected. Sociodemographic characteristics of the study population are provided in Table 1.

Common method deviation test

The principal component analysis revealed that six factors had eigenvalues exceeding 1, with the variance explained by the first factor amounting to 31.64%, falling below the critical index of 40%. Furthermore, the results of the confirmatory factor analysis indicated a poor model fit, with $\chi^2 = 9995.82$, $df = 464$, CFI = 0.59, TLI = 0.57, RMSEA = 0.12, and SRMR = 0.10. Overall, these findings suggest that there was no significant common method bias present in the data.

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TABLE 1 Sociodemographic characteristics of sample ($N = 1,555$).

Characteristic	Category	*N*	%
Age (*M*, *SD*)	18.98 (1.28) years old		
Gender	Male	870	55.9
	Female	685	44.1
Whether only child	Only child	497	32.0
	Non-only child	1,058	68.0
Family location	Major city	122	7.8
	Medium city	301	19.4
	County town	485	31.2
	Countryside	647	41.6
Monthly family income	Below 3,000 yuan	316	20.6
	3,000–5,000 yuan	494	31.8
	5,000–8,000 yuan	345	22.2
	8,000–10,000 yuan	211	13.6
	10,000–15,000 yuan	113	7.3
	15,000–2,000 yuan	40	2.6
	Over 20,000 yuan	36	2.3

Descriptive statistics and correlation analysis

Table 2 displays the means, standard deviations, and intercorrelations among all study variables. Notably, family functioning exhibited negative correlations with each subscale of mental health problems.

Effects of sociodemographic variables and family functioning on college students' mental health

Table 3 presents the results of the regression analyses examining the influence of sociodemographic variables and family functioning on college students' mental health. The findings reveal that family functioning significantly impacts students' mental health. Additionally, sex and family location are associated with fear, obsessive-anxiety, and hypochondriasis. Furthermore, monthly family income demonstrates an effect on all mental health symptoms.

Mental health during the first 3 month of the pandemic: a latent profile analysis

Next, latent profile analysis was employed to explore distinct clusters in college students' mental health symptoms, as depicted in Table 4. Entropy values for all clusters exceeded 0.8, indicating high accuracy in assigning individuals to their respective clusters. Significance was observed in the results of the LMR and BLMR tests for Models 2, 3, and 4. Notably, Models 3 and 4 exhibited lower adjusted Bayesian Information Criterion (aBIC) values, with one cluster in Model 4 comprising only 1% of the total participants. Among the tested models, Model 3 demonstrated superior values for both AIC and BIC, along with adequate entropy, suggesting its superiority in capturing the underlying structure of the data.

Table 5 illustrates a comparison among three distinct clusters characterized by varying levels of mental health symptoms. The first cluster comprises individuals exhibiting low-level symptoms ($n = 1,169$, 75%), the second group manifests intermediate-level symptoms ($n = 288$, 19%), while the third group is characterized by high-level symptoms ($n = 98$, 6%), as shown in Figure 1. Single-factor ANOVA analysis revealed significant different in the mean scores of all mental health symptoms across each cluster.

The influence of family functioning on the three symptom profiles: a regression mixture model

The findings from the regression mixture model are presented in Table 6. Comparing against the high-level symptom cluster as the baseline, family functioning exhibited a significant association with the low-level symptom cluster ($b = 0.24$, $SE = 0.04$, $p < 0.001$), whereas no significant association was observed with the medium-level symptom cluster ($b = 0.08$, $SE = 0.05$, $p > 0.05$). To elaborate, for each incremental increase of one point in family functioning score, there was a corresponding 24% increase in the likelihood of being categorized into the low-level symptom cluster. Conversely, when the medium-level symptom cluster served as the reference group, family functioning displayed a significant association with the low-level symptom group ($b = 0.16$, $SE = 0.03$, $p < 0.001$). In this case, with each one-point rise in family functioning score, there was a 16% rise in the probability of being classified into the low-level symptom cluster.

Discussion

The present study examined the association between family functioning and pandemic-related mental health among Chinese college students' during the first 3 months of the COVID-19 pandemic. This period marked a unique phase in China's history, characterized by unprecedented public health challenges, such largescale home quarantine for the entire population. Our findings showed that, as expected, better family functioning was associated with lower pandemic-related psychological symptoms. Additionally, higher monthly income was associated with fewer symptoms. Moreover, the results indicated that for college students, each one-point increase in family functioning score corresponded to a respective 16 and 24% greater likelihood of belonging to the low-level mental health symptom cluster compared to the medium or high-level symptom clusters. Taken together, these findings support the idea that better family functioning buffers the psychological effects of a major public health crisis, in this case among Chinese college students impacted by the stress of the COVID-19 pandemic.

The observed protective effects of family functioning in the present study align with prior findings among Chinese young adults coping with the COVID-19 pandemic (31, 32, 47) and the broader public health literature (37, 48–50). When facing a major public health crisis like the COVID-19 pandemic, people are likely to turn to their social networks for practical and emotional support. Among these

TABLE 2 Intercorrelations among study variables.

Variables	*M*	*SD*	1	2	3	4	5
1 Depression	1.39	0.50					
2 Neurasthenia	1.40	0.47	0.64**				
3 Fear	1.81	0.51	0.45**	0.59**			
4 Obsessive-anxiety	1.15	0.31	0.63**	0.66**	0.41**		
5 Hypochondriasis	1.22	0.38	0.41**	0.60**	0.47**	0.65**	
6 Family functioning	5.86	2.50	−0.19**	−0.22**	−0.10**	−0.16**	−0.12**

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, same below.

TABLE 3 Linear regression analysis of sociodemographic variables and family functioning on college students' mental health.

Variables	Depression		Neurasthenia		Fear		Obsessive-Anxiety		hypochondriasis	
	β	*t*	*β*	*t*	*β*	*t*	*β*	*t*	*β*	*t*
Sex	−0.06	−1.25	0.05	1.17	0.33	6.83***	−0.16	−4.02***	−0.10	−2.26*
Only child	0.02	0.47	0.03	0.59	0.13	2.35*	−0.01	−0.24	0.11	2.08
Family location	−0.05	−1.93	−0.05	−1.73	−0.07	−2.65**	−0.04	−1.80	−0.06	−2.28*
Monthly family income	−0.04	−2.66**	−0.04	−2.66**	−0.03	−2.01*	−0.05	−3.26**	−0.04	−2.51*
family functioning	−0.18	−7.69***	−0.20	−8.77***	−0.10	−4.19***	−0.13	−6.21***	−0.10	−4.42***
R^2	0.04***		0.05***		0.05***		0.04***		0.02***	
F	14.02***		68.95***		16.39***		13.53***		7.29***	

Sex 1 indicates male, 2 indicates female. Only child 1 indicates only child 2 indicates not-only child. Family location 1 indicates major city, 2 indicates medium city, 3 indicates county town, 4 indicates countryside. Monthly family income 1 indicates below 3,000 yuan, 2 indicates 3,000–5,000 yuan, 3 indicates 5,000–8,000 yuan, 4 indicates 8,000–10,000 yuan, 5 indicates 10,000–15,000 yuan, 6 indicates 15,000–2,000 yuan, 7 indicates over 20,000 yuan.

TABLE 4 Latent profile fit statistics for the different models of college students' mental health symptoms.

Model	AIC	BIC	aBIC	Entropy	LMR	BLMR	Probability of clusters
1	16100.05	16164.24	16126.12				
2	13075.62	13177.26	13116.90	0.96	499.149**	2980.485**	0.87, 0.13
3	11929.24	12068.32	11985.72	0.93	532.172*	1138.259*	0.75, 0.19, 0.06
4	11151.14	11327.66	11222.83	0.93	683.983*	776.998*	0.73, 0.18, 0.08, 0.01
5	9334.34	9334.34	9421.24	0.97	52397.128	1795.886	0.08, 0.60, 0.02, 0.08, 0.22

networks, the family holds particular significance, perhaps especially in China, where it has traditionally occupied a central role in cultural life (20). Notably, the present study was conducted during China's largest family-oriented holiday, the 'Spring Festival' (similar to the Western Christmas), so that family life was highly salient at the time of the study. Moreover, during periods of lockdown and amidst a public health crisis, the functioning of families may further gain in psychological significance. Thus, the family serves as a vital coping resource in navigating through public health emergencies.

Moreover, cultural nuances may shape how mental health symptoms are perceived and expressed. Stigma surrounding mental illness and help-seeking behaviors can vary across cultures, influencing individuals' willingness to disclose psychological distress and seek professional support (51). Additionally, an intervention study with Iranian college athletes indicated that COVID-19 had an impact on athletic performance (52), echoing findings from a separate large-scale international study that also highlighted effects on athletes' diet quality (53). Considering the intricate nexus between mental and physical health (54), which becomes even more pronounced during stressful events like a global health crisis, our study emphasizes the influence that physical health difficulties during the COVID-19 pandemic may have on mental well-being, highlighting the critical role of family functioning in maintaining overall health.

In developing public health policies, it is useful to know whether a population is composed of different meaningful subgroups. Our latent profile analysis revealed three distinct clusters characterized by

TABLE 5 Mean scores of potential clusters in different mental health (standard deviations between brackets).

Project	Depression	Neurasthenia	Fear	Obsessive-anxiety	Hypochondriasis
Total	1.39 (0.50)	1.40 (0.47)	1.81 (0.51)	1.15 (0.31)	1.22 (0.38)
Low symptom cluster	1.18 (0.28)	1.19 (0.23)	1.66 (0.43)	1.04 (0.10)	1.10 (0.22)
Medium symptom cluster	1.88 (0.48)	1.92 (0.38)	2.26 (0.44)	1.28 (0.23)	1.40 (0.39)
High symptom cluster	2.33 (0.49)	2.34 (0.44)	2.37 (0.44)	2.12 (0.39)	2.07 (0.53)
F-value	869.27***	1375.99***	313.79***	2107.81***	590.37***
Multiple comparisons	1 < 2 < 3	1 < 2 < 3	1 < 2 < 3	1 < 2 < 3	1 < 2 < 3

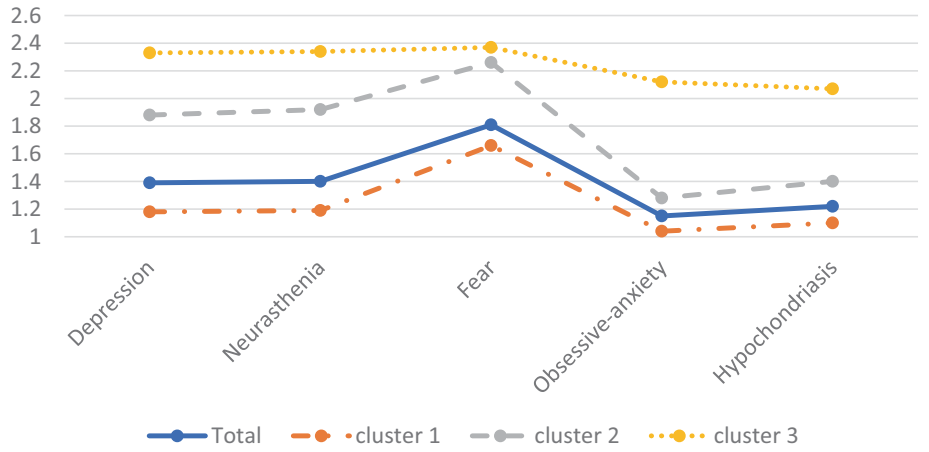

FIGURE 1
Mean symptoms for the three profiles of college students' mental health. The *y*-axis represents PQEEPH scores.

low, middle, and high levels of symptoms. These clusters hold significance as they may represent groups with varying psychological needs. Students in the high-level symptom cluster exhibited elevated scores across all symptoms, indicating a heightened need for social and emotional support or targeted psychological counseling during public health emergencies (55). The middle-level symptom cluster, being the largest group, warrants attention as individuals within this cluster may be susceptible to transitioning into the high-level symptom cluster. Providing timely guidance and support to students in this cluster may prevent such transitions, potentially leading to a shift toward the low-symptoms cluster. However, further research is required to validate this hypothesis. As expected, fear in response to the COVID-19 pandemic emerged as the highest-scoring symptom across all clusters compared to other symptoms. Studies have indicated that nearly half of college students reported experiencing some degree of fear during the COVID-19 pandemic (56).

Amidst public health crises like the COVID-19 pandemic, a supportive family environment is particularly crucial as it serves as a psychological buffer against stress and challenges. Policymakers should consider developing and implementing policies that bolster family support systems, enhance awareness of the significance of family functioning through public health campaigns, and allocate resources to mental health services that ensure families have the necessary support to deal with stress. Educators can strengthen students' psychological resilience by incorporating family engagement strategies and mental health education into curricula, ensuring students and their families are informed about available mental health resources. Additionally, mental health professionals should adopt family-centered therapeutic approaches (57) and develop targeted interventions that address the unique stressors of crises, focusing on strengthening family bonds and coping mechanisms. Overall, supporting students during crises requires a comprehensive approach that not only focuses on individual mental health but also values the well-being of the family as a key factor in mitigating the psychological impacts of such crises.

The current study inevitably has limitations. First, although the sample size of more than 1,500 participants was substantial, it was limited to college students from Hunan Province in China, potentially limiting the generalizability of the findings to other regions. Future research may include a broader and more varied geographic samples, longitudinal tracking, cross-cultural comparative analyses, and the adoption of mixed-methods for a comprehensive understanding. Second, the present study design was cross-sectional, precluding the testing of causal relationships between family functioning and pandemic-related psychological symptoms. It is conceivable that the relationship between family functioning and symptoms is bidirectional, with better family functioning serving as a protective factor against symptoms, and

TABLE 6 Regression mixture model of the association between family functioning and the mental health profiles.

Predictor		Low-level cluster vs. medium-level cluster	Low-level cluster vs. high-level cluster	Medium-level cluster vs. high-level cluster
Family functioning	Intercept	0.48	1.19	0.71
	B	0.16	0.24	0.08
	SE	0.03	0.04	0.05
	T	5.17***	5.88***	1.73

less severe symptoms facilitating better family functioning (58, 59). Future research should test the causal impact of family functioning through longitudinal or experimental designs, including the investigation of family-based interventions (60). Third, given the present study's reliance on self-reported data, which is prone to biases like memory distortion and social desirability, future research could benefit from a multi-method approach that combines quantitative and qualitative data, including in-depth interviews or focus groups, to gain a deeper understanding of family functioning and mental health.

Despite these caveats, the present study contributes to the growing body of evidence indicating that family functioning provides psychological protection against the adverse effects of public health crises on mental health among young adults (31, 32, 61, 62). The present findings provide a unique window into the mental health of young adults in China during the first 3 months of the COVID-19 pandemic, a time when young adults were largely living in quarantine with their family. When managing largescale public health crisis, policy makers will do well to consider the protective role of family functioning in mental health.

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: https://osf.io/85qp3/.

Ethics statement

The studies involving humans were approved by Hunan Agricultural University ethics committee. 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

ZZ: Conceptualization, Data curation, Funding acquisition, Writing – original draft. KH: Methodology, Writing – review & editing, Validation. IV-L: Supervision, Writing – review & editing, Validation. SK: Funding acquisition, Project administration, Supervision, Writing – review & editing.

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Conflict of interest

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

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EDITED BY
Yuka Kotozaki,
Iwate Medical University, Japan

REVIEWED BY
Luis Felipe Dias Lopes,
Federal University of Santa Maria, Brazil
Assis Kamu,
Universiti Malaysia Sabah, Malaysia

*CORRESPONDENCE
Shazana Shahwan
shazana_mohamed_shahwan@imh.com.sg

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The protective role of resilience and social support against burnout during the COVID-19 pandemic

Shazana Shahwan*, Eng Hong Tay, Saleha Shafie, Yoke Boon Tan, Savita Gunasekaran, Rachel Hsiao Shen Tan, Pratika Satghare, Yunjue Zhang, Peizhi Wang, Sing Chik Tan and Mythily Subramaniam

Research Division, Institute of Mental Health, Singapore, Singapore

Background: The COVID-19 pandemic brought on a range of stressors in homes and workplaces. With no sign of ending after one year, burnout was a concern. Resilience has been known to shield against the effects of stress. While often thought of as an individual trait, previous studies have shown social support to improve resilience. The study aimed to examine the extent of burnout in the Singapore population and whether social support and resilience cushioned the impact of COVID-19 related stressors a year into the pandemic.

Methods: Participants were 858 Singapore residents who participated in a larger study between October 2021 and September 2022. The Copenhagen Burnout Inventory provided Work-and Personal-related burnout scores. Multivariable linear regression was used to identify demographic variables associated with burnout. Path analysis revealed the associations between COVID-19 stressors, social support, resilience and burnout.

Results: 22 and 19% of the sample reported work and personal burnout respectively, with younger adults being more burnt out than older adults. Higher stress was associated with higher burnout and higher social support was associated with lower burnout. Path analysis revealed that the relationship between social support and burnout was partially accounted for by increased resilience.

Conclusion: Managing altered work arrangements, career expectations, and increased responsibilities at home may contribute to greater levels of burnout in the younger adults. Increased employer support and targeted interventions could mitigate the impact of these stressors. The study also highlighted the importance of maintaining social connections even while physically distancing.

KEYWORDS

resilience, social support, burnout, pandemic, stress

Introduction

The COVID-19 outbreak was declared a Public Health Emergency of International Concern (PHEIC) on 30 January 2020 by the World Health Organisation, retaining its status for three years till the declaration was lifted on 5 May 2023. In the initial weeks after COVID-19 was first detected in countries around the globe, citizens were engulfed in panic

and trepidation as news of spikes in the number of new cases, hospitalisation rates and death tolls flooded the media. Hospitals were overburdened and medical resources ran low. In order to mitigate transmission of the virus and prevent medical systems from reaching breaking point, stringent physical distancing policies such as school and workplace closures, travel restrictions, quarantine, gathering size limits and at the forefront of these, lockdown was imposed in many countries.

These containment measures would have severe economic, health and social impacts. Governments were faced with difficult trade-offs among these factors (1). As regulations were adjusted with the evolving situation, civilians and institutions altered their routines and operational procedures to comply with them. In addition to the need to acclimatise to the new regulations and the dynamics it brought, individuals battled with the constant negative presence of COVID-19 on media, prolonged social deprivation and other stressors that had no foreseeable end in sight, taxing them physically and mentally, causing burnout over time (2, 3).

The concept of burnout was defined by Maslach and Jackson as a psychological syndrome characterised by emotional exhaustion, feelings of cynicism or depersonalisation and reduced personal accomplishment (4). Majority of the research that examined pandemic burnout focused on frontline healthcare workers who faced the harshest impact of this crisis attributed to long working hours without adequate rest, torment from having to make life-and-death decisions hastily, and pain of losing their patients and colleagues (5). Where burnout was originally conceptualised in the workplace context, it has expanded to other chronically stressful situations (6).

Within homes, burnout was recognised to be heightened among young parents who were struggling with full-time parenting and home-schooling while simultaneously working from home (7). Those who were not parents also reported struggles with work–family conflict, in the form of increased interruptions and distractions due to the presence of family and additional household responsibilities. Adding to that burden, there were expectations—whether real, perceived, or self-imposed—regarding one's availability to respond quickly during remote working as individuals were assumed to be confined to the home. Combined with the impression that saved commuting time could be used to extend work hours, workers found themselves under increased pressure (8).

High levels of burnout have been shown to be significantly associated with depression, anxiety, and insomnia (9). It has also been associated with weakened immune functioning (10). While some individuals suffer the impact of the pandemic more acutely, others appear to cope better. According to the Transactional Model of Stress, individuals respond to the same stressor differently due to individual characteristics and contextual factors (11). Resilience is an individual response to adverse situations that has been found to mitigate the detrimental effects of stress on burnout (12). Resilience refers to the "ability to bounce back quickly" from highly distressing events (2). Smith et al. proposed that resilience involves confronting (rather than avoiding or denying) the stressful event, orienting oneself towards a future positive outcome of the event and actively engaging in efforts to cope with it (13). As an example, a study among emergency response workers during the second COVID-19 wave in Italy showed that problem-focused coping, being able to get past negative feelings and a strong sense of purpose appeared to offer workers protection against burnout (14).

A contextual factor that has been found to buffer the negative effects of stress from adverse life events on mental and physical health is social support (15). Nitsche et al. reported that greater social connectedness during the lockdown period was associated with lower levels of perceived stress as well as general and COVID-19 specific worries (16). According to the stress-buffering hypothesis, the more social support or resources a person has or perceives to have available, the more likely the individual is to feel in control of the stressful situation. Perceived social support has been theorised to prevent a situation from being appraised as highly stressful whereas received support has been theorised to cushion the impacts of stress by assisting with coping (17). Several studies have in turn shown that social support can be a key mechanism in bolstering resilience (18, 19). Conversely, individuals who lacked social interaction were hypervigilant to threats and had higher negative appraisal of threats resulting in increased overall stress (17).

Singapore is a small metropolitan city-state measuring 728.6 km^2 with a population of 5.64 million (20). It is regarded as one of the medical hubs in the Asia Pacific region (21) and billed itself as an efficient business city with one of the busiest shipping ports in the world (22). While Singapore's healthcare system remained resilient during the pandemic and its nationwide vaccination campaign was a success with 80% of the population being fully vaccinated by the end of August 2021, a survey across six Asian countries stated that it was the only country to report burnout as the leading factor affecting mental health of residents during the pandemic (3). This contrasted with Japan, South Korea, and Hong Kong whose residents were most affected by public measures to keep the pandemic under control such as mask-wearing and travel restrictions, while Malaysia and Indonesia were most affected by financial burden due to income loss (3). The uniqueness of this finding to Singapore could be a reflection of the competitive and efficiency-driven culture which was embodied even amidst the pandemic.

The aims of this study were to identify the extent of burnout in the population, sociodemographic correlates of the population that were most affected by burnout and understand the relationships between COVID-19 related stress, burnout, resilience, and social support. Based on Lazarus and Folkman's Transactional Model of Stress and earlier studies that demonstrated the associations between stress, burnout and resilience (23–25), we hypothesized that (i) greater perceived COVID-19 stressors predict higher levels of burnout and (ii) the impact of perceived COVID-19 stressors on burnout is mediated by resilience. Additionally, in line with the stress-buffering hypothesis and earlier studies showing that social support acts as an effective mechanism to boost resilience (19, 26, 27), we hypothesized that (iii) greater perceived social support predicts lower levels of burnout, and (iv) social support increases individual resilience.

Methods

Participants and procedure

The current investigation was part of the larger study examining the impact of COVID-19 on psychological well-being in Singapore. Participants comprised 858 Singapore Residents and Permanent

residents aged 21 years and above who had agreed to be recontacted during the first phase of the study (28, 29). Prior to the commencement of the survey, researchers went through an information sheet detailing the study objectives, procedures, potential benefits, risks, confidentiality as well as the participant's rights to refuse participation. Written consent to participate in the current follow-up study was obtained from each participant. 76% of participants who completed the first study participated in the current study. The current study was approved by the National Healthcare Group Domain Specific Review Board (Ref: 2021/00566).

The study was conducted between October 2021 and September 2022 and coincided with the "Stabilisation" and "Transition" phases wherein the number of community cases stabilised, and safe management measures were relaxed, gradually preparing the nation to transit into endemicity. Even so, social gathering limits, mandatory mask wearing, border control measures and default work from home for many companies were still applicable. Interviews were carried out by trained researchers primarily via the videoconferencing platform "Zoom". In-person interviews were offered to participants who wished to participate but were not comfortable with the "Zoom" format. Interviews were conducted in English, Malay or Mandarin, based on the language the participant was most comfortable with. The interviews took about 1 h, and participants were compensated SGD40 for their time and effort. A helpline brochure containing a list of organisations providing psychological support was shared with all participants before the survey interview.

Measures

The measures used in the current study comprised the following:

a Sociodemographic information on age, gender, ethnicity, marital status, employment status, highest educational attainment, parental status, and monthly personal income.

b COVID-19 related stress was assessed using a binary (Yes/No) scale that asked participants about the presence of worry relating to ten items including fear of the self or friends and family contracting the virus, fear of the self or friends and family dying due to the virus, overseas travel restrictions, working from home, restrictions on social gathering, unemployment, having to take unpaid leave and school closure. Total stress was obtained by summing the number of stressors endorsed. The internal consistency of this scale was 0.73.

c The Copenhagen Burnout Inventory (CBI) Personal-related and Work-related subscales (30). The Personal-related burnout scale consists of six items measuring both general physical and psychological exhaustion and was administered to all participants (e.g., How often do you feel worn out?). Items were rated on a 5-point scale where "Always" = 100, "Often" = 75, "Sometimes" = 50, "Seldom" = 25 and "Never/Almost never" = 0. The Work-related burnout scale consists of seven items measuring fatigue derived from work and were administered to those who were currently employed, home-makers and those who had recently been unemployed in the last month. Homemakers and those who were recently unemployed could opt not to answer questions this scale if they felt that work-related burnout was not relevant to them. Three items (e.g., Does your work frustrate you?) used the response scale "To a very high degree" = 100, "To a high degree" = 75, "Somewhat" = 50, "To a low degree" = 25 and "To a very low degree" = 0 while four items used the same response options as the Work-related scale (e.g., Are you exhausted in the morning at the thought of another day at work?'. Total scores on the sub-scales were the average of the scores on the items, with the last item, "Do you have enough energy for family and friends during leisure time?" being reverse coded. A cut-off score of 50 and above on each subscale indicates moderate or higher levels of burnout (31). The CBI has been previously validated and found to have good psychometric properties (32). It has been used widely in Asian settings (33). Confirmatory factor analysis supported the 2-factor structure of the CBI (Personal related and Work-related Burnout; Refer to Supplementary Figure S1). The CBI was also found to discriminate low-resilience and normal-high resilience individuals in this sample using a survey-weighted t-test ($p < 0.01$). In this study, the internal consistency of Personal-related and Work-related subscales as measured using Cronbach's alpha were 0.87 and 0.89, respectively. The Client-subscale was omitted for this community sample.

d Social support was measured using the 6-item Medical Outcomes Study Social Support Survey (MOS-SSS-6) (34). Respondents were asked a stem question about the level of social support they received from various sources. Each item was answered on a 5-point scale ranging from "None of the time" to "All of the time", with scores being 1 to 5, respectively. Mean scores across the six items were calculated with higher scores indicating higher levels of social support. The MOS-SSS-6 has been previously validated with satisfactory psychometric properties (34) and had a Cronbach's alpha of 0.90 in the current study.

e Resilience was measured using the Brief Resilience Scale (BRS), a 6-item instrument that assesses the ability of individuals to bounce back or recover from stress (35). Participants indicated the extent to which they agreed with each statement on a 5-point scale from "Strongly Disagree" to "Strongly Agree", with scores ranging from 1 to 5, respectively. Negatively worded items were reverse coded, and a score was derived from the mean of the six items. The BRS has been validated with undergraduates in Singapore and shown to have satisfactory psychometric properties (36). The Cronbach's alpha for the BRS in this study was 0.80.

Analysis

All analyses performed in our study included post-stratification survey weights to ensure that the results were reflective of the general population. Data were analyzed using STATA S/E version 15 with a two-sided test and a significance level of 5%. Descriptive statistics of the sample were calculated. Categorical variables were represented as weighted percentages and unweighted frequencies while weighted mean and standard deviation were included for

continuous variables. Cronbach's alpha values were calculated for the individual scales to measure the internal consistency. A confirmatory factor analysis was performed on the burnout scale to test its structural validity (Supplementary Figure S1). Multivariable linear regression was conducted on the sociodemographic variables to investigate which factors were significantly associated with burnout. The sociodemographic variables include age, gender, ethnicity, employment status, marital status, highest education attained, monthly personal income and having any children. Path analysis was conducted using Mplus version 8.8 (Muthen & Muthen) to investigate whether resilience mediated the relationship between social support and COVID-19 stressors with burnout. Beta coefficients were standardized using Mplus STDYX output. Age, gender and ethnicity were adjusted for in the mediation model as perceived social support, stress, burnout and resilience have been reported to be significantly associated with these sociodemographic variables in previous studies (37–44). Criteria for the model were selected in accordance with Hu et al. (45); Root mean square error of approximation (RMSEA) <0.05, comparative fit index (CFI) ≥ 0.95, Tucker-Lewis index (TLI) ≥ 0.95, Standardized root mean residual (SRMR) <0.05.

