


Anxiety, depression and post-traumatic stress disorder and related factors among Chinese population during the COVID-19 pandemic

A cross-sectional study

Yang Liu, PhD^a, Yi-Fei Liu, BS^a, Ke-Xian Liu, BS^b, Yao-Jie Xie, PhD^c, Wen-Gang Li, PhD^d, Yue Kong, MS^e, Hai-Hua Zhu, BS^f, Jie-Min Zhu, PhD^a, Bai-Bing Mi, PhD^g, Jin-Qiu Yang, PhD^a, Zhuo Huang, BS^a, Ji-Wei Du, EdD^h, Hong-Gu He, MD, PhDⁱ, Qu Shen, EdD^{a,*} 

Abstract

The sudden outbreak of coronavirus disease 2019 (COVID-19) has deep and wide negative mental impacts on the public, and studies on the impact of COVID-19 on social and mental well-being are necessary. This study aimed to evaluate mental distress, including anxiety, depression, and post-traumatic stress disorder (PTSD), and its related risk factors in Chinese adults in the early stages of the COVID-19 pandemic. This study used a large-scale cross-sectional design. A total of 2067 adult participants completed the online survey via REDcap from 1st to 15th of March 2020 during the COVID-19 outbreak in China. Anxiety, depression, PTSD, and related risk factors, including self-efficacy, coping style, and social support, were measured using valid and reliable instruments. The data were analyzed using multiple linear regression. We found that 201 (9.7%) participants reported moderate-to-severe anxiety, 669 (33.8%) reported depression, and 368 (17.8%) reported symptoms of PTSD. Self-efficacy, coping style, and social support significantly affected anxiety, depression, and PTSD symptoms. Participants' sociodemographic characteristics, COVID-19 pandemic-related factors, low self-efficacy, low social support, and negative coping were predictors of mental distress during the COVID-19 pandemic. Our study will help healthcare professionals carry out early predictions and identification of high-risk groups and provide appropriate interventions to target groups during public health emergencies that plague the world.

Abbreviations: COVID-19 = coronavirus disease 2019, PTSD = post-traumatic stress disorder, REDcap = Research Electronic Data Capture.

Keywords: anxiety, COVID-19, depression, mental health, post-traumatic stress disorder, self-efficacy, social support

1. Introduction

The 2019 coronavirus disease (COVID-19) pandemic has led to a global crisis, and continues to raise significant changes on

the public's mental health and behaviors. As a country where the "dynamic-zero control" policy was first and persistently employed, China has responded to the pandemic actively by adopting comprehensive mobilization and strict prevention and

The cost of data collection, analysis, interpretation and trial design of this study were supported by the Ministry of Education, Humanities and social science research projects (The Construction and Application Study of PTSD Psychological Prediction Model based on Mobile Health Technology, no. 21YJAZH071) and the COVID-19 Emergency Prevention and Treatment Research Fund of Xiamen University (20720200025, 20720200018). The cost of patient recruitment was supported by the Fundamental Research Funds for the Central Universities (XZY032020033). This study was also funded by the Social Science Foundation of Fujian Province (FJ2022B061).

The study procedures were approved by the Medical Ethics Committee of School of Medicine, Xiamen University (XDYX2020005), and we designed the informed consent on the first page of the online survey. The submission of the online survey was considered as the participant providing informed consent.

The authors have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

^a Department of Nursing, School of Medicine, Xiamen University, Xiamen, China,

^b Department of Nursing, School of Medicine, Zhejiang University, Hangzhou,

China, ^c FG424, School of Nursing, The Hong Kong Polytechnic University,

Hong Kong, China, ^d Discipline of Hepatobiliary Surgery, Department of Clinical

Medicine, School of Medicine, Xiamen University, Xiamen, China, ^e 900th Hospital

of Joint Service Support Force of Chinese People's Liberation Army, Fuzhou,

China, ^f Department of Nursing, The First Affiliated Hospital of Xiamen University,

Xiamen, China, ^g Department of Epidemiology and Biostatistics, School of Public Health and Global Health Institute, Xi'an Jiaotong University Health Science Center, Xi'an, China, ^h Nursing Department, The University of Hong Kong – Shenzhen Hospital, Shenzhen, China, ⁱ Alice Lee Centre for Nursing Studies, Yong Loo Lin School of Medicine, National University of Singapore, Singapore; National University Health System, Singapore.

* Correspondence: Qu Shen, Department of Nursing, School of Medicine, Xiamen University, 4221 Xiang'an South Road, Xiamen 361102, China (e-mail: shenqu@mail@163.com).

Copyright © 2022 the Author(s). Published by Wolters Kluwer Health, Inc. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial License 4.0 (CCBY-NC), where it is permissible to download, share, remix, transform, and build upon the work provided it is properly cited. The work cannot be used commercially without permission from the journal.

How to cite this article: Liu Y, Liu Y-F, Liu K-X, Xie Y-J, Li W-G, Kong Y, Zhu H-H, Zhu J-M, Mi B-B, Yang J-Q, Huang Z, Du J-W, He H-G, Shen Q. Anxiety, depression and post-traumatic stress disorder and related factors among Chinese population during the COVID-19 pandemic: A cross-sectional study. *Medicine* 2022;101:51(e32336).

Received: 5 October 2022 / Received in final form: 22 November 2022 / Accepted: 29 November 2022

<http://dx.doi.org/10.1097/MD.00000000000032336>

control measures. Therefore, during the pandemic, all the citizens were in a relatively social-isolated environment. The severity of COVID-19, the development of the pandemic, and the government's control measures were all uncertain for the public in the early stages. In this context, people experienced and interacted with a unique external environment developed by both the disease itself and the prevention and control measures, and various psychological reactions and disorders appeared in the public.^[1]

Previous studies have indicated that higher rates of depression and anxiety were associated with increased concern about the threat of COVID-19 worldwide.^[2–4] COVID-19 diagnosed cases, suspected cases, and related healthcare professionals may have difficulty coping with the circumstances and developed fear, anxiety, depression, uncertainty, stigma, and even extreme behaviors such as refusal of treatment, violence, and suicide because of the severe consequences of this pandemic.^[5–7] And beyond the disease itself, prevention and control measures such as quarantine may also lead to higher depression and anxiety levels, as well as obesity-related behaviors.^[8] The pandemic brought a crisis to the public's mental and behavioral health.

