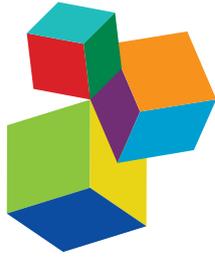# RESILIENCE AND HEALTH IN THE CHINESE PEOPLE DURING THE COVID-19 OUTBREAK

EDITED BY: Julian Chuk-ling Lai, Kay Chang, Tina L. Rochelle, Feng Jiang, Nancy Xiaonan Yu, Su Lu and Siu-man Ng

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RESILIENCE AND HEALTH IN THE CHINESE PEOPLE DURING THE COVID-19 OUTBREAK

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Editorial: Resilience and Health in the Chinese People During the COVID-19 Outbreak

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Editorial on the Research Topic

Resilience and Health in the Chinese People During the COVID-19 Outbreak

The COVID-19 pandemic is a global trauma. To date, the pandemic has not only taken away the lives of four million people, but also created an unprecedented impact on the mental health in both infected patients and non-infected populations, both directly due to the medical complications associated with infection, and indirectly because of the implementation of public health measures such as social distancing, lockdowns and quarantines [reviewed by Kontoangelos et al. (1) and Vindegaard and Benros (2)]. The availability of effective vaccines to the general public once sparked the hope of impending emergence from the trauma. Unfortunately, this has been undermined recently by the emergence of new and more contagious variants of the virus. Amidst the progressive return to "normal" in some places, a number of countries are now facing the challenges of a new wave of epidemic caused by the latest variant of the COVID-19 virus. Despite the pandemic's widespread impact on mental health in different populations including the general public and healthcare workers [e.g., (2)], the focus of research since the beginning of the outbreak has been on medical complications of infection. This collection is expected to fill this gap by focusing on the indirect or mental health impact of the COVID-19 pandemic, with special attention to the Chinese people during the early stage of the outbreak.

The editorial and call for submissions for a special edition on resilience and health of Chinese people during the Covid-19 outbreak received a great response. This special issue includes the papers and reports on the topic. In addition to evaluating the mental health impact of the outbreak, we are also interested in examining risk and resilience factors modulating the impact of stress related to the pandemic and mental health outcomes. The focus on China serves to highlight the importance of contextual factors in determining the impact and responses to the challenges of the pandemic at both the individual and collective level. This focus seems to be justified with hindsight because China is one of the very few economies emerging from this unprecedented global trauma (3). This recovery would not have taken place without the unique combination of strong leadership and collectivistic obedience (4, 5). Admittedly, the best that this collection can do is to provide a snapshot of the impact of and responses to the COVID-19 outbreak in China and other Chinese communities. Despite this limitation, it is hoped that the findings and ideas growing from this collection would be able to leave a inerasable mark in the timeline of psychiatric research.

This collection consists of 21 studies with a total of over 46,500 participants from different cities/provinces across China. A number of studies used a nationwide sample from various cities or provinces (e.g., Bressington et al.; Chen et al.). A diversified array of mental health outcomes including depression (e.g., Bressington et al.; Zhang Y-t. et al.), anxiety (e.g., Chen et al.),

symptoms of PTSD (e.g., Duan et al.), perceived stress (e.g., Zhang X. et al.), and psychosomatic burden (e.g., Yi et al.) were examined, and in a handful of studies, in relation to specific stressors (e.g., Wong et al.). In addition to risk factors, factors that confer resilience to stressful situations like hope (e.g., Zhang Z. et al.), gratitude (e.g., Tong and Oh), adaptive coping (e.g., Cheng et al.), and tolerance of uncertainty (e.g., He et al.) were also examined. Gender differences in vulnerability were examined in Liu et al., which revealed heightened vulnerability of post-traumatic stress and depression among younger men aged 26–30 years. Public health policy recommendations to alleviate the "emotional shocks" and psychiatric aftermaths of the outbreak were also put forward in specific studies (e.g., Zhao et al.). The findings from the studies featured in this special issue echo the wider health and psychology literature emphasizing the importance of resilience and adaptability in the move forward with COVID. Within the Chinese context, psychologists and behavioral scientists have provided major contributions in the effort to raise awareness, educate and reduce the impact of COVID-19. The studies featured within this special issue have identified key areas, issues and factors that could be targeted in interventions. However, much less is known about what types of interventions are effective, for what types of patient groups and populations etc. In the move forward with COVID, this must now be the next step in enlightening our knowledge.

AUTHOR CONTRIBUTIONS

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

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Association Between Depression, Health Beliefs, and Face Mask Use During the COVID-19 Pandemic

Daniel Thomas Bressington [1,2†], Teris Cheuk Chi Cheung [1†], Simon Ching Lam [1,3*†], Lorna Kwai Ping Suen [1,3†], Tommy Kwan Hin Fong [1], Hilda Sze Wing Ho [4] and Yu-Tao Xiang [5]

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The 2019 novel coronavirus (COVID-19) pandemic is associated with increases in psychiatric morbidity, including depression. It is unclear if people with depressive symptoms understand or apply COVID-19 information differently to the general population. Therefore, this study aimed to examine associations between depression, health beliefs, and face mask use during the COVID-19 pandemic among the general population in Hong Kong. This study gathered data from 11,072 Hong Kong adults via an online survey. Respondents self-reported their demographic characteristics, depressive symptoms (PHQ-9), face mask use, and health beliefs about COVID-19. Hierarchical logistic regression was used to identify independent variables associated with depression. The point-prevalence of probable depression was 46.5% ($n = 5,150$). Respondents reporting higher mask reuse ($OR = 1.24$, 95%CI 1.17–1.34), wearing masks for self-protection ($OR = 1.03$ 95%CI 1.01–1.06), perceived high susceptibility ($OR = 1.15$, 95%CI 1.09–1.23), and high severity ($OR = 1.33$, 95%CI 1.28–1.37) were more likely to report depression. Depression was less likely in those with higher scores for cues to action ($OR = 0.82$, 95%CI 0.80–0.84), knowledge of COVID-19 ($OR = 0.95$, 95%CI 0.91–0.99), and self-efficacy to wear mask properly ($OR = 0.90$ 95%CI 0.83–0.98). We identified a high point-prevalence of probable major depression and suicidal ideation during the COVID-19 outbreak in Hong Kong, but this should be viewed with caution due to the convenience sampling method employed. Future studies should recruit a representative probability sample in order to draw more reliable conclusions. The findings highlight that COVID-19 health information may be a protective factor of probable depression and suicidal ideation during the pandemic. Accurate and up-to-date health information should be disseminated to distressed and vulnerable subpopulations, perhaps using digital health technology, and social media platforms to prompt professional help-seeking behavior.

Keywords: depression, health belief model, face mask, COVID-19, Hong Kong

BACKGROUND

The novel coronavirus (2019-nCoV) has been transmitting around the world since January 2020. The resulting COVID-19 pandemic has undoubtedly resulted in great medical and psychosocial challenges that can damage mental health, including potentially increasing rates of depression.

Depression is a common mental disorder that is highly prevalent in the general population and is a major contributor to the overall global burden of disease (1). The importance of depression worldwide is illustrated by its inclusion as a priority condition within the World Health Organization's Mental Health Gap Action Programme (2). The average point prevalence of depression in the absence of a global pandemic has been recently reported to be 12.9% across 30 countries (3). However, preliminary evidence highlights that levels of stress, fear, anxiety, Post-traumatic stress disorder (PTSD), sleep disorders and depressive symptoms may dramatically increase in response to the COVID-19 pandemic (4–6). It is also possible that suicide rates may increase due to a variety of COVID-19 related issues, such as financial hardship, loneliness and lack of support (7).

A number of studies have been published reporting the mental health impact of the COVID-19 pandemic, but the majority of studies on the prevalence of depressive symptoms during COVID-19 have been conducted in mainland China and are not directly generalizable to settings with lower rates of infections and deaths. These internet-based surveys report varied depression prevalence rates in the general Chinese population, for example, 17.1% (6), 20.1% (8), and 34.7% (9). However, direct comparisons of prevalence estimates from these studies are impossible due to the use of different screening and diagnostic approaches and the inclusion of different subpopulations. Despite these complications, interestingly, one study involving 205 participants (9) found lower rates of probable major depression in people who had been infected by the virus (29.2%) and in those who had been officially quarantined (9.8%), when compared to the general public (34.7%). This may suggest that the fear of infection within the context of social restrictions is more psychologically challenging than actually contracting the disease or being subjected to enforced quarantine measures.

At the time of writing (late May 2020), the numbers of COVID-19 infections in Hong Kong were lower than many other countries, with just over 1,066 known infections and four confirmed deaths. Despite these comparatively low infection rates, the Hong Kong public may also be experiencing an increase in depressive symptoms as people have been experiencing the continuous fear of COVID-19 and restrictions on their daily lives since mid-January 2020. Still, it is currently unclear how this prolonged psychosocial stress has impacted on mental health because information on the rates of depressive symptoms in Hong Kong during COVID-19 is scarce. A recent cross-sectional survey highlights the possibility of increased anxiety; 88% of over 1,000 Hong Kong citizens reported a high perceived susceptibility of being infected with COVID-19 and the mean anxiety level of 8.82 was borderline abnormal as measured by the Hospital Anxiety and Depression Scale (10). Also, a large internet survey (11) with over 52,000 responses from 36 regions of China, including the Special Administrative Regions of Hong Kong and Macao, reported that overall 35% of respondents were experiencing COVID-19 related psychological distress. The highest rates of distress were found in the central area of China, which includes Hubei province where the virus was first detected, perhaps suggesting that regions of China with lower infection rates, such as Hong Kong, may experience a lesser impact of COVID-19 on mental health (11). The current lack of empirical evidence on depression rates in Hong Kong during COVID-19 is an important gap in understanding because such information would help to inform mental health service planning and the development of policies to promote mental health in the community.

It is also important to better understand how people with depressive symptoms may perceive the severity of COVID-19 and their susceptibility to being infected as this could influence how they respond to, and comply with public health advice and policies designed to reduce infection rates. Given that self-care and other health behaviors are often sub-optimal in people with depression with chronic physical illnesses (12, 13), it is logical to assume that similar issues may exist in infection control behaviors. Indeed, poor adherence to health behavior advice in people with depression is in part due to cognitive, motivational, and volitional deficits associated with the illness, such as poor self-efficacy and negative outcome expectations (14). In Hong Kong, the public is advised to adopt a range of measures to prevent virus transmission, consisting of maintaining a safe distance from others, performing good hand hygiene, and wearing face masks when in public (15). There is currently conflicting advice about the use of personal protective equipment (PPE), such as face masks, across different countries and from the WHO (16). However, wearing a surgical mask when unwell has become very common in Hong Kong since the outbreak of the COVID-19 pandemic, with a recent survey reporting that 98.8% of 1,005 people in Hong Kong wore face masks when venturing outside their homes (17).