Results

The sociodemographic profile and classification of the sample by Personal-and Work-related burnout severity are presented in Table 1. Mean scores on the resilience, social support, COVID-19 stress and Personal-and Work-related burnout scales and their respective standard deviation are summarised in Table 2.

Sociodemographic factors significantly associated with burnout

The five assumptions of multivariable liner regression (MLR) of (i) linearity, (ii) little/no multicollinearity, (iii) multivariate normality, (iv) no auto correlation and (v) homoscedasticity were met. MLR for sociodemographic variables showed that, age was significantly associated with both Personal-related and Work-related burnout. The coefficients decreased progressively as age increased, indicating that individuals aged 21–35 years were the most burnt-out age group in our study. Those of Malay ethnicity (β = 6.71, 95% CI: −5.58 to 1.78) and those whose highest educational level was secondary school (β = 6.56, 95% CI: 0.62 to 12.51) were significantly associated with higher Personal-related burnout. Those who were unemployed (β = 19.94, 95% CI: 6.41 to 33.74) were significantly associated with higher Work-related burnout. The MLR analyses are summarised in Table 3.

Mediation analysis

Our final path analysis is presented in Figure 1. The model was adjusted for age, gender, and ethnicity. Model fit indices and the criteria of good fit (RMSEA = 0.012, CFI = 0.999, TLI = 0.994, SRMR = 0.018) are presented in Table 4. The direct, indirect, and total effects of the final model are presented in Table 5.

Mediation effects of resilience on COVID-19 stressors

The direct effects of COVID-19 stressors on Personal-related burnout (β = 0.243, $p < 0.001$) and Work-related burnout (β = 0.258, $p < 0.001$) were significant, indicating that greater COVID-19 stressors was associated with a higher burnout. The indirect effects of COVID-19 stressors on personal burnout (β = 0.072, $p < 0.001$) and work burnout (β = 0.054, $p = 0.001$) via resilience were found to be significant as well indicating that resilience partially mediated the relationships between COVID-19 stressors and both Personal-and Work-related burnout.

Mediation effects of resilience on social support

The direct effects of social support on Personal-related burnout (β = −0.136, $p = 0.004$) and Work-related burnout (β = −0.134, $p = 0.007$) were significant, suggesting that higher social support can lead to lower burnout. The indirect effects of social support on Personal-related burnout (β = −0.073, $p < 0.001$) and Work-related burnout (β = −0.055, $p = 0.001$) via resilience were significant as well, indicating that resilience partially mediated the relationships between social support and both Personal and Work-related burnout.

Discussion

Twenty-two percent (22%) of the sample reported elevated levels of work-related burnout which was slightly lower than the proportion found among non-clinical staff of a community mental health service assessed in 2019 prior to the outbreak (25%) (46). The percentage of those who reported elevated personal-related burnout in our study was even lower at 19%. While we were not able to identify other studies conducted in the general population for comparison, our mean burnout scores (Personal: 31; Work-related: 31) were lower than those among samples working non-clinical jobs reported in other countries during the pandemic. To illustrate, a study in Thailand among librarians reported Personal and Work-related burnout scores of 44 and 42 (47) while another among teachers in Ireland reported scores of 65 and 61, respectively (48). A possible explanation offered by See et al. who observed lower burnout rates among physicians in Singapore and Hong Kong (31 and 31%) compared to their counterparts in the US (45–55%) pre-pandemic, was that local work culture and values including collectivism, persistence and *guanxi* (respecting social orders and protecting others' reputation) could have blunted overall self-reports of burnout (31). This explanation however conflicts with the survey findings alluding to the high level of burnout in Singapore compared to other countries (3). Likely, burnout symptoms may have alleviated as our study extended till September 2022 when majority of the safety measures were relaxed.

However, as predicted, higher personal-and work-related burnout was observed among those who experienced greater COVID-19 related stress during the second year of the pandemic. Longitudinal studies have shown that excessive and prolonged stress that is not ameliorated leads to feelings of physical and mental exhaustion, cynicism and depersonalisation, and low personal efficacy, which are the hallmarks of

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TABLE 1 Frequencies and weighted percentages of sociodemographic variables.

	Weighted percentage	Unweighted frequencies
Age groups		
21–34	26.35	312
35–49	29.36	287
50–64	26.60	171
65+	17.69	88
Gender		
Female	48.93	393
Male	51.07	465
Ethnicity		
Chinese	76.48	322
Malay	11.05	190
Indian	7.73	218
Other	4.74	128
Marital status		
Never married	26.82	264
Married/ cohabitation	63.30	535
Divorced/ widowed/ separated	9.88	59
Employment status		
Unemployed	3.55	33
Economically inactive*	21.09	130
Employed/self-employed	75.36	690
Highest education attained		
Below primary	11.87	31
Secondary school	23.56	104
Pre-U/JC/ITE/polytechnic	25.92	293
University and above	38.65	425
Children		
Yes	60.74	487
No	39.26	371
Monthly personal income (SGD)		
Below 2,000	31.99	196
2,000 to 3,999	26.61	242
4,000 to 5,999	18.79	194
6,000 to 9,999	14.97	138
Above 10,000	7.64	78
Burnout-work ($n = 674$)		
None-mild	77.29	506
At least moderate	22.71	168
Burnout-personal ($n = 858$)		
None-mild	81.07	664
At least moderate	18.93	194

*Economically inactive group includes retirees, students, and homemakers.
Missing data: employment status $n = 5$, highest education attained $n = 5$ and monthly personal income $n = 10$.

burnout (49). Additionally, the impact of COVID-19 stressors on elevated burnout levels was partially accounted for by reduced resilience, corroborating earlier research (23, 25, 50, 51). Our finding also extends the relevance of this mediational relationship that has largely been documented in workplace settings among frontline staff such as doctors, nurses and police officers to those in the home and community settings.

TABLE 2 Weighted mean and SD of variables of interest.

	Cronbach's alpha	Weighted mean	SD	*n*
Resilience	0.80	3.61	0.60	857
Social support	0.90	69.45	22.00	849
COVID-19 stressors	0.73	3.44	2.61	828
Burnout-personal	0.87	31.36	19.69	857
Burnout-work	0.89	31.71	22.51	673

SD, Standard deviation.

TABLE 3 Multivariable linear regression between sociodemographic factors and burnout.

	Burnout-personal (*n* = 839)				Burnout-work (*n* = 664)			
	β-coefficient	*p*-value	95% Confidence interval		β-Coefficient	*p*-value	95% Confidence interval	
Age groups								
65+ (ref)								
21–34	**17.97**	**<0.001**	**10.27**	**25.67**	**26.68**	**<0.001**	**16.74**	**36.62**
35–49	**15.06**	**<0.001**	**7.7**	**22.42**	**21.58**	**<0.001**	**11.41**	**31.75**
50–64	**7.45**	**0.04**	**0.09**	**14.81**	**9.93**	**0.02**	**1.49**	**18.36**
Gender								
Female (ref)								
Male	−1.9	0.311	−5.58	1.78	1.72	0.44	−2.59	6.02
Ethnicity								
Chinese (ref)								
Malay	**6.71**	**0.01**	**1.84**	**11.58**	3.92	0.17	−1.70	9.55
Indian	2.36	0.23	−1.49	6.19	−0.34	0.88	−4.91	4.23
Others	3.55	0.15	−1.27	8.35	−0.49	0.87	−6.28	5.31
Employment status								
Employed/self-employed (ref)								
Unemployed	7.16	0.08	−0.76	15.06	**19.94**	**0.01**	**6.14**	**33.74**
Economically inactive	6.04	0.11	−1.32	13.38	0.35	0.94	−9.13	9.83
Highest education attained								
Degree and above (ref)								
Below primary	4.85	0.23	−2.99	12.69	2.60	0.54	−5.72	10.92
Secondary school	**6.56**	**0.04**	**0.62**	**12.51**	0.82	0.83	−6.47	8.10
Pre-U/ JC/ ITE/ Poly	1.09	0.59	−2.93	5.11	1.56	0.57	−3.83	6.96
Marital status								
Never married (ref)								
Married/cohab	−2.59	0.42	−8.93	3.75	−4.04	0.21	−10.31	2.23
Divorced/widowed/separated	−3.76	0.40	−12.56	5.04	3.33	0.52	−6.87	13.52
Monthly personal income								
2,000 to 3,999 (ref)								
Below, 2,000	0.03	0.99	−6.57	6.64	2.81	0.52	−5.74	11.36
4,000 to 5,999	2.76	0.25	−1.98	7.49	3.54	0.42	−5.04	12.12
6,000 to 9,999	0.46	0.87	−4.90	5.82	2.38	0.61	−6.86	11.61
10,000 and above	2.81	0.39	−3.53	9.15	8.00	0.16	−3.06	19.06
Have children?								
No (ref)								
Yes	−0.93	0.80	−8.18	6.31	−0.67	0.83	−6.94	5.59

Sample sizes for burnout-personal is different from the burnout-work as the latter was not applicable to some respondents (e.g., students, retirees). Cases with missing data were removed from the analysis. Bold values refer to *p*-value <0.05.

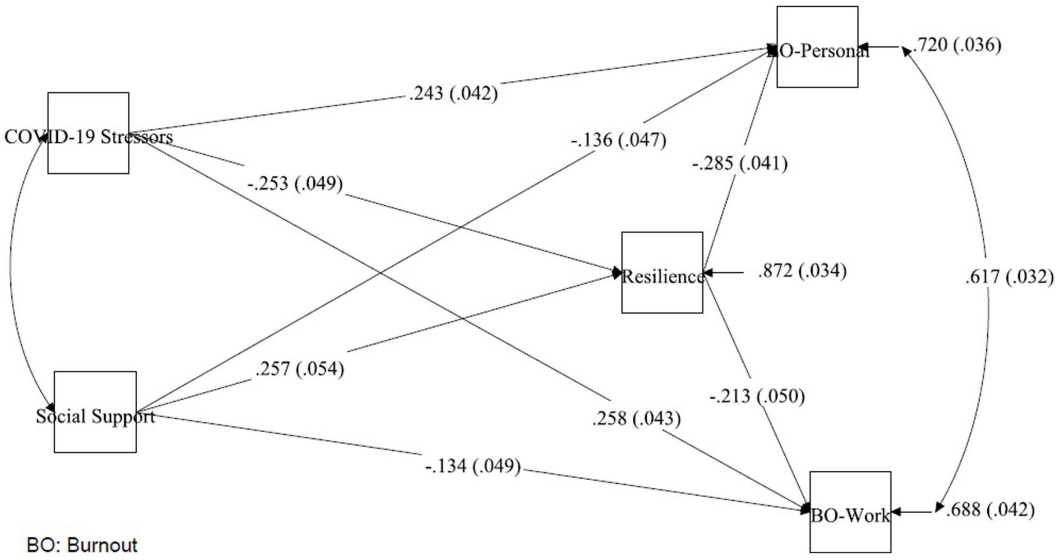

FIGURE 1
Standardised paths of COVID-19 stressors, social support to burnout, with resilience as a mediator.

TABLE 4 Model fit indices from the path analysis.

Fit indices	CFI	TLI	RMSEA	SRMR
Results	**0.999**	**0.994**	**0.012**	**0.018**
Criteria	>=0.95	>=0.95	<0.05	<0.05

Bold values refer to *p*-value <0.05.

TABLE 5 Standardized effects for the paths between COVID-19 stressors and social support with burnout, mediated by resilience.

	Standardized effects*	SE	*p*-value
Direct effects for burnout work (n = 653)			
COVID-19 stressors → BO work	0.258	0.043	<0.001
Social support → BO work	−0.134	0.049	0.007
Direct effects for burnout personal (n = 821)			
COVID-19 stressors → BO personal	0.243	0.042	<0.001
Social support → BO personal	−0.136	0.047	0.004
Indirect effects for burnout work (n = 653)			
COVID-19 stressors → Resilience → BO work	0.054	0.017	0.001
Social support → Resilience → BO work	−0.055	0.017	0.001
Indirect effects for burnout personal (n = 821)			
COVID-19 stressors → Resilience → BO personal	0.072	0.017	<0.001
Social support → Resilience → BO personal	−0.073	0.02	<0.001

*Model was adjusted for age, gender and ethnicity.

Resilience has been described as mental fortitude to navigate unpleasant challenges or positive adaptation to adversity (51, 52). The Conservation of Resources (COR) theory asserts that individuals strive to acquire, maintain and protect valuable resources (e.g., finances, health, energy) and experience stress when access to essential resources are threatened. Based on this theory, resilience constitutes a personal resource that supports an individual's ability to bounce back from negative emotional states, flexibly adapt to the changing demands of stressful experiences, allowing the individual to recoup their resources (53). For instance, in the context of the pandemic, resilient individuals may set boundaries to manage their new work-life arrangements or adjust their financial goals while seeking alternate sources of income. Some attributes of resilient individuals include optimism, hope, enthusiasm, and the ability to develop meaning from hardship (54). The resilience trait thus creates a positive feedback loop that sustains a "gain spiral" preserving an individual's well-being during challenging times (55).

Our findings further supported the hypothesis that those with higher perceived social support will be less burnt out both on the personal and work fronts and that resilience has a role to play in these relationships. Our findings were similar to that of Shang and Yang (26) who demonstrated that higher social support was associated with lower athlete burnout and this relationship was partially mediated by resilience. Our results espouse assertions that resilience can be augmented by supportive social environments. When dealing with a crisis such as the COVID-19 epidemic, effective social support may reduce respondent's worries in a similar way that illness support groups do. When respondents had support networks to confide in, their concerns and worries can be better understood and soothed. The individual could also obtain strength, confidence and inspiration from others undergoing similar challenges as them, thereby reducing distress and burnout in the long run (56).

The protective effects of resilience in enhancing well-being and preventing psychological morbidity is well-established and resilience training programmes have gained popularity in the recent years. Presently, resiliency training is a loosely defined set of interventions aimed at enhancing resilience through a range of therapeutic approaches such as mindfulness, stress-management or cognitive behavioral techniques and may feature explicit teaching of emotion-regulation, optimism and self-efficacy (57). Although the lack of standardisation of resilience programmes has been criticised, there is no "one size fits all" formula as different aspects of resilience could be differentially valued based on factors such as nature of the stressor, culture, life-stage etc. Nevertheless, in regard to the pandemic, Kauderer et al. recommended that interventions could include effortfully maintaining positive emotions even in the presence of negative ones (e.g., seeking gratitude for what has not been), reframing negative circumstances (e.g., conceptualising quarantine as a chance to pick up a new skill), maintaining social connectedness (e.g., virtually with restrictive measures) and practicing spirituality (e.g., turning to religion for guidance or engaging in meditation) (57). Moving further upstream, efforts to improve community resilience such as continuous investment in public mental health surveillance and programmes, clear and up-to-date accessible communication between government agencies and the public to reduce anxiety and confusion and cultivating a culture of strong community support and cohesiveness can better prepare societies for future outbreaks (58).

Our study also showed that younger age was associated with both personal and work-related burnout with the 21–35 years age group reporting the highest level of burnout. Various studies have reported comparable age trends (59–61). Huang et al. reasoned that age affects how individuals perceive and cope with stress; as one matures, they acquire traits and psychological capital that improve their resilience towards stressors. They may also become more skilful in rallying support that can buffer the impact of stress (61). Furthermore, the 21–35 years age group are a part of the "sandwich generation" that are caring for both young children and older adult parents, who are more vulnerable to the virus, a point earlier identified by other researchers (59, 62). In addition, those in their 30s are likely to be middle managers who have been reported to be most stressed during the pandemic, as a result of increased complexities in their work that could jeopardise their position in the organisation or career aspirations, in contrast to those 40 years and older who have achieved more stability in their careers (3, 50).

Next, we found that individuals who were recently unemployed demonstrated higher levels of work-related burnout compared to those who were employed. Safety measures that persisted in the second year of the pandemic gave rise to and exacerbated stressful work environments (63). Healthcare sectors continued to have high caseloads whereas industries such as aviation and hospitality were forced to make budget cuts that added to workloads, resulting in reduced job satisfaction (64, 65). Additionally, increased virtual meetings due to remote working and screen time led to "Zoom fatigue" and digital exhaustion (66), while the absence of in-person interaction led to isolation and feeling of lack of support. These factors have been associated with burnout and turnover intentions (64, 65, 67). Thus, it is possible that such factors could have caused individuals in our study to resign, explaining the association between recent unemployment and higher work-related burnout. Indeed, another local survey among 1,002 workers in Singapore aged 16–55 years reported that 46% experienced increased stress, 44% perceived heavier workloads, 33% felt more burnout, 20% felt isolated, 49% realised that they do not like their current job and 24% planned to leave their current employer in the next 6 months (68) mirroring the trend observed in the United States dubbed the Great Resignation where monthly resignations in 2021 were the highest in country's 20-year history (67). Various studies have emphasized the importance of providing employer, peer and job support to reduce burnout and turnover intentions (69).

Finally, it was observed that those with secondary school education (compared to university) and Malay ethnicity were associated with higher personal burnout. Individuals with lower education levels tend to occupy non-PMET (Professionals, Managers, Executives, Technicians) vocations, that are generally lower paying and face higher job insecurity. Similarly, local reports indicate that those of Malay ethnicity are concentrated in lower rung vocations or in sales and service industries that tend to be most affected by the outbreak (70). These groups may face the impact of the pandemic more severely due to financial instability, higher risk of exposure to the virus, a lack of resources and conducive home environment to manage home-based learning, less help with childcare, and means to afford medical care among other stressors (58), highlighting widening social inequalities during this period.

In Singapore, national reserves and past budgetary savings allowed the government to introduce a series of initiatives swiftly to protect jobs, support households and companies. For instance, the Workfare Special Payment, Self-employed Person Relief Scheme and COVID-19 Support Grant were implemented to provide income support and alleviate financial hardship. Efforts from various government agencies were also aimed at creating jobs and re-skilling workers (58). In contrast, mental health interventions and responses were inadequate and slow, placing a spotlight on investments needed in mental health infrastructure, programmes, and research to enhance and accelerate the public's psychological preparedness for adversity. Recently, the National Mental Health and Well-being Strategy was launched to tackle mental health issues. The strategy comprises not only an expansion of mental health services but the promotion of well-being through whole-of-society efforts that involve an individual's microsystem such schools, workplaces, healthcare, and social services. The new strategy also involves identifying varying mental health needs in the population using a tiered care model and emphasizes a preventative approach to improving mental health (71). Continued

tracking of the nation's psychological health is needed to better understand the aftermath of the pandemic and assess the impact of the newly launched strategy.

Strengths and limitations

The study comprised a representative sample in Singapore and efforts were made to conduct the interviews in local languages (English, Chinese and Malay), using the modality (Zoom or face to face) preferred by respondents. However, as there was no baseline data, the results were analyzed cross-sectionally and causality cannot be inferred. All measures were based on self-report; it is possible that individuals who are burnt out were less likely to take part in survey, thus the data may be an under-representation of burnout levels in the community. Nevertheless, important insights into sections of the population that reported high levels of burnout and the protective effects of social support and resilience on COVID-19 stressors and burnout were identified.

Data availability statement

The data supporting the conclusions of this article will be made available, upon request to the corresponding author.

Ethics statement

The studies involving humans were approved by National Healthcare Group, Singapore Domain Specific Review Board (Ref: 2021/00566). 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

ShS: Conceptualization, Investigation, Project administration, Writing – original draft, Writing – review & editing. ET: Formal analysis, Investigation, Writing – review & editing. SaS: Project administration, Supervision, Writing – review & editing, Methodology. YT: Project administration, Writing – review & editing. SG: Project administration, Writing – review & editing. RT: Project administration, Writing – review & editing. PS: Project administration, Writing – review & editing. YZ: Project administration, Writing – review & editing. PW: Project administration, Writing – review & editing. ST: Project administration, Writing – review & editing. MS: Conceptualization, Funding acquisition, Investigation, Methodology, Supervision, Writing – review & editing.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2024.1374484/full#supplementary-material

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EDITED BY
Gabriele Nibbio,
University of Brescia, Italy

REVIEWED BY
Jian-Hong Ye,
Beijing Normal University, China
Hamid Sharif-Nia,
Mazandaran University of Medical Sciences, Iran

*CORRESPONDENCE
Ru Gao
✉ 154475957@qq.com
Si-Yuan Song
✉ si-yuan.song@bcm.edu
Yi Wang
✉ w_yi2022@163.com

†These authors have contributed equally to this work

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Mental well-being and sleep quality among vocational college students in Sichuan, China during standardized COVID-19 management measures

Ru Gao[1*†], Hailian Wang[2†], Shan Liu[1], Xia Wang[3], Xiaomei Xiong[1], Si-Yuan Song[4*] and Yi Wang[5*]

[1]The People's Hospital of Wenjiang, Chengdu, Sichuan, China, [2]Clinical Immunology Translational Medicine Key Laboratory of Sichuan Province, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [3]Department of Clinical Medicine, Chengdu University, Chengdu, Sichuan, China, [4]Baylor College of Medicine, Houston, TX, United States, [5]Clinical Immunology Translational Medicine Key Laboratory of Sichuan Province, Sichuan Academy of Medical Science and Sichuan, University of Electronic Science and Technology of China, Chengdu, Sichuan, China

Purpose: This research investigated the impact of the COVID-19 pandemic on the mental well-being and sleep quality of students in higher vocational colleges in Sichuan, China, identifying key factors influencing their psychological health during this period.

Methods: Between January and February 2022, a comprehensive survey was conducted among students from several higher vocational colleges in Sichuan, utilizing a randomized selection approach to involve 3,300 participants. Data were collected through direct interviews executed by skilled interviewers.

Results: Out of 3,049 valid responses, a significant number reported experiencing symptoms of poor mental health, anxiety, depression, and insomnia, with prevalence rates of 21.2%, 9.7%, 14.1%, and 81.9%, respectively. Factors contributing positively to mental health and sleep included a higher family economic status, reduced stress from the pandemic, and decreased online activity. Conversely, lack of physical activity post-pandemic, disruptions to education and employment, and deteriorating relationships emerged as negative influencers. Interestingly, a lack of pre-pandemic mental health knowledge acted as a protective factor against insomnia.

Conclusion: The ongoing management of COVID-19 has notably influenced the psychological and sleep health of vocational college students, driven by economic, emotional, lifestyle, and educational factors. The findings underscore the necessity for targeted interventions to address these challenges effectively.

KEYWORDS

mental health, sleep status, vocational college students, COVID-19 management, family economic status, online behavior, psychological pressure, intervention measures

1 Introduction

As 2022 commenced, COVID-19 emerged with multifaceted transmission pathways, a prolonged asymptomatic phase, robust transmissibility, swift propagation, and a notably elevated mortality rate (1). The pandemic has globally resulted in an extensive toll of infections and fatalities (2). Concurrently, it has exacerbated psychological strain and mental health symptoms across diverse societal sectors (3). Manifestations commonly include depressive and anxious episodes, pervasive worry or fear, sleep disturbances such as insomnia, and a spectrum of somatic symptoms (4–6). Research indicates that anxiety and depression prevalence among infected individuals (31.91, 54.26%) starkly exceeds that in the uninfected demographic (9.18, 21.36%; $p < 0.05$) (7), with the former group also encountering heightened suicidal risks and diminished sleep quality (8).

The human response to crises is multifactorial, influenced by age, educational background, geographical location, economic standing, and the magnitude of the crisis, exemplified by COVID-19 (9, 10). The World Health Organization (WHO) has observed a substantial upsurge in mental disorders post-COVID-19, with anxiety disorders escalating by approximately 25% annually (nearing 100 million cases) and depression by 60 million (11). In China, a substantial survey (56,932 participants) unveiled that during the pandemic, instances of depression, anxiety, insomnia, and acute stress stood at 27.9%, 31.6%, 29.2%, and 24.4%, respectively (12). Participants with confirmed or suspected COVID-19 cases were particularly prone to depressive symptoms (13). The pandemic-induced stress is likely to amplify the prevalence and intensity of anxiety, depression, PTSD, and substance dependency, especially among adolescents globally (14). It underscores the necessity for continued research into the ramifications of the pandemic on youth mental health.

Research across the globe has highlighted the profound impact of the COVID-19 pandemic on college students' psychological health, with notable increases in anxiety and depression. A comprehensive meta-analysis revealed that anxiety and depression were prevalent in 31 and 34% of college students worldwide, respectively (15). This analysis also noted significant regional variations in these mental health challenges, linking them to the intensity of the local COVID-19 outbreaks. In particular, students from the United States, Spain, and other nations reported escalated mental health issues during the pandemic, marking a rise in anxiety and depression rates from pre-pandemic levels. Similarly, in China, there has been a noticeable uptick in anxiety and depression among college students during the COVID-19 crisis. Research by Nan et al. identified that the rates of depression and anxiety stood at 331.8% and 10.4%, respectively (16). Further studies by Yang Xingjie et al. demonstrated that the prevalence of anxiety and depression symptoms reached 39.0 and 26.9%, respectively (17). These findings underscore the significant psychological toll of the pandemic on the student population, with varying degrees of impact across different countries, influenced heavily by the severity of the COVID-19 situation.

Despite the similarities in the physical and mental development characteristics of university and vocational college students within the broader social context, significant differences exist between higher vocational education and general undergraduate education. These differences are evident in educational philosophy, training objectives, modes of education, and career choices. Particularly in the traditional Chinese context, where academic qualifications hold substantial importance, the lower degree of social recognition for vocational education often leads to feelings of inferiority among vocational college students (18). Amidst the backdrop of higher vocational education, students are at a pivotal stage of psychological and physical maturity. As they navigate social reforms and the rapidly developing market economy, they face escalating academic competition and employment pressures. The accelerated pace of life and reduced communication time further influence their self-evaluation and expectations, frequently leading to discrepancies between their ideals and reality (19). This disparity can result in internal conflicts and significantly challenge their psychological adaptability, increasing their susceptibility to depression, anxiety, PTSD, sleep disorders, and other mental health issues, particularly during the pandemic (20). Notwithstanding the importance of this issue, there remains a scarcity of research addressing mental health concerns, including depression, anxiety, and insomnia, and their contributory elements among vocational college students during the pandemic or its subsequent normalization phase (21). This study is thus focused on exploring the mental health status and sleep quality of higher vocational college students, alongside the determinants that influence these conditions amidst the ongoing normalization of COVID-19 management in Sichuan, China.

The 2020–2023 global COVID-19 pandemic has concluded, offering numerous lessons. During this significant health crisis, the mental health of vocational college students experienced substantial changes, manifesting in fluctuations and negative emotions such as anxiety, discrimination, hypochondria, and emotional collapse (22). Additionally, the preventive and control measures implemented during the pandemic may have heightened the risk of students developing anxiety, depression, and other mental disorders. There were also potential deviations in students' perceptions of society and events, leading to feelings of dissatisfaction or pessimism, and in some cases, causing social withdrawal or fear of venturing outdoors (23). This study emphasizes that in response to similar future adversities, it is crucial to adopt a proactive approach, leverage positive influences that protect mental health, and ensure the well-being of college students.