Among all of the psychologic reactions and risks above, post-traumatic stress disorder (PTSD) can be one of the most severe disorder that need urgent and comprehensive interventions and prevention measures. Existing studies have implied the relationship between the exposure to COVID-19 pandemic and PTSD.^[9] However, there were not many studies exploring other psychosocial factors related to PTSD in the context of COVID-19 pandemic. Meanwhile, the relationship among PTSD, anxiety and depression also needs further investigation.

Several psychosocial characteristics have been found to be associated with the incidence and severity of PTSD and other common distress (i.e., anxiety and depression) by studies prior to the pandemic. Among an individual's characteristics, coping style, social support, and self-efficacy can be critical when she/he encounters an emergency, major setback, or difficulty.^[10] She/he will need timely psychological crisis interventions to avoid the occurrence of post-traumatic stress disorder (PTSD) after the exposure, and the characteristics mentioned above can be the focus of the interventions.^[11] Therefore, there is an urgent need to investigate PTSD, anxiety, depression and their related factors in the context of COVID-19 pandemic, especially for Chinese population, to whom more strict prevention and control measures have been applied compared to that in other countries.

2. Materials and Methods

2.1. Aims

Our study aimed to investigate anxiety, depression, and PTSD symptoms and their predictors in Chinese population during the COVID-19 pandemic. It can help relevant government departments and health and epidemic prevention professionals improve their abilities to respond to global public health emergencies. The research questions were as follows.

- What were the participants' levels of anxiety, depression, PTSD symptoms, self-efficacy, social support, and coping style during the COVID-19 pandemic?
- What were the differences in anxiety, PTSD symptoms, and depression between and among subgroups of different sociodemographics, COVID-19 related factors, self-efficacy, social support, and coping styles?
- What were the relationships between anxiety, depression, PTSD symptoms, social support, self-efficacy, and coping style?
- What are the predictors of anxiety, depression, and PTSD symptoms?

2.2. Design

A cross-sectional study was conducted from March 1 to March 15, 2020 in four Chinese cities (Wuhan, Xiamen, Qingdao, and Beijing). Research Electronic Data Capture (REDCap, Vanderbilt University, TN, West Xianning Road, Xi'an city, Shaanxi province, China)^[12,13] was used to collect data through convenient sampling.

2.3. Participants

Participants were eligible if they were: able to understand Mandarin to the extent necessary to participate; aged no less than 18; and able to use mobile phones to fill in an online questionnaire. This study used the mean sampling formula $N = (U_{\alpha} \sigma / \delta)^2$, where U_{α} is the v value corresponding to test level α , σ is the overall standard deviation, and δ is the allowable error. Based on our preliminary experiment, the standard deviation was 2.09, and given that $\alpha = 0.05$ and $\delta = 0.1$, the sample size was calculated as 1679. Considering a 10% to 15% loss rate and sampling error, we aimed to recruit a minimum of 1847 participants.

2.4. Data collection procedure

The online survey link was sent through Qzone, WeChat, and Microblog (The Chinese social media apps) to potential respondents. After scanning the QR code on the invitation letter, each invitee was directed to the online questionnaire. On the platform, we set a randomized 10-to-20-CNY (approximately US\$3) red packet as a reward for the completion of each questionnaire. Participants could click on the red packet after completing the questionnaire. After completing the questionnaires, REDCap automatically collected the questionnaires and coded the responses. The researchers excluded invalid questionnaires with missing answers, incorrect information, or the same answers for all the items.

2.5. Outcomes and measurements

A questionnaire comprising sociodemographics and scales on anxiety, depression, PTSD, social support, coping style, and self-efficacy was developed.

Sociodemographics collected included gender, age, ethnicity, education, marital status, family members, personal monthly income, and employment status. Participants were also asked to report whether worked as medical staff, whether they had been exposed to Wuhan, had been confirmed COVID-19 patients, accepted isolation, and had seen a doctor during the COVID-19 period.

2.5.1. Anxiety. We assessed anxiety using the Chinese version of 20-item Self-Assessment of Anxiety (SAS).^[14,15] Each item was measured using a four-point Likert scale. The raw scores ranged from 20 to 80, and were converted to index scores by dividing the sum of the original scores by 80 and multiplying by 100. Potential scores ranged from 25 to 100. Scores from 25 to 49 indicated healthiness, 50 to 59 indicated slight anxiety, 60 to 69 indicated moderate anxiety, and ≥ 70 indicated severe anxiety.^[16] The SAS proved to have good internal consistency, with a Cronbach's alpha value of 0.86.^[16] The scale has been widely used in the Chinese population and has shown good reliability and validity.^[17] In this study, Cronbach's alpha coefficients was 0.88.

2.5.2. Depression. Depression was assessed using the nine-item Patient Health Questionnaire (PHQ-9).^[18] It consisted of nine items, each scored from 0 to 4, with total scores ranging from 0 to 27. A total score ≥ 5 indicated that the individual was likely to be depressed.^[19] The coefficient of the scale was

0.89, indicating good internal consistency.^[20] This scale has been widely used with Chinese samples, showing good reliability and validity.^[19,21] Cronbach's alpha coefficients was 0.91 in this study.

2.5.3. PTSD. We assessed PTSD using the Chinese version of the 17-item PTSD Checklist-Civilian Version (PCL-C).^[22,23] Each item was measured on a five-point scale, with potential total scores ranging from 17 to 85. A total score from 17 to 37 indicated no apparent symptoms of PTSD, and a score >38 indicated the existence of PTSD symptoms.^[23] Yang revised the scale and demonstrated good validity and reliability.^[23] Cronbach's alpha coefficients was 0.96 in this study.