Despite the popularity of face masks and the Hong Kong government's advice to wear a mask in certain situations (15), it is currently unknown if safe guidelines for use are adhered to or clearly understood, particularly amongst people with depressive symptoms. Furthermore, with the limited supply of face masks, the practice of reusing face masks has not been explored. The limited earlier studies on the use of PPE and safety practices in people who are depressed have mainly involved farmers. These studies reported that farmers with depressive symptoms in the USA were more likely to engage in high-risk safety behaviors most associated with farm injuries than those without depressive symptoms (18) and that low levels of safety knowledge in depressed individuals were more strongly associated with injuries than in those without depressive symptoms (19). Therefore, research on how depressive symptoms are associated with infection prevention behaviors and COVID-19 related health beliefs is imperative, particularly due to the apparent recent increases in psychological distress within the general population. In order to reduce the potential of confounding factors associated with age (i.e., proven susceptibility to severe complications from COVID-19 or age-related capacity to complete the survey) and to

enhance direct comparability with previously published studies, we included only working aged adults (aged 18–59 years) in the current study.

The Health Belief Model (HBM) (20) was adopted as a general conceptual framework to hypothesize that bidirectional relationships may exist between participants' level of depressive symptoms, their COVID-19 related beliefs and mask wearing practice. We tentatively hypothesized that COVID-19 related health beliefs and infection control behaviors induced by the pandemic would exacerbate transient or pre-existing chronic depressive symptoms (possibly because people may feel overwhelmed by the perceived risk of COVID-19 infection, but perceive they are ill-equipped to protect themselves) (21). Subsequently, the resulting cognitive distortions/deficits associated with increases in depressive symptoms [i.e., perceived poor self-efficacy and negative outcome expectations (14)] may further trigger and maintain depressive symptoms. Although it is impossible to demonstrate temporal relationships due to the cross-sectional nature of the current study, we hoped to obtain preliminary evidence that people who are depressed may conceptualize, understand, and act upon COVID-19 related health beliefs differently than those with low levels of depressive symptoms. Such information would have implications for the design and delivery of targeted COVID-19 public health information. The findings could also be used by mental health professionals to profile typical COVID-19 related health beliefs and face mask use patterns in people who are being treated for depression in order to devise empowering psychoeducational interventions with the potential to enhance self-efficacy, improve safety of face mask use, and thus reduce levels of distress that maintain depression.

Given the aforementioned knowledge gaps and general study aims, the specific objectives of this study were to: (a) establish the point prevalence of depressive symptoms in working-aged adults in the general Hong Kong population and; (b) profile and compare COVID-19 related health beliefs and face mask use in individuals with and without depressive symptoms.

METHODS

Study Design and Setting

This large internet-based cross-sectional study was conducted in the general population in Hong Kong during the outbreak of COVID-19 using a convenience sampling method.

Participants and Inclusion/Exclusion Criteria

To be eligible, participants needed to be Hong Kong working-aged residents, aged 18–59 years and able to read English or Chinese.

Recruitment of Subjects/Data Collection

The questionnaire was delivered to several online platforms (i.e., Google form and Qualtrics), including a discussion forum, community peer groups (e.g., COVID-19 information group, child parenting group, working adult peer groups, etc.), and organizational or personal Facebook pages. The subject line of

the invitation was: Study about face mask use among the general public during COVID-19 (Hong Kong). Data collection spanned from 24 March to 20 April 2020. Given that this was a self-selecting sample, we aimed to recruit as many participants as possible over the recruitment period to improve the potential representativeness of the sample, and thus did not calculate a minimum sample size a-priori.

Ethical Considerations

This study was approved by the Human Subjects Ethics Sub-committee of the Hong Kong Polytechnic University (reference no: HSEARS20200227002-01). Participants provided their written informed consent prior to participation online. Participants were assured of their anonymity and confidentiality, and their rights of withdrawal were respected. Given the sensitive nature of some of the questions, and the potential for some respondents to experience distress when considering their mood/suicidal ideation, we provided contact details where they could receive a referral for professional emotional support and receive additional advice.

Instruments

Participants were required to fill in a questionnaire (presented in bilingual mode: Traditional Chinese and English languages) comprising four sections. Section A solicited information regarding participants' gender, age, marital status, educational level, occupation, monthly household income, whether they have direct patient contact (yes/no), and the frequency of experiencing influenza like symptoms in the past 12 months. All questionnaires are available from the corresponding author upon request.

Section B included the face mask use scale (FMUS) (22) which involved two categories: (1) protect self, (2) protect others; and in three areas: (1) public, (2) clinic, (3) home. The relevant mask types were clearly defined at the start of the questionnaire (i.e., paper/gauze, washable sponge/cotton, surgical, activated carbon, and N95 respirator). This scale comprised 6 items on a 5-point scale indicating the frequency of face mask use practice. Scores ranged from 0 to 24 representing the overall practice of FMU. Higher score indicated higher frequency of FMU. The psychometric properties of the Chinese version of the FMUS were satisfactory, with Cronbach's alpha of 0.80–0.81 and the corrected item-total correlation coefficients of 0.46~0.67. The test-retest stability of intraclass correlation coefficient was $r = 0.84$ (23).

Section C solicited participants' understanding of the COVID-19 public health risk and their reasons for face mask use. Thirteen questions were asked to examine the HBM components in participants. These included perceived susceptibility toward the COVID-19 outbreak, the severity of the pandemic, cues to action for self-protection by the government /family members/friends, perceived benefits/barriers of wearing masks, their knowledge of COVID-19 and the self-efficacy of wearing a mask properly. All the questions constructed in this section were derived from the Health Belief Model (HBM), which was used as a conceptual framework to explain health-related behaviors on face mask use. The HBM is most widely used framework for predicting

and examining face mask use in previous studies (24–26) and the components of Health Belief Model were shown to be the significant factors in explaining face mask use (26). These items were translated into Chinese based on the principles of Brislin's model of forward and backward translation (27). The items were then revised to enhance the relevance. A panel of six experts evaluated the relevance of these items for measuring the said concepts and a satisfactory content validity of all items was obtained. Participants indicated their response on a 4-point scale (1: not at all; 2: slightly; 3: very; 4: extremely). Higher scores indicated that participants were highly aware of the public health risk brought by COVID-19 and also reflected their face mask use patterns. Examples of questions (and the associated HBM component) include: Do you feel vulnerable to contracting the disease (perceived susceptibility)? What is the degree to which you are worried that your living place would become a quarantine city because of the widespread outbreak of the disease in the community (perceived severity)? What is the degree to which you agree wearing facemasks could prevent contracting and spreading the disease (perceived benefits)? What is the degree to which you have difficulty in obtaining facemasks (perceived barriers)? What is the degree to which the local government encouraged you to wear facemasks (cues to action)? What is the degree to which you believed you were able to properly wear face masks (self-efficacy)?

Section D assessed participants' depressive symptoms using the PHQ-9. This measure consists of nine items to measure the presence and severity of self-reported depressive symptoms in the previous 2 weeks. Each item ranges from 0 to 3, with a summed total score ranged from 0 to 27. A score of 5–9 indicated 'mild' depressive symptoms, 10–14 'moderate' depressive symptoms, 15–19 'moderately severe' depressive symptoms and ≥ 20 'severe' depressive symptoms. In accordance with established procedures, participants with a total PHQ9 score of ≥10 were classified as having probable depression. Cronbach's alpha for the internal consistency reliability of the Chinese version of the PHQ-9 was 0.86 and the correlation coefficient for the 2-week test–retest of the total score was 0.86 (28). The Cronbach Alpha for PHQ-9 in this study was 0.91. The Chinese version of the PHQ9 was validated by comparing its scores with the clinical diagnosis of a major depressive episode, using the DSM-IV criteria (AUC = 0.95, sensitivity = 0.88, specificity = 0.88) at the cut-off point of 9/10 with good internal consistency (Cronbach's α = 0.89) (29).

Statistical Analysis

Data analyses were performed using SPSS 25.0 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive analysis, chi-square statistics and independent samples t-tests were used to examine the associations between sociodemographic characteristics, face mask use, core components of health belief model and depression. Hierarchical logistic regression analysis was performed to identify factors which were independently associated with depressive symptoms, in order to test our tentative hypothesis that COVID-19 related health beliefs and face mask use patterns/beliefs would account for a significant amount of variance in depressive symptoms. The total score of the PHQ-9 was the dependent variable, with a cut-off point

of ≥10 indicating probable depression. All the significant sociodemographic characteristics, face mask use patterns, and HBM components were entered in the multivariate binary logistic regression analysis as independent variables in a hierarchical procedure. The level of significance was set as $p < 0.05$ (two-tailed).

RESULTS

A total of 11,072 participants fully completed the online survey (52.5% of those who started the survey). Due to the nature of recruitment/sampling and the online survey mode, we are unable to calculate a survey response rate. We excluded around 300 responses that were ineligible to participate due to their age (i.e., over 59 and under 18 years). **Table 1** reports the severity of depressive symptoms and response to the suicidality/self-harm ideation question for the entire sample and across genders. A disproportionate number ($n = 8,815$, 80.7%) were female. Participants' age ranged from 18 and 59 years, with those aged 31 and 40 being most represented (20% of the entire sample). Over two-thirds (68.3%, $n = 7,466$) were married. Participants were generally well-educated, with less than one quarter of (24.6%) only having obtained secondary school education or below. Around one in 10 ($n = 1,217$, 11%) were health professionals. Most respondents (38.4%, $n = 4,257$) earned 5,130 USD or less per month. There were small statistically significant differences in demographic characteristics across males/female groups (all $ps < 0.05$), for example in relation to age group distribution, marital status, education level and occupation (please see **Table 2**). These significant differences may suggest that that the results may not be generalisable to both genders.