2 Methods

2.1 Research hypotheses

> *Hypothesis 1*: The standardized COVID-19 management measures has a negative relationship with Mental Well-Being.
>
> *Hypothesis 2*: Mental Well-Being has a positive relationship on Sleep Quality Among Vocational College Students.

2.2 Study population

The research was conducted from January to February 2022 through face-to-face surveys, with strict confidentiality of data

maintained. Considering a 12% prevalence of potential mental health issues, such as anxiety or depression, a Type I error probability of less than 0.05, and an allowable error margin of 1%, the minimum sample size was calculated to be 2,800 for this study.

A multi-stage random cluster sampling method was employed. The sampling process consisted of three phases. In the first phase, one district (Wen Jiang) was randomly selected from 12 districts in Chengdu city, with the district serving as the cluster sampling unit. In the second phase, five vocational colleges were randomly chosen from all the vocational colleges in Wen Jiang district, each college acting as a cluster sampling unit. In the final phase, a random selection of 3,300 students was made across these five vocational colleges in Wen Jiang district. The study included students who were actively enrolled, willingly participated, and completed the survey while residing on campus during the study period. We excluded students who were staying at home or were under home quarantine. This study was approved by the ethical committee of Wenjiang District People's Hospital of Chengdu City (Approval Notice No. 2023-008).

2.3 Data collection instruments

This investigation gathered data through a comprehensive questionnaire encompassing demographic details, lifestyle habits, psychological stress, mental health issues, and sleep quality.

2.4 Demographics and lifestyle factors

Participants provided demographic data, economic background, parents' educational levels, and their experiences during the pandemic, including quarantine, stress levels, study habits, physical activity, screen time, job concerns, and interactions with family and friends.

2.5 Mental health and sleep assessment tools

The 12-Item General Health Questionnaire (GHQ-12) (24–26), in its Chinese version, was utilized to evaluate the overall mental well-being of individuals over the past month. Recognized for its widespread application in community-based mental disorder epidemiological research, the GHQ-12 includes 12 questions, each with a score ranging from 0 to 1, leading to a maximum score of 12. The scoring system categorizes mental health risk into three tiers: scores of 0 to 1 indicate low risk, scores of 2 to 3 suggest medium risk, and scores of 4 or above denote high risk. A threshold of 3 or higher was employed to identify individuals with potential mental health concerns. In this study, the internal consistency is $\alpha = 0.896$.

For anxiety assessment, the Generalized Anxiety Disorder-7 (GAD-7) questionnaire was employed (27, 28). This tool, grounded in DSM-IV criteria, aims to measure the severity and impact of seven anxiety symptoms experienced by individuals in community settings over the preceding 2 weeks. The GAD-7 has a scoring system from 0 to 3 for each of its 7 items, totaling a maximum score of 21, with defined levels of anxiety: scores from 0 to 4 indicate no anxiety, scores between 5 and 9 point to mild anxiety, scores from 10 to 14 suggest moderate anxiety, and scores of 15 or above reflect severe anxiety. A score of 10 or more signifies notable anxiety symptoms. In this study, the internal consistency is $\alpha = 0.966$.

Depressive symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9) (29, 30), which aligns with DSM-IV criteria for depression. This instrument is designed for the screening of depression in community dwellers over the last 2 weeks, comprising 9 items with scores ranging from 0 to 3, for a total possible score of 27. The scoring breakdown is as follows: 0 to 4 for no depression, 5 to 9 for mild depression, 10 to 14 for moderate depression, and 15 or higher for severe depression. A score of 10 or more is indicative of significant depressive symptoms. In this study, the internal consistency is $\alpha = 0.948$.

The Insomnia Severity Index (ISI) was used to quantify the severity of recent insomnia symptoms (31). This index includes 7 items, each scored from 0 to 4, culminating in a total score of 28. The severity of insomnia is categorized as follows: 0 to 7 indicates non-significant symptoms, 8 to 14 represents mild insomnia, 15 to 21 denotes moderate insomnia, and 22 to 28 suggests severe insomnia. Scores of 8 or more were considered indicative of insomnia symptoms. In this study, the internal consistency is $\alpha = 0.928$.

2.6 Statistical procedures

Descriptive statistics summarized scale scores and categorical data was expressed in frequencies and percentages. The chi-square test defined as Eq. (1) was used to compare categorical data across groups.

$$\chi^2 = \Sigma \frac{(O-E)^2}{E} \tag{1}$$

where χ^2 is the chi-square test statistic, O is the observed frequency, and E is the expected frequency under the null hypothesis.

Normally distributed measures were reported as mean ± standard deviation, defined as follows Eq. (2).

$$\mu = \frac{1}{n}\sum_{i=1}^{n} x_i \tag{2}$$

where $\propto$ is the mean of a set of n observations $x_1, x_2, \ldots, x_n$. And the standard deviation of the same set of observations can be calculated as Eq. (3):

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \mu)^2} \tag{3}$$

where σ is the standard deviation.

Binary regression analysis identified factors linked to mental health and sleep disturbances. The logistic function is defined as follows Eq. (4):

$$P(Y=1|X) = \frac{1}{1+e^{-(\beta_0+\beta_1 X_1+\ldots+\beta_n X_n)}} \tag{4}$$

where $P(Y=1|X)$ is the probability of the outcome Y being 1 given the predictor variables X. β_n is the regression coefficient. Xn is the predictor variable. e is the base of the natural logarithm. The regression coefficients were estimated using maximum likelihood estimation. A p-value <0.05 was regarded as statistically significant.

3 Results

3.1 Participant demographics and COVID-19-related factors

3.1.1 Participant demographics

Table 1 delineates the demographic details and COVID-19-related attributes of the study's participants. The analysis incorporated data from 3,049 individuals, comprising 903 males (29.6%) and 2,146 females (70.4%), with a mean age of 20.9 ± 0.02 years. A majority of respondents, 58.3%, reported living in households of 4 to 6 people. Regarding the previous year's family economic situation, 75.6% described it as average. The prevalent marital status was single, with 71.9% indicating they were not in a romantic relationship. The educational attainment of parents was varied, with 42.0% of fathers having an education of primary school level or lower, and 40.7% of mothers having completed middle school.

3.1.2 The COVID-19 related characteristics of the participants

Table 2 delineates the concerning the COVID-19 pandemic's impact, 91.6% of students reported they were not quarantined during the epidemic's normal management phase. About 60.2% felt that their studies had partially resumed to normalcy post-epidemic. Internet usage during the epidemic was moderate among participants, with 56.3% spending between 2 to less than 5 h online daily. Physical activity was notably reduced, with 68.8% not engaging in exercise during the pandemic. The epidemic's influence on daily routines was significant, yet 64.3% anticipated a gradual return to normal life routines as the situation improved. Prior to the pandemic, 63.9% had sought information on mental health. Relationships with family and friends, including romantic partners, remained unchanged for 69.9% of the participants. Moreover, 64.8% believed that the pandemic had minimally impacted their ongoing education and job search efforts.

3.2 General health and mental well-being during COVID-19

According to Table 2, the assessment of the general health, anxiety, depression, and sleep quality revealed that 645 participants (21.2%) displayed general health concerns (GHQ-12 scores ≥ 3), 295 individuals (9.7%) exhibited anxiety symptoms (GAD-7 scores ≥ 10), 430 students (14.1%) showed signs of depression (PHQ-9 scores ≥ 10), and a significant 2,497 (81.9%) experienced insomnia (ISI scores ≥ 8) in the context of the pandemic (Table 3).

3.3 Associations with general health and mental well-being

Participants from lower economic backgrounds, with quarantine history, facing psychological stress, spending 2–5 h daily online, lacking physical activity, and having poor familial and social relationships reported poorer general health ($p < 0.05$, or $p < 0.001$; Table 2). Those who perceived their studies and daily routines as heavily impacted by COVID-19, along with those whose educational pursuits and job searches were disrupted post-COVID-19, also reported poorer health ($p < 0.001$).

3.4 Anxiety and related factors

Anxiety was more prevalent among students from lower-income families, those with fathers holding college degrees or higher, individuals with quarantine experiences, subjects under high psychological stress, those spending 2–5 h online daily, and those with weaker ties to family and partners. The pandemic's disruption to daily life, education, and job prospects was also linked to increased anxiety (Table 3).

3.5 Depression correlates

Depression correlated with factors such as lower economic status, high psychological stress, quarantine history, disrupted studies, 2–5 h

TABLE 1 The demographic of the participants.

Variables	*N*(%)	Variables	*N*(%)
Gender		In love	832(27.3)
Male	903(29.6)	Married	25(0.8)
Female	2,146(70.4)	**One-child families**	
Ethnic		Yes	832(27.3)
Han	2,725(89.4)	No	2,217(72.7)
Minority	324(10.6)	**Father education level**	
Total number of families living together		Primary School or Below	1,281(42.0)
1 to 3 people	1,096(35.9)	Middle school	1,156(37.9)
4 to 6 people	1,718(58.3)	High school or technical secondary school	448(14.7)
More than 7 people	175(5.7)	College degree and above	164(5.4)
Self-assessment of family economic income last year		**Mother education level**	
Very good	107(3.5)	Primary School or Below	992(32.5)
Average	2,306(75.6)	Middle school	1,240(40.7)
Poor	636(20.9)	High school or technical secondary school	488(16.0)
Marital status		College degree and above	329(10.8)
No love	2,192(71.9)	Severely affected	246(8.1)

10.3389/fpubh.2024.1387247

TABLE 2 The COVID-19 related characteristics of the participants.

Variables	*N*(%)	Variables	*N*(%)
You were be quarantined during the normal management of epidemic		Moderately affected	1,671(54.8)
Yes	256(8.4)	Severely affected	238(7.8)
No	2,793(91.6)	**Whether the rule of the life will gradually return after the epidemic is gradually controlled**	
The psychological pressure caused by the epidemic and various restrictions		No recovery	127(4.2)
Little affected	1,499(49.2)	Partial recovery	1,960(64.3)
Moderately affected	1,304(42.8)	Full-Recovery	962(31.6)
Severely affected	246(8.1)	**Learn the mental health related knowledge before the epidemic**	
Study will return to normal after the epidemic is controlled		Never really learn	1,100(36.1)
No recovery	86(2.8)	Learn About	1,949(63.9)
Partial recovery	1,836(60.2)	**Relationships with family and friends(including Lover), compared with before of the epidemic**	
Full-Recovery	1,127(37.0)	Little deterioration	70(2.3)
Average total Internet used per day during normal epidemic management (hours)		Moderately deterioration	358(11.7)
≤2 h	738(24.2)	No deterioration	1,877(61.6)
2–≤5 h	1,718(56.3)	Moderately improvements	325(10.7)
≤5–<7 h	484(15.9)	Great improvement	92(3.0)
7 h≤	109(3.6)	Unclear	223(7.3)
Physical exercise during the epidemic		**Epidemic affected the continuing education and job hunting**	
Yes	950(31.2)	Little affected	1,977(64.8)
No	2,099(68.8)	Moderately affected	6,601(21.6)
Eepidemic affected the rule of the life		Severely affected	152(5.0)
Little affected	1,140(37.4)	Unclear	260(8.5)

of internet use, lack of exercise, strained relationships, and pandemic-related impacts on daily life, education, and employment ($p < 0.05$; Table 3).

3.6 Insomnia indicators

Insomnia was associated with lower economic status, not being an only child, quarantine experience, higher stress levels, disrupted studies, 2–5 h of daily internet use, absence of physical activity, lack of prior mental health knowledge, and the pandemic's influence on daily routines, educational continuation, and job hunting ($p < 0.05$; Table 3).

3.7 Analysis of predictive factors for general health and anxiety symptoms during the pandemic

3.7.1 Influences on general health status

Table 4 delineates the associations between self-perceived family economic status and general health. Participants who rated their family's economic status as either 'very good' (OR = 0.362, 95%CI = 0.19–0.69, $P < 0.005$) or 'average' (OR = 0.655, 95%CI = 0.53–0.81, $P < 0.001$) the previous year were found to have a considerably reduced risk of a higher GHQ score. Similarly, those who reported minimal (OR = 0.554, 95%CI = 0.40–0.77, $P < 0.001$) or moderate (OR = 0.65, 95%CI = 0.48–0.88, $P < 0.05$) psychological pressure due to the pandemic and related restrictions also exhibited a lower risk of elevated GHQ scores. Reduced total daily online time was associated with lower GHQ scores, with ≤2 h (OR = 0.50, 95% CI =0.31–0.80, $P < 0.05$) and 2–≤ 5 h (OR = 0.61, 95% CI = 0.39–0.96, $P < 0.05$) being significant. Participants who experienced little (OR = 0.47, 95%CI = 0.34–0.60, $P < 0.001$) or moderate (OR = 0.0.60, 95%CI = 0.44–0.82, $P < 0.005$) disruption to their daily routines due to the pandemic were less likely to have higher GHQ scores. However, those who reported severe impacts on their education and job searching activities (OR = 1.85, 95%CI = 1.11–3.09, $P < 0.001$) had a higher risk of an increased GHQ score.

3.7.2 Predictors of anxiety

Table 4 further demonstrates that participants with an 'average' economic assessment last year (OR = 0.73, 95%CI = 0.55–0.99, $p < 0.05$) had a reduced likelihood of elevated GAD-7 scores. Individuals experiencing little (OR = 0.34, 95%CI = 0.23–0.50, $p < 0.001$) or moderate (OR = 0.53, 95%CI = 0.37–0.77, $p < 0.05$) psychological pressure from the pandemic and restrictions also showed a lower risk of increased GAD-7 scores. Daily online time of ≤2 h (OR = 0.43, 95%CI = 0.24–0.76, $p < 0.005$), 2–≤ 5 h (OR = 0.48, 95%CI = 0.28–0.82, $p < 0.005$), and 5–<7 h (OR = 0.40, 95%CI = 0.22–0.73, $p < 0.05$) were linked to a higher risk of increased GAD-7 scores. Those with a minimal (OR = 0.54, 95%CI = 0.35–0.83, $p < 0.05$) or moderate (OR = 0.61, 95%CI = 0.41–0.90, $p < 0.05$) pandemic impact during standard management were more likely to have heightened GAD-7 scores. A deterioration in the relationship with family and friends (including lovers) that was slight (OR = 3.50, 95%CI = 1.70–7.17, $p < 0.005$) or significant (OR = 3.38, 95%CI = 1.35–8.47, $p < 0.05$) corresponded to a greater risk of increased GAD-7 scores, as did a moderate deterioration (OR = 3.49, 95%CI = 1.49–8.78, $p < 0.005$).

3.7.3 Predictive factors for depression

As illustrated in Table 4, students who perceived their family's economic standing as average in the previous year exhibited a reduced likelihood of heightened PHQ-9 scores (OR = 0.63, 95%CI = 0.49–0.81, $p < 0.001$). Those minimally (OR = 0.40, 95%CI = 0.28–0.56, $p < 0.001$) or moderately (OR = 0.51, 95% CI = 0.37–0.72, $p < 0.001$) affected by pandemic-induced psychological pressure were found to have an increased risk of higher PHQ-9 scores. Daily internet use for ≤2 h (OR = 0.34, 95%CI = 0.21–0.57, p < 0.001), 2–≤ 5 h (OR = 0.43, 95%CI = 0.27–0.68, $p < 0.001$), and 5–<7 h (OR = 0.41, 95%CI = 0.25–0.69,

10.3389/fpubh.2024.1387247

TABLE 3 Single factor analysis of the detection rate of mental health disorder, sleep status in college students (n = 3,049).

Variables	GHQ-12 ≥ 3分	X^2	GAD-7 ≥ 10分	X^2	PHQ-9 ≥ 10分	X^2	ISI ≥ 8	X^2
Gender								
Male	175(19.4)	2.42	95(10.5)	1.05	145(16.1)	4.05	695(77.0)	21.03##
Female	470(21.9)		200(9.3)		285(13.3)		1,802(84.0)	
Ethnic								
Han	580(21.3)	0.26	267(9.8)	0.44	383(14.1)	0.049	2,233(81.9)	0.04
Minority	65(20.1)		28(8.6)		47(14.5)		264(81.5)	
Total number of families living together								
1 to 3 people	217(19.8)	5.18	106(9.7)	2.27	167(15.2)	3.42	875(79.8)	5.13
4 to 6 people	399(22.4)		174(9.8)		245(13.8)		1,479(83.2)	
More than 7 people	29(16.6)		15(8.6)		18(14.3)		143(81.7)	
Self-assessment of family economic income last year								
Very good	13(12.1)	34.71##	11(10.3)	13.94#	16(15.0)	28.59##	69(64.5)	22.7##
Average	446(19.3)		198(8.6)		283(12.3)		1,901(82.4)	
Poor	186(29.2)		86(13.5)		131(20.6)		527(82.9)	
Marital status								
No love	455(20.8)	1.33	203(9.3)	4.06	299(13.6)	1.85	1,800(82.1)	0.29
In love	186(22.4)		87(10.5)		126(15.1)		677(81.4)	
Married	4(16.0)		5(20.0)		5(20.0)		20(80.0)	
One-child families								
Yes	161(80.6)	2.23	82(9.8)	0.043	124(14.9)	0.11	653(78.5)	8.98#
No	1,733(78.2)		213(9.6)		306(13.8)		1,844(83.2)	
Father education level								
Primary School or Below	274(21.4)	0.83	110(8.6)	9.42#	159(12.4)	7.52	1,049(81.9)	0.26
Middle school	239(20.7)		118(10.2)		169(14.6)		955(82.6)	
High school or technical secondary school	100(22.3)		41(9.2)		71(15.8)		368(82.1)	
College degree and above	32(19.5)		26(15.9)		31(18.9)		125(76.2)	
Mother education level								
Primary School or Below	208(21.0)	0.36	90(9.1)	4.43	125(12.6)	4.35	808(81.5)	1.44
Middle school	259(20.9)		120(9.7)		175(14.1)		1,023(82.5)	
High school or technical secondary school	108(22.1)		43(8.8)		75(15.4)		403(82.6)	
College degree and above	70(21.3)		42(12.8)		55(16.7)		263(79.9)	
You were be quarantined during the normal management of epidemic								
Yes	71(27.7)	7.25#	28(10.9)	0.51#	45(17.6)	2.79	225(87.9)	6.77#
No	574(20.6)		267(9.6)		385(13.8)		2,272(81.3)	
The psychological pressure caused by the epidemic and various restrictions								
Little affected	260(17.3)	46.61##	98(6.5)	67.04##	161(10.7)	69.15##	1,135(75.7)	75.94##
Moderately affected	297(22.8)		141(10.8)		194(14.9)		1,145(87.8)	

(Continued)

TABLE 3 (Continued)

Variables	GHQ-12 ≥ 3 分	X^2	GAD-7 ≥ 10分	X^2	PHQ-9 ≥ 10分	X^2	ISI ≥ 8	X^2
Severely affected	88(35.8)		56(22.8)		75(30.5)		217(88.2)	
Study will return to normal after the epidemic is controlled								
No recovery	29(33.7)	21.64##	19(22.1)	23.53##	27(31.4)	30.64##	71(82.6)	34.50##
Partial recovery	421(22.9)		193(10.5)		277(15.1)		1,563(85.1)	
Full-recovery	195(17.3)		83(7.4)		126(11.2)		863(76.6)	
Average total Internet access per day during normal epidemic management (hours)								
≤2 h	124(19.2)	23.36##	63(21.4)	17.72#	82(19.1)	34.76##	551(22.1)	36.78##
2–≤5 h	363(56.3)		166(56.3)		242(56.3)		1,435(57.5)	
≤5–<7 h	121(18.8)		43(14.6)		71(16.5)		415(16.6)	
7 h≤	37(5.7)		23(7.8)		35(8.1)		96(3.8)	
Physical exercise during the epidemic								
Yes	171(18.0)	8.23#	81(8.5)	2.89	102(10.7)	12.91##	722(76.0)	32.35##
No	474(22.6)		214(10.2)		328(15.6)		1,775(84.6)	
Eepidemic affected the rule of the life								
Little affected	188(16.5)	65.35##	87(7.6)	37.93##	120(10.5)	65.99##	849(74.5)	68.64##
Moderately affected	362(21.7)		159(9.5)		237(14.2)		1,437(86.0)	
Severely affected	95(39.9)		49(20.6)		73(30.7)		211(88.7)	
Whether the rule of the life will gradually return after the epidemic is gradually controlled								
No recovery	41(32.3)	27.71##		29.12##	35(27.6)	33.78##	99(78.0)	47.49##
Partial recovery	449(22.9)		27(21.3)		298(15.2)		1,675(85.5)	
Full-recovery	155(16.1)		202(10.3)		97(10.1)		723(75.2)	
Learn the mental health related knowledge before the epidemic								
Never really learn	253(23.0)	3.51	105(9.5)	0.03	161(14.6)	0.40	874(79.5)	6.92 #
Learn about	392(20.1)		190(9.7)		269(13.8)		1,623(83.3)	
Relationships with family and friends(including Lover), compared with before of the epidemic								
Little deterioration	25(35.7)	21.58#	15(21.4)	26.88##	20(28.6)	26.06##	57(81.4)	8.12
Moderately deterioration	89(24.9)		52(14.5)		59(16.5)		298(83.2)	
No deterioration	353(18.8)		151(8.0)		227(12.1)		1,544(82.3)	
Moderately improvements	109(23.6)		48(10.4)		71(15.4)		383(82.9)	
Great improvement	26(25.0)		10(9.6)		18(17.3)		76(73.1)	
Unclear	43(24.2)		19(10.7)		35(19.7)		139(78.1)	
Epidemic affected the continuing education and job hunting								
Little affected	366(18.5)	46.5 ##	170(8.6)	18.64##	241(12.2)	32.46##	1,595(80.7)	15.52#
Moderately affected	168(25.5)		78(11.8)		114(17.3)		574(87.0)	
Severely affected	60(39.5)		27(17.8)		41(27.0)		124(81.6)	
Unclear	51(19.6)		20(7.7)		34(13.1)		204(78.5)	

#$P < 0.05$, ##$P < 0.001$.

$p < 0.005$) were associated with an elevated risk of depression symptoms. Engaging in physical exercise during the pandemic was linked to a lower risk of increased PHQ-9 scores (OR = 0.73, 95%CI = 0.56–0.95, $p < 0.05$). An improved relationship with family and friends, including partners, was correlated with a higher risk of depression symptoms (OR = 2.71, 95%CI = 1.30–5.65, $p = 0.008$).

3.7.4 Influences on sleep quality

Table 4 also identifies factors influencing sleep quality. Females had a lower risk of experiencing increased ISI scores (OR = 0.78,95%CI = 0.63–0.97, $p < 0.05$). Participants with a 'very good' self-assessed family income from the previous year were less likely to have elevated ISI scores (OR = 0.52, 95% CI = 0.32–0.84,

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TABLE 4 Binary logistics regression analysis of mental health, sleep status in college students (n = 3,049).

Variables	β	S_E.	P	OR(95% CI)	Variables	β	S_E.	P	OR(95% CI)
Impact factors of the mental health					The relationship with family and friends (including lovers) had Little deterioration	1.25	0.37	0.001	3.50(1.70–7.17)
Self-assessment of family income was very good last year	−1.02	0.33	0.002	0.36(0.19–0.69)	The relationship with family and friends (including lovers) had great improvement	1.22	0.47	0.010	3.38(1.35–8.47)
Self-assessment of family income was average last year	−0.42	0.11	0.000	0.65(0.53–0.81)	**Impact factors of the depression symptoms**				
The psychological pressure caused by the epidemic and various restrictions was Little affected	−0.59	0.16	0.000	0.55(0.40–0.77)	Self-assessment of family income was average last year	−0.46	0.13	0.000	0.63(0.49–0.81)
The psychological pressure caused by the epidemic and various restrictions was Moderately affected	−0.43	0.16	0.006	0.65(0.48–0.88)	The psychological pressure caused by the epidemic and various restrictions was Little affected	−0.92	0.18	0.000	0.40(0.28–0.56)
Average total Internet access per day was ≤2 h during normal epidemic management	−0.70	0.24	0.004	0.50(0.31–0.80)	The psychological pressure caused by the epidemic and various restrictions was Moderately affected	−0.67	0.17	0.000	0.51(0.37–0.72)
Average total Internet access per day was 2–≤5 h during normal epidemic management	−0.49	0.23	0.032	0.61(0.39–0.96)	Average total Internet used was ≤2 h per day, during normal epidemic management	−1.07	0.26	0.000	0.34(0.21–0.57)
Eepidemic Little affected rule of the life	−0.76	0.17	0.000	0.47(0.34–0.65)	Average total Internet used was 2–≤5 h per day hours during normal epidemic management	−0.85	0.24	0.000	0.43(0.27–0.68)
Eepidemic moderate affected rule of the life	−0.51	0.16	0.001	0.60(0.44–0.82)	Average total Internet used was ≤5–<7 h per day during normal epidemic management	−0.89	0.26	0.001	0.41(0.25–0.69)
Continuing education and job hunting	0.62	0.26	0.018	1.85(1.11–3.09)	Had the Physical exercise during the epidemic	−0.32	0.13	0.018	0.73(0.56–0.95)

(Continued)

TABLE 4 (Continued)

Variables	β	$S_{E.}$	P	OR(95% CI)	Variables	β	$S_{E.}$	P	OR(95% CI)
Impact factors of the anxiety symptoms					The relationship with family and friends (including lovers) had great improvement	1.0	0.37	0.008	2.71(1.30–5.65)
Self-assessment of family income was average last year	−0.31	0.15	0.040	0.73(0.55–0.99)	**Impact factors of the insomnia symptoms**				
The psychological pressure caused by the epidemic and various restrictions was Little affected	−1.08	0.20	0.000	0.34(0.23–0.50)	Female	−0.25	0.11	0.023	0.78(0.63–0.97)
The psychological pressure caused by the epidemic and various restrictions was Moderately affected	−0.63	0.19	0.001	0.53(0.37–0.77)	Self-assessment of family income was very good last year	−0.67	0.25	0.008	0.52(0.32–0.84)
Average total Internet access per day was ≤2 h during normal epidemic management	−0.85	0.29	0.004	0.43(0.24–0.76)	Be quarantined during the normal management of epidemic	0.47	0.21	0.023	1.60(1.07–2.40)
Average total Internet access per day was 2–≤5 h during normal epidemic management	−0.74	0.27	0.007	0.48(0.28–0.82)	The psychological pressure caused by the epidemic and various restrictions was Little affected	−0.60	0.22	0.007	0.55(0.36–0.85)
Average total Internet access per day was ≤5–<7 h during normal epidemic management	−0.91	0.31	0.003	0.40(0.22–0.73)	Study partial return to normal after the epidemic is controlled	0.23	0.11	0.045	1.25(1.01–1.56)
Eepidemic little affected the rule of the life	−0.61	0.22	0.005	0.54(0.35–0.83)	Average total Internet used was ≤2 h per day, during normal epidemic management	−0.97	0.32	0.003	0.38(0.20–0.71)
Epidemic Moderately affected the rule of the life	−0.50	0.20	0.013	0.61(0.41–0.90)	Eepidemic little affected the rule of the life	−0.63	0.23	0.007	0.54(0.34–0.84)
The relationship with family and friends (including lovers) had Moderately deterioration	1.25	0.44	0.004	3.49(1.49–8.78)	Before the epidemic had Learned about the mental health related knowledge	−0.23	0.10	0.027	0.79(0.65–0.98)

$p < 0.05$). Minimal psychological pressure due to the pandemic was associated with a lower risk of poor sleep quality (OR = 0.55,95%CI = 0.36–0.85, $p < 0.05$). Those who utilized the internet for ≤2 h daily had a reduced risk of sleep issues (OR = 0.38, 95%CI = 0.20–0.71, $p < 0.005$). A small impact of the pandemic on daily life was also linked to better sleep quality (OR = 0.54,95%CI = 0.34–0.84, $p < 0.05$). Pre-pandemic knowledge about mental health correlated with better sleep status (OR = 0.54, 95%CI = 0.65–0.98, $p < 0.05$). Being quarantined (OR = 1.60, 95%CI = 1.07–2.40, $p < 0.05$) and a partial return to normal studies post-pandemic (OR = 1.25, 95%CI = 1.01–1.56, $p < 0.005$) were associated with an increased risk of insomnia.