2.5.4. Self-efficacy. Self-efficacy was assessed using the ten-item Chinese version of the General Self-Efficacy Scale (GSES).^[24] The total score ranged from 10 to 40. A score of 10 to 20 indicated a low level of self-efficacy, a score of 21 to 30 indicated a moderate level of self-efficacy, and a score of 31 to 40 indicated a high level of self-efficacy.^[25] For Chinese university students, the internal consistency was 0.91.^[26] This scale has been widely used in Chinese population with acceptable reliability and validity.^[24] The Cronbach's alpha coefficients was 0.94 in this study.

2.5.5. Social support. We assessed social support using the Chinese version of the 12-item Perceived Social Support Scale (PSSS).^[15,27] It is used to measure the level of perceived support from various sources, such as family, friends, and others. Each item is measured from strongly disagree to strongly agree on seven levels (1–7 points). The total PSSS scores ranged from 12 to 84. The total score ranges from 12 to 36 for low support, from 37 to 60 for intermediate support, and from 61 to 84 for high support.^[28,29] The reliability and validity of the scale were good, the internal consistency coefficient of the total scale was 0.88, and the retest reliability was 0.85.^[27] The scale has been widely used in the Chinese population and has shown good reliability and validity.^[30] Cronbach's alpha coefficients was 0.96 in this study.

2.5.6. Coping style. We assessed coping style using the 20-item Self-Report Coping Scale (SCS).^[31] The scale was divided into two dimensions. Item 1 to 12 measured active coping, and item 13 to 20 evaluated negative coping dimensions. The scores of 1 to 12 items are added up to obtain a positive response score, and the scores of 13 to 20 items were added up to obtain a negative response score. The two scores were then normalized and subtracted to obtain the coping trend scores. A coping tendency score greater than 0 indicated positive coping and a score of less than 0 indicated negative coping.^[32] The retest coefficient of the scale was 0.89. Cronbach's alpha for the internal consistency test was 0.90; Cronbach's alpha of the positive response dimension was 0.89. Cronbach's alpha for the negative response dimension was 0.78.^[31] Cronbach's alpha coefficients was 0.91 in this study.

2.6. Statistical analysis

IBM SPSS Statistics 25 (IBM corporation, New Orchard Road, Armonk, NY) was used for the statistical analysis. We used multiple interpolations to replace the missing age data. First, we described individual characteristics; factors related to the COVID-19 pandemic; self-efficacy; social support; coping style; and the three key outcomes of anxiety, depression, and PTSD symptoms using descriptive statistics. Continuous and categorical variables are presented as mean (SD) and *n* (%), respectively. Second, to compare the differences in anxiety, depression, and PTSD between and among subgroups of different sociodemographics, COVID-19 related factors, self-efficacy, social support, and coping style, we used an independent two-sample *t* test or analysis of variance (ANOVA). Third,

Pearson's correlation analysis was used to examine the relationships among the three key outcomes: self-efficacy, social support, and coping style. Finally, we used multiple linear regressions to explore the predictors of the three key outcomes. The *F* test method was used to test the whole hypothesis of the regression model, and a *P* value of less than .05 was considered statistically significant.

2.7. Ethical considerations

The ethical approval for this study was obtained from the Ethics Committee of the School of Medicine, Xiamen University (No. XDYX2020005). All participants were briefed about the study and asked to provide written informed consents. The participants' information was completely confidential and served only

Table 1

Participants' sociodemographic characteristics (n = 2067).

Variable	n	%
Gender		
Male	469	22.7
Female	1598	77.3
Age (yr)		
≤25	1162	56.2
26–35	643	31.1
36–45	177	8.6
>45	85	4.1
Ethnicity		
Han	1962	94.9
Minority	105	5.1
Education		
Senior high school and below	164	7.9
Junior college	1069	51.7
Bachelor and above	834	40.3
Marital status		
Unmarried	1458	70.5
Married	609	29.5
Family members		
≤2	153	7.4
3–4	1407	68.1
≥5	507	24.5
Personal monthly income		
≤¥3500	495	23.9
¥3501–¥5000	490	23.7
¥5001–¥8000	502	24.3
¥8001–¥12,500	345	16.7
≥¥12,501	235	11.4
Employment		
Yes	1167	56.5
No	900	43.5
Working as a medical staff		
Yes	801	38.8
No	1266	61.2
Exposure to Wuhan		
Yes	62	3.0
No	2005	97.0
Traveled by public transports		
Yes	407	19.7
No	1660	80.3
Experience of seeing a doctor		
Yes	193	9.3
No	1873	90.7
Isolation		
Yes	161	7.8
No	1906	92.2
Confirmed COVID-19 patients around		
Yes	84	4.1
No	1983	95.9

COVID-19 = coronavirus disease 2019.

*¥1 = \$0.14 (exchange rate on 5 October 2022).

Table 2**Descriptions of anxiety, depression, and post-traumatic stress disorder, self-efficacy, social support, coping styles (n = 2067).**

Variable	Category	n (%)	Mean (SD)
Self-efficacy (GSES)	Total		26.0 (6.6)
	Lower	449 (21.7)	17.5 (2.8)
	Average	1180 (57.1)	25.8 (3.1)
	Higher	434 (21.0)	35.3 (3.4)
Social support (PSSS)	Total		62.4 (14.3)
	Lower	90 (4.4)	25.1 (8.6)
	Average	778 (37.6)	51.6 (5.7)
	Higher	1199 (58.0)	72.1 (7.1)
Coping style (SCS)	Total		0.0 (1.1)
	Negative	1085 (52.5)	-0.9 (0.5)
	Positive	982 (47.5)	1.0 (0.7)
Anxiety (SAS)	Total		42.1 (9.3)
	Normal	1688 (81.7)	38.5 (4.7)
	Mild	245 (11.9)	53.8 (2.6)
	Moderate	90 (4.4)	63.2 (2.8)
	Severe	43 (2.0)	73.9 (4.2)
Depression (PHQ-9)	Total		4.6 (5.1)
	Healthy	1368 (66.2)	1.6 (1.7)
	Depressed	699 (33.8)	10.4 (4.2)
PTSD (PCL-C)	Total		28.3 (12.0)
	Negative	1699 (82.2)	23.6 (6.1)
	Positive	368 (17.8)	49.6 (9.5)

GSES = General Self-Efficacy Scale, PCL-C = PTSD Checklist-Civilian Version, PHQ-9 = Patient Health Questionnaire, PSSS = Perceived Social Support Scale, PTSD = post-traumatic stress disorder, SAS = self-assessment of anxiety, SCS = Self-Report Coping Scale.

for the purposes of the study. The participants' involvement was voluntary.