In consideration of the first study objective, to establish the point prevalence of depressive symptoms in working-aged adults in the general Hong Kong population, the mean score of depression in this study was 9.06 (SD 6.04), indicating an overall mild level of depressive symptoms for the entire sample. A total of 46.5% of the sample reported at least a moderate level of depressive symptoms (total PHQ-9 score ≥10), suggesting a probable major depressive disorder, with no differences across genders ($p > 0.05$). A concerning proportion of the overall sample (22.5%) had suicide or self-harm ideation for at least several days over the previous 2 weeks, with more males reporting this than their female counterparts (26.5 vs. 21.5%). Significant differences were also observed in the frequencies of suicide/self-harm thoughts across genders ($p < 0.001$).

In consideration of the second study objective (to profile and compare COVID-19 related health beliefs and face mask use in individuals with and without depressive symptoms), **Table 2** provides details of health beliefs/face mask use across genders and **Table 3** reports the sociodemographic characteristics, face mask use, and COVID-19 health beliefs of the whole sample and the probable depression/non-depression groups. Chi-square test of independence revealed that there were statistically significant associations between probable depression and categories of age, marital status, educational level, occupation, monthly household income, experiencing influenza-like symptoms in the past year,

TABLE 1 | Prevalence/severity of depressive symptoms and suicide/self-harm ideation.

	Entire sample	Male	Female	Chi-square/*t*-test (df)	*P*-value
PHQ-9 total Mean (*SD*)	9.60 (6.04)	9.71 (6.24)	9.58 (6.00)	*t* (0.88) (10918)	0.38
Depression severity *n* (valid %)	11,072 (100)	2105 (19.3)[#]	8815 (80.7)[#]	4.88 (4)	0.30
Minimal/None	2,463 (22.2)	484 (23.0)	1945 (22.1)		
Mild	3,459 (31.2)	628 (29.8)	2788 (31.6)		
Moderate	2,820 (25.5)	529 (25.1)	2246 (25.5)		
Moderately severe	1,609 (14.5)	311 (14.8)	1278 (14.5)		
Severe	721 (6.5)	153 (7.3)	558 (6.3)		
Probable depression *n* (valid %)	5,150 (46.5)	993 (47.17)	4082 (46.31)	0.51 (1)	0.47
Suicide/self-harm ideation *Thoughts that you would be better off dead, or of hurting yourself in some way*				25.34 (3)	<0.001***
Not at all	8,584 (77.5)	1547 (73.5)	6922 (78.5)		
Several days	1,711 (15.5)	387 (18.4)	1300 (14.8)		
More than half	567 (5.1)	121 (5.7)	435 (4.9)		
Nearly everyday	210 (1.9)	50 (2.4)	158 (1.8)		

Cut off points for PHQ-9: Score 0–4 "minimal/none"; 5–9 "mild"; 10–14 "moderate"; 15–19 "moderately severe"; 20–27 "severe."
Probable depression (PHQ-9 score ≥10). [#]Missing value (1.4%, n = 152) ***p < 0.001.

safety of reusing face mask, and transparency of face mask reuse guidelines (all $p < 0.05$). Results from the independent samples *t*-tests showed that participants' frequency of reusing face masks, susceptibility, perceived severity, cues to action on taking precautionary measures against the infection, knowledge of the coronavirus disease outbreak and self-efficacy to wear mask properly were significantly different across the probable depression and no depression groups (all $p < 0.005$). Similarly, there were small but significant differences in COVID-19 related health beliefs and face mask use across genders (all $p < 0.05$) apart from the "protecting others" and "self-efficacy using face masks" subscales.

Table 4 shows the results of regression analyses using probable depression as the dependent variable. Three models were built using multivariate binary logistic regression in which independent variables were entered the final model in a hierarchical procedure in three stages. Participants' sociodemographic variables and experiencing influenza-like symptoms in the past year were entered in Model 1. In Model 2, variables from Model 1 remained in the regression analysis as control confounding variates. Variables for face mask use and COVID-19 related beliefs were also entered.

Core elements of the HBM were entered at Model 3 along with the variables from Model 1 and 2. The adjusted *R* square was 0.164 indicating that the significant predictors identified in this final regression model accounted for 16% of the variance in depression. Results show that in terms of demographics, older participants (*OR* 0.97, 95% CI 0.97, 0.98) and those who earned a monthly household income of USD 7,701 or above (*OR* 0.96, 95% CI 0.94, 0.99) were less likely to be depressed. Whereas,

participants who had experienced influenza-like symptoms in the past year were more likely to report depression (*OR* 1.04, 95% CI 1.03, 1.06).

In relation to face mask use/health beliefs, participants who had higher frequency of reusing masks (*OR* 1.24, 95% CI 1.17, 1.33), those wearing face masks for self-protection (*OR* 1.03 95% CI 1.00, 1.06), believed themselves to be more susceptible to the disease (*OR* 1.15, 95% CI 1.09, 1.21) and perceived high severity of COVID-19 illness (*OR* 1.33, 95% CI 1.28, 1.37) were more likely to report depressive symptoms. Whereas, the likelihood of having probable depression was lower in participants that reported feeling safe reusing facemasks (*OR* 0.93, 95% CI 0.89, 0.98), higher scores for cues to action (*OR* 0.82, 95% CI 0.80, 0.84), knowledge of the disease pandemic (*OR* 0.95 95% CI 0.91, 0.99), and self-efficacy to wear masks properly (*OR* 0.90 95% CI 0.83, 0.98). Participants who were unclear about mask reuse guidelines, however, were more likely to report depression than those who thought the guidelines were clear (*OR* 0.92 95% CI 0.87, 0.98).

DISCUSSION

The overall point-prevalence of probable depression (as defined by a total PHQ-9 score ≥10) in the 11,072 respondents was 46.5%, which is four times greater than the estimate of 11.2% in Hong Kong in late 2019 using the same cut-off score (30) and far higher than prevalence of 4.3% of respondents with PHQ9 scores >9 reported in a household telephone survey involving over 6,000 people in the Hong Kong general population (31). This is also greater than the 34% of the general population who reported

TABLE 2 | Demographic characteristics, face mask use and health beliefs by genders.

	Entire sample (n = 10,920)		Male (n = 2,105)		Female (n = 8,815)		χ²/t (d.f.)	p-value
	N	valid%	N	%	N	%		
Age (years)								
18–30	2,025	19.11	458	22.34	1567	18.33	17.57 (3)	0.001**
31–40	4,342	40.97	801	39.07	3541	41.43		
41–50	3,161	29.83	585	28.54	2576	30.14		
51–59	1,069	10.09	206	10.05	863	10.10		
Marital status								
Single	3,073	28.27	591	28.17	2482	28.29	12.38 (2)	0.002**
Married/In a relationship	7,438	68.41	1463	69.73	5975	68.10		
Divorced/Separated/Widowed	361	3.32	44	2.10	317	3.61		
Education level								
Elementary or below	25	0.23	7	0.33	18	0.21	33.18 (2)	<0.001***
High School	2,651	24.36	410	19.57	2241	26.03		
University or higher	8,208	75.41	1678	80.10	6350	73.76		
Occupation								
Healthcare workers	1,214	11.15	162	7.72	1052	11.96	30.78 (1)	<0.001***
Non-healthcare workers	9,677	88.85	1936	92.28	7741	88.04		
Monthly income (USD)								
<2,650	3,913	36.26	575	27.56	3338	38.35	96.46 (3)	<0.001***
$2,651–5130	4,236	39.25	895	42.91	3341	38.38		
$5,131–7,700	1,671	15.49	364	17.45	1307	15.01		
≥7,701	971	9.00	252	12.08	719	8.26		
Experiencing influenza-like symptoms in the past year								
No	4,231	55.23	833	58.05	3398	54.59	5.65 (1)	0.018*
Yes	3,429	44.77	602	41.95	2827	45.41		
Safety of reusing face mask								
Very unsafe	3,722	34.08	658	31.26	3,064	34.76	27.24 (4)	<0.001***
Unsafe	3,898	35.70	745	35.39	3,153	35.77		
Unsure	2,241	20.52	440	20.90	1,801	20.43		
Safe	1,018	9.32	250	11.88	768	8.71		
Very safe	41	0.38	12	0.57	29	0.33		
Transparency of face mask reuse guidelines								
Very unclear	3,432	31.45	797	37.88	2,635	29.91	65.95 (3)	<0.001***
Unclear	5,251	48.12	969	46.06	4,282	48.61		
Clear	2,020	18.51	294	13.97	1,726	19.59		
Very clear	210	1.92	44	2.09	166	1.88		
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**		
Frequency of reuse face mask	1.66	0.75	1.73	0.85	1.65	0.73	t 4.78 (10,918)	<0.001***
Face mask use	24.48	4.01	24.71	4.26	24.43	3.95	t 2.95 (10,918)	0.003**
Subscale of self-protection	11.98	2.04	12.20	2.16	11.93	2.01	t 5.37 (10,918)	<0.001***
Subscale of protecting others	12.50	2.34	12.52	2.45	12.49	2.31	t 0.39 (10,918)	0.70
Susceptibility for infection	2.95	0.89	2.88	0.89	2.96	0.89	t −3.98 (10,865)	<0.001***
Severity after infection	6.56	1.41	6.41	1.46	6.60	1.39	t −5.58 (10,893)	<0.001***
Cues to action	14.10	1.76	13.97	1.81	14.13	1.74	t −3.75 (10,838)	<0.001***
Knowledge on outbreak	5.21	1.09	5.15	1.16	5.22	1.08	t −2.92 (10,884)	0.003**
Self-efficacy using face masks	3.33	0.57	3.35	0.60	3.33	0.56	t 1.38 (10,904)	0.17

*p < 0.05, **p < 0.01, and ***p < 0.001.
Chi-square/t-tests comparing depressed/non-depressed groups.

TABLE 3 | Demographic characteristics, face mask use, and health beliefs by depression category.