3.7.5 Interrelationships among mental health variables

As depicted in Table 5, Pearson correlation analysis revealed significant relationships between anxiety and depression (R = 0.861, $p < 0.001$), as well as between anxiety, depression, and insomnia (R = 0.644, 0.716, $p < 0.001$), indicating a strong interconnectivity among these mental health issues.

4 Discussion

This study focuses on examining the mental and sleep health of vocational college students in Sichuan, China, during the ongoing COVID-19 pandemic's normalization phase, identifying key factors influencing their psychological well-being. Our research underscores the significant effects various determinants have on students' mental health and sleep patterns, advocating for customized psychosocial strategies to improve their overall well-being. In educating students through the pandemic, acknowledging the substantial stress and potential psychological impact infectious disease outbreaks can exert is crucial. Experiencing negative emotions during such times is natural and should not lead to excessive mental strain. Acceptance of these feelings is vital for timely mental adjustment and proactive engagement with the pandemic. Rational processing of epidemic information, understanding the virus's nature, staying informed about the pandemic without succumbing to misinformation, and maintaining trust in governmental public health measures can transform anxiety into constructive action. Ensuring personal protection without undue worry, maintaining open communication channels, and leveraging technology for social interactions can mitigate feelings of isolation. Upholding a healthy lifestyle, including adhering to regular eating and sleeping schedules, helps sustain normalcy. Additionally, establishing sound hygiene practices and mastering stress management and emotional release techniques are essential for psychological resilience (32).

TABLE 5 Analysis of the correlation between mental health status and sleep status in college students (n = 3,049).

	GHQ-12 total scores	GAD-7 total scores	PHQ-9 total scores	ISI total scores
GHQ-12 total scores	1			
GAD-7 total scores	0.399**	1		
PHQ-9 total scores	0.390**	0.861**	1	
ISI total scores	0.309**	0.644**	0.716**	1

**$P < 0.001$. GHQ-12,12-Item General Health Questionnaire; GAD-7, Generalized Anxiety Disorde-7; PHQ-9, Patient Health Questionnaire-9; ISI, Insomnia Severity Index.

4.1 The prevalence of general health, anxiety, depression, and insomnia in vocational college students

Our research reveals that in the context of normalized COVID-19 management, the prevalence of general health, anxiety, depression, and insomnia in vocational college students in Sichuan stands at 21.2%, 9.7%, 14.1%, and 81.9%, respectively. These figures are notably higher than those reported in earlier studies, where anxiety and depression rates among 1,676 college students were documented at 9.4% and 27.7% (33, 34). It is evident that the pandemic has exacerbated the mental health challenges faced by college students (35). Possible reasons include significant psychological stress and mental health symptoms experienced by students during the pandemic. Constraints such as home quarantine, limited social interaction, disrupted routines, employment concerns, and strained family relations could contribute to heightened anxiety, depression, and insomnia (36, 37). Nonetheless, some studies suggest that students' mental health during the normalized phase may be better than at the onset of the pandemic, which could be attributed to post-traumatic growth (38). Additionally, variations in the timing of research, regional and cultural distinctions among study subjects, or the employment of diverse research methodologies could account for discrepancies in the findings.

4.2 Family economic conditions, psychological stress, and online engagement affected the mental health and sleep status during the pandemic

The current study also found that students with more robust family economic conditions, lower psychological stress, and reduced online engagement during the pandemic had better overall health and fewer symptoms related to anxiety, depression, and insomnia. The pandemic's normalization phase has seen a significant impact on the financial status of many students' families (39). A more stable economic background may help students manage the emotional toll of the pandemic, reducing psychological stress and symptoms of anxiety, depression, and insomnia, aligning with the findings of this study (40). In line with previous studies, our analysis also reveals that students subjected to quarantine measures and those not participating in physical activities tended to report higher levels of mental health challenges, including symptoms of anxiety, depression, and insomnia. Engaging in regular physical activity and maintaining a structured routine can bolster students' resilience and willpower, enhance physical capabilities, enrich emotional wellbeing, boost self-efficacy and achievement, thereby augmenting their psychological capital. Such practices lead to a more persistent and stable sense of

contentment. This study underscores the positive correlation between physical activity, a regulated lifestyle, and the psychological capital of college students, emphasizing the importance of these factors in fostering mental health (41).

4.3 Physical activity and a consistent lifestyle, engaging in exercise affected the mental health disorder, sleep status during the pandemic

This research indicates a positive association between physical activity and a consistent lifestyle with enhanced mental health outcomes among college students during the pandemic's normalization phase, notably in reducing symptoms of depression and insomnia. Engaging in exercise is posited to strengthen the resilience and psychological health of college students throughout and subsequent to the pandemic (39). It has been previously documented that the occurrence of anxiety and insomnia symptoms saw an uptick preceding and during the normalized phase of the pandemic (42). Further, existing literature supports that anxiety and depression can negatively impact sleep quality, while poor sleep may aggravate symptoms of depression and anxiety, a finding that aligns with the outcomes of this study. In essence, physical activities such as jogging, yoga, tennis, and swimming have been identified as beneficial for alleviating anxiety. The critical benefit of exercise lies in its capacity to facilitate comprehensive muscle relaxation, which is particularly significant for managing anxiety disorders. Furthermore, physical exercise is known to enhance the secretion of neurotransmitters like dopamine, norepinephrine, and serotonin, contributing to a reduction in symptoms of anxiety and depression. Additionally, engaging in regular physical activity can diminish the physiological stress response, thereby lowering muscle tension and heart rate, which, in turn, helps alleviate anxiety symptoms. Exercise also fosters social engagement and enhances social support, further contributing to the mitigation of anxiety symptoms (43, 44).

4.4 Epidemic affected the continuing education and job hunting

The necessity for further investigation into this critical domain is evident. Our findings reveal that students facing disruptions in their educational and career trajectories tend to suffer from deteriorated mental health, a conclusion that aligns with prior studies (45, 46). The adverse effects of the pandemic on internships and job opportunities (47), along with its sustained global economic repercussions, have posed significant challenges for businesses and intensified competition in the job market for graduates. The broadening scale of university admissions has placed higher vocational college students at a disadvantage, particularly in comparison to their undergraduate and graduate counterparts, in terms of academic capabilities and employment prospects.

There exists a subconscious drive among these students to continuously enhance their skills and never allow complacency, spurred by the heightened employment pressures catalyzed by the pandemic's economic fallout in recent years. This accumulation of stressors can escalate physical and mental strain, potentially leading to severe health issues and psychological disturbances in extreme cases(?). Highlighting the importance of supporting students in their academic and professional endeavors as a means to promote mental well-being is crucial (48, 49).

4.5 Relationships with family and friends (including lover) affected by the epidemic

Our research reveals a decline in the quality of students' relationships with family, peers, and romantic partners since the onset of the pandemic, correlating with an increase in anxiety and depression levels amid COVID-19's normalized management. These findings echo prior studies that have documented elevated anxiety and depression rates among college students during these challenging times (37). The family unit serves as a critical emotional anchor throughout an individual's development, significantly influencing college students' mental health. Evidence suggests that strong familial bonds can mitigate feelings of depression and loneliness, fostering mental well-being among students. The support, empathy, and warmth from family members are pivotal for the psychological health of students, especially given their physical distance from home during college years (50). The role of family in shaping students' personalities and mental health education is profound (38). Peer interactions constitute a vital aspect of the college experience, significantly impacting students' mental health. Positive peer relationships can provide a sense of security, compensating for deficiencies in family and academic environments (51). Rust and support from peers can enhance students' self-esteem and social skills, decreasing the likelihood of depression and anxiety. Conversely, poor peer relations can lead to negative mental health outcomes, including feelings of rejection, isolation, and even suicidal ideation. Enhancing social skills and fostering genuine friendships can improve the quality of peer relationships, which is beneficial for mental health maintenance. Romantic relationships are notably significant during college years, with the satisfaction derived from these relationships closely linked to students' mental health. Research indicates that students in satisfying relationships experience higher levels of happiness and lower incidences of negative emotions like depression and anxiety (52). Furthermore, engaging in romantic relationships can bolster social competencies and self-awareness, while inspiring personal goals and aspirations. Nevertheless, relationship challenges or breakups can exert considerable psychological stress and detriment to students' well-being.

4.6 Mental health knowledge and self-regulation skills affect the mental health and sleep quality

Our findings intriguingly suggest that those lacking prior knowledge of mental health were less prone to suffer from insomnia. This observation implies that individuals aware of mental health issues before the pandemic may have been more susceptible to its stressors, increasing their risk of insomnia. It has been documented that the emotional state of college students regarding sleep has shifted significantly due to the pandemic. The introduction of online learning and the pressures associated with isolation have potentially

deteriorated their sleep quality and emotional well-being. Furthermore, possessing knowledge about mental health could allow for some degree of self-regulation and adjustment psychologically. Additionally, college students who consistently engage in physical activity display greater resilience in managing public health crises. Research indicates that students dedicating 30 min to 1 h daily to exercise experience the least stress. Regular moderate exercise is an effective strategy to mitigate stress and anxiety, with physical activity fostering positive mental states. This, in turn, supports mental health, alleviates anxiety, and promotes sound sleep (53). Earlier studies reveal that students experiencing higher stress, fatigue, and sleepiness shortly after the onset of the COVID-19 pandemic reported elevated anxiety and depression levels, alongside compromised sleep quality, in response to public health emergencies. Hence, it is crucial to focus on the capacity of vocational college students to navigate public health crises through the acquisition of mental health knowledge and self-regulation skills, aiming to reduce anxiety and depression and enhance sleep quality (54). The importance of continued research in this area is evident.

4.7 The characteristics of the vocational students and the contributions of the study for psychological construction in college students

This study highlights that as societal dynamics evolve, the perspectives of college students in our country have also undergone significant transformations. Universities can only enhance the relevance of mental health education for college students by comprehensively understanding and addressing their mental states, which are continuously evolving. Higher vocational college students, who are particularly curious about external information, often experience psychological fluctuations in response to public opinion and crises. Consequently, it is crucial to prioritize mental health education for vocational college students during public crises to foster their overall development (55). For future educational initiatives, the following strategies are recommended: First, enhance the awareness of mental health education among teachers, stressing the integration of mental health education into vocational training programs, with teacher evaluations in higher vocational colleges including an assessment of their awareness of mental health education. Second, enrich the appeal of mental health education activities in higher vocational colleges by ensuring that these activities are engaging, varied, and capable of stimulating student participation. Third, emphasize the central role of students by valuing their involvement and fostering their enthusiasm for participating in activities, tailoring mental health education strategies to the unique physical and mental development needs of vocational students, especially during public crises. Fourth, leverage the supportive role of network information technology in education, utilizing tools such as WeChat public accounts for diverse instructional delivery, to enhance learning interest and effectively focus on the core aspects of mental health education for higher vocational college students, thereby promoting their mental well-being.

It is important to acknowledge the limitations of this study. Firstly, the cross-sectional nature of this survey means that the relationships between mental health issues, insomnia, and potential risk factors cannot be inferred as causational. Secondly, the reliance on self-reported data for general health, anxiety, depression, and sleep status may not fully correspond with evaluations conducted by mental health professionals. Thirdly, due to varying social conditions, the applicability of our findings to other regions may be limited.

5 Conclusion

It is necessary to infiltrate mental health education in daily teaching, create a good environment and atmosphere of mental health education, and implement mental health education in order to maintain the normalization and sustainable development of mental health education. Teachers should integrate more contemporary content into mental health education based on the psychological state of vocational college students, take some hot issues in the new era as mental health education resources, so as to arouse students' thinking, and realize the goal of mental health education in the discussion and reflection of psychological problems, so as to seek the effectiveness of education. Actively excavate the educational resources contained in public crisis events, guide students to maintain a good attitude toward people in the face of danger, and face difficulties bravely.

The COVID-19 pandemic has significantly altered individuals' lifestyles and behaviors, leaving a lasting impact on society. Among the affected, college students have faced considerable psychological stresses, necessitating a comprehensive approach to their mental well-being. It is essential for governmental bodies, educational institutions, community organizations, and families to work in concert toward enhancing the mental health framework for students. This collaborative effort should include leveraging public resources like mental health platforms and support hotlines established by governments, alongside colleges and universities initiating mental health screenings and offering a mix of virtual and in-person mental health seminars. These steps ensure students facing mental health issues receive prompt, professional psychological counseling or treatment to help stabilize their emotional state. Moreover, community and familial support structures need to actively provide accessible measures, with parents particularly encouraged to engage more deeply in communication with their college-aged children, fostering a supportive environment for their mental health. Conducting this study 2 years after the pandemic's onset has shed light on the ongoing mental health and sleep challenges faced by students in Sichuan, China, during this global health emergency. The findings underscore the critical need for targeted health policies and psychosocial interventions designed to support student mental health resilience in the face of public health crises.

Data availability statement

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

Ethics statement

This study was approved by the Ethical Committee of Wenjiang District People's Hospital of Chengdu City (Approval Notice No. 2023-008). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements.

Author contributions

RG: Data curation, Writing – original draft, Funding acquisition, Validation. HW: Data curation, Writing – original draft. SL: Formal analysis, Methodology, Writing – original draft. XW: Formal analysis, Writing – original draft. XX: Formal analysis, Writing – original draft. S-YS: Conceptualization, Investigation, Validation, Writing – review & editing. YW: Conceptualization, Funding acquisition, Investigation, Project administration, Supervision, Writing – review & editing.

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Conflict of interest

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

Publisher's note

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EDITED BY
Gabriele Nibbio,
University of Brescia, Italy

REVIEWED BY
Mohammadreza Shalbafan,
Iran University of Medical Sciences, Iran
Frank Quansah,
University of Education, Winneba, Ghana
Paul W. C. Wong,
The University of Hong Kong,
Hong Kong SAR, China

*CORRESPONDENCE
Liang Bian
liangbian@henu.edu.cn

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Influence of the first wave of COVID-19 on Chinese students' psychology and behavior: a case study approach

Xiudi Zhang[1] and Liang Bian[2*]

[1]School of Education Science, Zhoukou Normal University, Zhoukou, China, [2]School of Philosophy and Public Administration, Henan University, Kaifeng, China

During the first wave of COVID-19, China demonstrated a strong commitment to epidemic prevention and control. This case study focuses on Z University, which adopted closed management when the epidemic was serious, and examines the influence of COVID-19 on students' psychology and behavior through interviews with 10 students. The research reveals that while students perceive closed management during the epidemic as enhancing safety and promoting learning engagement to some extent, the epidemic also has adverse effects on their physical health, psychology, and social life. These impacts included deteriorating physical health, feelings of rebellion and depression regarding college life, alongside concerns and aspirations regarding future job stability. In the discussion, we suggest that higher education institutions can utilize this information to shape policies and procedures, particularly concerning mental health and risk communication, not only during the current pandemic but also in future emergency or disaster scenarios.

KEYWORDS

case study, pandemic, psychology and behavior, influence, university students

Introduction

Universities, for a long time, have played an important role in disseminating knowledge and skills. Universities contribute to the training and development of university students' knowledge and professional skills to address various scientific and social issues (1). However, previous studies have shown that university students are more likely to have mental health problems (2). University students have just completed high school and entered a relatively unfamiliar environment with its unique set of life and psychological characteristics. For most, they are learning to live independently, meeting new people, and, often, living in close confines with strangers, as well as managing their own finances. Additionally, they may be confronted by challenges posed by a course that may leave them feeling overwhelmed (3). Therefore, to some extent, the prevalence of depressive symptoms

among college students is higher than that of the general population or non-college students (4–6).

During the first wave of COVID-19, China was committed to epidemic prevention and control. Based on the severity of the epidemic, China had a series of effective public health measures, such as quarantine of potential cases, monitored tracing of contacted individuals, complete hospitalization of diagnosed patients, and so on (7). In order to protect teachers and students from infection as much as possible, China's Ministry of Education and Ministry of Industry and Information Technology (8) suggested "suspending classes without suspending learning". Therefore, students in China made use of different modes of learning, including online learning based on different platforms to achieve this goal. Since the epidemic became severe, universities have also taken many measures. Some universities adopted a closed management approach as an emergency measure to prevent the spread of the virus. Some universities resorted to undertaking innovative online teaching to make sure that students' learning was going well (9).

Understanding the experience of university students during a global pandemic is crucial, given that the years they spend in university have been indicated as a critical period for life development (10, 11).

According to current research, pandemic experiences can affect student health, study motivation and life satisfaction. Chinese university students attracted significant attention in the fields of public health (12, 13), education (14, 15) and psychology (16–18). A study of 7143 Chinese students has reported that 25% of respondents perceived moderate or severe psychological impact during the COVID-19 pandemic (19). Cao's (19) research is based on a large population. However, Cao's study failed to understand the psychological and behavioral changes of students in the specific context of the university implementing closed emergency management during the severe COVID-19 pandemic.

Zhang and Tian (20) found that the challenges Chinese universities faced manifested in the government's strict management requirements and the students' demands for freedom of entry and exit. However, Zhang and Tian (20) did not investigate students' experiences.

In summary, previous research has focused on the manifestation of students' psychological well-being through anxiety in general and Chinese university challenges, rather than students' experiences during closed management. Therefore, it is necessary to conduct research on exploring Chinese university students' coping experiences during closed management.

Objectives statements

Because of the restrictions, students could not freely go outside of the university. For undergraduate students, they have started the new term in a novel way. This paper aims to investigate the anxiety of Chinese undergraduate students during COVID-19, analyze the impact of the first wave of COVID-19 on undergraduate students, explore whether COVID-19 has increased or decreased their anxiety, and explore the relationship between COVID-19 and student anxiety.

Materials and methods

Methodology

To gain a detailed view on the student experience during closed management, a qualitative case study design was used for this study. We adopted naturalistic strategies that paralleled students' lives and experiences during university closed management, typically interacting with students in a natural and unobtrusive manner (21, 22).

First, case studies are a common way to do qualitative inquiry. The case study not only provides a detailed description of the phenomenon, but also provides an in-depth analysis of the reasons behind the phenomenon, which answers both "how" and "why", which helps researchers grasp the ins and outs and essence of events. Second, case studies come from practice, without theoretical abstraction and simplification, are a comprehensive and true reflection of objective facts, and taking case studies as a starting point for scientific research can effectively increase the effectiveness of empirical evidence. Third, case studies contain various elements of real-world scenarios, special phenomena, and unexpected phenomena. Indeed, researchers in the case study process may find some causes, phenomena or results and other variables that have not been perceived before, which often become the implicit hypothesis to be tested in the case study, and the basis for future research.

Therefore, this research has drawn attention to the question of what especially could be learned about the case of Chinese students' stress and personalities during closed management – an instance in time and space.

Study context

Z University is a provincial-level undergraduate institution with 10 disciplines such as literature, history, economics, management, law, science, engineering, agriculture, education and the arts, as well as 20 colleges (departments) and 65 undergraduate majors. The school has over 20,000 full-time students and 1727 teaching staff. We chose Z University as the research site because it was rated as playing a leading role in pandemic control and prevention at the universities of this city by the municipal government.

From 2020 to the end of 2022, according to the severity of COVID-19, Z University has responded with semi-closed or fully closed management to ensure that students are protected from virus transmission to the greatest extent. Semi-closed management means students can go outside of the campus in the morning and must come back to the campus before 8 p.m. Fully closed management means that students cannot go outside of the campus until the measure is lifted.

Participants' rights

We invited participants from a variety of disciplines who were studying at Z University. We send volunteer forms to the school advisors who let the potential participants know about this research. As soon as the person invited had read the Participant Information Sheet and had given their informed consent to participate in this

study, we then scheduled a suitable time and method to conduct the interviews. In the data collection, the participants may refuse to answer any questions and are free to leave without giving a reason. All participants have the right to have the audio-recorder turned off at any stage. The participants are entitled to withdraw interview data at any time up to December 2022. The participants were given 50 yuan (around 7 dollars) in gift coupons at the end of the interview. Interview data will be kept anonymous and confidential.

Participant selection

All the interview data were digitally audio-recorded with the informed consent of the interviewees, and the duration of each interview ranged from 40 to 45 minutes. All the face to face interviews were semi-structured, starting with some pre-designed questions, such as, "How has the COVID-19 effected your life and study?", "What do you think of the closed management" and "Has/have there been change (s) in your personality?" While the participants verbally shared reflections on events or personal views, we also made additional, spontaneous follow-up inquiries to elicit a more detailed explanation of what the respondent had experienced and how they had experienced it in a bid to collect their stories, thoughts, and feelings in detail (23).

According to the interview sampling literature, the ideal cohort size is between 6 and 12 people (24). Most themes in the study were identified within six interviews, and no new codes emerged after conducting 10 interviews (25). A number of new codes were identified in the first eight individual interviews with over 80% saturation (26). Based on these results, we started the interview process and continued until we recognized data saturation to have been reached. After the analysis process, the interview data were gathered from 10 students. The demographic features of the students are shown in Table 1.

Ethical considerations

As the nature of this study required the students to evaluate their views on the closed management, ethical conditions needed to be considered. Addressing ethical issues was not a process that ended with ethical approval by the Z University Ethics Committee (ZKNHPEC 012378). Specifically, we took the interviews at the dining hall with some snacks and drinking which made the students relax and comfortable.

Text encoding

In this research, we utilized reflexive thematic analysis, a method recognized for its accessibility and theoretical adaptability in interpreting qualitative data. This approach enables the systematic identification and analysis of patterns or themes within a dataset (27). A central tenet guiding our study was the commitment to faithfully represent students' opinions and experiences, while also acknowledging and addressing the reflexive influence of our own interpretations as researchers. First, we imported the interview data into the NVivo software, and then the imported material was analyzed and coded to establish free nodes, which could then be rooted. Secondary coding of free nodes was produced according to the research direction and purpose. After that, the visualized content was obtained through the software.

The specific operation process is as follows: import the already organized verbatim manuscripts into NVivo 12 Plus software; and using the grounded theoretical research method, encode the verbatim text of the interviews at different levels. Through a summary of the interview outline, the research group divided all coding variables into two categories: external factors and internal factors. These two classes were used as coding level one nodes, and the subsequent factors were level two. The secondary nodes of external factors included Freedom, School, and Class, whereas the secondary nodes of internal factors included Stable, Negative, Study, and Understanding. We focused on highly repetitive text content during the encoding process. The more frequently the text appeared, the more it reflected the universal significance of the respondent's psychological behavior.

Through the scientific encoding of the text, 54 valid coding entries were finally obtained, from which the following nine main nodes could be excavated: online, social life, study, psychical health, life, job, habits,

TABLE 1 Interviewee demographics (n=10).

Number	Interview	Gender	Seniority	Group	Interview data
1	A	Female	2nd year	Arts	2–9-2022
2	B	Male	4th year	Science	12–9-2022
3	C	Female	3rd year	Literature	21–9-2022
4	D	Male	2nd year	Management	30–9-2022
5	E	Female	1st year	Education	8–10-2022
6	F	Male	4th year	Agriculture	13–10-2022
7	G	Female	1st year	History	18–10-2022
8	H	Male	3rd year	Engineering	23–10-2022
9	I	Female	4th year	Law	28–10-2022
10	J	Female	2nd year	Economics	2–11-2022

policy and influences. In our qualitative research endeavor, resolving discrepancies among the team regarding nodes was a collaborative and iterative process marked by open dialogue and mutual respect. We approached these discrepancies with a commitment to thoroughness and intellectual honesty, recognizing that diverse perspectives enrich our analysis. Through frequent discussions, we shared our interpretations, allowing for a rich exchange of ideas that often illuminated new insights. After the research group finally sorted the coding results, Figure 1 was obtained.

From the data in Figure 1, it can be seen that during the process of closed management of COVID-19, the students' responses focused on the following aspects: job intentions, reflections on the closed management, life at the university, online learning quality, and habits, etc.

The legitimacy of the study

The study's credibility didn't hinge on the sheer volume of data amassed but rather on the specific topics distilled through scientific scrutiny of one interviewee's experiences and insights. Its aim was to gather and scrutinize narratives and perspectives from Z University's students regarding pandemic closed management. This systematic amalgamation of data and theorization, known as systematic combination (28), allowed for the emergence of cognitive patterns among these individuals, striving for coherence in comprehending all facets of the gathered data (29). Ultimately, the topics were crafted to elucidate life of students within the context of closed management at Z University and to delve into insights for the post-pandemic period.

Results

To be safe or free, that is a question

Colleges and universities have an important position in pandemic prevention and control, and the characteristics of dense populations increase the difficulty of pandemic prevention and control. Relevant departments have issued a number of targeted policies, especially the "Technical Plan for the Prevention and Control of the COVID-19 Epidemic in Colleges and Universities (Fourth Edition)" released in August 2021. This plan puts forward detailed requirements for the school management measures of colleges and universities, and emphasizes that under the guidance of local health departments and disease control institutions, emergency measures such as closed management would be taken for universities with epidemic cases or close contacts depending on the situation. Interviewees from the research responded to these matters.

Student I: I think the university closed management makes me feel safer. Without this, we may also face the same serious risk of the epidemic as other places. The closed management brings the greatest guarantee to our lives – this is a better place. And then, the bad thing about it is that we can't go out of school freely.

Students A and B also think they felt safe in the closed university. However, in the process of closed management, university students must not only adapt to the new changes in comprehensive online teaching, and complete various learning tasks arranged by the school, but they also encounter changes in daily life brought about by the closed environment, which is very prone to producing various negative emotions (30).

Student D: I usually don't go out even if we are allowed to, but the kind of psychology that I have now is that I may not go out when you open the school door. But now that you don't let me go out, I may be a little anxious in my heart.

Student E: I feel that there is a psychology of wanting to rebel. That is, I may not go out, but you cannot refuse to let me out.

Student H: Being unable to freely enter and exit school has given me a certain sense of oppression. I want to release this stress.

We further asked H whether they went over the wall.

Student H: Hahaha. Can this be said? I went over the wall once or twice, because I really couldn't hold back in the last semester. Hahaha.

An interesting contribution from Student F is that his anxiety was mostly due to filling out health forms.

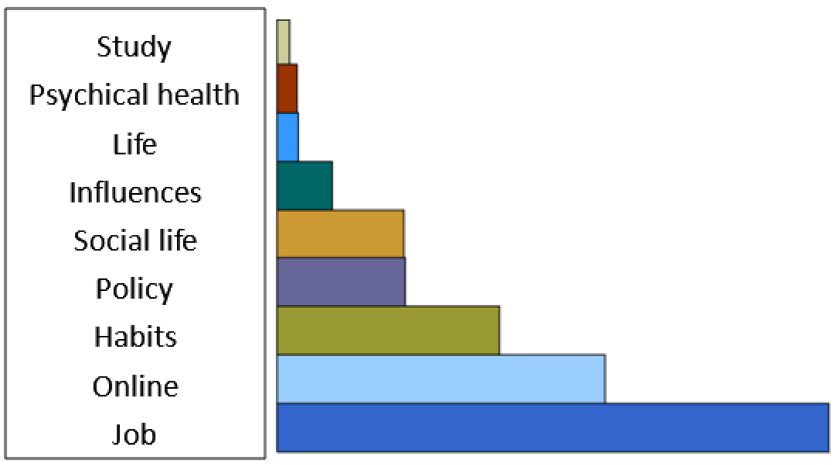

FIGURE 1
The percentage of the nodes.