3. Results

3.1. Participant characteristics

A total of 2111 participants were recruited. After excluding questionnaires with incomplete or incorrect information, 2067 (97.9%) valid questionnaires were used in the final analysis. As shown in Table 1, most of the participants were female (n = 1598, 77.3%), and more than half were ≥ 25 years old (n = 1162, 56.2%). As shown in Table 2, 449 (21.7%) participants reported low self-efficacy, 90 (4.4%) reported lower social support, and 1085 (52.5%) reported negative coping. Severe anxiety occurred in 43 (2.0%) participants, and 699 (33.8%) were likely to have experienced depression. PTSD symptoms occurred in 368 (17.8%) participants.

3.2. Anxiety, depression, PTSD, and their risk factors

As shown in Table 3, statistically significant differences were found in anxiety, depression, and PTSD symptoms between and among all individual sociodemographic subgroups, COVID-19 pandemic-related factor subgroups, and subgroups of self-efficacy, social support, and coping style ($P < .05$).

Based on the Pearson product-moment correlation coefficient test, self-efficacy was negatively correlated with anxiety ($r = -0.164$, $P < .01$), depression ($r = -0.250$, $P < .01$), and PTSD symptoms ($r = -0.199$, $P < .01$). Social support was negatively correlated with anxiety ($r = -0.329$, $P < .01$), depression ($r = -0.337$, $P < .01$), and PTSD symptoms ($r = -0.310$, $P < .01$). Coping styles were negatively correlated with anxiety ($r = -0.409$, $P < .01$), depression ($r = -0.390$, $P < .01$), and PTSD symptoms ($r = -0.365$, $P < .01$) (Fig. 1).

As shown in Table 4, sociodemographic characteristics and COVID-19 pandemic-related factors, including male, ethnic minorities, high educational levels, married/cohabiting, large family sizes, high personal monthly incomes, not being medical staff, those who were exposed to Wuhan, having been around

confirmed COVID-19 patients, accepted isolation, having seen a doctor during the COVID-19 pandemic, low self-efficacy, low social support, and negative coping, were significant predictors of anxiety, depression, and PTSD during the COVID-19 pandemic. These predictors accounted for 27.2%, 23.1%, and 23% of the variance in anxiety ($F = 65.1$, $P < .001$), depression ($F = 57.2$, $P < .001$), and PTSD symptoms ($F = 62.7$, $P < .001$), respectively.

4. Discussion

This study investigated the predictors of anxiety, depression, and PTSD symptoms in Chinese population during the COVID-19 pandemic. We found that more than 30% of the participants experienced depression and nearly 20% of them experienced anxiety and PTSD symptoms.

Previous studies indicated that there have been many problems with public mental health during the COVID-19 pandemic.^[24] Long-term isolation, fear of infection, boredom, shortage of necessities, insufficient information, economic loss, and reputation damage can be stressors during a pandemic.^[33] In our study, participants with anxiety or depression developed PTSD symptoms more easily than normal population.^[34] Anxiety, depression, and PTSD symptoms may impair people's physical health, increase their burden, and hinder family harmony and social development.^[35] Therefore, during the COVID-19 pandemic, it is important to pay attention to public mental health problems. We suggest conducting convenient and quick mental distress assessments on the population during the COVID-19 pandemic and providing effective preventive and mental intervention measures to people in need.

Gender, marriage, the number of family members, personal income, and level of education may act as important factors that related to psychological distress. Our findings showed that males were more prone to develop the distress than females. Recent studies that explored differences in mental health by gender often found that stress and anxiety rates are higher among women^[36,37] which is inconsistent with our findings. The reason for this inconsistency may be the special role of males in the Chinese family, as men may take more responsibility

Table 3**Comparison of anxiety, depression, and PTSD between and among subgroups of sociodemographics, COVID-19 related factors, self-efficacy, social support, and coping styles (n = 2067).**