	Entire sample (n = 11,072)		Depression (n = 5,150)		No depression (n = 5,922)		χ^2/t (d.f.)	p-value
	N	Valid%	N	%	N	%		
Age (years)								
18–30	2,028	19.1	1,182	23.8	846	14.9	311.95 (3)	<0.001***
31–40	4,348	40.9	2,179	44.0	2,169	38.2		
41–50	3,181	29.9	1,277	25.8	1,904	33.5		
51–59	1,079	10.1	319	6.4	760	13.4		
Marital status								
Single	3,092	28.3	1,570	30.9	1,522	26.1	33.29 (2)	<0.001***
Married/In a relationship	7,466	68.4	3,334	65.7	4,132	70.7		
Divorced/Separated/Widowed	362	3.3	174	3.4	188	3.2		
Education level								
Elementary or below	25	0.2	9	0.2	16	0.3	7.05 (2)	0.03*
High School	2,668	24.4	1,186	23.3	1,482	25.3		
University or higher	8,244	75.4	3,888	76.5	4,356	74.4		
Occupation								
Healthcare workers	1,217	11.1	520	10.2	697	11.9	7.95 (1)	0.005**
Non-healthcare workers	9,731	88.9	4,574	89.8	5,157	88.1		
Monthly income (USD)								
<2,650	3,929	36.2	1,966	38.9	1,963	33.9	64.75 (3)	<0.001***
$2,651–5,130	4,257	39.3	2,015	39.9	2,242	38.7		
$5,131–7,700	1,678	15.5	704	13.9	974	16.8		
≥7701	977	9.0	369	7.3	608	10.5		
Experiencing influenza-like symptoms in the past year								
No	4,284	55.2	1,837	50.77	2,447	59.0	53.31 (1)	<0.001***
Yes	3,479	44.8	1,781	49.23	1,698	41.0		
Safety of reusing face mask								
Very unsafe	3,777	34.1	1,828	35.5	1,949	32.9	73.70 (4)	<0.001***
Unsafe	3,957	35.7	1,890	36.7	2,067	34.9		
Unsure	2,262	20.4	1,064	20.7	1,198	20.2		
Safe	1,035	9.3	354	6.9	681	11.5		
Very safe	41	0.4	14	0.3	27	0.5		
Transparency of face mask reuse guidelines								
Very unclear	3,470	31.4	1,776	34.6	1,694	28.6	79.13 (3)	<0.001***
Unclear	5,312	48.1	2,470	48.1	2,842	48.0		
Clear	2,060	18.6	819	15.9	1,241	21.0		
Very clear	213	1.9	75	1.5	138	2.4		
	Mean	SD	Mean	SD	Mean	SD		
Frequency of reuse face mask	1.66	0.75	1.68	0.76	1.65	0.74	t −2.23 (11,070)	0.03*
Face mask use	18.48	4.00	18.46	4.10	18.51	3.90	t −0.53 (11,070)	0.58
Subscale of self-protection	8.98	2.04	9.01	2.00	8.96	2.07	t −1.22 (11,070)	0.22
Subscale of protecting others	9.50	2.34	9.50	2.25	9.50	2.41	t 0.11 (11,070)	0.91
Susceptibility for infection	2.95	0.90	3.07	0.89	2.84	0.88	t −13.96 (11,003)	<0.001***
Severity after infection	6.56	1.41	6.94	1.22	6.24	1.47	t −26.87 (11,031)	<0.001***
Cues to action	14.10	1.76	13.68	1.71	14.48	1.71	t 24.52 (10,973)	<0.001***
Knowledge on outbreak	5.21	1.09	5.05	1.09	5.34	1.08	t 13.85 (11,023)	<0.001***
Self-efficacy using face masks	3.33	0.57	3.29	0.57	3.37	0.57	t 7.89 (11,043)	<0.001***

*p < 0.05, **p < 0.01, and ***p < 0.001.
Chi-square/t-tests comparing depressed/non-depressed groups.

TABLE 4 | Binary Logistic Regression identifying variables associated with depressive symptoms.

Factors	Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI
Constant	3.042		2.733		5.130	
Age (range)^	0.962	(0.957, 0.967)***	0.962	(0.957, 0.967)***	0.973	(0.967, 0.978)***
Gender (male)	1.034	(0.934, 1.144)	0.987	(0.891, 1.094)	1.033	(0.928, 1.150)
No. of persons living together (living alone)	1.016	(0.990, 1.042)	1.015	(0.989, 1.042)	1.002	(0.975, 1.030)
Close contact with patients (yes)	1.017	(0.962, 1.076)	1.009	(0.954, 1.068)	0.998	(0.941, 1.059)
Monthly income	0.943	(0.915, 0.972)***	0.944	(0.916, 0.973)***	0.964	(0.935, 0.995)*
Experiencing influenza-like symptoms in the past year	1.058	(1.044, 1.071)***	1.058	(1.045, 1.072)***	1.041	(1.028, 1.055)***
Occupation (Healthcare workers)	1.295	(1.059,1.584)	1.236	(1.082, 1.625)	1.088	(0.880, 1.345)
Education (University or above)	0.987	(0.890, 1.095)	0.989	(0.890, 1.098)	1.103	(0.988, 1.231)
Frequency of reuse face mask			1.270	(1.194, 1.352)***	1.243	(1.165, 1.327)***
Safety in reusing face mask (safe)			0.875	(0.834, 0.918)***	0.934	(0.888, 0.982)**
Transparency of face mask reuse guidelines (clear)			0.823	(0.779, 0.869)***	0.920	(0.869, 0.975)**
Face masks for self-protection			1.038	(1.010, 1.066)**	1.033	(1.004, 1.062)*
Face masks for protecting others			0.992	(0.969, 1.016)	0.985	(0.962, 1.010)
Susceptibility for infection					1.148	(1.092, 1.206)***
Severity after infection					1.326	(1.282, 1.371)***
Cue					0.821	(0.799, 0.842)***
Knowledge					0.951	(0.911, 0.992)*
Efficacy					0.903	(0.834, 0.977)*
Adjusted R^2		0.057		0.072		0.164

OR, odds ratio; CI, confidence interval. *$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$. ^ range refers to the defined age range in *Tables 2, 3*.

PHQ9 scores of ≥ 10 in mainland China during COVID-19 (9). While our findings suggest higher levels of depressive symptoms than other Chinese studies, direct comparisons should be viewed with caution due to the fact that the current study was conducted during a time when people in Hong Kong were facing great adversities associated with widespread social unrest and economic concerns in conjunction with fears about the emerging pandemic. Despite these contextual differences, the current study's findings share some important characteristics with previous studies involving Chinese people, specifically that probable depression was found to be more likely in those that are younger and those in lower income brackets, a result that seems to concur with findings from a survey involving 10,000 primary care patients in Hong Kong (32) and a recent Chinese web-based survey (33) that reported rates of depression during COVID-19 were highest in people aged under 35 years.

Although the very high levels of depressive symptoms are concerning, it is possible that these reported symptoms could be artifacts of various confounding factors and methodological shortfalls. For example, due to the cross-sectional design of the study we cannot be sure that the PHQ9 data collected are specifically measuring COVID-19-related depressive symptoms because it is impossible to differentiate pre-existing depressive symptoms from those recently triggered by the COVID-19 pandemic. This is a particularly important consideration given that high levels of depressive symptoms may have already existed in the sample due to the social unrest evident in Hong Kong

since 2019. It is also important to highlight that many of the 46.5% of participants with symptoms suggestive of probable depression would be unlikely to be diagnosed with major depression because the depressive symptoms may be transient and PHQ9 is a screening tool that measures severity of depressive symptoms rather than being a diagnostic instrument. Indeed, a diagnostic meta-analysis of the PHQ9 reported only reasonable diagnostic accuracy using the summed score method, with a pooled sensitivity and specificity of 0.78 [95% CI, 0.70–0.84] and 0.87 (95% CI, 0.84–0.90), respectively when using a cut off score of ≥ 10 (34).

Although many of the reported depressive symptoms may be transient, it is extremely concerning that 21% ($n = 2,330$) of respondents in the current study reported moderately-severe to severe depressive symptoms and 7% ($n = 777$) indicated that they had thoughts of suicide and/or self-harm on the majority of days in the previous 2 weeks. Treatment guidelines suggest that such high levels of depressive symptoms and suicidality require prompt active treatment with psychotherapy and or/medications from mental health services (32, 35). Contextually, these findings are worrying because figures from the Hong Kong Hospital Authority (36) indicate that 45,800 people, or around 1% of the working-aged adult population of 4.4 million (37) are treated annually for depression by specialist inpatient/outpatient psychiatric services. Given that 6% of people in the current study reported severe depressive symptoms warranting prompt psychiatric treatment, it is quite

possible that the already stretched Hong Kong mental health services could be overwhelmed if the reported symptoms are not transient and do not subside after the pandemic resolves.

Our findings of an increase in psychiatric morbidity during COVID-19 seem to concur with research conducted in the early stages of the 2002–2003 SARS outbreak, which report increases in rates of suicidality and persistent depression (38). However, the levels of depressive symptoms in the current study were reported in the midst of a spike in the numbers of Hong Kong infections. Therefore, future studies conducted once the pandemic resolves and that utilize stratified random sampling to recruit a representative sample are urgently required to confirm the generalizability and veracity of our results.

The overall use of face masks in the current study (as indicated by the total FMUS score) is high, however similar studies are very rare and this limits opportunities to make direct comparisons. Before the COVID-19 outbreak, some local data indicated a medium total face mask use score (i.e., mean = 9.78–10.63, *SD* 4.89–5.40) among 971 members of the general public (23). Whereas, the current results (mean = 18.5, *SD* 3.90–4.10) indicate a great increase in frequency of face mask use practice since the pandemic. Furthermore, our results related to health beliefs on COVID-19 and face mask use highlight some important health literacy issues. Good levels of health literacy are crucial because the effective prevention of communicable diseases requires individuals to understand and take personal responsibility to avoid behaviors that present a high risk for infection and understand the rationale behind recommendations calling for social responsibility to fight the pandemic (39, 40).

The rate of face mask re-use in this sample was 54%, where 83.8% of these participants reused each mask 1–2 times. This relatively high rate of facemask re-use in a fairly wealthy sample may be explained by an actual or perceived lack of mask stocks during the survey period. It is clear that a stable supply of quality face masks is required to achieve large-scale mass masking within a population (41), however, during the time of data collection regional studies and local news reports indicated that the market was flooded with fake face masks, the price of masks escalated, and there were occasional shortages (42). In consequence, the practice of reusing face masks was also prevalent, as detailed in some local studies and news reports (43). These circumstances seemed to have contributed to a high level of stress in the general public, a recent study also showed worsening sleep quality (30–40%) and causing insomnia (30%) among the general public (44). These studies seem to support our findings on high rate of mask reuse and the potential of this to be associated with depressive symptoms in Hong Kong. Unfortunately, nearly 70% of respondents felt unsafe to reuse face masks and almost 80% stated that they were unclear about guidelines for reuse. This lack of clarity combined with a high level of perceived susceptibility to COVID-19 infection is very likely to cause additional mental distress in the general public. To some extent this lack of health literacy is understandable given the huge amounts of conflicting COVID-19 information available, which has recently been described as an "infodemic"

(45). This "infodemic" may be particularly problematic for people who have difficulty locating and processing health advice, such as those experiencing depression.