Student F: The university is constantly posting about the epidemic situation. My anxiety was caused by filling out the forms to report my health situation to the university. I am afraid of infection and I am worried about my physical health.

From the above interview excerpts, we can see that "anxiety" and "stress" are common words when describing students' states of mind, and they perceive that time has been "eaten" by the pandemic. Student E's psychology of "wanting to rebel" reflects that if an individual's freedom is reduced or threatened, they will be motivated to reestablish the lost freedom (31). However, reverse psychology can be used ineffectively as a persuasion technique (32) in the Chinese context. Further, the interviewee H indicated "Can this be said?" He means that he needs to be careful about what he has done – go over the wall. Even though he had done so, he would not like the university to know.

Living in a gilded settings

The university campus is an environment pursuing educational purposes, and it provides "learning" and "opportunities" so that the individual's inner potential can flourish (33).

In the interviews, we asked the students to generalize their life at Z University during closed management.

Student J: I cannot go out of the school. Therefore, I can focus on studying to enrich myself. However, staying at the classroom, library and dormitory every day makes me feel a bit bored.

Student C: I feel that it is a pity that I can't go out freely to understand the culture of this city. I am just studying in the school and I don't know anything else.

Student F: There are not too many recreational activities. We spend a lot of time learning. We go into the evening self-studying every day. When there is no class, we either go to the library to study by ourselves, or play sports – playing badminton is a popular sports activity on campus. It is common to make a booking without a venue. Sometimes we also "nest" in the dormitory to chase drama.

The pandemic resulted in university settings that are unique given the typical permeability of their boundaries and the groups that make up university life, and the activities within the institution that affect social contact between its members (34). The university has formed its own settings so that students' activities are limited within the university boundary. Students had to adjust to a "study" life as the COVID-19 pandemic affected their social lives and health. Even the researcher found that it is not easy for students to adapt to university life in response to a sudden pandemic such as COVID-19 (35), and they have suggested some solutions for copying challenges for university leaders (20) and students (35). Based on current research, this paper has revealed that students' perception of college life during closed management is one of enrichment, yet it is also monotonous and one of regret.

Walking on thin ice

According to the interviews, a phenomenon we cannot ignore is that university students rethink their job intentions in the closed pandemic environment. Many students might be prone to psychological stress because the COVID-19 pandemic has resulted in financial losses and an extreme lack of the social capital normally gained in daily college life and friendships (36).

Question: Did you have thoughts about your future job?

Student F: The epidemic made a lot of people unemployed, so it seems that the budgeted post position is a relatively stable job.

Student G: The epidemic has greatly affected many people's work and income. I feel that I would like to take the civil service examination to get a job with the government.

Question: Work within the system, right?

Student B: Yes. Everyone wants to be stable now. It looks like everyone is preparing for the public examination. Whether they can be admitted or not, they just give themselves a chance.

According to an online survey jointly conducted by the Economic Department and the Social Investigation Center of China Youth Daily, "due to the impact of the epidemic, 60% of the graduates surveyed have 'stabilized' in employment", which shows that fresh graduates will also change their employment needs and employment orientation according to changes in the employment situation in the face of the impact of the pandemic. Previous studies have also confirmed that natural disasters or major crises can weaken an individual's risk appetite and change their attitudes and career choices.

Question: Do you want to have a stable life?

Student I: Yes, when there wasn't an epidemic in the past, I thought a lot and felt that I could do anything, and I had the idea of whimsically thinking about what kind of work to do, but now, I would not have that kind of thinking.

Student A: Of course, yes. Now I think it's good to be alive. Many shops closed. I felt a little pressure from them. I want to go back to my hometown to work and live.

According to previous research, McFarland (37) found that the pandemic created instability related to students' current employment. But in this present study, we found that the pandemic also impacts students' future employment. More particularly, students are changing their conceptualization of employment from the development of the industry to valuable and guaranteed companies and positions. This also means more people are considering returning to their hometown. On the positive side, the pandemic has accelerated the personal growth of university students and make preparations for personal growth.

Running on empty

From April to June 2022, Z University implemented the fully closed management, which meant students had online classes in the school and the teachers taught online at home.

Question: Do you think online teaching has any impact on your health?

Student E: For me, it seems like my myopia has increased. Then, I sit for a long time. There may often be some pain in the waist or something.

Student B: It's myopia, and then I gained weight. I don't move and then I go to bed very late.

Virtual learning has inevitably increased the amount of time students spend on digital devices every day. Online learning has also

affected the physical activity levels of students. Not walking between classes has made some students stationary for hours on end in front of their computers. The public health consequences stemming from a pandemic can be both wide-ranging and long-lasting, affecting not only the most vulnerable, but also leaving a mark on the next generation in profound ways (38). This being said, not every student has issues with health. For example, Student I learned sports skills during the closed management.

Student I: I was a person who especially disliked sports before. But recently, it has becoming boring. Before university closed management, I certainly was not able to exercise as I would go out to shop on Saturdays and Sundays. Now, I think I cannot go out so I have time to exercise by learning a sport inside the university.

Generally, with closed management, students' living environment has become relatively singular, and they are prone to overuse of electronic products and immersing themselves in virtual worlds, which will lead to poor physical health. As the main avenue for learning activities during the COVID-19 pandemic, long hours spent learning with digital devices affect students' vision, and long hours sitting are associated with a higher likelihood of poor health status among students in the study sample.

At the end, we categorized the above four sub-themes, which can be framed by the three main themes: physical, emotional and intellectual dimensions, as well as social dimensions as shown in Table 2.

Discussion

Despite the positive achievements of the University in managing the outbreak, such as students feeling safe and aware of the importance of health, it is grateful to the Chinese government. COVID-19 has caused stress related to students' psychological and physical health. Previous research (35, 39–41) revealed that students leaving campus reported stress, depression, loneliness, lack of motivation, difficulty focusing on schoolwork, restless sleep, appetite changes, job loss concerns, and difficulties coping. To be more specific, this study mainly focused on students who were at the university implementing closed management.

Generally, the university period is an important turning point for the socialization of interpersonal relationships. Social interaction is a vital part of university life, and it is also a critical element in the adaptability of university students to integrate into the new environment in another city (33). This is not only conducive to a deeper exercise of university students' social abilities, but also conducive to the enrichment of university students' learning lives.

In a practical way, the university environment itself serves as a crucial platform for students to develop and refine their social skills through diverse interactions with peers, professors, and other members of the campus community. Engaging in group projects, extracurricular activities, and campus events offers opportunities for students to enhance their communication, collaboration, and leadership abilities, which are vital for navigating various social settings beyond academia.

Moreover, the quality of social interactions within the university setting can significantly impact students' overall well-being and academic success. Building strong social support networks fosters a sense of belonging and connection, reducing the feelings of isolation and stress commonly experienced by students. Access to resources such as counseling services, peer mentoring programs, and inclusive campus initiatives further contributes to the development of students' social resilience and emotional intelligence. Additionally, cultivating cultural competency and empathy through exposure to diverse perspectives and experiences enriches students' social awareness and interpersonal skills, preparing them for success in an increasingly globalized and interconnected world. Ultimately, investing in initiatives that promote positive social engagement and inclusivity not only enhances students' university experience but also equips them with invaluable social competencies essential for their personal and professional growth beyond graduation.

However, due to the closed management, students in this research devoted more time to learning and received more attention. Their offline social networks are obviously smaller than before. The closed management has a certain influence on the physical and mental health of students. Many students inexplicably felt exhausted, and some even explicitly stated that their physical health had been compromised. In the interview surveys, some students stated that during the university closed management period, they sat for a long time and used their phones and computers for extended durations. Therefore, they developed symptoms of lower back pain and low vision. Young university students have not yet fully matured their minds, and their overall psychological quality and psychological adjustment ability are not yet sound enough (42). As such, the university must pay more attention to the psychological issues of students under the conditions of closed management and provide them with the necessary assistance.

The practice of closed management in universities has also had a certain influence on the future planning of students. Some students have a clearer understanding of their career choices and have clearer plans for their lives. As with early interview surveys, some students stated that due to the pandemic, employment for university graduates has become more difficult, and many jobs have been negatively affected, while civil servants and government-sponsored institutions have been less affected. Therefore, they plan to take postgraduate entrance exams or personnel exams in government affiliated institutions in order to become civil servants, work in government funded institutions, or find other good jobs.

Universities can foster stronger partnerships with industries to create more internship and job placement opportunities tailored to students' fields of study. Offering career counseling services, resume workshops, and networking events can equip students with the skills and resources needed to navigate the job market successfully. Furthermore, integrating practical, hands-on learning experiences

TABLE 2 Themes of the influence of COVID-19.

Sub-Themes	Main Themes
To be safe or free, that is a question	Physical
Running on empty	
Living in a gilded settings	Emotional and intellectual
Walking on thin ice	Social

into the curriculum can better prepare students for the workforce and enhance their employability. By aligning academic programs with industry demands and providing robust support services, universities can help students feel more confident and prepared to pursue their desired career paths post-graduation, ultimately enhancing their college experience and future prospects.

The limitations of this study

This study still has some limitations. Firstly, this is a one-off study. We are unable to report changes over time. It is crucial that, based on the actual situation of the pandemic, the time for each university to adopt closed management is not consistent. Secondly, this study only focuses on a small case study of students at Z University. Future research endeavors may benefit from an expansion in sample sizes to better achieve research objectives and enhance the robustness of findings. Increasing the sample size holds significant promise for improving generalizability.

Furthermore, future research could explore innovative recruitment strategies to reach underrepresented or marginalized groups within the population. This may involve leveraging administration, utilizing online platforms, or implementing targeted outreach efforts to ensure the inclusion of diverse perspectives and experiences. Adopting longitudinal designs or collecting data at multiple time points allows researchers to examine track developmental trajectories and explore changes over time, thereby providing richer insights into the phenomena under research.

Conclusion

This small-scale study explored students' experiences of closed management at Z University during the COVID-19 pandemic. This study contributes to our understanding of students' lives during closed management by highlighting three areas: physical, emotional, intellectual and social, as well as social. By hearing students' voices related to closed management, this can help universities improve their leadership practices and responsiveness. Universities need to strengthen their communications with students based on the tutor responsibility system of full staff, all-round, and whole-process education. Universities should communicate and cooperate with families and society, and work together to do a good job in the psychologically dynamic monitoring of students. Universities also need to strengthen their capabilities in psychological counseling, psychological assistance, and positive psychological education management and maintenance, so as to enhance the psychological resilience of university students and ensure the maintenance of positive mental health.

Data availability statement

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

Ethics statement

The studies involving humans were approved by Zhoukou Normal University Ethics Committee. 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

XZ: Writing – original draft, Conceptualization, Data curation, Formal analysis, Methodology, Investigation, Funding acquisition. LB: Writing – review & editing, Conceptualization, Methodology, Investigation, Visualization, Validation, Funding acquisition.

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Conflict of interest

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

Publisher's note

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EDITED BY
Chong Chen,
Yamaguchi University Graduate School of Medicine, Japan

REVIEWED BY
Francisco Manuel Morales Rodríguez,
University of Granada, Spain
Yuke Tien Fong,
Singapore General Hospital, Singapore
Maura Pilotti,
Prince Mohammad bin Fahd University, Saudi Arabia
Morteza Taheri,
University of Tehran, Iran

*CORRESPONDENCE
Ruichen Jiang
1811516004@sus.edu.cn

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The mediating role of emotional intelligence between self-efficacy and resilience in Chinese secondary vocational students

Ruichen Jiang[1,2,3]*

[1]School of Teacher Education, Anqing Normal University, Anqing, China, [2]Institute of Educational Neuroscience, Anqing Normal University, Anqing, China, [3]Affective Computing and Intelligent Learning Cognitive Psychology Experimental Center, Anqing Normal University, Anqing, China

Purpose: This study aimed to explore the relationship between self-efficacy and resilience in Chinese secondary vocational students and examine the mediating effect of emotional intelligence.

Methods: In September 2023, a cross-sectional survey was conducted in 282 Chinese students from three secondary vocational schools by using a voluntary and anonymous structured questionnaire, which included a general self-efficacy scale (GSES), emotional intelligence scale (EIS), and resilience scale (RS). The data were analyzed using SPSS 26.0 software and macro PROCESS.

Results: The scores of self-efficacy, emotional intelligence, and resilience of Chinese secondary vocational students were above the average level. Correlations among the self-efficacy, emotional intelligence, and resilience levels of students were significant. The analyses of mediating effect showed that emotional intelligence partially mediated the influence of self-efficacy on resilience of secondary vocational students.

Conclusion: Self-efficacy was positively associated with resilience. Self-efficacy not only has a direct effect on the resilience of secondary vocational students but it also indirectly affects the resilience through the mediating role of emotional intelligence. These findings valuable for designing the secondary vocational school programs aimed at improving students' psychological resilience.

KEYWORDS

secondary vocational students, self-efficacy, emotional intelligence, resilience, survey

Introduction

With the rapid development of Chinese economy, the demand for skilled professionals has become increasingly prominent (1). In this context, the number of secondary vocational schools has been steadily increasing, making secondary vocational students a significant part of China's youth. Professional training provided during vocational education equips young secondary vocational school students with necessary skills and competencies that are immediately valuable in the workplace and can reduce the risk of unemployment in the early years when teenagers enter the labor market (2). In 2022, the number of secondary vocational schools (including technical schools) in China was 7,201, enrolling 4,847,800 students, which accounts for 33.85% of the total number of students enrolled in senior high schools. In addition, the mental health condition of this group is of great concern to the public because of the challenges and dilemma they encounter in their study and life (3). Compared with ordinary high school students, secondary vocational students always experience family and social prejudice and are more prone to mental health problems (4, 5). Lu used the Chinese Secondary School Students Mental Health Scale (MSSMHS) to investigate 833 students from secondary vocational schools in X County, Guizhou Province, and found that the mental health problems of secondary vocational students include mainly obsessive tendency, anxiety, emotional instability, learning pressure, interpersonal relationship, and other factors (6). Thus, there is an urgent need to focus on the mental health status of secondary vocational students.

Resilience is an important mental resource for an individual to maintain positive adaptation in the face of challenging events and adverse situations. When facing problems in parent–child relationship or interpersonal relationships, resilient individuals tend to adopt more confrontational, proactive, and problem-solving coping strategies. In addition, resilience is also positive psychological resource to make the vocational students more employable (2). Thus, providing training and developing resilience among secondary vocational students have become crucial for improving their mental health and career development.

According to Bandura's social cognitive theory, self-efficacy is a subjective self-evaluation and belief derived from an individual's own experiences (7), that is, the result of an individual's evaluation of whether they can successfully complete a certain achievement behavior, which could be divided into three dimensions: magnitude, strength, and generality (8); After the self-assessment, an individual tends to set appropriate goals based on the evaluation results and determine the plan to achieve them (9). Previous studies have evidenced that adolescents with high self-efficacy are self-confident and less susceptible to mental disorders when they encounter setbacks, and show higher academic performance (10, 11). Andriani et al. showed that self-efficacy has a positive relationship with learning motivation (8). Strengthening self-efficacy can also improve the learning outcomes of vocational education students (12).

Emotional intelligence refers to a series of non-cognitive abilities and skills for an individual to recognize and monitor their or others' emotions and was proved to be positively correlated with self-efficacy (13, 14), mental health (15, 16), job performance (17), and positive adolescent development (12, 13). Numerous studies have suggested that emotional intelligence has a good predictive effect on resilience, stating that resilient people better understand and manage their emotions, which could also be related to higher levels of emotional intelligence (13, 18, 19). Teenagers are in a critical period of personality development, and their emotional state directly affects their mental health and future development (20). Secondary vocational students with a higher level of emotional intelligence can be more resilient (21).

According to the society-to-cells resilience theory (22), emotional regulation ability and optimism are important characteristics for building mental resilience. Therefore, it seems reasonable to infer that there may be potential interactions between self-efficacy, emotional intelligence and resilience.

Taken together, the relationship between self-efficacy and resilience of secondary vocational students has attracted the attention of researchers. Emotional intelligence, self-efficacy, and resilience appear to be highly correlated with each other in theory (23–25), however, the mechanism of influence of self-efficacy on emotional intelligence and resilience remains unclear. On the one hand, self-efficacy seems to be a predictor of emotional intelligence, and emotional intelligence is the individual's ability to control emotions and could provide a cognitive judgment to regulate self-efficacy. On the other hand, according to the related theoretical framework of resilience, self-efficacy is one of the important protective factors of resilience (26). In addition, a significant positive correlation between emotional intelligence and resilience has been demonstrated (14, 27). Against this backdrop, this study attempts to identify the effect of self-efficacy on the resilience of secondary vocational students and the possible mediating role of emotional intelligence between these two variables, aiming to provide a reference for preparing the school program to improve secondary vocational students' psychological resilience. Based on this, we hypothesized that. 1) self-efficacy, emotional intelligence, and resilience of secondary vocational school students would be correlated. 2) the self-efficacy of secondary vocational school students would predict resilience. 3) emotional intelligence would play a mediating role between self-efficacy and resilience in secondary vocational school student.

Materials and methods

Special Committee for Scientific Research and Academic Ethics of Anqing Normal University reviewed and approved this study. Informed consent was obtained from the study participants or their guardians before the study began, and guidelines outlined in the Declaration of Helsinki were followed.

Sampling and participants

The sample size calculator can be freely accessed at www.raosoft.com/samplesize.html. A total of 282 subjects from three secondary vocational schools in Anhui Province of China were selected as the objects of investigation by using the cluster sampling method. After obtaining informed consent from the

subjects, or their guadians the participants were tested in a group using unified guidance language, and the questionnaires were uniformly collected. A total of 281 (99.65%) valid questionnaires were collected. After eliminating unusable ones (such as answers with a missing rate of over 50%, incomplete information or regular answers), 267 valid questionnaires were retained, with a valid rate of 94.68%. The students' average age was 16.35 years (SD = 1.58), ranging from 14 to 20 years. Among them, 128 were male students, accounting for 47.94%; 157 students were from the rural area, accounting for 58.80%; and 124 students had good family relationship, accounting for 46.44% of the total.

Socio-demographic information

The socio-demographic information collected in this study included age, gender, grade, birthplace (urban vs. rural), and family relation (good vs. bad).

Research instruments

The structured questionnaire consisted of three separate scales developed or modified by local researchers in China and were suitable for assessing the subjects of this study.

General self-efficacy scale

The general self-efficacy scale (GSES) was developed by Ralf Schwarzer, and it was later revised and adopted to Chinese culture by Wang (28). It was used to check the overall self-evaluation of secondary vocational students (29). The scale contains 10 items, such as "I can always solve problems if I try my best. " It uses Likert's four-point scoring method, with "1" denoting "not at all true," "2" denoting "somewhat incorrect," "3" denoting "mostly true," and "4" denoting "exactly true." A higher score implied higher self-efficacy. The value of Cronbach's α of this scale was.88. The prediction validity of GSES was tested by using anxiety as criterion. There was a significant negative correlation between GSES and trait anxiety, state anxiety and test anxiety (TAS), and the correlation coefficients were -.301,.422 and.253, respectively.

Emotional intelligence scale

The emotional intelligence scale (EIS) was developed by Schutte et al. in 1988 and later translated and revised by Liu (30). This scale has been widely used in China (31, 32) and consists of 21 items, such as "I can always solve problems if I try my best," and four dimensions, namely regulation of perceived emotions, self-emotion management, others' emotion management, and emotion application. Likert's five-point scoring method was adopted, with "1" representing "strongly disagree" and "5" representing "strongly agree." A higher score implied a higher level of emotional intelligence. The value of Cronbach's α coefficient of this scale was.92. The pairwise correlation among the factors was significant, and the correlation coefficient was between .294 and .462, which was a low to moderate positive correlation. The correlation coefficient between the factors and the total score was ranging from .616 to .800, which denote strong positive correlation, indicating that each factor was consistent with the overall concept.

Resilience scale of adolescents

The Resilience Scale of Adolescents (RS) developed by Hu and Gan (33) was used in this study (33). This scale has been widely used in China (34) and comprises a total of 27 items, such as "My life has a clear purpose, " and 5 dimensions, including goal concentration, emotional control, positive cognition, family support, and interpersonal assistance (34). It uses Likert's five-point scoring method, with 1 indicating completely inconsistent, 2 indicating inconsistent, 3 indicating not sure, 4 indicating consistent, and 5 indicating completely consistent. A higher score implied a higher level of resilience. The internal consistency coefficient of the scale was .88, and the internal consistency coefficient of the subscale was ranging from.69 -.83. The pairwise correlation among the factors was significant, and the correlation coefficient was between.12 and.56, which was a low to moderate positive correlation. The correlation coefficient between the factors and the total score was ranging from.54 to.73, which was medium to high positive correlation, indicating that each factor was consistent with the overall concept.

Statistical analysis

SPSS26.0 and macro PROCESS were used for data processing and analysis. Descriptive statistical analysis, independent sample *t* test, Pearson correlation analysis, regression analysis, and mediation effect tests were the statistical methods used in this study.

Before the analysis, all data were tested for normality and were found to fulfill the criteria. The skewness coefficient method was used to test whether the scores obtained show normal distribution (35). The skewness values obtained for different scales used in this study were -.445 for the "General Self-efficacy Scale", "-.728" for the "Emotional Intelligence Scale," and ".365" for the "Resilience Scale of Adolescents." The normally distributed data are expressed as the mean ± standard deviation, and the numerical data are expressed as *n*.

Results

Common method variance

Following the recommendations of Williams and McGonagle (36), Harman's single-factor test was used for determining the common method variance bias. Variance was found to be less than the threshold of <25%, indicating that common method variance was not present (36).

Comparison of total scores of self-efficacy, emotional intelligence, and resilience in secondary vocational students with different demographic variables

The scores of self-efficacy, emotional intelligence, and resilience of Chinese secondary vocational students were above the average level. The total score of resilience and emotional intelligence did not differ between the male and female students. The self-efficacy score of boys was significantly higher than that of girls ($t = 2.77$, $p < 0.01$). The scores of self-efficacy ($t = -2.80$, $p < 0.01$) and resilience ($t = -3.48$, $p < 0.01$) of urban students were significantly higher than those of students from rural areas. In addition, the total scores of resilience ($t = 3.12$, $p < 0.01$) and self-efficacy ($t = 4.38$, $p < 0.001$) of secondary vocational students with different family relationships differed significantly (Table 1).

Correlation analysis of the studied variables

As shown in Table 2, Pearson's product difference analysis was conducted between self-efficacy, emotional intelligence, and resilience of secondary vocational students. The result confirmed hypothesis 1 and revealed an obvious correlation among the three variables ($p < 0.01$).

Mediating role of emotional intelligence between self-efficacy and resilience

Regression analysis was used to test whether emotional intelligence has a mediating effect. Three models were used to analyze the mediating effect: Model 1, regression analysis of the independent variable (X) and the dependent variable (Y); Model 2, regression analysis of the independent variable (X) and the mediating variable (M); Model 3, regression analysis of the independent variable (X), mediating variable (M), and dependent variable (Y). It was assumed that if X affects Y by affecting M, then M is the mediating variable. Self-efficacy was considered as the independent variable (X), level of resilience was the dependent variable (Y), and emotional intelligence ability was assumed to be the intermediary variable (M). The regression analysis was performed, and the results are shown in Table 3.

Self-efficacy had a significant predictive effect on resilience and confirmed hypothesis 2 ($\beta = .932$, $t = 7.168$, $p < 0.001$), and this result was true even after addition of the intermediary variable emotional intelligence ($\beta = .602$, $t = 4.035$, $p < 0.001$). Self-efficacy was a significant predictor of emotional intelligence ($\beta = .426$, $t = 7.250$, $p < 0.001$), and emotional intelligence was a significant predictor of resilience ($\beta =. 281$, $t = 4.162$, $p < 0.001$). The confidence intervals were estimated then by Bootstrap method with deviation correction. The results showed that 95% confidence intervals did not contain 0, indicating that the mediating effect was significant, which validated Hypothesis 3. Self-efficacy of secondary vocational students can directly predict resilience. Resilience can also be affected through the mediating effect of emotional intelligence, and the proportion of intermediary effect was 16.59 %. According to the test results, the intermediary role model was constructed in this study, as shown in Figure 1.

Discussion

Status of self-efficacy, emotional intelligence, and resilience of secondary vocational students

The self-efficacy of secondary vocational students was above the medium level, which is consistent with the findings of previous studies (12, 29). Compared with junior high school students, learning pressure among secondary vocational students is significantly low. Practical ability and employment-oriented learning content can mobilize students' learning enthusiasm, and therefore, secondary vocational students' learning interest was found to be significantly improved. All these factors contribute to the improvement of secondary vocational students' sense of self-efficacy.

The emotional intelligence of secondary vocational students was above the medium level. This result is in close agreement with that of a previous study conducted by Liu (29). Studies have shown that a variety of internal protective factors (such as emotional control ability and self-efficacy) and external environmental factors (such as relatives and peers) may affect the level of resilience of individuals (37). Moreover, the resilience of secondary vocational students was above the medium level, which

TABLE 1 Result of inferential statistics.

Variable	Mean	Gender			Birthplace			Family relation		
		Male (128)	Female (139)	t	Rural (157)	Urban (110)	t	Good (124)	Bad (143)	t
Self-efficacy	27.68	28.34±3.31	27.07±4.21	2.77**	27.13±3.95	28.46±3.57	-2.80**	28.75±3.47	26.75±3.92	4.38***
Emotional intelligence	78.42	79.34±8.34	77.58±8.58	1.70	77.83±8.44	79.26±8.54	-1.35	79.24±8.54	77.71±8.43	1.48
Resilience	89.44	90.27±8.45	88.67±9.25	1.48	87.89±9.18	91.65±8.02	-3.48**	91.23±8.88	87.88±8.65	3.12**

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

TABLE 2 Correlation analysis of self-efficacy, emotional intelligence, and resilience of secondary vocational students.

Variable	1	2	3	4	5	6	7	8
1 Self-efficacy	–	0.533**	0.190**	0.250**	0.185**	0.246**	0.236**	0.403**
2 Emotional intelligence	0.533**	–	0.299**	0.213**	0.234**	0.183**	0.200**	0.407**
3 goal concentration	0.190**	0.299**	–	-0.134*	0.413**	0.075	-0.171**	0.392**
4 emotional control	0.250**	0.213**	-0.134*	–	-0.125*	0.315**	0.483**	0.641**
5 positive cognition	0.185**	0.234**	0.413**	-0.125*	–	-0.013*	-0.015	0.368**
6 family support	0.246**	0.183**	0.075	0.315**	-0.013	–	0.421**	0.655**
7 interpersonal assistance	0.236**	0.200**	-0.171**	0.483**	-0.015	0.421**	–	0.664**
8 Resilience	0.403**	0.407**	0.392**	0.641**	0.368**	0.655**	0.664**	

*p < 0.05, **p < 0.01.

TABLE 3 Mediating role of emotional intelligence between self-efficacy and resilience.

Criterion variable	Predictor variable	Model fit indices			Parameter significance estimation	
		R	R^2	F	β	*t*
Resilience	self-efficacy	0.403	0.162	51.383***	0.932	7.168***
Emotional intelligence	self-efficacy	0.407	0.166	52.562***	0.426	7.250***
Resilience	self-efficacy	0.463	0.214	35.935***	0.602	4.035***
	Emotional intelligence				0.281	4.162***

***p < 0.001.

is consistent with previous research (29, 38). Secondary vocational students are shunted to vocational schools after graduation from junior high school, and they may face more challenges in life (39). Having faced examinations such as the senior high school entrance examination and various setbacks in life, along with the accumulated personal experience and improved environmental adaptability, secondary vocational students tend to exhibit significantly higher levels of resilience

We also found that the level of resilience of secondary vocational students with good family relationships was significantly higher than that of secondary vocational students with bad family relationships, which is consistent with some previous research results (6). Family is the first and most important place for individuals' growth, and therefore, family environment and atmosphere play a crucial role in cultivating an individual's resilience. A good family relationship can enable secondary vocational students to obtain safety and love.