	Anxiety (SAS)	P value	Depression (PHQ-9)	P value	PTSD (PCL-C)	P value
Gender						
Male	44.9 (11.5)	<.001	6.0 (6.1)	<.001	32.2 (15.1)	<.001
Female	41.3 (8.4)		4.1 (4.6)		27.1 (10.7)	
Age, yr						
≤25	41.6 (9.0)	.001	4.6 (5.2)	.047	27.9 (12.2)	.123
26–35	43.3 (10.0)		4.9 (5.1)		29.2 (12.3)	
36–45	41.5 (9.1)		4.0 (4.5)		27.6 (10.6)	
>45	41.3 (8.0)		3.5 (3.7)		27.8 (10.3)	
Ethnicity						
Han	41.9 (9.0)	<.001	4.4 (5.0)	<.001	27.9 (11.7)	<.001
Minority	46.6 (13.0)		6.8 (6.4)		34.7 (15.6)	
Education						
High school and below	45.2 (11.7)	<.001	5.7 (6.3)	<.001	31.7 (15.8)	<.001
Junior college	40.9 (7.9)		4.1 (4.7)		26.9 (10.6)	
Bachelor and above	43.1 (10.2)		4.9 (5.2)		29.3 (12.6)	
Marital status						
Unmarried ^a	41.8 (9.0)	.010	4.6 (5.1)	.679	28.1 (12.1)	.291
Married ^b	43.0 (9.9)		4.5 (4.9)		28.7 (11.8)	
Family members						
≤2	41.9 (9.5)	.003	4.5 (5.0)	.044	28.4 (12.6)	.024
3–4	41.7 (8.8)		4.4 (5.0)		27.8 (11.6)	
≥5	43.3 (10.5)		5.0 (5.3)		29.5 (13.0)	
Personal monthly income						
≤¥3500	40.4 (8.2)	<.001	3.9 (4.7)	.001	26.1 (10.3)	<.001
¥3501–¥5000	41.9 (8.5)		4.4 (4.9)		27.9 (11.7)	
¥5001–¥8000	42.6 (9.9)		4.7 (5.2)		28.9 (12.9)	
¥8001–¥12,500	43.5 (10.3)		5.2 (5.4)		30.5 (13.2)	
≥¥12,501	43.0 (9.9)		5.1 (5.1)		29.0 (11.8)	
Employment						
Yes	43.0 (9.7)	.001	4.7 (5.0)	.289	28.7 (12.1)	.050
No	41.0 (8.7)		4.4 (5.1)		27.7 (12.0)	
Working a medical staff						
Yes	41.9 (8.3)	.351	4.2 (4.5)	.003	27.5 (10.6)	.018
No	42.3 (9.9)		4.8 (5.4)		28.7 (12.9)	
Exposure to Wuhan						
Yes	54.8 (14.7)	<.001	10.3 (7.1)	<.001	44.9 (17.6)	<.001
No	41.7 (8.8)		4.4 (4.9)		27.7 (11.5)	
Traveled by public transports						
Yes	43.8 (11.1)	.001	5.6 (5.5)	<.001	30.9 (13.4)	<.001
No	41.7 (8.8)		4.3 (4.9)		27.6 (11.6)	
Experience of seeing a doctor						
Yes	48.6 (12.6)	<.001	7.7 (6.3)	<.001	36.4 (15.3)	<.001
No	41.4 (8.6)		4.2 (4.8)		27.4 (11.3)	
Isolation						
Yes	46.2 (12.4)	<.001	6.6 (6.0)	<.001	34.0 (15.3)	<.001
No	41.8 (8.9)		4.4 (4.9)		27.8 (11.6)	
Confirmed COVID-19 patients around						
Yes	54.7 (12.9)	<.001	10.6 (6.7)	<.001	43.6 (16.9)	<.001
No	41.6 (8.7)		4.3 (4.8)		27.6 (11.3)	
Self-efficacy (GSES)						
Lower	44.3 (8.6)	<.001	6.1 (5.3)	<.001	30.6 (12.0)	<.001
Average	42.1 (9.6)		4.7 (4.9)		28.8 (11.9)	
Higher	39.7 (8.5)		2.7 (4.5)		24.4 (11.5)	
Social support (PSSS)						
Lower	48.1 (10.0)	<0.001	7.5 (6.7)	.001	33.8 (15.4)	<.001
Average	45.1 (9.7)		6.3 (5.4)		32.0 (12.6)	
Higher	39.7 (8.2)		3.2 (4.2)		25.4 (10.4)	
Coping style (SCS)						
Negative	45.4 (10.1)	<.001	6.1 (5.7)	<.001	31.9 (13.7)	<.001
Positive	38.5 (6.6)		2.9 (3.5)		24.3 (8.2)	

Data are reported in mean (SD). P values were calculated by t test or ANOVA, as appropriate.

^aUnmarried/Separated/Divorced/Widowed.^bMarried/Cohabitated.

GSES = General Self-Efficacy Scale, PCL-C = PTSD Checklist-Civilian Version, PHQ-9 = Patient Health Questionnaire, PSSS = Perceived Social Support Scale, PTSD = post-traumatic stress disorder, SAS = self-assessment of anxiety, SCS = Self-Report Coping Scale.

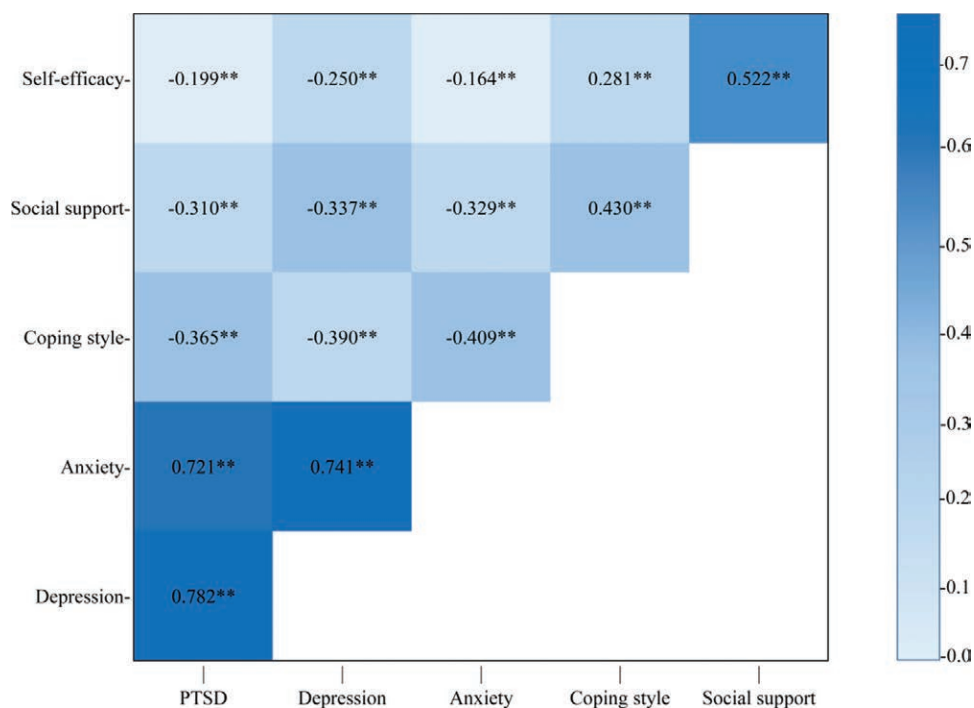


Figure 1. Correlations among anxiety, depression, PTSD, self-efficacy, social support, and coping style (n = 2067). **There was a significant correlation at the level of .01 (two-sided). PTSD = post-traumatic stress disorder.

in traditional family structures. Moreover, the anxiety scores of those who were married were higher than those who were unmarried, which may be because those who were married had more roles and responsibilities. Similarly, participants from large families faced greater family responsibilities.