The results also show that a higher proportion of people with probable depression were unclear about the reuse guidelines and tended to wear face masks for self-protection more often when compared with those with low levels of depressive symptoms. Whereas, participants who had better knowledge of the disease pandemic and higher perceived self-efficacy to wear masks properly were less likely to report depressive symptoms. These results seem to suggest that there is an important relationship between COVID-19 health literacy and depressive symptoms, a finding that is supported by the results of a recent Vietnamese study showing that a one score increment increase of COVID-19 health literacy resulted in 5% lower likelihood of having probable depression (46). Although these studies cannot demonstrate cause and effect, and there is a potential bi-directional relationship between health literacy and depression, these results have potential implications for health literacy provision during communicable disease epidemics. For example, this may suggest that improving health literacy may help to reduce depressive symptoms, or alternatively that COVID-19 health literacy is poorly grasped by people with depressive symptoms and therefore a tailored approach is required to improve the clarity of health literacy information provided for this group.

Our findings also indicate that participants who believed themselves to be more susceptible to the disease and perceived high severity of the disease outbreak were most likely to report probable depression. In addition, the significant predictors identified in the final regression model accounted for 16% of the overall variance in levels of depressive symptoms indicating probable depression. The addition of the HBM variables in model 3 resulted in explaining an additional 9% of the variance in depression, highlighting that these beliefs/attitudes account for greater variance than demographics and face mask use practice/beliefs combined. This finding may indicate that modifying COVID-19 related health beliefs could be a useful target for interventions to reduce depressive symptoms associated with COVID-19. In accordance with our initial hypotheses, it is possible that participants had higher levels of depressive symptoms because they felt distressed and overwhelmed by the threats posed by COVID-19 or conversely that the presence of depression/anxiety may magnify an individual's perceptions of the severity of the disease and their likelihood of contracting it. Indeed, it is well-established that people with depressive symptoms have a tendency to expect negative outcomes and can become preoccupied with negative thoughts, which are likely to both maintain and exacerbate levels of depressive symptoms (14). Irrespective of the reasons for these findings, our results seem to suggest that public health information about COVID-19 should be concise and aim to target peoples' COVID-19 health beliefs that may be a source of distress and improve their perception of self-efficacy to protect themselves from becoming infected.

STUDY LIMITATIONS

This study has some methodological limitations that require consideration. This was an online survey utilizing a convenience sampling approach; therefore, the participants are unlikely to be representative of the general Hong Kong population and this severely limits the generalizability of the study findings. For example, all respondents were able to use/access the internet, females were over-represented in the sample and we found some significant differences in demographic characteristics across genders. Also, we did not ask respondents to specify their ethnic group, and given the online mode of the survey we are unable to be certain that all respondents were from Hong Kong or verify their age/other demographic characteristics, further limiting the potential generalisability of the findings. The use of a non-probability sample in the current study also introduces potential bias resulting from selectively recruiting participants who may be more distressed by the pandemic, which may explain the high prevalence of probable depression. The HBM items were newly constructed with brief evaluation of psychometric properties which may compromise the measurement quality. Nonetheless, the use of FMUS and PHQ-9 is a study strength as they were validated with good psychometric properties (23, 28, 29). Recently, some published studies have adopted one or two items for measuring face mask use practice without comprehensive evaluation on psychometric properties (47). Therefore, future studies should adopt the validated instruments like FMUS and PHQ-9 for evaluation of the phenomenon.

CONCLUSIONS

The high point-prevalence of probable depression and suicidal ideation during COVID-19 in Hong Kong is very concerning and seems to have increased since late 2019. However, our estimate of the prevalence of probable depression in the current study should be viewed with caution due to the convenience sampling method employed, therefore future studies should recruit a representative probability sample in order to draw more reliable conclusions. People who perceived that they are at greater risk from the virus, who engage in higher levels of unsafe face mask use and who are unclear about COVID-19 related health information are more likely to report symptoms indicative

of probable depression. These findings may suggest that more emphasis should be placed on improving the clarity, quality and accessibility of COVID-19 related information to improve overall health literacy. This information could be specifically tailored toward modifying COVID-19 related health beliefs in people who feel highly distressed by the pandemic.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved the Human Subjects Ethics Sub-committee of the Hong Kong Polytechnic University (reference no: HSEARS20200227002-01). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SL: conception and design of the study and acquisition of data. SL and TC: data analysis. SL, DB, TC, LS, and TF: interpretation of data. DB and TC: drafting the manuscript. Y-TX, HH, and LS: critically review. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2020.571179/full#supplementary-material

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Self-Compassion Buffers the Adverse Mental Health Impacts of COVID-19-Related Threats: Results From a Cross-Sectional Survey at the First Peak of Hong Kong's Outbreak

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COVID-19 has brought tremendous and abrupt threats to various aspects of our daily lives, from school and work to interpersonal relationships. Self-compassion is put forth as a salutogenic perspective on oneself that buffers the adverse mental health impacts of these threats. During the peak of a local outbreak in Hong Kong in Spring 2020, 761 participants completed questionnaires on self-compassion, perceived threats, as well as perceived benefits and psychological distress. Controlling for demographic variables, negative indicators of self-compassion (aka self-coldness) was found to intensify the impacts of threats on psychological distress. The positive indicators of self-compassion also moderated the link between threats and perceived benefits, such that perceived benefits tend to be less related to threats in participants with higher self-compassion. Our findings highlight the impacts of both positive and negative indicators of self-compassion on the adjustment to such unprecedented challenges, and point to the possibility of enhancing people's resilience through fostering self-compassion and alleviating self-coldness.

Keywords: self-compassion, mental health, perceived benefit, COVID-19, Hong Kong, self-coldness

INTRODUCTION

The Coronavirus Disease-2019 (COVID-19) has imposed unprecedented changes to our everyday lives. In countries where cities were locked down, citizens were forced into furlough or work-/school-at-home arrangements with wide-spread suspension of services and businesses, entailing pervasive loneliness, and sense of insecurity (1, 2). The perfect storm from coupling psychological tension with 24/7 interactions with one's family in an enclosed space breeds conflicts or even domestic violence (3).

This study was conducted during the peak of the Spring 2020 outbreak in Hong Kong, when public health orders banning public gatherings, restricting catering capacity of restaurants to half and mandating closure of high-risk businesses were enforced for the first time after reports of infection clusters in March. Conceivably, these measures have drastically changed the citizens' daily routines and resulted in enormous challenges to the local businesses and the civil society, especially after months of conflicts during the Anti-extradition law amendment bill (Anti-ELAB) movement (4). In fact, Hong Kong experienced the worst drop in year-to-year GDP (8.9%) during Spring

2020 where the worst wave of local outbreak occurred, whilst the unemployment rate has reached a 15-years high (5.9%) (5). The ban on mass gatherings and apprehension over physical socializing has also hindered connections among stakeholders of the civil society, adversely impacting the community support networks. In such unprecedentedly challenging time, this study was conducted to explore how self-compassion, defined as a warm, kind and non-judgmental attitude to oneself during setbacks, modulates individuals' adjustment to the pandemic-related threats (6).

Neff proposed that self-compassion entails (i) extending kindness and understanding to oneself rather than treating oneself with harshness and criticism (self-kindness vs. self-judgment), (ii) seeing one's suffering as a part of the shared human experience rather than an isolated experience (common humanity vs. isolation), and (iii) a balanced perspective of one's suffering rather than overly attached to it (mindfulness vs. over-identification) (6). Accordingly, meta-analyses have reported robust negative associations of self-compassion with psychopathology and positive associations with well-being (7–9).

Self-compassion may modulate how people confront threats by encouraging adaptive coping responses. Allen and Leary summarized the associations between self-compassion and coping styles (10). Self-compassion tends to foster positive reappraisal and proactive coping and reduce avoidant behaviors. Evidence regarding self-compassion's salutary effects on problem-solving, support seeking and distraction was however mixed. Allen and Leary postulated that these associations could be qualified by perceived control, such that people with higher self-compassion exhibit higher proactivity (vs. passivity) when perceived control is higher (vs. lower) (10). Another line of research suggests that self-compassion induces favorable emotional regulation (e.g., emotion clarity, impulse control, acceptance of emotional response) which in turn engenders mental health benefits (11, 12). From a self-regulation perspective, self-compassion may facilitate healthy attainment of goals by facilitating proactivity, enabling one to take responsibility to both success and failure, evaluating the situation with equanimity, disengaging from relentless pursuits and countering the toxic effects of guilt and embarrassment (13–15). Accordingly, self-compassion moderated the impacts of stressors on well-being and adjustment in various samples, including women with breast cancer, college students, women with restricting eating tendencies, and even in a laboratory-induced stressful setting (16–19).

Self-compassion is often assessed with the full- or short-version of Self-Compassion Scale [SCS; (20, 21)]. Both versions assume a higher-order single factor structure and a six-factor structure encompassing three positive (self-kindness, mindfulness, common humanity) and three negative (self-judgment, over-identification, and isolation) factors. Thus, responses on the negative indicators are often reversed to attain an overall scale score of self-compassion. However, the construct validity of these scales is contentions, as many studies failed to replicate the six-factor model, but instead, yielded a bifactor structure with distinct but related positive

(self-compassion/self-reassuring) and negative factors (self-coldness/self-criticism) (22–24).

Moreover, the positive and the negative factors appear to be asymmetrically related to psychopathology and well-being. Muris and Petrocchi found that while the positive and the negative indicators are related to psychopathology in expected directions, comparisons over the strengths of the relationships revealed the negative indicators as significantly stronger predictors than the positive ones (9). Such an observation indicates the possibility of an inflated association between self-compassion and psychopathology when the overall scale score, with the oppositely-phrased items reversed, has been used. In fact, the tendencies to be reassuring vs. critical to oneself rely on distinct biological impetuses. Longe et al. found that self-reported measures of self-criticism were associated with areas for error-processing and behavioral inhibition, including the dorsolateral prefrontal cortex, and those of self-reassurance with areas of empathy, including the ventrolateral prefrontal cortex (25). Accordingly, Brenner et al. proposed a theoretical model of self-relating based on Gilbert's theories of social mentalities (26–28). While self-compassion, which stems from a safeness system rooted in the parasympathetic nervous system, infers a non-judgmental, caring lens to own sufferings and therefore encourages positive connections to oneself and others; self-coldness, which stems from a threat-defense system rooted in the sympathetic nervous system, indicates a tendency to be critical, judgmental and overly attached to one's suffering, and exhibit vigilance or avoidance in behaviors toward others.