Relationship between self-efficacy, emotional intelligence, and resilience of secondary vocational students

This study provides evidence that higher levels of general self-efficacy predict higher levels of resilience, which is consistent with previous research findings (40, 41). Specifically, based on the results of previous studies and this study on secondary vocational school students, we determined that self-efficacy has a positive impact on the resilience of secondary vocational school students. Students with high levels of self-efficacy tend to be confident about their abilities and resources for overcoming challenges (23) and tend to develop different resilient behavioral responses to cope with stress and other negative experiences (40).

Research suggests that self-efficacy was positively correlated with emotional intelligence of secondary vocational school students, indicating its role as an important internal driving factor for promoting emotional intelligence of secondary vocational school students. This is in accordance with the results of previous studies (29, 40), which verified that a high level of self-efficacy could enhance students' ability to manage emotions and deal with stress. Higher levels of self-efficacy implied higher levels of emotional intelligence of secondary vocational school students. Strengthening self-efficacy and emotional intelligence can improve the learning outcomes of vocational education students (40).

We also determined the impact of emotional intelligence on the resilience of secondary vocational students. Secondary vocational students with high emotional intelligence tend to be confident and adopt a positive coping style when dealing with stressful life events, implying that they tend to be more resilient in life (40).

Interestingly, this study revealed that emotional intelligence serves as a partial mediating factor for the influence of self-efficacy on secondary vocational students' resilience. These results confirm that self-efficacy influences secondary vocational school students' resilience not only directly but also indirectly through emotional intelligence. Therefore, interventions that improve emotional intelligence as a strategy to enhance self-efficacy for promoting resilience are needed. The present study results also indicate that emotional intelligence plays an important role in enhancing

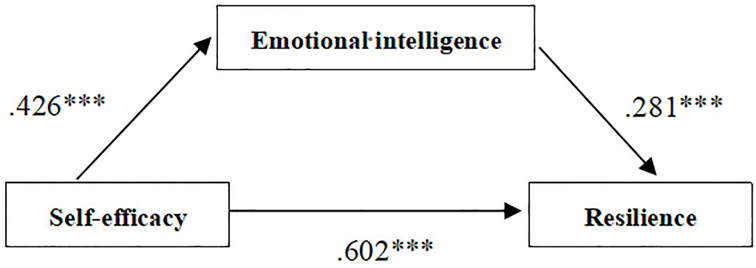

FIGURE 1
The mediating role of emotional intelligence. The number represents the regression coefficient of the two variables connected by the arrow line. ***$p < 0.001$.

secondary vocational students' resilience, in agreement with the results of previous studies. Liu (2019) conducted a study on emotional intelligence and resilience of secondary vocational students and determined that there was a significant correlation between the two variables (29). Armstrong et al. studied the relationship between emotional intelligence and resilience and observed a strong correlation between them (21). Therefore, promoting the level of psychological resilience of secondary vocational students by improving their self-efficacy can be a promising strategy. Improving self-efficacy can also promote individuals' emotional perception and positive regulation ability, thereby contributing to a positive change and enhancing resilience among secondary vocational students.

Implications for education

The results of this study highlight the necessity to design and implement intervention programs and active measures focused on self-efficacy and emotional intelligence, aiming to help secondary vocational school students to develop high resilience levels. In addition to daily learning activities, secondary vocational students should be encouraged to participate actively in outdoor activities, such as physical exercise, which can help them improve their self-confidence and self-efficacy, and further strengthen their psychological well-being (42). Administrators and teachers in secondary vocational schools should pay attention to cultivating the students' abilities, guide them to focus on their strengths, and strive to create a platform to display their talents. Finally, warm and friendly family atmosphere is a protective factor for the psychological development of adolescents. Family members should pay attention to the shaping of a good family environment in their daily life, which is conducive to the healthy development of secondary vocational school students.

Limitations and suggestions for future research

Several limitations of this study should be noted. First, the number of participants in the study is small. Secondly, the cross-sectional method was used for data collection from participants at a single point in time. In future studies, we can consider using longitudinal research methods to explore the continuous relationship between these different variables. In addition, the formation of resilience is not only affected by individual factors, but also by external factors such as family and school. In the follow-up research, other external variables can be included to achieve a deeper understanding of the development of psychological resilience of secondary vocational students.

Conclusion

We clarified the relationship between self-efficacy, emotional intelligence, and resilience of secondary vocational school students, and the key findings can be summarized are as follows:

(1) There is a pairwise positive correlation among self-efficacy, emotional intelligence, and resilience;
(2) The self-efficacy of secondary vocational school students could predict resilience;
(3) Emotional intelligence plays a partial mediating role in the influence of secondary vocational students' self-efficacy on their resilience.

Data availability statement

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

Ethics statement

The studies involving humans were approved by Special committee for scientific research and academic ethics of Anqing

Normal University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants or their guardians provided their written informed consent to participate in this study.

Author contributions

RJ: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2024.1382881/full#supplementary-material

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EDITED BY
Chong Chen,
Yamaguchi University Graduate School of Medicine, Japan

REVIEWED BY
Ihua Chen,
Qufu Normal University, China
Kanchan Thapa,
Noble Shivapuri Research Institute, Nepal

*CORRESPONDENCE
Yipeng Lv
epengl@163.com
Ying Jin
jyhshf@126.com
Zhaoxin Wang
supercell002@sina.com

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

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Psychological responses and factors associated with depression and anxiety in entry personnel under quarantine during pandemic in China

Liping Chen[1†], Qiao Chu[2†], Chenhui Xu[3], Feng Zhou[4], Xiaolong Hu[4], Zhaoxin Wang[5*], Ying Jin[1*] and Yipeng Lv[2,6*]

[1]Huangpu District Dapuqiao Community Health Center, Shanghai, China, [2]School of Public Health, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [3]Department of Orthopaedics, Shanghai Changzheng Hospital, Second Affiliated Hospital of Naval Medical University, Shanghai, China, [4]Huangpu District Center for Disease Control and Prevention, Shanghai, China, [5]The First Affiliated Hospital, Hainan Medical University, Haikou, China, [6]Key Laboratory of Urban Complex Risk Control and Resilience Governance, Shanghai Emergency Management, Shanghai Jiao Tong University, Shanghai, China

Background: The global COVID-19 pandemic has highlighted critical concerns surrounding mental health. Social isolation measures, such as the quarantine of incoming travelers, are essential public health strategies for the prevention and control of infectious diseases. However, quarantine can lead to adverse psychological outcomes, including feelings of confinement, boredom, perceived scarcity of supplies and information, financial hardship, and social stigma. This study aims to assess the mental states of quarantined individuals, investigate the factors affecting their mental well-being, and examine their coping mechanisms, with the objective of providing recommendations to enhance mental health in anticipation of future outbreaks, such as Disease X.

Methods: We surveyed 327 individuals in quarantine from September 22, 2020 to January 9, 2021, collecting general demographic data and information related to COVID-19. Depression and anxiety were assessed using the PHQ-9 and GAD-7 scales, respectively, while stress coping was evaluated with a simplified version of the Cope scale. We analyzed the relationships between independent variables and mental health outcomes.

Results: Among the individuals undergoing entry quarantine, 27.8% reported symptoms of depression, and 20.5% reported symptoms of anxiety. Students were more likely to experience depression compared to those with permanent jobs or no occupation. Significant risk factors for both depression and anxiety included pre-existing health conditions, lack of medical insurance, concerns about shortages of daily necessities during quarantine, and high scores for "guilt and self-blame." Additionally, participants who worried about the impact of the epidemic on their studies or work, and those with high scores for "denial," were more likely to exhibit depressive symptoms. On the other hand, participants who were concerned about potential rejection or discrimination from the outside world after quarantine were more prone to anxiety symptoms.

Conclusion: Attention should be paid to the negative psychological reactions of the entry quarantined personnel, especially those with pre-existing health conditions, those without medical insurance, and students studying abroad. Accurate and effective epidemic dynamic information and preventive and

control measures can be provided to the public to prevent fear and stigma against quarantined personnel.

KEYWORDS

quarantine, anxiety, depression, stress coping, pandemic

Introduction

Infectious diseases continue to pose a significant and ongoing threat to global health. For example, the recent COVID-19 pandemic has led to over 760 million confirmed cases and 6.9 million deaths globally since its emergence in December 2019, although the actual figures are likely higher (1). Mental health is among the most significant adverse outcomes of infectious diseases and the public health measures implemented to control them. A systematic review estimated that the COVID-19 pandemic resulted in an additional 53.2 million cases of major depressive disorder globally, representing a 27.6% increase, and 76.2 million additional cases of anxiety disorders, a 25.6% rise, between January 1, 2020 and January 29, 2021. In total, major depressive disorder accounted for 49.4 million disability-adjusted life years (DALYs), while anxiety disorders contributed 44.5 million DALYs globally in 2020 (2).

Although WHO has declared that the COVID-19 no longer constitutes a Public Health Emergency of International Concern (PHEIC), this does not imply that the virus is no longer a global health threat, given the ongoing uncertainties surrounding the potential evolution of SARS-CoV-2 (3). Additionally, numerous viruses and bacteria have the potential to infect humans. WHO uses the term "Disease X" to acknowledge the possibility that a future severe international epidemic could be caused by a pathogen that is currently unknown (4). On February 12, 2024, at the World Government Summit, WHO Director-General Tedros Adhanom Ghebreyesus remarked that COVID-19 exemplified a "Disease X" and cautioned that we are likely to face another pandemic within our lifetimes. He emphasized that if such a pandemic were to occur tomorrow, we would likely encounter many of the same challenges faced during the COVID-19 crisis (5).

Quarantine is a crucial public health measure for controlling the spread of infectious diseases; however, it often entails separation from family and friends, loss of freedom, and uncertainties regarding the disease and one's health status. These factors can adversely affect the emotional and mental well-being of individuals in quarantine. During previous infectious disease outbreaks, reports indicated a range of mental health symptoms related to quarantine measures, including intense anger, depression, fear, sadness, and anxiety. Depression and anxiety during the COVID-19 pandemic have significantly contributed to the global health burden and are expected to have long-term economic and social consequences (2).

Risk cognition refers to an individual's subjective perception of the potential or actual outcomes associated with various risk factors, and serves as a primary internal motivator for taking specific actions. A study conducted across 112 countries found that perceptions of risk related to COVID-19 were linked to emotional responses and, ultimately, to mental health outcomes (6). Other studies have shown that a higher perceived severity of the COVID-19 pandemic is associated with more severe symptoms of depression, anxiety, and stress in individuals (7, 8). Coping strategies can significantly influence both the nature and impact of psychological responses in stressful situations and can have either protective or detrimental effects on mental health (9). Research indicated that positive coping strategies can mitigate negative emotions, while negative coping strategies were associated with increased risk of negative emotions (10). Additionally, coping strategies were significant predictors of mental health outcomes (11). Given the link between emotions, disease perception, and coping strategies, it is crucial to identify factors that influence mental health and enhance protective coping mechanisms, which could serve as preventive measures in future crises.

Although existing studies have explored the associations between quarantine and mental health during the COVID-19 pandemic (12–14), there is a gap in evidence specifically regarding individuals who undergo a 14-day quarantine immediately upon arrival in mainland China. Therefore, this study aims to investigate the mental health status of individuals subjected to this quarantine process and to identify relevant influencing factors. We seek to identify high-risk groups who may benefit from targeted psychological interventions and to enhance the psychological well-being of vulnerable quarantined individuals.

Methods

Study design, sampling method and data collection

A cross-sectional study design was employed to conduct an electronic questionnaire survey among participants at centralized quarantine medical observation sites, including Zhongxingjunting, Quanji, Heyi, and Home Inns in Huangpu District, Shanghai. The convenience sampling method was utilized from September 22, 2020 to January 9, 2021. Participation in the online survey was voluntary and anonymous. Quarantine personnel were informed about the purpose and content of the study, and data collection was conducted only after obtaining their consent. The study received approval from the Ethics Committee of the School of Public Health, Shanghai Jiao Tong University.

Inclusion criteria

Participants were individuals who had been quarantined following entry into China during the COVID-19 epidemic. Inclusion criteria were: informed consent for participation in the study; ability to complete the questionnaire independently; age $\geq$ 14 years old, for those under 18, consent was also obtained from parents or legal guardians. Participants were excluded if they were: suspected cases or close contacts of

COVID-19; individuals with cognitive impairments, mental disorders, or serious physical illnesses that prevented them from completing the questionnaire.

Survey instrument

Based on a literature review and consultation with psychologists, our custom-designed questionnaire was consisted of five parts: I. Sociodemographic characteristics data, including nationality, gender, age, education level, marital status, occupation, income, personal health status, etc. II. Personal feelings and attitudes toward COVID-19 and quarantine were assessed using self-designed questionnaire items. This section focused on concerns related to the pandemic and quarantine measures, utilizing a 4-point Likert scale with scores of 0, 1, 2, and 3 representing "not worried at all," "a little worried," "relatively worried," and "very worried," respectively. The specific survey items are detailed in the horizontal headings of Table 1. III. Depression was tested by the Patient Health Questionnaire-9 (PHQ-9) which includes 9 items (15); a score of 0–4 is interpreted as no depression, 5–9 as mild depression,10–14 as moderate depression, and ≥15 as severe depression. Cronbach's α of PHQ-9 was 0.895 in this study. IV. anxiety was tested by the Generalized Anxiety Disorder 7-Item Scale (GAD-7) which includes 7 items (16); a score of 0–4 is interpreted as no anxiety, 5–9 as mild anxiety, 10–14 as moderate anxiety, and ≥15 as severe anxiety. Cronbach's α of GAD-7 was 0.938 in this study. V. Five

TABLE 1 Description of depression and anxiety symptoms of entry quarantine personnel with different levels of concern about the epidemic and quarantine.

Item	Classification	Depression symptoms			Anxiety symptoms		
		Number (percent)	Number (percent)	*p*-value	Number (percent)	Number (percent)	*p*-value
Worried about being infected during the COVID-19	Not worried at all	26 (86.7)	4 (13.3)	0.169	26 (86.7)	4 (13.3)	0.415
	A little worried	99 (73.3)	36 (26.7)		111 (82.2)	24 (17.8)	
	Relatively worried	62 (66.0)	32 (34.0)		71 (75.5)	23 (24.5)	
	Very worried	49 (72.1)	19 (27.9)		52 (76.5)	16 (23.5)	
Worried about the epidemic would affect studies/work	Not worried at all	49 (83.1)	10 (16.9)	0.000	51 (86.4)	8 (13.6)	0.003
	A little worried	104 (80.6)	25 (19.4)		111 (86.0)	18 (14.0)	
	Relatively worried	39 (69.6)	17 (30.4)		43 (76.8)	13 (23.2)	
	Very worried	44 (53.0)	39 (47.0)		55 (66.3)	28 (33.7)	
Worried about the epidemic would affect economic income	Not worried at all	60 (80.0)	15 (20.0)	0.000	64 (85.3)	11 (14.7)	0.005
	A little worried	91 (76.5)	28 (23.5)		99 (83.2)	20 (16.8)	
	Relatively worried	56 (75.7)	18 (24.3)		60 (81.1)	14 (18.9)	
	Very worried	29 (49.2)	30 (50.8)		37 (62.7)	22 (37.3)	
Worried about being infected during the journey	not worried at all	37 (78.7)	10 (21.3)	0.429	40 (85.1)	7 (14.9)	0.482
	A little worried	133 (69.6)	58 (30.4)		153 (80.1)	38 (19.9)	
	Relatively worried	45 (77.6)	13 (22.4)		45 (77.6)	13 (22.4)	
	Very worried	21 (67.7)	10 (32.3)		22 (71.0)	67 (29.0)	
Worried about being discriminated against or treated unfairly by the outside world if on a flight with a confirmed COVID-19 patient	Not worried at all	54 (79.4)	14 (20.6)	0.001	64 (94.1)	4 (5.9)	0.000
	a little worried	99 (76.7)	30 (23.3)		107 (82.9)	22 (17.1)	
	Relatively worried	60 (72.3)	23 (27.7)		64 (77.1)	19 (22.9)	
	Very worried	23 (48.9)	24 (51.1)		25 (53.2)	22 (46.8)	
Worried about having similar symptoms of COVID-19 during quarantine	Not worried at all	121 (80.7)	29 (19.3)	0.009	130 (86.7)	20 (13.3)	0.001
	A little worried	84 (67.7)	40 (32.3)		97 (78.2)	27 (21.8)	
	Relatively worried	17 (60.7)	11 (39.3)		16 (57.1)	12 (42.9)	
	Very worried	14 (56.0)	11 (44.0)		17 (68.0)	8 (32.0)	
Worried about lack of daily necessities during quarantine	Not worried at all	178 (82.8)	37 (17.2)	0.000	189 (87.9)	26 (12.1)	0.000
	A little worried	37 (54.4)	31 (45.6)		45 (66.2)	23 (33.8)	
	Relatively worried	13 (56.5)	10 (43.5)		15 (65.2)	8 (34.8)	
	Very worried	8 (38.1)	13 (61.9)		11 (52.4)	10 (47.6)	
Worried about losing contact with family and friends during quarantine	Not worried at all	188 (77.7)	54 (22.3)	0.001	206 (85.1)	36 (14.9)	0.000
	A little worried	31 (56.4)	24 (43.6)		33 (60.0)	22 (40.0)	
	Relatively worried	8 (44.4)	10 (55.6)		12 (66.7)	6 (33.3)	
	Very worried	9 (75.0)	3 (25.0)		9 (75.0)	3 (25.0)	
Worried about being rejected or discriminated by the outside world after quarantine	Not worried at all	161 (80.1)	40 (19.9)	0.000	177 (88.1)	24 (11.9)	0.000
	A little worried	58 (66.7)	29 (33.3)		63 (72.4)	24 (27.6)	
	Relatively worried	10 (43.5)	13 (56.5)		13 (56.5)	10 (43.5)	
	Very worried	7 (43.8)	9 (56.2)		7 (43.8)	9 (56.2)	

subscales of "face the problem, formulate strategies, denial, guilt and self-blame, and seek emotional support" of the simplified version of Carver's Cope scale were selected to investigate individual stress coping, with a total of 10 items and a total score of 10–40 points (17). Cronbach's α of the simplified version of Carver's Cope scale was 0.817 in this study.

Statistical analysis

Statistical analyses were conducted using SPSS 26.0 software. The reliability of the instrument was assessed with Cronbach's α. Descriptive statistics were used to analyze general characteristics of the participants. The Chi-square test was applied to categorical variables, while the Mann–Whitney U test was used for comparing two sets of continuous variables, and the Kruskal-Wallis test was employed for comparing three or more sets of continuous variables. The Spearman correlation coefficient was utilized to evaluate the relationships between depression, anxiety, psychological risk factors, and stress coping. Binary logistic regression analysis was conducted to identify factors associated with depression and anxiety symptoms and to calculate odds ratios (ORs) with 95% confidence intervals (CIs). Statistical significance was set at $p < 0.05$ (two-tailed).

Results

Participant characteristics

Of the 330 questionnaires sent, 327 valid completed ones were recovered, with an effective response rate of 99.1%. The age of 327 entry quarantine personnel who participated in the survey was 37.93 ± 13.26 years with a range of 14–75. There were 170 males (52.0%) and 157 females (48.0%). Two hundred and sixty were from Mainland China, forty eight from Hong Kong or Taiwan, five from Singapore, four from Germany, four from the United States, two from Japan, one from Canada, one from Italy, and one from the Czech Republic.

Depression and anxiety among the entry quarantined personnel

Participants had an average PHQ-9 score of 3.54 ± 4.67 in a range of 0–27, and GAD-7 was 2.32 ± 3.87 with a range of 0–21. Depression was identified in 27.8% of participants, with 19.6% classified as having mild depression, 3.7% as moderate, and 4.6% as severe. Anxiety was identified in 20.5% of participants, with 14.4% classified as having mild anxiety, 4.3% as moderate, and 1.8% as severe. The PHQ-9 and GAD-7 scores were moderately correlated ($r = 0.685$, $p < 0.001$).

There were statistically significant differences in PHQ-9 scores among entry quarantine personnel of different nationalities, different ages, different occupations, and different quarantine modes ($p < 0.05$). The PHQ-9 scores of individuals from Hong Kong/Taiwan were significantly lower than mainland Chinese and foreign nationals. The PHQ-9 scores were highest in the 26–35 age group, followed by the 14–25 age group. The PHQ-9 scores of international students were significantly higher than those of the other groups. The PHQ-9 scores were higher in individuals under the "14-day centralized quarantine" than in those under the "7-day centralized quarantine +7-day home quarantine" (Table 2).

There were statistically significant differences in GAD-7 scores among entry quarantine personnel of different nationalities, different occupations, and with family members or colleagues/friends that were infected with COVID-19 ($p < 0.05$). GAD-7 scores were lower in individuals from Hong Kong/Taiwan than in mainland Chinese and foreign nationals. The GAD-7 scores were higher in international students and those whose family members or colleagues/friends were infected with COVID-19 than in other individuals (Table 2).

Table 1 summarizes the rates of depression and anxiety symptoms among quarantined personnel who were at different levels of concern about the epidemic and quarantine. Depression had a statistically significant difference according to the fear that the epidemic would affect their studies/work ($p < 0.001$) and economic income ($p < 0.001$), the fear of being discriminated against or treated unfairly by the outside world if on a flight with a confirmed COVID-19 patient ($p = 0.001$), the fear of similar symptoms of COVID-19 during quarantine ($p = 0.009$), the fear of lack of daily necessities ($p < 0.001$), the fear of losing contact with family and friends ($p = 0.001$), and the fear of being excluded or discriminated by the outside world after quarantine ($p < 0.001$) (Table 1).

Anxiety had a statistically significant difference according to the fear that the epidemic would affect their studies/work ($p = 0.003$) and economic income ($p = 0.005$), the fear of being discriminated against or treated unfairly by the outside world if on a flight with a confirmed COVID-19 patient ($p < 0.001$), the fear of similar symptoms of COVID-19 during quarantine ($p = 0.001$), the fear of lack of daily necessities ($p < 0.001$), the fear of losing contact with family and friends ($p < 0.001$), and the fear of being excluded or discriminated by the outside world after quarantine ($p < 0.001$) (Table 1).

Correlation between depression, anxiety, and stress coping

Correlation analysis showed that PHQ-9 and GAD-7 scores of quarantined personnel were positively correlated with "denial, guilt and self-blame, and seeking emotional support" of personal stress coping ($p < 0.01$) and were negatively correlated with "facing problems and formulating strategies" ($p < 0.05$) (Table 3).

Logistic regression analysis of factors influencing the psychology of the entry quarantined personnel

We conducted logistic regression analyses by incorporating independent variables identified to be significant by univariate and correlation analyses, and variables considered to affect depression or anxiety based on expert opinion and previous literature reports, including nationality, age, education level, occupation, pre-existing health conditions, medical insurance, quarantine mode, whether they are worried that the epidemic would affect studies/work or economic income, whether worried about being discriminated, whether worried about having similar symptoms of COVID-19, lack of daily necessities,losing contact with family and friends during quarantine, and stress coping: face problems, formulating strategies, denial, guilt and self-blame, and seek emotional support.

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TABLE 2 Univariate analysis of depression and anxiety of entry quarantine personnel during the COVID-19 pandemic [cases (%), M (P25, P75)] $n = 327$.

Characteristics	Number (percent)	PHQ-9 Score	*p*-value	GAD-7 Score	*p*-value
Gender					
Male	170 (52.0)	2 (0, 5)	0.510	0 (0, 2)	0.105
Female	157 (48.0)	2 (0, 6)		0 (0, 4)	
Nationality					
Mainland China	260 (79.5)	2 (0, 6)	0.002	0 (0, 4)	0.029
Hong Kong/Taiwan, China	48 (14.7)	0 (0, 3)		0 (0, 1)	
Foreign nationality	19 (5.8)	1 (0, 7)		0 (0, 3)	
Age					
14-25 years old	69 (21.1)	2 (1, 6)	0.037	0 (0, 4)	0.325
26–35 years old	96 (29.4)	3 (0, 6)		1 (0, 4)	
36–45 years old	67 (20.5)	2 (0, 5)		0 (0, 4)	
46–55 years old	53 (16.2)	2 (0, 5.5)		0 (0, 4)	
≥56 years old	42 (12.8)	0 (0, 4)		0 (0, 1.25)	
Marital status					
Unmarried	134 (41.0)	2 (0, 6)	0.070	1 (0, 4)	0.182
Married	166 (50.8)	1 (0, 5)		0 (0, 3)	
divorced or widowed	27 (8.2)	2 (0, 3)		0 (0, 4)	
Education level					
Junior high school and below	20 (6.1)	1 (0, 3.75)	0.399	0 (0, 1.75)	0.102
High school/ Technical secondary school/Junior college	66 (20.2)	2 (0, 4)		0 (0, 2)	
Undergraduate	129 (39.4)	2 (0, 7)		0 (0, 4)	
Bachelor above	112 (34.3)	2 (0, 5.75)		1 (0, 4)	
Occupation					
Student studying abroad	68 (20.8)	4 (1, 8)	0.004	1.5 (0, 6)	0.045
Have a permanent job	168 (51.4)	1 (0, 4)		0 (0, 2.75)	
Self-employed or freelance	22 (6.7)	1 (0, 5)		0 (0, 2)	
No occupation	29 (8.9)	1 (0, 4)		0 (0, 1.5)	
Retired	40 (12.2)	3 (0, 6)		0 (0, 4.75)	
Main place to work/study					
Mainland China	176 (53.8)	2 (0, 6)	0.108	0 (0, 4)	0.735
Hong Kong, China	25 (7.6)	0 (0, 3)		0 (0, 4)	
Taiwan, China	13 (4.0)	0 (0, 3.5)		0 (0, 2)	
Abroad	113 (34.6)	2 (0, 6)		0 (0, 4)	
Annual household income					
≤100,000 RMB	71 (21.7)	1 (0, 4)	0.614	0 (0, 4)	0.684
100,000–300,000 RMB	126 (38.5)	2 (0, 6)		0 (0, 4)	
300,000–500,000 RMB	44 (13.5)	2 (0, 6)		0.5 (0, 2.75)	
≥500,000 RMB	86 (26.3)	2 (0, 5)		0.5 (0, 4)	
Pre-existing health conditions					
No	277 (84.7)	2 (0, 4.5)	0.051	0 (0, 3)	0.154
Yes	50 (15.3)	3.5 (0, 8)		0.5 (0, 6)	
Resident medical insurance or commercial medical insurance					
No	77 (23.5)	2 (0, 7.5)	0.057	0 (0, 5)	0.195
Yes	250 (76.5)	2 (0, 4.25)		0 (0, 3)	

(Continued)

TABLE 2 (Continued)

Characteristics	Number (percent)	PHQ-9 Score	*p*-value	GAD-7 Score	*p*-value
Family members or colleagues/friends infected with COVID-19					
No	320 (97.9)	2 (0, 5)	0.150	0 (0, 4)	0.045
Yes	7 (2.1)	4 (2, 7)		4 (1, 6)	
Quarantine mode					
14-day centralized quarantine	285 (87.2)	2 (0, 6)	0.010	0 (0, 4)	0.060
7-day centralized quarantine + 7-day home quarantine	42 (12.8)	0 (0, 4)		0 (0, 1)	

RMB: Chinese yuan. The average exchange rate between USD and CNY from September 2020 to January 2021 was 6.406–6.365.