We found that the higher the personal monthly income, the more likely participants were to experience the distress. Although COVID-19 has caused different levels of economic pressure on various groups of people, this phenomenon warrants further investigation. Also, more educated participants had higher depression scores. However, Schmitt et al found that the impact of quarantine on depressive symptoms was higher among individuals with lower levels of education.^[38] Contrary to the conclusions of this study, further research is needed. Furthermore, our results showed that the depression scores of the non-medical group were higher than those of medical professionals. Medical staff may adopt different strategies to protect themselves and their family members from infections. Therefore, medical professionals are less likely to develop anxiety and panic than general population during the COVID-19 pandemic.

Regarding COVID-19 pandemic-related factors, participants who had been exposed to Wuhan (2020), traveled by public transportation, seen a doctor, were surrounded by confirmed COVID-19 patients, or underwent isolation scored higher on anxiety, depression, and PTSD. Understandably, these participants were more likely to be exposed to infected or suspected patients and was thus more likely to worry about infection. Therefore, more attention should be paid to the mental distress of these high-risk groups.

There were moderate-to-strong correlations among self-efficacy, social support, coping style, and the distress. We found that participants with lower self-efficacy experienced higher anxiety, depression, and PTSD scores. The higher the perception of self-efficacy, the more confident the person is in dealing with the epidemic, the more positive the attitude, and the lower the probability of suffering from PTSD. Moreover, participants with problems with social support were relatively prone to experiencing mental distress. Lack of social support is one of the most

important risk factors for the development and the maintenance of PTSD symptoms.^[39] Inadequately perceived social support is a risk factor for sleep disturbance during the COVID-19 pandemic.^[40] Our study and previous findings indicate the importance of providing adequate social and specific support during pandemics. Social distancing may interfere with physical and social interactions.

Furthermore, we found that participants with negative coping styles were more likely to experience mental distress. Previous studies have pointed out that negative coping style is a risk factor for PTSD,^[41] which supports our research findings. Individuals who adopted negative coping styles were not as proficient as those with positive coping styles in the application of anti-epidemic knowledge and rational arrangements of daily life throughout the COVID-19 pandemic. Negative behaviors will also contribute to other health concerns, such as depression.^[8] Therefore, we encourage the public to actively seek social support, find positive meaning in daily life, and avoid negative behaviors.

Our study identified various significant predictors of anxiety, depression, and PTSD symptoms among the general public during the COVID-19 pandemic. We suggest integrating the power of educational, mental, medical, civil, and other related resources to establish sustainable community-based mental-support systems. Different mental assessments and interventions should be performed at different stages for different groups, especially for the aforementioned high-risk groups.

4.1. Limitations

This study recruited a large number of participants from various backgrounds. Several limitations could affect the interpretation of the study. First, self-report surveys had limitations, as misinterpretation of the questions could occur. Second, this study used nonrandom sampling based on an online survey, and the sample recruited in this study does not represent the entire population of China. Third, the predictors may differ in different countries, regions, and populations; therefore, extrapolation of the conclusions is limited. Further studies are required to address these limitations.

Table 4**Predictors of anxiety, depression and post-traumatic stress disorder (n = 2067).**

Dependent variable	Independent variable	Unstandardized coefficients		Standardized coefficient	β value	<i>t</i> value	<i>P</i> value	95% Confidence interval
		β value	SE					
Anxiety	(constant)	87.95	3.01			29.24	<.001	[82.05, 93.85]
	Gender	-1.13	0.44	-0.05		-2.58	.010	[-1.99, -0.27]
	Ethnicity	1.44	0.82	0.03		1.77	.078	[-0.16, 3.04]
	Marital status	1.18	0.41	0.06		2.87	.004	[0.37, 1.99]
	Family members	0.24	0.14	0.03		1.65	.099	[-0.04, 0.52]
	Personal monthly income	0.47	0.14	0.07		3.31	.001	[0.19, 0.75]
	Exposure to Wuhan	-5.37	1.15	-0.10		-4.67	<.001	[-7.63, -3.12]
	Confirmed COVID-19 patients around	-6.95	1.00	-0.15		-6.98	<.001	[-8.90, -5.00]
	Isolation	-1.53	0.68	-0.04		-2.23	.026	[-2.87, -0.19]
	Experience of seeing a doctor	-3.20	0.64	-0.10		-4.97	<.001	[-4.47, -1.94]
	Coping style	-4.69	0.38	-0.25		-12.40	<.001	[-5.44, -3.95]
	Self-efficacy	-0.67	0.30	-0.05		-2.25	.024	[-1.26, -0.09]
	Social support	-2.99	0.35	-0.19		-8.50	<.001	[-3.68, -2.30]
Depression	(constant)	28.00	1.55			18.04	<.001	[24.96, 31.05]
	Gender	-0.57	0.25	-0.05		-2.26	.024	[-1.07, -0.08]
	Education	0.37	0.17	0.05		2.16	.031	[0.03, 0.71]
	Personal monthly income	0.30	0.08	0.08		3.80	<.001	[0.14, 0.45]
	Exposure to Wuhan	-2.30	0.64	-0.08		-3.59	<.001	[-3.55, -1.04]
	Confirmed COVID-19 patients around	-3.56	0.55	-0.14		-6.42	<.001	[-4.65, -2.47]
	Isolation	-1.04	0.39	-0.05		-2.68	.008	[-1.80, -0.28]
	Experience of seeing a doctor	-1.72	0.36	-0.10		-4.79	<.001	[-2.42, -1.02]
	Whether a medical staff	0.68	0.23	0.07		3.01	.003	[0.24, 1.12]
	Coping style	-1.96	0.21	-0.19		-9.26	<.001	[-2.38, -1.55]
	Self-efficacy	-0.90	0.17	-0.12		-5.35	<.001	[-1.22, -0.57]
	Social support	-1.47	0.20	-0.17		-7.50	<.001	[-1.86, -1.09]
PTSD	(constant)	88.07	3.87			22.77	<.001	[80.49, 95.65]
	Gender	-2.01	0.58	-0.07		-3.47	.001	[-3.14, -0.88]
	Ethnicity	2.79	1.08	0.05		2.58	.010	[0.67, 4.91]
	Personal monthly income	0.79	0.18	0.09		4.40	<.001	[0.44, 1.14]
	Exposure to Wuhan	-7.74	1.53	-0.11		-5.06	<.001	[-10.74, -4.74]
	Confirmed COVID-19 patients around	-7.96	1.32	-0.13		-6.02	<.001	[-10.56, -5.37]
	Isolation	-2.59	0.91	-0.06		-2.85	.004	[-4.38, -0.81]
	Experience of seeing a doctor	-4.10	0.86	-0.10		-4.79	<.001	[-5.77, -2.42]
	Coping style	-4.75	0.50	-0.20		-9.42	<.001	[-5.73, -3.76]
	Self-efficacy	-1.46	0.40	-0.08		-3.68	<.001	[-2.24, -0.68]
	Social support	-3.05	0.47	-0.15		-6.54	<.001	[-3.97, -2.14]