A bifactor model that distinguishes self-compassion from self-coldness may better fit how Asians affectively evaluate things in general. For instance, a dialectical thinking style, which has roots in Asian philosophies and religions (e.g., Confucianism and Buddhism), facilitates tolerance and flexible integration of affectively opposite judgments and coping strategies (29, 30). The Chinese circumplex model of affect also postulates the positive and the negative affect as independent but associated constructs, rather than two poles on the same line (31). Hence, we reckon that in the ethnic context of Hong Kong, it may make more sense to assume individuals can exhibit both self-compassion and self-coldness, although likely to different degrees and on different aspects of even the same event. For instance, one can be compassionate about one's worsening job prospect due to the financial meltdown, but still be self-critical about not being industrious enough to follow up with every client.

In this study, we tested the moderation effects of self-compassion and self-coldness simultaneously on the impacts of pandemic-related perceived threats on well-being. Also, as self-compassion and self-coldness may be differentially associated with well-being and psychopathology, we tested on outcomes indicating both negative and positive adaptations (26). The negative impacts were indicated by psychological distress that encompasses symptoms of anxiety and depression. Perceived benefits experienced in the pandemic were used to indicate positive adaptation to the challenging situation (32, 33). We expected self-compassion to buffer the positive relationship between perceived threats and psychological distress, as well as the negative relationship with perceived benefits. In other words,

individuals with higher self-compassion should experience less emotional harm from threats and that their perceived benefits will be less hampered by threats. Brenner et al. put forth self-coldness as a separate vulnerability factor (26). We therefore anticipated self-coldness to intensify the positive relationship between perceived threats with psychological distress and the negative relationship with perceived benefits. That is, individuals with higher self-coldness should be more susceptible to the emotional harm from perceived threats and that their perceived threats should hamper perceived benefits more.

METHODS

Design

This is a part of a longitudinal study on how people of Hong Kong adjust to the COVID-19 pandemic. The current analysis utilized only the cross-sectional data collected between mid-March to early-April 2020, right after the World Health Organization declaring COVID-19 a pandemic (34). The study was approved by the Human Research Ethics Committee of the University of Hong Kong (EA2003003).

Participants

Adults aged 18 or above residing in Hong Kong were eligible for the study. Participants who could not read traditional Chinese or had no access to the internet were excluded. Conducted as a swift response to the situation, participants were recruited through snowballing by social media and email lists. Participants were reimbursed HKD$50 in cash or supermarket coupons for participating in the current survey.

Instruments
Perceived Threats
Participants were asked to rate the extent to which the pandemic has rendered threats to their (i) work/academic life, (ii) personal finance, (iii) family relationships, and (iv) social life on a 10-point scale running from 1 (not at all) to 10 (extremely). The four self-constructed items were averaged to form an overall perceived threats scale, with good reliability (Cronbach $\alpha = 0.79$).

Self-Compassion and Self-Coldness
The 12-item Self-Compassion Scale Short Form [SCS-SF; (21)] were used. These twelve short-form items were drawn from the published translation of the Chinese Self-Compassion Scale (35). Participants answered on a 5-point scale running from 1 (almost never) to 5 (almost always). The positive subscale (*self-compassion*) included the six items on self-kindness, mindfulness and common humanity, whereas the negative subscale (*self-coldness*) encompassed the six items on self-judgment, over-identification and isolation. The subscale scores were obtained by taking the average across responses on the items. The reliability of the two subscales were adequate with Cronbach alphas of 0.83 (positive) and 0.81 (negative), respectively.

Psychological Distress
Psychological distress over the past 2 weeks was measured by the Patient Health Questionnaire-4 [PHQ-4; (36)]. The first two items indicated anxiety levels and were taken from the

Generalized Anxiety Disorder-7 [GAD-7; (37)]; while the last two items were from the Patient Health Questionnaire-2 (PHQ-2) that has been used for screening depression (38). These items were drawn from the published translation of the Chinese GAD-7 and PHQ-2 (39, 40). Participants answered on a four-point scale running from 0 (not at all) to 3 (nearly everyday). A summed response exceeding 5 indicates moderate to severe psychological distress. The reliability of the scale was good (Cronbach $\alpha = 0.87$).

Perceived Benefits
Eleven self-constructed items were employed to indicate perceived benefits experienced by our participants during the pandemic (34). Example items include "The pandemic afforded me more time for rest and relaxation," "I learned a new skill/knowledge from the pandemic," and "I gained greater trust in the power of the citizens." Participants answered on a seven-point scale running from 1 (strongly disagree) to 7 (strongly agree). The scale score was derived by taking the average across the responses on the items. The scale exhibited good reliability (Cronbach $\alpha = 0.86$).

Demographic information, such as gender, age, education background, marital status, income, religion as well as health and pandemic exposure related data, such as presence of a chronic health condition, co-residence with an individual vulnerable to a severe course of illness in case of infection (e.g., children, elderly, individuals with chronic illness, pregnant women, etc.), level of risk at occupational setting, SAR-CoV-2 test results (if any) and medical quarantine experience were also collected from the online survey. The online survey was conducted in traditional Chinese.

Statistical Analyses

Descriptive statistics were used to explore the levels of perceived threats, self-compassion, self-coldness, perceived benefits and psychological distress of the participants, while the intercorrelations among the key variables were scrutinized by Pearson's correlations. The moderating role of self-compassion and self-coldness were tested with SPSS PROCESS macro (version 3). Assuming a moderate effect size ($f^2 = 0.15$), alpha of 0.05, power of 95% and 13 predictors (control variables, predictor variables and two interaction terms), a minimum of 189 participants were needed based on the calculation by G*Power (version 3.1.9.2). The current sample size exceeded what is minimally required for testing the model. The directions of the moderation effects were indicated by the effects of the focal predictor (i.e., perceived threats) on the outcome (i.e., psychological distress and perceived benefits) at 16th, 50th, and 84th percentile of the moderators (i.e., self-compassion and self-coldness). All analyses were conducted with SPSS (version 25.0).

RESULTS

Sample Characteristics

Among the 761 participants (**Table 1**), 67.7% were female with age ranging from 18 to 79 [Mean (SD) = 40.31 (14.02)]. 62.4% of the sample received university education or above and 49.9% were married. 47.0% were affiliated to a religion.

The median monthly family income was HKD$40,000–49,999, which was higher than the population median (HKD$27,000). About one-third of the participants (35.7%) reported they were working in a high-risk occupation (e.g., healthcare, retail, catering, and beverage, jobs that require frequent travel abroad). A quarter (24.6%) declared having at least one chronic physical or psychological illness, while about half of the sample (50.6%) were living with individuals vulnerable to a severe course of illness in case of COVID-19 infection. There were seven cases (0.9%) of positive test results of SAR-CoV-2 and 11 (1.4%) cases subjected to medical quarantine.

Both perceived threats and benefits from COVID-19 were moderate [Means (SDs) = 4.89 (2.10), 4.65 (0.99), respectively]. The mean of PHQ-4 was 3.29 (SD = 2.91). The percentages of participants showing none (score 0–2), mild (score 3–5),

moderate (score 6–8), and severe (score 9–12) psychological distress were 46.3, 35.9, 11.4, 6.4%, respectively. In other words, 17.8% of the sample scored above the cut-off for moderate to severe psychological distress.

Table 2 shows the intercorrelations among the key variables. The negative association between self-compassion and self-coldness was moderate in magnitude. Perceived threats were positively related to psychological distress and self-coldness, but negatively associated with self-compassion. Self-compassion and self-coldness were negatively and positively related to psychological distress, respectively. Of note, perceived benefits were unrelated to perceived threats and psychological distress, but were positively and negatively correlated with self-compassion and self-coldness.

Moderating Roles of Self-Compassion and Self-Coldness

Table 3 provides the results of the moderation models. For psychological distress, the relationship with perceived threats was significantly moderated by both self-coldness (p = 0.0009) and self-compassion (p = 0.0439). Inspecting the effects of perceived threats on psychological distress at the 16th, 50th, and 84th percentiles of the moderators (**Figure 1**), self-coldness appeared to strengthen the positive association between perceived threats and psychological distress, while higher self-compassion was related to weaker positive association. The main effects of perceived threats, self-compassion, and self-coldness were non-significant.

For perceived benefits, the main effect of self-compassion was significant, meaning that higher self-compassion was related to more perceived benefits, whereas that from self-coldness was non-significant. The main effect of perceived threat remained significant but positive, indicating more perceived benefits from higher levels of perceived threat. Only the moderation effect from self-compassion was significant (p = 0.0151). Inspecting the direction of the moderation, higher self-compassion was related to a weaker positive relationship between perceived threats and perceived benefits (**Figure 2**). In other words, in people

TABLE 1 | Sample characteristics (N = 761).

	N/M	Valid %/SD
Gender		
Female	515	67.7
Male	246	32.3
Age	*40.31*	*14.02*
Education backgrounds		
Primary or less	6	0.8
Secondary	157	20.6
Higher diploma/Associate degree	123	16.2
Undergraduate	262	34.4
Post-graduate or above	213	28.0
Marital status		
Single, divorced, separated, bereaved	381	50.1
Married	380	49.9
Income (in Hong Kong Dollar)		
<10,000	57	7.5
10,000–19,999	91	12
20,000–29,999	107	14.1
30,000–39,999	89	11.7
40,000–49,999	86	11.3
50,000–69,999	132	17.4
70,000–89,999	85	11.2
90,000 or more	114	15
Religion		
Yes	358	47
No	403	53
Own chronic health condition		
Yes	187	24.6
No	574	75.4
Live with a vulnerable person		
Yes	385	50.6
No	376	49.4
In a high-risk occupation		
Yes	272	35.7
No	489	64.3

Italics refers to M/SD = (means/standard deviation).

TABLE 2 | Intercorrelations among the key variables (N = 761).