Table 4 shows the results of the logistic regression analysis of factors associated with depression symptoms of entry quarantine personnel. Compared to students, participants who had permanent jobs and had no occupations were less likely to have depression symptoms (OR = 0.352, 95% CI: 0.171–0.726, $p = 0.010$;OR = 0.239, 95%CI:0.065–0.872, $p = 0.030$).Pre-existing health conditions (OR = 4.586, 95% CI: 2.038–10.319, $p < 0.001$), without medical insurance (OR = 0.511, 95% CI:0.268–0.972,$p = 0.041$),worry about the impact of the epidemic on their studies/work (OR = 1.562, 95%CI:1.187–2.054, $p = 0.001$), worry about the lack of daily necessities during quarantine (OR = 1.999, 95% CI:1.471–2.718, $p < 0.001$), a high total score of "denial, guilt and self-blame" (OR = 1.201, 95%CI:1.016–1.420, $p = 0.032$; OR = 1.306, 95%CI:1.075–1.587, $p = 0.007$)were significant risk factors for depression symptoms (Table 4).

With regard to the presence of anxiety symptoms, we found that participants with pre-existing health conditions (OR = 2.236, 95% CI:1.055–4.737, $p = 0.036$), without medical insurance, (OR = 0.475, 95% CI:0.244–0.924, $p = 0.028$), worry about the lack of daily necessities during quarantine (OR = 1.634, 95% CI:1.188–2.247, $p = 0.003$), worry about being rejected or discriminated against by the outside world after quarantine (OR = 1.839, 95% CI:1.295–2.612, $p = 0.001$), and with a high score of "guilt and self-blame" (OR = 1.410, 95% CI:1.167,-1.703, $p < 0.001$) were more likely to be anxious (Table 5).

Discussion

In this study, we found that 27.8% of entry quarantine personnel exhibited symptoms of depression, and 20.5% experienced symptoms of anxiety. Students were particularly susceptible to depression. Key risk factors negatively impacting mental health included pre-existing health conditions, lack of medical insurance, concerns about shortages of daily necessities during quarantine, worries about the epidemic's effects on studies or work, and fears of rejection or discrimination. Additionally, individuals with high scores for "denia" or "guilt and self-blame" were more likely to experience negative emotions.

Anxiety, stress, and depression have been widespread globally due to quarantine and social isolation during the COVID-19 pandemic. A systematic review of 19 studies involving 93,569 participants reported that during the COVID-19 epidemic, the incidence of depressive symptoms among the general population ranged from 14.6 to 48.3%, while anxiety symptoms ranged from 6.33 to 50.9% (18). Our study, which focused on individuals undergoing a closed-loop quarantine system for up to 14 days after entering mainland China, found that the incidence of depression and anxiety fell within these reported ranges. Previous research indicates that depression and anxiety symptoms worsened on average in the first two months of the pandemic (19). Given that our study was conducted between September 22, 2020, and January 9, 2021, it is possible that the prevalence of depression and anxiety among quarantined entry personnel may have been higher during the initial phase of the outbreak.

We found that quarantined individuals with pre-existing health conditions had higher scores of depression and anxiety. During the epidemic, patients with pre-existing health conditions need to simultaneously deal with existing diseases and COVID-19 (20). With limited medical resources, the medical system often gives the highest priority to people who are positive for coronavirus, while those with chronic diseases may not receive immediate treatments (21). The main challenges of quarantine for people with chronic diseases are a reduction of daily exercise and health care, and delays in routine physical examinations or laboratory examinations (22), both of which may exert marked negative impacts. In Parkinson's disease, studies confirmed lockdown restrictions increase levels of psychological distress and impose limitations on physical activities (23). In dialysis patients, 22.4% hemodialysis patients and 13.4% peritoneal patients were classified as having moderate or severe posttraumatic stress symptoms (PTSS), which need psychological support (24). The COVID-19 lockdown caused a disruption to the continuity of care for patients with chronic obstructive pulmonary disease (COPD), with associated worry, anxiety and disappointment (25). An Australian national survey showed high rates of depression, anxiety and stress among inflammatory bowel disease (IBD) patients during the COVID-19 pandemic, even those without a prior diagnosis of depression or anxiety had high rates of significant depression (34.9%), anxiety (32.0%) and stress (29.7%) (26). Individuals with pre-existing diseases may have a greater risk of infection with the novel coronavirus than healthy people. Once infected, they may also have higher rates of severe disease, mortality, and complications, which can independently increase their psychological burdens. Therefore, centralized quarantine sites should be equipped with full-time medical staff who are trained and provided with adequate resources to comprehensively analyze the individual's relevant disease history and treatment needs, and to conduct ongoing disease monitoring, evaluations of treatment response, and treatment adjustments as required. If the condition changes beyond the treatment capacity offered at the quarantine point, the patient should be promptly transferred to an appropriate medical center for further management.

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TABLE 3 Correlation analysis between depression, anxiety, and stress coping of entry quarantine personnel during the COVID-19.

	Facing problems	Formulating strategies	Denial	Guilt and self-blame	Seeking emotional support
PHQ-9 score	−0.197	−0.170	0.155	0.211	0.182
p-value	0.000	0.002	0.005	0.000	0.001
GAD-7 score	−0.140	−0.127	0.208	0.200	0.203
p-value	0.011	0.022	0.000	0.000	0.000

TABLE 4 Logistic regression of factors associated with depression symptoms of entry quarantine personnel.

Variable	Beta	Standard error	Odd ratio (95% CI[1])	*p*-value
Occupation				
	Student studying abroad (reference)			
Have a permanent job	−1.045	0.369	0.352 (0.171,0.726)	0.005
Self-employed or freelance	−0.955	0.643	0.385 (0.109,1.356)	0.137
No occupation	−1.432	0.661	0.239 (0.065,0.872)	0.030
Retired	−0.491	0.483	0.612 (0.238,1.578)	0.310
Pre-existing health conditions	1.523	0.414	4.586 (2.038,10.319)	0.000
Resident medical insurance or commercial medical insurance	−0.672	0.328	0.511 (0.268,0.972)	0.041
Worried that the epidemic would affect studies/work	0.446	0.140	1.562 (1.1872.054,)	0.001
Worried about lack of daily necessities during quarantine	0.693	0.157	1.999 (1.471,2.718)	0.000
Denial	0.183	0.085	1.201 (1.016,1.420)	0.032
Guilt and self-blame	0.267	0.099	1.306 (1.075,1.587)	0.007

1, CI = confidence interval.

Literature regarding medical insurance impact during the COVID-19 outbreak is sparse. Our study found that depression and anxiety scores in quarantined people who lack resident medical insurance or commercial medical insurance were higher than in those with such insurance. During the quarantine, individuals without medical insurance, especially the older adult or those with pre-existing health conditions, may have greater concerns or psychological pressures arising from their potential financial burdens, so more attention should be paid to their physical and mental health. It is also important to recognize that the COVID-19 pandemic has led to an increase in unemployment, resulting in a loss of insurance access for many individuals (27). Some studies argue that unemployment insurance or more generous government economic policies (such as higher minimum wages, greater trade union protections, and tax credits for low-income families, etc.) can alleviate the negative associations of economic downturns with population health and promote better health outcomes (28, 29).

In this study, we showed that quarantined people who were worried that the epidemic would affect their studies or work were more prone to depression. Syed et al. also found that students and the unemployed had significantly higher depression scores during COVID-19 (30). In this study, international students accounted for 20.8%, and most were college students studying abroad. Because of the epidemic, they had to return to China and continue their studies via distance education, which disrupted their normal education and academic planning. Other studies also showed that during COVID-19, study disruption leading to feelings of uncertainty about the future as a consequence of delay in students' graduation time, lack of practical sessions and guidance, difficulty adjusting to new norms of learning, and loss of momentum, etc. (31, 32). In addition, it is difficult for most students to accept online classes after paying high fees for studying abroad. All these factors contribute to international students feeling more pressure, leading to depression and other adverse emotions. During the COVID-19 epidemic, many people switched to working at home, and some companies implemented measures such as layoffs and reduction of recruitment plans due to difficulties in resuming in-person work (33). Other studies also showed that income loss or unemployment due to the COVID-19 pandemic was associated with higher psychological distress (34, 35). As such, there is an urgency to improve the unemployment security system and increase investment in employment and entrepreneurship subsidies. We recommend the development and promotion of health initiatives aimed at alleviating the impact of COVID-19-related unemployment on mental health.

Research on SARS, the Ebola epidemic, and Middle East Respiratory Syndrome (MERS) showed that a lack of basic supplies (such as food, water, clothing, and accommodation) during quarantine contributes to feelings of depression, anxiety and anger (36–38). Furthermore, insufficient access to these basic necessities during quarantine is linked to ongoing emotional stress even 4–6 months after quarantine ends. In the early stage of the COVID-19 outbreak, the spread of the epidemic and the implementation of control measures led to weakened material production, disrupted logistics, and shortages of daily necessities, resulting in widespread panic among the population. Quarantine sites in Shanghai distribute masks, thermometers, disinfectants, and other epidemic prevention materials

TABLE 5 Logistic regression of factors associated with anxiety symptoms of entry quarantine personnel.

Variable	Beta	standard error	odd ratio (95% CI[1])	*p*-value
Pre-existing health conditions	0.804	0.383	2.236 (1.055, 4.737)	0.036
Resident medical insurance or commercial medical insurance	−0.745	0.340	0.475 (0.244, 0.924)	0.028
Worried about lack of daily necessities during quarantine	0.491	0.163	1.634 (1.188, 2.247)	0.003
Worried about being rejected or discriminated by the outside world after quarantine	0.609	0.179	1.839 (1.295, 2.612)	0.001
Guilt and self-blame	0.343	0.096	1.410 (1.167, 1.703)	0.000

1, CI = confidence interval.

to the quarantined personnel, and provide three meals a day, drinking water, coffee, etc. Other daily necessities can be obtained through online shopping. Although material supplies are available, our survey results still showed that "worrying about the lack of daily necessities during quarantine" was significantly related to depression and anxiety scores, which showed the importance of daily necessities supplies to the quarantined personnel. Therefore, efforts must be made to ensure that people's daily life needs are met during quarantine to reduce the likelihood of negative emotional sequela.

This study showed that fear of being rejected or discriminated against by the outside world after the quarantine was an independent risk factor for depression and anxiety among quarantined people. Previous research found that individuals subjected to forced isolation were more vulnerable to discrimination and exclusion (39), and among the quarantined population, those with stigma were 12 times more likely to suffer from depression than those without stigma (40). Bigya Shah et al. also reported that COVID-19-related internalized stigma is associated with anxiety and depression symptoms, prior experience of quarantine, self-blame (41). Stigma, in essence, is a response to danger where the targets are regarded as somehow immoral. Although the public has a certain understanding of COVID-19, they may attribute fault to quarantined and infected individuals, along with their close contacts, believing them to be engaged in risky behaviors. The media has a strong influence on public attitudes, dramatic and fear-mongering misinformation across media platforms were shown to contribute to stigmatization during pandemic (42, 43). Therefore, it is necessary to guide public opinion by providing accurate scientific facts and avoid promoting a state of panic about the disease and specific groups. Public health officials should convey clear information to the entire affected population in a timely and effective manner, and explain to the public the reasons for quarantine and other public health measures. In addition, affected individuals should also receive access to information and other public health measures aimed at promoting a clear self-awareness, and should be helped to not internalize the public stigma into self-stigma.

According to Meyer (44), coping strategies can be divided into adaptive strategies (including active coping, planning, using emotional support, using tool support, positive reconstruction, religion, humor, and acceptance) and maladaptive strategies (including venting, denial, substance use, self-blame, behavioral disengagement, and self-distraction). Our study found that maladaptive strategies including "denial" and "guilt and self-blame" were independent risk factors for depression and anxiety among quarantined people. "Denial" is considered to be an avoidant coping strategy and a dysfunctional response to stressful situations. Although it can temporarily alleviate stress, in the long run, it can lead to poor health and aggravate anxiety, distress, and depression (45). Other studies also showed that the use of denial and self-blame coping strategies is positively related to stress perception, depression and anxiety (46, 47). Our findings highlight the associations between positive coping behaviors and psychosocial well-being, therefore, psychological support and intervention services can be offered to the quarantined individuals to help them develop positive thinking, adopt active coping strategies, and minimize the use of negative coping mechanisms.

This study had some limitations. First, this was a cross-sectional study, which only provided a brief snapshot of the psychological responses of quarantined individuals; longitudinal studies are needed to analyze mental health trajectories and evaluate whether these depressive and anxiety responses persist after quarantine. Second, we utilized an exploratory analysis involving a convenience sample without a specific power analysis because we were uncertain as to the relevant formula and metrics to determine the optimal sample size. As such there may be some sample size bias. Finally, internet data collection is prone to selection bias, and we cannot fully explain the questionnaire to the respondents face-to-face, so there may be respondents' understanding bias that affects the results.

Despite these limitations, this study has several notable strengths. It is, to our knowledge, the first to provide an in-depth exploration of the psychological and emotional conditions of individuals who entered quarantine immediately upon arriving in Mainland China from abroad—an area that has received relatively little attention. The results are highly representative, offering valuable insights into the mental health of this specific demographic during the COVID-19 pandemic. Additionally, our findings provide new perspectives on the relationships between quarantine-related stress, coping strategies, stigma, and psychological outcomes. This research establishes a baseline for monitoring mental health during quarantine and offers practical implications for managing mental health during the COVID-19 pandemic and future outbreaks of Disease X.

Conclusion

The results of this study indicate that depression and anxiety among individuals in entry quarantine are associated with factors such as pre-existing health conditions, lack of medical insurance, perceptions of the epidemic and quarantine, availability of daily necessities during quarantine, stigma, and coping strategies. These findings can aid in identifying the most vulnerable groups in such situations, for whom targeted interventions and tailored social support should be provided. Measures such as ensuring the provision of adequate information, maintaining open

communication channels, securing access to daily necessities, and reducing stigma can enhance psychosocial and social outcomes during outbreaks.

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 humans were approved by the Ethics Committee of the School of Public Health, Shanghai Jiao Tong University. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was required from the participants or the participants' legal guardians/next of kin.

Author contributions

LC: Writing – original draft, Formal analysis, Data curation, Conceptualization. QC: Writing – review & editing, Methodology, Formal analysis, Data curation, Conceptualization. CX: Writing – review & editing, Data curation. FZ: Writing – review & editing, Data curation. XH: Writing – review & editing, Data curation. ZW: Writing – review & editing, Software, Project administration, Conceptualization. YJ: Writing – review & editing, Supervision, Conceptualization. YL: Writing – review & editing, Formal analysis, Conceptualization.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2024.1368463/full#supplementary-material

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EDITED BY
Gabriele Nibbio,
University of Brescia, Italy

REVIEWED BY
Saeid Komasi,
Mind GPS Institute, Iran
Alexis B. Manrique Guzman,
Private Technical University of Loja, Ecuador
Izolde Bouloukaki,
University of Crete, Greece

*CORRESPONDENCE
Xiaorui Huang
huangxiaorui@126.com

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Latent profile of personality traits for American older adults and its transition during the COVID-19 pandemic

Mingqi Fu[1], Jing Guo[2], Hao Kang[3] and Xiaorui Huang[4]*

[1]School of Public Administration, Central South University, Changsha, Hunan, China, [2]Department of Health Policy and Management, School of Public Health, Peking University, Beijing, China, [3]School of Humanities and Social Science, The Chinese University of Hongkong, Shenzhen, China, [4]School of International Relations, Huaqiao University, Xiamen, Fujian, China

Background: The impact of COVID-19 on older adults' personality development is essential for emergency management but under-researched. This study seeks to explore the personality profiles of older adults living in the United States and how these profiles transitioned during the pandemic.

Methods: Longitudinal data were collected from 3,550 adults aged 60 and older who participated in both the 2016 and 2020 waves of the Health and Retirement Survey (61.18% female, mean age 65.85 in 2016). Personality traits were assessed using the Midlife Development Inventory. COVID-19-related experiences including pandemic concerns, restricted healthcare access, financial instability, work challenges, disrupted social connections, and mutual aid behaviors. Latent Profile Analysis and Transition Analysis were used for analysis.

Results: Three distinct personality profiles were identified: Well-adjusted, Moderate-adjusted, and Poor-adjusted. About 42% of respondents experienced personality changes during the pandemic. Higher levels of COVID-19 concern were linked to an increased likelihood of transitioning to Poor-adjusted from Moderate (OR=1.06, $p<0.05$) or Well-adjusted (OR=1.05, $p<0.01$). Challenges such as healthcare delays and financial hardships hindered transitions from Poor- to Moderate-adjusted (Healthcare delay: OR=0.39, $p<0.05$; Financial hardships: OR=0.67, $p<0.05$) but increased the likelihood of Moderate-adjusted individuals transitioning to Poor-adjusted (Healthcare delay: OR=1.46, $p<0.05$; Financial hardships: OR=1.51, $p<0.05$). However, Poor-adjusted individuals who provided help to others were more likely to transition to Moderate-adjusted (OR=2.71, $p<0.01$).

Conclusions: Personality transitions during crisis are significant among older adults. Future interventions should focus on addressing traumatic concerns, encouraging helping behaviors, and mitigating healthcare and financial challenges to support older adults' personality development during crisis.

KEYWORDS

COVID-19 pandemic, frail elderly, latent transition analysis, personality, psychological response

1 Introduction

Personality traits by definition are descriptions of individuals based on relatively stable patterns of behaviors, thoughts and emotions (1), which may flow into the decision-making process and have significant impacts on various aspects of life (2). For older adults, personality plays a crucial role in executive functioning and the development of mental health issues, such as dementia and depression (3). In current studies, the most widely used system of personality traits is the Five-Factor Model (1), which organizes numerous traits into five broad dimensions: neuroticism, extraversion, agreeableness, openness to experience, and conscientiousness.

These dimensions are considered as distinct and combined to affect how individuals cope with stress (4). For instance, neuroticism, characterized by emotional instability, is linked to maladaptive coping strategies like avoidance and worry, hindering effective stress management (5). In contrast, extraversion, marked by sociability and assertiveness, encourages active problem-solving and optimism (6), while agreeableness, associated with cooperation and compassion, fosters social support and interpersonal effectiveness (5). Openness to experience, which includes creativity and intellectual curiosity, aids in adapting to complex situations. And, conscientiousness, involving determination and planning, is vital for success in structured, goal-oriented environments (7).

Despite their distinctiveness, it is worth noting that these traits can be correlated to some extent. Existing research suggests that individuals high in conscientiousness may also demonstrate agreeable tendencies, as they tend to be reliable and cooperative in their interactions with others (8). This interconnectedness indicates that while the Five-Factor Model provides a framework for understanding distinct traits, individuals can exhibit a combination of these traits that interact and influence each other.

1.1 Latent profile of personality traits in individuals' late life

The study of individuals' personality traits has traditionally been explored using variable-centered methods, which overlook the interconnected nature of these traits within individuals (9). Alternatively, a person-centered methodology such as latent profile analysis (LPA) can identify person-specific patterns in multiple traits and group individuals into subgroups with similar personality organization (10).

There is no consensus on the number or configuration of personality profiles in older adults. Many studies, based on the vulnerability model, have identified three to four profiles (4). The most common profiles are: Resilient (low neuroticism, average to high levels of other traits), Overcontrolled (low extraversion and emotional stability, high conscientiousness), and Undercontrolled (low emotional stability and conscientiousness, high extraversion) (11, 12). More recent studies suggest a fourth profile, the Vulnerable or Poor-adjusted, characterized by high neuroticism and low levels of the other traits (13, 14). Another proposed four-profile model includes Vulnerable, Moderate (average levels of all traits), Resilient, and Undercontrolled profiles (15). Some studies, such as Van der Wal's in the Netherlands, identified only two profiles: Resilient and Distressed (16). Additionally, a five-profile model has been noted in various countries, with one predominant Well-adjusted (Resilient) profile and four others with distinct characteristics (17, 18). These profiles' prevalence varies significantly, with the most wide-known Resilient profile ranging from 10.10% to 61.40% (19). This variability may be due to methodological differences including sample size, age range, instruments used, and analytic techniques (13), as well as cultural and socioeconomic factors (20). Thus, this study focuses on older adults in the U.S. to provide further clarity on personality profiles in late adulthood.

1.2 Personality traits changes and life events

Traditional studies often consider personality as a relatively stable characteristic linked to demographic factors like gender, race, age, and socioeconomic factors (21, 22). Recently, there has been a growing focus on understanding personality change as a result of the information-coping process. According to the cognitive-adaptive trait theory, personality development is associated with strategies for adapting to environmental opportunities and pressures, with cognitive skills and self-knowledge acting as mediators (23). Personal events in late life, such as retirement, onset of health issues, and the loss of loved ones, have been examined as factors that drive personality changes (24, 25). In contrast, collective stressful life events such as natural disasters seemed to be nonsignificant (26). However, there is still limited research on how personality changes among older adults during the COVID-19 pandemic.

The COVID-19 pandemic might be a driver for older adults' personality changes due to the unique challenges that individuals faced during this period. Older individuals, in particular, may experience heightened levels of anxiety and stress stemming from concerns about their susceptibility to the virus and fears surrounding mortality. If these concerns exceed their sense of control, it could lead to dysfunctional aspects of self-regulation, resulting in increased emotional instability (27). Moreover, older adults during the pandemic may encounter more severe deprivations that prompt changes in their personality. Exposure to the coronavirus puts older adults at a greater risk of infection and experiencing more severe disease syndromes. Once infected, older adults may undergo shifts in their worldview and understanding of their place in the world due to impacts of the compromised central nervous system and subsequent negative ruminations (28). Additionally, compared to their younger counterparts, older adults are more likely to face challenges across various aspects of daily life during the pandemic, including accessing healthcare, maintaining financial sustainability, fulfilling daily work responsibilities, and sustaining social connections. For instance, social distancing measures and lockdowns have posed challenges for older adults who are not accustomed to tele-healthcare, making

non-infectious healthcare services harder to access (29). Moreover, older individuals may experience increased financial strain as navigating life on a limited budget becomes more challenging, while a significant portion of disadvantaged older adults lack emergency savings (30). The challenges associated with COVID-19 could lead to increased feelings of isolation and insecurity, which may result in withdrawal or a stronger desire for social interaction, ultimately affecting individuals' personalities during the pandemic (31).

Despite the challenges faced by older adults during the COVID-19 pandemic, those who are motivated and resilient may adopt new coping mechanisms, such as engaging in mutual help behaviors to combat initial challenges. Previous evidence suggests that during emergencies, interpersonal assistance in communication, shopping and other essential activities becomes more prevalent, which may stimulate positive changes in older adults' personality, such as increased levels of agreeableness and extraversion (32). However, there are also concerns and debates regarding the potential negative effects of giving and receiving help. For older adults, especially those at higher risk during a pandemic, providing assistance to others may lead to caregiver stress, burnout, and strain on their own health, potentially contributing to increased emotional instability (33). Similarly, receiving help may sometimes be perceived as a loss of independence, impacting one's sense of intelligence and autonomy (34). Furthermore, the dynamics of mutual help can vary based on individuals' preexisting personality characteristics (35). Some older adults may thrive in caregiving roles, finding fulfillment and purpose in supporting others, while others may experience conflicts related to expectations, boundaries, and reciprocity in social interactions. Thus, it is essential acknowledge the complexity and potential controversies surrounding the dynamics of giving and receiving help when considering older adults' personality development within the unique context of the COVID-19 pandemic.

1.3 Aims and hypothesis

The main goal of this study is to expand upon prior research by examining transitions in personality traits among older adults within a COVID-19 context, which will be achieved by identifying distinct profiles both before and during the pandemic, utilizing a person-centered approach. Additionally, the study will explore how COVID-19 experiences, including concerns, various challenges and mutual help behaviors, may relate to the development of individuals' personalities.

The first hypothesis is exploratory in nature, positing that there are distinct patterns in the personalities of older adults. The second hypothesis relates to personality transitions among individuals living under the pandemic threats. Drawing from insights in previous studies (27, 31), it is anticipated that older individuals experiencing the pandemic to a greater extent (e.g., higher levels of COVID-19 concern, encountering more COVID-19-related difficulties, and engaging in mutual help behaviors) are more likely to undergo changes in their personality patterns. However, individuals with different personality profiles before the pandemic might exhibit varied trajectories in their personality development in response to COVID-19 experiences. This expectation is based on findings from prior research (35) and highlights the complexity of how individuals' pre-existing personality traits may interact with pandemic-related experiences to shape their personality changes over time.

2 Methods

2.1 Research design and participation

Data in this study was obtained from the 2016 and 2020 waves of the Health and Retirement Survey (HRS). HRS is a national longitudinal study focusing on adults aged 45 and older in the United States. Since its inception in 1992, the HRS has been conducted every two years and enrolled over 15,000 individuals per wave (more details see https://hrs.isr.umich.edu). The 2020 wave of the HRS took place from June 2020 to May 2021, a period marked by fluctuations in COVID cases and rapid advancements in scientific understanding, policies, and coping strategies related to the pandemic (36). Significantly, prior to the survey launch, the federal government declared a national emergency in March 2020. Subsequently, lockdown measures and stay-at-home orders were widely implemented by May, leading to frequent delays in healthcare access, financial difficulties, disrupted job opportunities, and interrupted social networking activities among older adults (37). Consequently, the survey included a section to capture individuals' perceptions and experiences of the pandemic since March 2020. This allowed researchers to analyze the immediate impact of the initial outbreak of the pandemic on the multidimensional living conditions of older adults. For information on ethical approval, sampling design, informed consent, response rates, and survey content of HRS, readers are directed to Fisher & Ryan (38).

In this study, due to the limited participation of older adults in consecutive waves of psychological assessment, we used personality data from 2016 as a proxy for participants' pre-pandemic status. The initial sample size was 4,101. Following the World Health Organization's definition of individuals aged 60 and above as older adults, who were identified as particularly vulnerable during the COVID-19 pandemic (39), we set the age limit at 60 years. After excluding individuals below this age (342 observations) and those with missing information on two or more of the COVID-19 experiences (124 observations) or either wave of personality trait assessments (85 individuals), our final analysis included 3,550 cases. Missing data were handled with Listwise deletion.

2.2 Measures

Personality in this study was assessed using the Midlife Development Inventory (MIDI), an inventory that is commonly employed in large panel surveys of adults (40). The MIDI comprises a total of 26 adjectives describing individuals' big five traits, with specific items allocated for extraversion, agreeableness,

conscientiousness, neuroticism, and openness. Respondents are asked to rate how well each item describes them based on their feelings at the time of the interview, using a scoring system ranging from 1 (not at all) to 4 (a lot). The average score across the included items was calculated for each trait, with higher scores indicating more pronounced sub-scaled traits. The MIDI has been validated as a reliable tool for assessing personality traits in older adults (41). The overall Cronbach's alpha coefficient for the MIDI was 0.76 in the 2016 wave and 0.77 in the 2020 wave, indicating good internal consistency. Through latent profile analysis, personality was then categorized into three profiles: Well-adjusted, Moderate-adjusted, and Poor-adjusted.

COVID-19-related experiences among older adults included concerns about the pandemic, deprivations resulting from pandemic-related measures, and mutual help behaviors since March 2020.

COVID-19 concern was evaluated using a 10-point scale, asking respondents to rate "how concerned are you about the pandemic." Higher scores indicated greater levels of COVID-19 concerns.