^a $R^2 = 0.276$, adjusted $R^2 = 0.272$, $F = 65.1$, $P < .001$.^b $R^2 = 0.235$, adjusted $R^2 = 0.231$, $F = 57.2$, $P < .001$.^c $R^2 = 0.234$, adjusted $R^2 = 0.230$, $F = 62.7$, $P < .001$.

5. Conclusion

Our study has provided evidence on the significant predictors of mental stress (anxiety, depression, and PTSD symptoms) and their related predictors in Chinese adults during the COVID-19 pandemic using reliable and valid instruments. Policymakers should use strategies to improve the public's mental health during the pandemic. Future studies are needed to build a high-risk group prediction model and examine the effects of multidisciplinary interventions that consider the various mental stress-related factors that have been identified in the improvement of people's mental health nationally and worldwide.

Acknowledgments

We thank the hospital managers for their support in this study. We thank all the participants for their participation in this study. We appreciate the Medical Publications Support Unit of the National University Health System, Singapore, for assistance with the language editing of this manuscript.

Author contributions

Conceptualization: Jin-qiu Yang, Hong-gu He, Qu Shen.
Data curation: Yang Liu, Ke-xian Liu, Yue Kong, Hai-hua Zhu, Ji-wei Du.
Formal analysis: Yi-fei Liu, Yao-jie Xie, Bai-bing Mi.
Funding acquisition: Wen-gang Li, Jie-min Zhu, Qu Shen.
Investigation: Yang Liu, Yi-fei Liu, Yue Kong, Hai-hua Zhu, Bai-bing Mi, Zhuo Huang, Ji-wei Du.
Methodology: Bai-bing Mi, Hong-gu He, Qu Shen.
Project administration: Yao-jie Xie, Wen-gang Li, Qu Shen.
Resources: Yang Liu, Yue Kong, Hai-hua Zhu, Zhuo Huang, Ji-wei Du, Qu Shen.
Software: Bai-bing Mi, Zhuo Huang.
Supervision: Wen-gang Li, Jie-min Zhu, Jin-qiu Yang, Hong-gu He, Qu Shen.
Visualization: Ke-xian Liu, Qu Shen.
Writing – original draft: Yang Liu, Yi-fei Liu, Ke-xian Liu.
Writing - review & editing: Yang Liu, Ke-xian Liu, Yao-jie Xie, Yue Kong, Hai-hua Zhu, Jie-min Zhu, Bai-bing Mi, Jin-qiu Yang, Zhuo Huang, Ji-wei Du, Hong-Gu He, Qu Shen.