	Mean (SD)	1	2	3	4	5
1. Self-compassion	4.89 (2.10)	1.00	–	–	–	–
2. Self-coldness	3.59 (0.68)	−0.28***	1.00	–	–	–
3. Perceived threats	3.19 (0.73)	−0.16***	0.28***	1.00	–	–
4. Psychological distress	3.29 (2.91)	−0.29***	0.40***	0.41***	1.00	–
5. Perceived benefits	4.65 (0.99)	0.32***	−0.11**	0.06	−0.06	1.00

SD, standard deviation.
*p < 0.05; **p < 0.01; ***p < 0.001.

with lower self-compassion, greater perceived threats instill more perceived benefits. However, in people with higher self-compassion, perceived benefits were weakly related to perceived

threats. Higher self-coldness appeared to be related to weaker association between threats and benefits, but the moderation was non-significant.

TABLE 3 | Results of moderation models (N = 761).

	Psychological distress B (SE)	Perceived benefits B (SE)
Female (vs. male)	0.36 (0.19)	0.20 (0.07)**
Age	−0.00 (0.01)	0.00 (0.00)
University educated (vs. no)	0.08 (0.21)	−0.01 (0.08)
Income	−0.00 (0.03)	−0.01 (0.01)
Presence of own chronic health problems (vs. no)	0.25 (0.22)	0.02 (0.08)
Co-living with a vulnerable individual (vs. no)	0.25 (0.18)	0.02 (0.07)
Religious affiliation (vs. no)	−0.24 (0.18)	0.04 (0.07)
In a high-risk occupation (vs. no)	0.05 (0.19)	−0.05 (0.07)
Perceived threats	0.24 (0.29)	0.34 (0.11)**
Self-coldness	0.13 (0.30)	0.09 (0.11)
Self-compassion	−0.15 (0.32)	0.73 (0.12)***
Self-coldness × perceived threats	0.19 (0.06)***	−0.03 (0.02)
Self-compassion × perceived threats	−0.12 (0.06)*	−0.05 (0.02)*
Model summary: Δr^2	0.2968***	0.1412***

B, unstandardized coefficient; SE, standard error.
*p < 0.05; **p < 0.01; ***p < 0.001.

DISCUSSION

Based on a bifactor model that distinguishes self-compassion from its negative counterpart—self coldness, our findings underscore the moderating roles of both constructs on how pandemic-related threats may impact well-being (26). Specifically, as hypothesized, self-compassion buffered, while self-coldness amplified, the association between perceived threats and psychological distress. We also anticipated that self-compassion would reduce, while self-coldness would intensify, the negative impacts of perceived threats on perceived benefits. However, first, the moderating role of self-coldness was not supported in our findings. Second, rather than diminishing a negative relationship between perceived threats and perceived benefits, self-compassion dampened a *positive* relationship between perceived threats and perceived benefits.

The findings on the buffering role of self-compassion and the amplifying role of self-coldness on the threat-psychopathology link echo with the conceptualization of the former as a protective factor in Neff and colleagues as well as the model of self-relating of Brenner et al. that views the latter as a risk factor (6, 26). Under both models, self-compassion may palliate the adverse impact of pandemic-related threats by enabling people to be kinder to oneself, evaluate the global threat as a shared experience with

FIGURE 1 | Moderation roles of self-compassion and self-coldness on the effects between perceived threats and psychological distress (N = 761). Effects were unstandardized coefficients of the conditional effects of perceived threats on psychological distress.

FIGURE 2 | Moderation roles of self-compassion and self-coldness on the effects between perceived threats and perceived benefits ($N = 761$). Effects were unstandardized coefficients of the conditional effects of perceived threats on perceived benefits.

others and being mindful to one's needs. On the other hand, self-coldness may exacerbate psychological distress through further isolating one's pain from the fact that everyone is going through similar pains under the pandemic, forcing one to take more criticism than one's fair share in this macro catastrophe and hindering one from putting their difficulties in perspective.

In contrary to our expectation, more benefits were actually perceived in people facing more pandemic-related threats. The levels of perceived threats experienced by our participants were in general moderate. Such a level of threats would be threatening enough to trigger a response, but not too severe to have "frozen" the participants from responding or incurred resource loss so severe that adaptive coping strategies became impossible. Hence, greater threat perceptions could have triggered vigilance as well as cognitive and behavioral adaptations, which in turn enabled the discovery of benefits (41, 42). Our findings further suggest that those who scored higher on self-compassion experienced a weaker threats-benefits contingency than their counterparts who scored lower on that scale. Studies have noted people with high self-compassion were more inclined to using positive reinterpretation as a coping strategy and attuned to the positive aspects of their life even at the pre-conscious level (10, 43–45). Hence, our participants with high self-compassion were likely to have found benefits, regardless of their levels of perceived threats.

The relationship of self-coldness with perceived benefits might be less straight forward then the one with psychological distress. In the Asian culture that rewards modesty and emphasizes group harmony, being critical to oneself is not necessarily bad (46–48). Self-effacement may motivate self-improvement (49). That is, if benefit-finding is a way to improve oneself, individuals who have a tendency to self-efface may comply to win over the situation. Surely, if such efforts were ingenuine, there could be emotional costs. The line between of self-criticism due to adherence to social norms vs. self-disparagement is however often unclear (24).

Study Limitations

Due to the unprecedented nature of COVID-19 pandemic, we relied on self-constructed measures to assess the degree of perceived threats imposed onto the participants' daily lives and the extent to which benefits and gains are experienced from the disrupted livelihood. As noted by Horesh and Brown, COVID-19 may represent a new type of mass trauma characterized by its global nature, lethality, novelty, and unpredictability, as well as the enormous anticipatory anxiety it ensues (50). As the pandemic appears to continue at least for a while with lasting aftermaths to our socio-economic-political landscape, psychologists should gather efforts to conceptualize the similarities and differences of the threats and benefits experienced by people under this global catastrophe, as compared to those of the victims of other disease outbreaks and disasters. Also, as the sample was non-random, the generalizability of our findings to the general population could be compromised. Specifically, males and individuals with lower socio-economic statuses were under-represented in this survey that took about 20–30 min to complete. COVID-19 could hit particularly hard on people without a financial and social safety net to fall on, including gig workers, individuals with physical or psychological disability and their caregivers, people living in poverty, and ethnic minorities. The suspension of support services and the worsening economic outlook means immense threats to their already-challenging lives. Thus, our estimates of psychological distress and perceived threats could be underestimates.

Practical Implications

Mental health scientists are calling for studies on the causal and modifiable psychological factors that foster people's coping in the pandemic (51). Our findings point to the need to not only enhance the protective factors, such as self-compassion, but also to alleviate risk factors, such as self-coldness. Ferrari et al.

conducted a meta-analysis with 27 randomized controlled trials and found that self-compassion interventions may result in a large effect size for rumination and moderate effect sizes for self-compassion, stress, depression, self-criticism, mindfulness, and anxiety, with sustained effects on self-compassion gains (52). Studies have also shown that regular but brief compassion meditation training via mobile applications and webpages can enhance well-being and self-compassion (53, 54). These interventions can be adapted to reach a larger audience during the pandemic using online channels. Based on the bifactor model of self-relating, therapists should explore means to, on one hand, facilitate a compassionate attitude to self, and on the other hand, alleviate toxic self-criticism, excessive rumination, and isolation (26).

CONCLUSIONS

The COVID-19 pandemic is a humbling experience for many of us. Instead of a relentless chase after self-enhancement and self-esteem, acknowledging one's limitations as a part of the shared human experience with compassion could be particularly salutogenic, especially in such an unprecedented, challenging time. Our findings highlight the role of self-compassion to buffer the adverse consequences of perceived threats on well-being and to facilitate a general tendency to find benefits regardless of threats. Our findings also caution mental health professionals against the detrimental effects of self-coldness, as it may amplify psychological distress from perceived threats.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusion of this article will be available upon request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Human Research Ethics Committee of University of Hong Kong. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

BL conducted the data analysis. All authors contributed significantly to the conception, data collection, and writing up of the study.

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Mental Health Impacts of the COVID-19 Pandemic on International University Students, Related Stressors, and Coping Strategies

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Background: The coronavirus disease 2019 (COVID-19) pandemic has disrupted university teaching globally. The mental health impacts on international university students have been overlooked.

Aims: This study examined the differences in COVID-19-related stressors and mental health impacts between international university students studying in the UK or USA who returned to their home country or region (returnees) and those who stayed in their institution country (stayers), and identified COVID-19-related stressors and coping strategies that were predictors of mental health.

Method: An online questionnaire survey was conducted from April 28 through May 12, 2020 using an exponential, non-discriminative snowball sampling strategy (registered at the National Institutes of Health: NCT04365361).

Results: A total of 124 full-time international university students (36.3% male) were included: 75.8% had returned to their home country or region for reasons related to COVID-19; 77.4% were pursuing a bachelor's program, and 53.2% were in programs with practicum component. 84.7% of all students had moderate-to-high perceived stress, 12.1% had moderate-to-severe symptoms of anxiety and depression, and 17.7% had moderate-to-severe symptoms of insomnia. Compared with returnees, stayers had significantly higher stress from COVID-19-related stressors such as personal health and lack of social support (Cohen's d: 0.57–1.11), higher perceived stress [10-item Perceived Stress Scale (PSS-10)] {22.6 ± 6.2 vs. 19.1 ± 6.1, β [95% confidence interval (CI)]: 4.039 (0.816, 7.261), Cohen's d: 0.52}, and more severe insomnia symptoms [Insomnia Severity Index (ISI)] [11.8 ± 6.1 vs. 7.6 ± 5.2, β (95% CI): 3.087 (0.262, 5.912), Cohen's d: 0.45], with moderate-to-large effect sizes. Compared with males, females reported significantly higher stress from uncertainties about academic program (Cohen's d: 0.45) with a small effect size. In the total sample, stress related to academics (e.g., personal attainment, uncertainties about academic program, and changes in teaching/learning

format), health (including personal health and health of family and friends), availability of reliable COVID-19-related information, and lack of social support predicted more negative mental health impacts. Resilience, positive thinking, and exercise were predictors of less severe mental health impacts.

Conclusions: Stayers experienced more adverse mental health impacts than returnees. We call on educators and mental health professionals to provide appropriate support for international students, particularly the stayers, during the pandemic.

Keywords: mental health, stress, anxiety, depression, insomnia, students, university, coping

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has aroused fear and anxiety globally, which may lead to an upsurge in the incidence and severity of mental health problems (1). Global attention has largely focused on infected patients and frontline health workers. Our PubMed search on June 26, 2020 using keywords including "international students," "mental health," "pandemic," "epidemic," and "outbreak" yielded a limited number of articles on the mental health impacts of COVID-19 in local students (2–4). We found one correspondence piece on the need for mental health care for Chinese international students and one qualitative article on 28 Chinese international students' health risk perception during travel (5, 6). However, there were no articles focused specifically on the mental health impacts of COVID-19 on international students; this group's mental health has been overlooked.