COVID-19-related difficulties encompassed various challenges that individuals had since March 2020. These difficulties included: 1. Being infected, which assessed the risk of exposure to the virus with the question "Have you ever been diagnosed with COVID-19?" 2. Healthcare delays, measured through five questions about their experiences such as delayed doctor visit. 3. Financial hardships, evaluated with six items like "could not pay medical bills due to COVID reasons." 4. Work challenges, consisting of five items such as "I lost my job because of the pandemic." 5. Impeded social networking, indicated by five types of experiences like "had to cancel family gatherings due to COVID restrictions." During the survey, participants reported whether they had experienced each item during the pandemic, with a score of 1 indicating "yes" and 0 indicating "no". Scores were then summed to reflect the level of corresponding difficulties, with total scores of 5 for healthcare delay, 6 for financial hardships, 5 for work challenges, and 5 for social connection difficulties.

Mutual help behaviors against the pandemic were assessed as received help and gave help. For received help, participants were asked if anyone outside their household helped them with bills or chores during the pandemic, with a response of 1 for "yes" and 0 for "no". Gave help was measured by asking if participants helped anyone outside their household with bills or chores during the pandemic, with a score of 1 for affirmative responses and 0 otherwise.

Covariates in this study included age, gender (male/female), marital status (married or partnered/single), race (white/black/others) and Medicaid eligibility (yes/no). These variables have been examined to associated with older adults' personalities (21, 22).

2.3 Analytic strategies

Descriptive analyses were conducted for all variables as of 2016 and 2020, respectively. For continuous variables, means and standard deviations were reported, while for categorical variables, numbers and percentages were reported.

To examine the development of older adults' personalities during the pandemic and the influence of COVID-19 experiences on the transition probability, we used the Bolck-Croon-Hagenaars method (BCH) Latent transition analysis (LTA). The BCH-LTA involves three steps. First, by conducting LPA at each time point, we determined the optimal number of latent profiles for each time. Second, we independently estimated and assigned BCH weights to each sample, solely relying on the latent class indicators specific to that particular time point. Third, we estimated the LTA model with covariates.

In the first phase, we conducted LPA to identify unobserved clusters of individuals sharing similar personality profiles. This analysis was performed separately for the years 2016 and 2020 to determine if the combination of personality indicators remained stable over time. The LPA process involved estimating models with varying numbers of profiles, starting with a one-profile model and progressing to more complex models with increasing numbers of profiles. Each model (K profiles) was compared to the previous model with one less profile (K-1 profiles) until the larger model (K profiles) was not found to be significantly better than the one with fewer profiles. Various indicators were used to evaluate the models, including Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), sample size-adjusted BIC (ssaBIC), entropy, values of the Lo-Mendell-Rubin Test (LMRT), and the Bootstrap Likelihood Ratio Test (BLRT). Generally, a more optimal model is indicated by lower AIC, BIC, and ssaBIC values; relatively higher entropy (> 0.60 is considered acceptable); the smallest class size exceeding 5%; and significant LMRT and BLRT values (42). Last, membership for individuals in each profile was determined based on their average posterior probabilities.

Then, the BCH weights were calculated and employed to compare differences between profiles in terms of related demographic and socioeconomic characteristics. Unlike methods that assume no error, BCH considers uncertainties in classification. This approach saves the posterior probabilities and model class assignments from the optimal classification model. Next, the inverse logits of individual-level classification error rates are computed and then used as profile weights in estimating distal variables, such as profile characteristics. More information about BCH methods can be found in Nylund-Gibson's previous work (43). In the current study, pairwise comparisons of the characteristics between profiles were conducted simultaneously using Wald's test.

In the third stage, we utilized latent transition analysis (LTA) without covariates, a type of autoregressive model, to model changes in group membership over time (44). Transition probabilities are conditional probabilities that describe the probability of being in a given state, conditional on the state from the previous time point. For example, the probability of individual i transitioning into a state m (m=1, …, s) from state k (k=1, …, s) could be estimated using the following equation:

$$\tau_{ikm} = \frac{exp(\alpha_m + \beta_{km})}{\Sigma_{s=1}^{s} exp(\alpha_s + \beta_{ks})}$$

Where the term in the denominator for the reference class (last class) is 1 because α_s=0 and β_{ks}=0 for standardization (45). Older adults who did not experience a change in personality traits from 2016 to 2020 were categorized as "stayers", while those who did were categorized as "movers".

Finally, the COVID-19 experiences variables were added as covariates to the mixture model following a BCH-LTA approach (43). The effect of the covariates on the transition probability odds ratios were reported.

All tests were two-sided with an alpha level of 0.05 for statistical significance and the analyses were carried out using Mplus version 8.

3 Results

3.1 Descriptive analysis

Among the older adults in the sample, the majority were female (N=2171, 61.18%) and identified as non-Hispanic White (2599, 73.48%). The average age at baseline was approximately 65.85 years (Standard deviation, SD=10.16), with around 34.01% (N=1207) of participants reporting being single. By the year 2020, the percentage of single individuals had increased to 38.77% (N=2168), and the number of Medicaid recipients rose from 9.56% (N=338) in 2016 to 10.55% (N=371). During the pandemic, older adults expressed relatively high levels of COVID-19 concern (Mean, M=7.77, SD=2.59). Although only 5.06% (N=127) of respondents had been diagnosed with the disease, they experienced notable challenges in social networking (M=1.99, SD=1.54) and financial hardships (M=1.09, SD=0.55). Approximately 23% (N=821) of individuals received social support to cope with the pandemic, and about 36.51% (N=1296) reported having helped others.

In terms of personality traits, there was an increase in the mean score for neuroticism from 1.93 (SD=0.36) in 2016 to 1.95 (SD=0.36) in 2020, indicating a heightened level of emotional instability and irritability among older adults during the COVID-19 threats. Conversely, extraversion decreased from 3.21 (SD=0.36) in 2016 to 3.15 (SD=0.34) in 2020; openness decreased from 2.95 (SD=0.33) to 2.93 (SD=0.34); agreeableness declined from 3.53 (SD=0.24) to 3.49 (SD=0.27); and conscientiousness declined from 3.40 (SD=0.23) to 3.36 (SD=0.25) in 2020. Further details are provided in Table 1.

TABLE 1 Mean and standard deviation for socioeconomic characteristics, pandemic-related experiences and personality traits variables for the wave 2016 and wave 2020 (N=3550).

		Wave-2016	Wave-2020
		M/N (*SD*/P)	*M*/N (*SD*/P)
Gender	Male	1378 (38.83)	
	Female	2172 (61.18)	
Race	White	2599 (73.48)	
	Black	640 (18.09)	
	Others	298 (8.43)	
Age		65.85 (10.16)	69.84 (10.24)
Marital Status	Married/ Partnered	2342 (65.99)	1373 (61.23)
	Single	1207 (34.01)	2168 (38.77)
Medicaid Eligibility	Yes	338 (9.56)	371 (10.55)
	No	3198 (90.44)	3147 (89.45)
COVID-19 Concern			7.77 (2.59)
COVID-19-related difficulties	Being infected		127 (5.06)
	Healthcare delay		0.496 (0.896)
	Work challenge		0.213 (0.578)
	Financial hardships		1.091 (0.547)
	Impeded social networking		1.992 (1.536)
Mutual Help Behaviors against COVID-19	Received support		821 (23.13)
	Gave support		1296 (36.51)
Personality Traits	Neuroticism	1.93 (0.36)	1.95 (0.36)
	Extroversion	3.21 (0.32)	3.15 (0.34)
	Openness to experience	2.95 (0.33)	2.97 (0.34)
	Agreeableness	3.53 (0.24)	3.49 (0.27)
	Conscientious	3.40 (0.23)	3.36 (0.25)

M, Mean; N, Counts; SD, Standard Deviation; P, Proportion.
Mean and Standard Deviation were reported for continuous variables, and Counts and Proportion were reported for categorical variables.

3.2 Exploration of latent personality profiles for wave 2016 and wave 2020

The exploration of measurement model helps to identify whether similar classes emerge at each time point of interest. As shown in Table 2, both in wave 2016 and wave 2020 the three-class solution fitted the data best. Based on the estimated personality profile of respondents from each latent class (See Figure 1), we further summarized the detected profiles as Poor-adjusted, Moderate-adjusted, and Well-adjusted.

The Poor-adjusted profile was characterized by a relatively high level of neuroticism and low levels of the other four traits. Individuals in the Poor-adjusted profile might exhibit heightened emotional reactivity to stressors but may be less capable of coping with them effectively. On the other hand, the Well-adjusted profile (or Resilient) was the opposite of the Poor-adjusted profile, with individuals believed to experience adaptive outcomes in the face of stressful circumstances. The Moderate-adjusted profile possessed a middle level of all traits, representing a resilience profile but possibly with a slightly lower level of adaptation compared to the Well-adjusted profile. The proportion of individuals in the Poor-, Moderate-, and

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TABLE 2 Model fit indices.

	Solution	Loglikelihood	AIC	BIC	ssaBIC	Entropy	LMR		BLRT		Class Proportion			
							2LL	P	2LL	P				
Wave-2016	1-class	-14236.74	28456.26	28555.22	28523.44									
	2-classes	-12510.42	25036.63	25151.64	25100.80	0.79	3452.62	0.000	3452.63	0.000	32.10	67.90		
	3-classes	**-12034.94**	**24135.36**	**24249.72**	**24179.82**	**0.79**	**950.96**	**0.006**	**950.96**	**0.000**	**45.06**	**9.99**	**44.95**	
	4-classes	-11802.84	23765.55	23834.57	23745.60	0.76	464.20	0.120	464.20	0.000	3.00	25.60	49.50	21.90
Wave-2020	1-class	-14708.65	29326.52	29499.04	29467.26									
	2-classes	-12935.69	25863.24	26002.19	25951.35	0.78	3545.89	0.000	3475.05	0.000	32.80	67.20		
	3-classes	**-12356.13**	**24756.26**	**24892.10**	**24822.20**	**0.79**	**1159.13**	**0.000**	**1135.98**	**0.000**	**44.45**	**21.71**	**33.84**	
	4-classes	-12152.33	24501.24	24533.56	24444.59	0.76	407.59	0.012	399.45	0.013	4.20	26.30	25.00	44.50

AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; ssaBIC, sample size-adjusted BIC; LMRT, Lo-Mendell-Rubin Test; BLRT, Bootstrap Likelihood Ratio Test. The bold values indicate that the 3-classes solutions have the best model fit indices.

Well-adjusted groups was 9.99%, 45.06%, and 44.95% in 2016, respectively, and 21.71%, 44.45%, and 33.84% in 2020.

Supplementary Table S1 further examined the sociodemographic characteristics associated with older adults' personality profiles. The results indicated that all profiles significantly differed from one another in terms of gender and Medicaid eligibility, both before and during the pandemic. The Poor-adjusted profile tended to have fewer females (44.74% in 2016; 50% in 2020) and more individuals receiving Medicaid (15.86% in 2016, 19.83% in 2020) compared to other profiles. In a pandemic context, individuals of White race seemed more likely to be in the Moderate-adjusted (75.11%) or Well-adjusted (72.76%) profiles rather than the Poor-adjusted profile (66.12%).

3.3 Exploration of latent transition patterns and its relationships with COVID-19 experiences

Table 3 illustrated personality changes between 2016 to 2020 using cross-sectional LPAs. The values along the diagonal describe stability in personality, while the off-diagonals reflect movements. As observed, 64.30% of individuals with a Moderate-adjusted personality, 49.9% of those in the Poor-adjusted group, and 54.3% of the Well-adjusted group would remain in the same group during the pandemic.

The detailed stayer-mover patterns are presented in Table 4. Overall, approximately 58.39% of older adults maintained stable personalities throughout the pandemic, while nearly 41.61% experienced some degree of personality changes. The most common patterns of movement were from Well-adjusted individuals to Moderate-adjusted (12.58%) or Poor-adjusted (7.95%), and from Moderate-adjusted to Poor-adjusted (8.77%). These changes are viewed as negative, as individuals may find it challenging to engage in adaptive behaviors once these transitions occur. However, there were also some positive changes observed. Around 7.3% of the sampled individuals shifted from Moderate-adjusted to Well-adjusted, and to a lesser extent from Poor-adjusted to Moderate-adjusted (2.89%) or Well-adjusted (2.11%).

Table 5 explores whether COVID-19-related experiences are related to transition probabilities. Notably, a higher level of COVID-19 concern was associated with a lower chance for Poor-adjusted individuals to transition into the Moderate-adjusted (OR=0.95, $p<0.001$) or Well-adjusted (OR=0.94, $p<0.05$) personality profiles. Individuals with Moderate-adjusted (OR=1.06, $p<0.05$) or Well-adjusted (OR=1.05, $p<0.01$) personalities who experienced heightened COVID-19 concerns were more likely to transition into a Poor-adjusted personality rather than maintaining their previous profiles. However, disease infection did not show a significant relationship with personality changes. Additionally, in the context of COVID-19-related challenges and mutual support behaviors, notable correlations were observed among individuals classified as Poor-adjusted or Moderate-adjusted before the pandemic. Factors such as healthcare delays and financial strain were linked to an increased likelihood of developing a Poor-adjusted personality during the pandemic. Conversely, engaging in helping behaviors towards others appeared to be associated with a higher probability of developing a Moderate-adjusted personality for Poor-

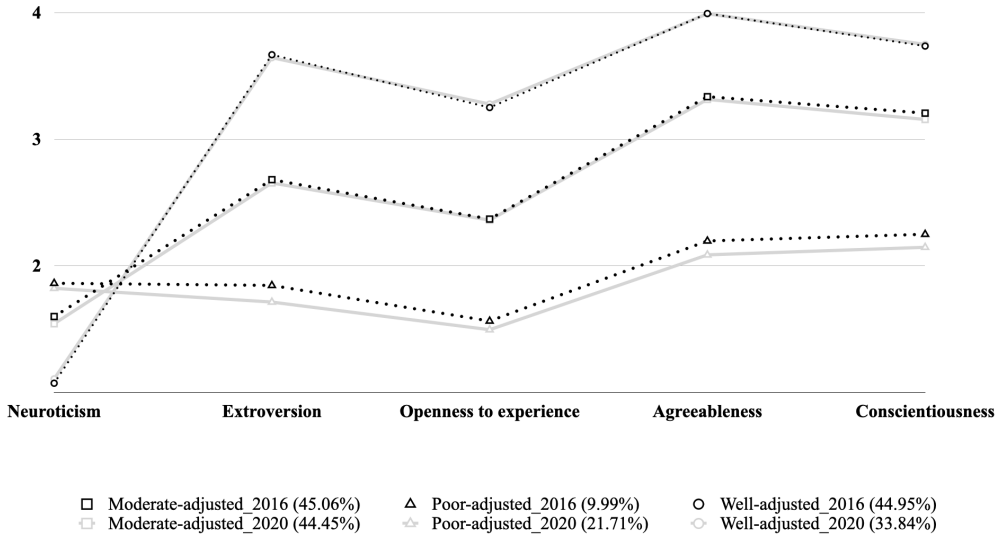

FIGURE 1
Conditional response means of the 3-class solution.

adjusted individuals amidst the COVID-19 circumstances (OR=2.08, p<0.01).

4 Discussion

This study with a sample of 3,550 older adults from the United States observed three latent personality profiles: Well-adjusted, Moderate-adjusted and Poor-adjusted. It is noteworthy that during the COVID-19 pandemic, there was roughly a 42% probability of personality transition among older adults. Among these transitions, the most common were Well-adjusted individuals transitioning to the Moderate-adjusted profile (12.58%), followed by transitions from Moderate- to Poor-adjusted (8.77%), and from Well- to Poor-adjusted (7.95%). Moreover, we provided empirical support for the cognitive-adaptation traits theory, showing that heightened pandemic concern and difficulties related to COVID-19 may associated with an increased likelihood of transitioning to the Poor-adjusted profile. Conversely, engaging in supportive behaviors toward others during public emergencies was linked to a higher probability of transitioning from Poor- to Moderate-adjusted.

Several findings of this study warrant further discussion. First, this study identified three distinct latent personality profiles within the sampled older adult population, noting that the majority fell into the categories of Well- or Moderate-adjusted. An interesting observation was the configuration of personality profiles, particularly the prevalence of a middle level of personality expressions among elderly individuals, which was less frequently observed in younger age groups (11–14). This aligns with the notion that personality traits can adapt across the lifespan, with individuals generally becoming more "average" as they age (46). Notably, consistent with previous research (20), neuroticism emerged as the most crucial trait distinguishing these personality profiles, with significant variance observed in over 30% of the independent sample. In terms of profile size, the proportion of Moderate-adjusted and Well-adjusted older adults during the pandemic exceeded 50%, which was notably higher compared to estimates for adults at earlier life stages (47, 48). This aligned with prior findings that younger adults experienced increased neuroticism and decreased agreeableness and conscientiousness than older counterparts during the pandemic (27). It is possible that older individuals, despite facing disproportionate stressors during the pandemic, might possess greater psychological resources such as accumulated life experiences and a broader perspective on life. With which, older adults may view challenges as temporary and part of a larger context, and maintain adaptability during difficult times (49). Moreover, older adults may employ more sophisticated coping strategies to navigate environmental uncertainties. As previous research noted, individuals improve at regulating emotions as they age, with many older adults prioritizing what matters most, focusing on positive aspects of life, and managing stress effectively (50). Thus, this study highlights the potential for positive personality outcomes among older adults facing pandemic threats. Moreover, encouraging the preservation of their psychological resources, fostering adaptive coping strategies, and

TABLE 3 Preliminary transition tables based on trait classifications from the cross-sectional LPA modeling results.

	Moderate-adjusted-2020	Poor-adjusted-2020	Well-adjusted-2020
Moderate-adjusted-2016	0.64	0.20	0.16
Poor-adjusted-2016	0.29	0.50	0.21
Well-adjusted-2016	0.28	0.18	0.54

TABLE 4 Percent of older adults in each pattern of personality transition, orders by the frequency of the patterns, by movers then stayers.

	Wave-2016	Wave-2020	Frequency
Movers (41.61%)	Well-adjusted	Moderate-adjusted	12.58%
	Moderate-adjusted	Poor-adjusted	8.77%
	Well-adjusted	Poor-adjusted	7.95%
	Moderate-adjusted	Well-adjusted	7.30%
	Poor-adjusted	Moderate-adjusted	2.89%
	Poor-adjusted	Well-adjusted	2.11%
Stayers (58.39%)	Moderate-adjusted	Moderate-adjusted	28.98%
	Well-adjusted	Well-adjusted	24.42%
	Poor-adjusted	Poor-adjusted	4.99%

addressing heightened neuroticism during such challenging times might be crucial.

In addition, we found that males and Medicaid recipients were more prone to being Poor-adjusted, whereas in a COVID-19 context in particular, individuals from non-white racial groups showed a higher likelihood of exhibiting a Poor-adjusted personality. Inconsistent with previous research (21), evidence from this study suggested that older females may have better self-regulation skills based on their biological and social characteristics, leading to a higher likelihood of being Well-adjusted compared to males (51). Additionally, we revealed that individuals enrolled in Medicaid programs were more likely to exhibit Moderate-adjusted or Poor-adjusted personality profiles, which underscored the potential exacerbation of socioeconomic vulnerability among this group. With regard to the significant racial variations in personality profiles, reasons could be attributed to heightened socioeconomic challenges such as lower income and limited access to healthcare among disadvantaged racial groups (52). Therefore, it is recommended that special attention should be given to the vulnerability of males, Medicaid recipients, and individuals from non-white racial groups in terms of personality development during health crises like the COVID-19 pandemic.

Moreover, this study observed frequent changes in the personalities of older individuals during the pandemic, with higher levels of COVID-19 concern significantly linked to negative changes, such as transitioning from a state of Well-adjusted or Moderate-adjusted to becoming Poor-adjusted. This aligned with the Cognitive-adaptive Trait Theory's assertion that enduring and severe stressors like the COVID-19 pandemic could impact older adults' personality traits (23). More detailed, older adults experiencing heightened concern about the pandemic might be more vulnerable to enduring distress characterized by fear, insecurity, and uncertainty (27). As a result, this vulnerability increases the likelihood of experiencing heightened emotional instability and reduced levels of extroversion, openness, agreeableness, and conscientiousness. However, contrary to prior research (28), this study did not find a significant link between disease infection and personality changes among older adults. This may be due to older individuals' tendencies to underestimate and lack awareness of disease infection (53), as well as their inclination to attribute the causes and consequences of infection to external factors (49). Moreover, the short-term nature of the threats posed by contracting the coronavirus may also contributed to the lack of significant personality changes. The clear and simple solutions to these threats might hinder the accommodation of the enduring and dynamic nature of personality development (54). Thus, it might be important to address and support the ongoing concerns of older adults during health crises like the COVID-19 pandemic to foster more adaptive personality outcomes.

Besides, the impact of healthcare delays, financial hardships, and mutual help behaviors on the personality development of older adults was found to vary significantly based on individuals' pre-existing personality profiles. This study introduced a novel finding that Well-adjusted individuals, who might possess more effective coping and reflective strategies, experienced less impact on their personality traits due to pandemic-related difficulties. In general, Well-adjusted older adults may have a greater reserve of resources, leading to a reduced impact of COVID-19-related challenges such

TABLE 5 The odds ratio of latent transition probabilities as a function of COVID-19 related experiences (stayers as reference).

	Poor-adjusted		Moderate-adjusted		Well-adjusted	
	P-M	P-W	M-P	M-W	W-B	W-M
COVID-19 Concern	0.95***	0.94*	1.06*	0.99	1.05**	1.05**
COVID-19 Infection	1.35	0.93	1.37	1.31	1.23	1.19
Healthcare Delay	0.39*	0.55	1.46*	0.91	1.01	0.99
Work Challenge	0.70	0.83	1.17	0.98	1.16	1.19
Financial Hardship	0.67*	0.73	1.51*	0.64	1.19	1.03
Impeded Social networking	0.93	0.94	1.02	0.95	0.99	1.12
Received Support	0.70	0.30	1.43	0.94	1.08	0.83
Gave Support	2.08**	2.48	0.80***	1.44	0.88	1.35

P, Poor-adjusted; W, Well-adjusted; M, Moderate-adjusted, *** P<0.001, ** P<0.01, * P<0.05.

as income reduction and healthcare delays on their personality development (55). Also, it appears that Well-adjusted individuals may have a higher threshold for negative personality changes, possibly due to their ability to maintain stable personalities through positive social comparisons and lower negative self-reflection compared to their peers (56). Conversely, for Poor-adjusted and Moderate-adjusted individuals, challenges related to healthcare access and financial stability—two critical aspects significantly affected during the pandemic—might disrupt their self-knowledge foundation (57). They were more prone to withdrawing from social connections, engaging in maladaptive ruminations, and adopting passive self-regulation strategies, all of which contribute to negative personality changes (28). Based on these findings, this study proposed that fostering a well-adjusted personality among older individuals might better prepare them for future emergencies. Also, timely intervention and support should be provided to Poor-adjusted and Moderate-adjusted individuals experiencing healthcare delays and financial hardships to mitigate the negative impact on their personality development.

Last, it is noteworthy that the pandemic might also presents opportunities for positive personality development. We added to existing knowledge by demonstrating that offering assistance to others may facilitate the development or maintenance of a Moderate-adjusted personality. Perhaps, engaging in acts of service may shift the focus of older adults from personal worries to the needs of others, potentially reducing self-centeredness and alleviating anxiety or fears (58). Moreover, helping others might provide a sense of purpose and foster social connections, leading to increased self-esteem, reduced feelings of loneliness and isolation, and contributing to emotional stability, extraversion, and openness during difficult times (32). However, contrary to our initial hypothesis, receiving help from others did not show a significant relationship with changes in older adults' personalities. This could be due to a counterbalancing effect, where increased appreciation for life may be offset by a perceived decrease in self-efficacy through peer comparison (34). Therefore, it might be useful to promote helping behaviors among older adults during emergencies. Individuals with Poor- or Moderate-adjusted personality profiles should be particularly prioritized in these efforts to support their well-being and foster positive personality development.

4.1 Strength and limitations

This study is among the first to use a person-centered methodology to explore personality transitions among older adults, considering impacts of the COVID-19 pandemic. The findings provided valuable insights into how older adults' personality traits may evolve in response to significant stressors like the pandemic, which might inform interventions and support systems aimed at promoting resilience and well-being among this population during challenging times.

However, several limitations should be acknowledged. Firstly, the assessment of pre-pandemic personality used data from four years before the pandemic, potentially introducing confounding factors unrelated to the pandemic that could influence observed personality transitions. Additionally, the impact of the pandemic on personality profiles was assessed only in the first year after the outbreak, highlighting the need for future research to explore if these changes persist in post-pandemic phases. Furthermore, although it appeared reasonable in the temporal sequence to assess the impact of COVID-19 experiences on personality changes during the pandemic, it is important to note that these variables were assessed in a cross-sectional study. Variables like COVID-19 concern, which were estimated using a single self-reported item, should be interpreted cautiously regarding their influence on personality transitions. Therefore, longitudinal evidence with more comprehensive measures is critical for future studies to validate this relationship. Lastly, although cognitive skills and self-knowledge are believed to influence personality changes in older adults, these variables were not directly measured in our study. Additionally, confounders such as co-morbidities may have influenced personality development but were not a primary focus due to data limitations. Future research is needed to empirically investigate how these factors contribute to personality changes among older adults.

5 Conclusion

With a sample of 3,550 older adults from the United States, we observed three distinct personality profiles: Well-adjusted, Moderate-adjusted and Poor-adjusted. We found that over 40% of the individuals may experience personality transitions during the pandemic. While a higher level of COVID-19 concern and greater pandemic-related difficulties associated with a higher probability of being Poor-adjusted during the pandemic, engaging in helping services might facilitate changes from Poor-adjusted to Moderate-adjusted. The study extends existing findings and provides novel evidence on the relationship between traumatic experiences and changes in older adults' personality traits. Identification of personality profiles and its developmental trajectories might be useful in targeting those who may be at risk for undesirable personality changes. To the extent that personality traits are modifiable, the present findings may also provide valuable information for tailoring interventions based on constellations of individual differences in personality, especially for those who are experiencing negative personality changes.

Data availability statement

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

Ethics statement

All experimental protocols in this study were approved by the University of Michigan Health Sciences/Behavioral Sciences Investigational Review Board (HUM00061128). All respondents gave verbal or written informed consent to this survey.

Author contributions

MF: Writing – original draft, Writing – review & editing. JG: Supervision, Writing – review & editing. HK: Writing – review & editing. XH: Writing – review & editing.

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Conflict of interest

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

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2024.1358000/full#supplementary-material

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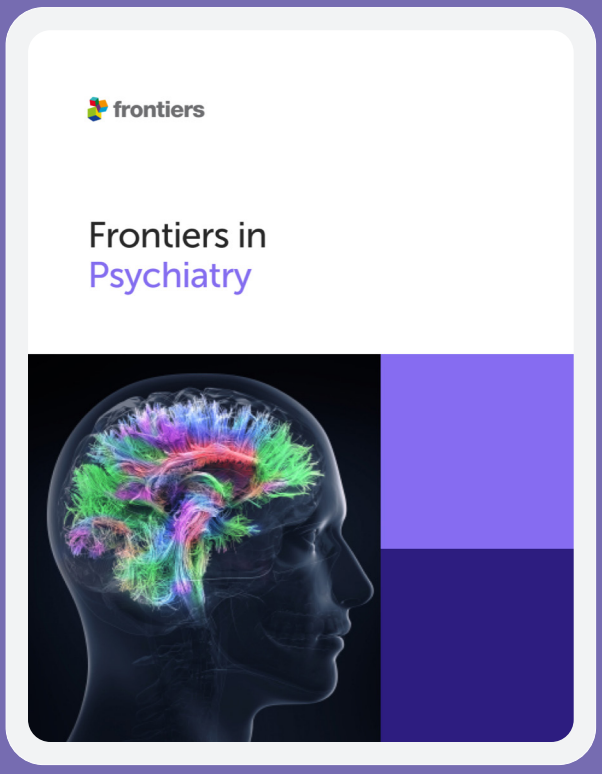

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