References

- [1] Pan W, Wang R-J, Dai W-Q, et al. China public psychology analysis about COVID-19 under considering Sina Weibo Data. *Front Psychol*. 2021;12:713597.
- [2] Motrico E, Domínguez-Salas S, Rodríguez-Domínguez C, et al. The impact of the COVID-19 pandemic on perinatal depression and anxiety: a large cross-sectional study in Spain. *Impacto del COVID-19 en la Depresión y Ansiedad Perinatal*. *Psicothema*. 2022;34:200–8.
- [3] Yang S, Lin H, Zhu J, et al. Depression and anxiety symptoms among returning workers during the COVID-19 period in East China. *Soc Psychiatry Psychiatr Epidemiol*. 2021;56:1233–40.
- [4] Wang Z, Luo S, Xu J, et al. Well-being reduces COVID-19 anxiety: a three-wave longitudinal study in China. *J Happiness Stud*. 2021;22:3593–610.
- [5] Salaton NF, Bulgiba A. Depression, anxiety, and stress among frontline primary health care workers during the COVID-19 pandemic. *Asia Pac J Public Health*. 2022;34:416–9.
- [6] Mosolova E, Sosin D, Mosolov S. Stress, anxiety, depression and burnout in frontline healthcare workers during two peaks of COVID-19 pandemic in Russia. *Psychiatry Res*. 2021;306:114226.
- [7] Xiang Y-T, Yang Y, Li W, et al. Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. *Lancet Psych*. 2020;7:228–9.
- [8] Mediouni M, Madiouni R, Kaczor-Urbanowicz KE. COVID-19: how the quarantine could lead to the depreobesity. *Obes Med*. 2020;19:100255.
- [9] Tang W, Hu T, Hu B, et al. Prevalence and correlates of PTSD and depressive symptoms one month after the outbreak of the COVID-19 epidemic in a sample of home-quarantined Chinese university students. *J Affect Disord*. 2020;274:1–7.
- [10] Bundy J, Pfarrer MD, Short CE, et al. Crises and crisis management: integration, interpretation, and research development. *J Manag*. 2017;43:1661–92.
- [11] Pan Y, Wang H, Chen S, et al. Research on strategies to solve the psychological crisis intervention dilemma of medical staff in epidemic prevention and control. *Chin Med Ethics*. 2020;9:1–5.
- [12] Harris PA, Taylor R, Thielke R, et al. Research electronic data capture (REDCap) – a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42:377–81.
- [13] Harris PA, Taylor R, Minor BL, et al.; REDCap Consortium. The REDCap consortium: building an international community of software platform partners. *J Biomed Inform*. 2019;95:103208.
- [14] Zung WW. A rating instrument for anxiety disorders. *Psychosomatics*. 1971;12:371–9.
- [15] Wang XD, Wang XL, Ma H. Handbook of mental health rating scale (revised edition). *Chin J Mental Health*. 1999;1:1999.
- [16] Dunstan DA, Scott N, Todd AK. Screening for anxiety and depression: reassessing the utility of the Zung scales. *BMC Psych*. 2017;17:329.
- [17] Sun XZ. Comparative Study on Preoperative Application of Zung Self-rating Scale and Hamilton Rating Anxiety and Depression Scale in Patients with Coronary Heart Disease [master's thesis]. Dalian: Dalian Medical University; 2018.
- [18] Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med*. 2001;16:606–13.
- [19] Zhang X, Zhan Y, Liu J, et al. Chinese translation and psychometric testing of the cardiac self-efficacy scale in patients with coronary heart disease in mainland China. *Health Qual Life Outcomes*. 2018;16:43.
- [20] Spitzer RL, Kroenke K, Williams JB. Validation and utility of a self-report version of PRIME-MD: the PHQ primary care study. *Primary Care Evaluation of Mental Disorders. Patient Health Questionnaire*. *JAMA*. 1999;282:1737–44.
- [21] Wang W, Bian Q, Zhao Y, et al. Reliability and validity of the Chinese version of the Patient Health Questionnaire (PHQ-9) in the general population. *Gen Hosp Psych*. 2014;36:539–44.
- [22] Weathers FW, Litz BT, Herman DS, et al. The PTSD checklist (PCL): reliability, validity, and diagnostic utility. Poster session presented at the annual meeting of the International Society for Traumatic Studies, TX: San Antonio; 1993. Available at: https://www.researchgate.net/publication/313709159_PSTD_Checklist_Reliability_validity_and_diagnostic_utility.
- [23] Yang XY. Experimental Study on the Generation Attribution and Intervention of Post-traumatic Stress Disorder of Medical College Students [doctoral dissertation]. Dalian: Liaoning Normal University; 2007.
- [24] Wang CK, Hu ZF, Liu Y. Evidences for reliability and validity of the Chinese version of general self efficacy scale. *Chin J Appl Psychol*. 2001;7:37–40.
- [25] Zhao H, Yu R, Gu D, et al. Relationship between nurses' self-efficacy and job stress in period of COVID-19. *Med Educ Res Pract*. 2020;28:211–4.
- [26] Schwarzer R, Bäßler J, Kwiatek P, et al. The assessment of optimistic self-beliefs: comparison of the German, Spanish, and Chinese versions of the general self-efficacy scale. *Appl Psychol*. 1997;46:69–88.
- [27] Zimet GD, Dahlem NW, Zimet SG, et al. The multidimensional scale of perceived social support. *J Pers Assess*. 1998;52:30–41.
- [28] Gjerdingen D, McGovern P, Attanasio L, et al. Maternal depressive symptoms, employment, and social support. *J Am Board Fam Med*. 2014;27:87–96.
- [29] Su JL. Research on the Correlation between Oncology Nurses' Work Stress, Perceived Social Support, Resilience and Compassion Fatigue [master's thesis]. Nanchang: Nanchang University; 2019.
- [30] Chen W, Lu C, Yang X, et al. A multivariate generalization analysis of Perceived Social Support Scale. *Psychol Explor*. 2016;36:75–8.
- [31] Xie YN. A preliminary study on the reliability and validity of the Simple Coping Style Scale. *Chin J Clin Psychol*. 1998;6:114–5.
- [32] Dai XY. Handbook of Commonly Used Psychological Assessment Scale. Beijing: People's Military Medical Publishing House; 2010.
- [33] Brailovskaia J, Truskauskaitė-Kuneviciene I, Margraf J, et al. Coronavirus (COVID-19) outbreak: addictive social media use, depression, anxiety and stress in quarantine – an exploratory study in Germany and Lithuania. *J Affect Disord Rep*. 2021;5:100182.
- [34] Wendlandt B, Ceppe A, Choudhury S, et al. Risk factors for post-traumatic stress disorder symptoms in surrogate decision-makers of patients with chronic critical illness. *Ann Am Thor Soc*. 2018;15:1451–8.
- [35] Teicher MH. Childhood trauma and the enduring consequences of forcibly separating children from parents at the United States border. *BioMed Central*. 2018;16:146.
- [36] Pappa S, Ntella V, Giannakas T, et al. Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: a systematic review and meta-analysis. *Brain Behav Immun*. 2020;88:901–7.
- [37] Lai J, Ma S, Wang Y, et al. Factors associated with mental health outcomes among health care workers exposed to coronavirus disease 2019. *JAMA Netw Open*. 2020;3:e203976.
- [38] Schmitt JAA, Brenner AM, Primo de Carvalho Alves L, et al. Potential predictors of depressive symptoms during the initial stage of the COVID-19 outbreak among Brazilian adults. *J Affect Disord*. 2021;282:1090–5.
- [39] Simon N, Roberts NP, Lewis CE, et al. Associations between perceived social support, posttraumatic stress disorder (PTSD) and complex PTSD (CPTSD): implications for treatment. *Eur J Psychotraumatol*. 2019;10:1573129.
- [40] Li DJ, Ko NY, Chen YL, et al. COVID-19-related factors associated with sleep disturbance and suicidal thoughts among the Taiwanese public: a facebook survey. *Int J Environ Res Public Health*. 2020;17:44794479.
- [41] Smith RJ, Drevo S, Newman E. Covering traumatic news stories: factors associated with post-traumatic stress disorder among journalists. *Stress Health*. 2018;34:218–26.