Many universities around the world have implemented preventive measures, including closing campuses or facilities, canceling classes, transitioning to online-based teaching/learning curriculum and examinations, and postponing practicums. However, up to now (mid-June 2020), many universities are still uncertain about how long such measures will continue, and it is unclear how these changes have affected students. Such disruptions due to the COVID-19 pandemic can exert unique additional pressures, adversely affecting students' mental health, with impacts including increased stress, anxiety, and depression (3, 4). In general, university students face a wide range of transitional events and ongoing stressors while adapting to new academic environments and demands. Ongoing stress can affect academic performance as well as mental well-being (7). Such stress may have a disproportionate impact on females compared with males. It has been demonstrated that stress exposure during puberty has stronger proximal effects on girls, including increased risks of developing mood- and stress-related disorders, such as depression, anxiety, and posttraumatic stress disorder (8). More psychological support from academic institutions is needed to enhance female students' mental health and resilience.

For international students, living abroad, adjustment to the host country's culture and norms, and being away from central social support systems such as family and friends can be additional challenges that affect mental health. Students from different countries may have different cultural characteristics, which might affect their coping strategies (9).

During the early stages of the outbreaks in the UK and USA (March 2020), publicly available information and recommendations were often unclear or conflicting. For example, while wearing face masks was not initially advised as a preventive measure, the international recommendations regarding masks subsequently changed. International students from Asia (e.g., students from Hong Kong) might have experienced conflict because places such as Hong Kong had almost 100% mass masking since the end of January and seen good outbreak control. These challenges might be amplified during difficult times such as the COVID-19 pandemic. For example, some Asian international students have reported experiencing isolation and discrimination because they were perceived as potential COVID-19 carriers in their institution country (6). Wearing masks could also be stigmatized.

The current study focused on international students, some of whom stayed in their institution country and some of whom returned to their home country or region (which had a less severe outbreak or with outbreak better controlled) during the COVID-19 pandemic during the COVID-19 outbreaks. During the survey period (from April 28, 2020 through May 12, 2020), the COVID-19 outbreaks were escalating, with average daily increases of 4,681 and 28,185 confirmed COVID-19 cases per day, and a total of 223,064 and 1,322,054 confirmed cases on May 12, 2020 in the UK and USA, respectively (10). In Hong Kong, to where most of the students returned, the situation was under control with zero to four local cases per day during the study period (11). Owing to the escalating outbreaks in their institution countries, many students had returned to their home country or region where the outbreaks were perceived to be under better control.

Since major university destinations for international students such as the UK and the USA had more serious pandemic outbreaks with strict lockdown measures that may have impeded normal access to social support from family, friends, and universities, we hypothesized that international university students who stayed in their institution country (stayers) would have higher stress from COVID-19-related stressors (including individual, interpersonal, and environmental factors), which were associated with higher negative mental health impacts (perceived stress, and symptoms of anxiety, depression, and insomnia), than those who returned to their home country or region (returnees). We also hypothesized that compared with males, females would have more adverse mental health impacts,

FIGURE 1 | Recruitment flow chart.
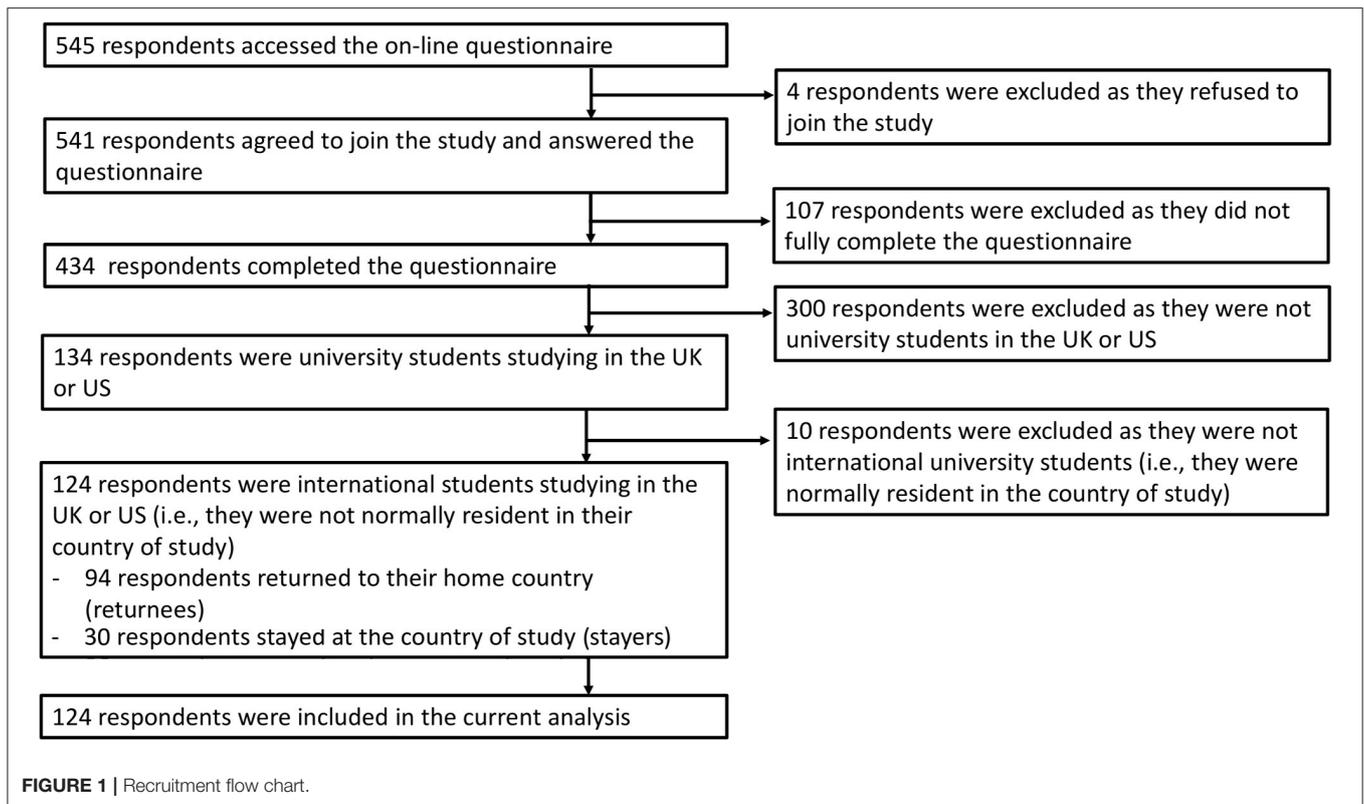
since females might experience higher stress from COVID-19-related stressors.

The objectives of this study were to (i) investigate whether stayers face more or less stress from COVID-19-related stressors and mental health problems than returnees, (ii) examine the differences in COVID-19-related stressors and mental health impacts between males and females, (iii) explore the association between resilience and family functioning and the mental health impacts of COVID-19 on students, and (iii) identify the COVID-19-related stressors and coping strategies that predict students' perceived stress level [Perceived Stress Scale-10 (PSS-10)], severity of anxiety and depression symptoms [Patient Health Questionnaire-4 (PHQ-4)], and severity of insomnia symptoms [Insomnia Severity Index (ISI)].

METHODS

Study Design and Participants

We conducted a cross-sectional online questionnaire survey to collect information on the mental health impacts of the COVID-19 outbreak, resilience, family functioning, and stress coping strategies in international students studying abroad. Written informed consent was obtained before answering the survey. Ethics approval was granted by the Institutional Review Board of The University of Hong Kong/Hospital Authority Hong Kong West Cluster (reference number: UW20-298). The study was registered with the National Institutes of Health (identifier number: NCT04365361).

The inclusion criteria targeted full-time international university student aged 18 years or older studying abroad in the UK or USA. Written informed consent was obtained from all respondents.

Procedures

The online questionnaire was distributed through an anonymous link with an exponential non-discriminative snowball sampling strategy. Considering time sensitivity, snowball sampling was a cost-effective and efficient method to reach our study population, which may have been difficult to sample otherwise (12). The link was first disseminated through the WhatsApp messaging platform to university students studying in Hong Kong or overseas. These students were encouraged to forward the survey link to their friends. To protect against duplicate responses, the online questionnaire was set up such that browser cookies would prevent respondents from taking the survey a second time using the same browser. Upon completion of the questionnaire, respondents received automatically computed scores with brief interpretations and explanations for scales included in the questionnaire in order to promote mental health awareness. No incentives were given to respondents, but links for reliable information on COVID-19 (e.g., link to the World Health Organization website) and telephone numbers for seeking help, support, or further information were provided.

Measurement Tools

A self-administered, anonymous questionnaire based on components of the transactional model of stress and adaptive

	All n = 124 n (%)	Returnees n = 94 n (%)	Stayers n = 30 n (%)	P-value
Sex				
Males	45 (36.3)	33 (35.1)	12 (40.0)	0.63
Females	79 (63.7)	61 (64.9)	18 (60.0)	
Age group				
18–25 years	107 (86.3)	87 (92.6)	20 (66.7)	<0.001***
25 years or above	17 (13.7)	7 (7.4)	10 (33.7)	
Ethnicity				
Asian	116 (93.5)	89 (94.7)	27 (90.0)	0.36
Non-Asian	8 (6.3)	5 (5.3)	3 (10.0)	
Country of study				
UK	115 (92.7)	91 (96.8)	24 (80.0)	0.006**
USA	9 (7.3)	3 (3.2)	6 (20.0)	
Country or region of residence				
Hong Kong, China	100 (80.6)	84 (89.4)	16 (53.3)	<0.001***
Others	24 (19.4)	10 (10.6)	14 (46.7)	
Education program level				
Undergraduate	96 (77.4)	83 (88.3)	13 (43.3)	<0.001**
Postgraduate	28 (22.6)	11 (11.7)	17 (56.7)	
Program year				
Final year	52 (41.9)	32 (34.0)	20 (66.7)	0.002**
Non-final year	72 (58.1)	62 (66.0)	10 (33.3)	
Program with practicum component				
Yes	66 (53.2)	53 (56.4)	13 (43.3)	0.21
No	58 (46.8)	41 (43.6)	17 (56.7)	
Field of study				
Medical or health-related	57 (46.0)	50 (53.2)	7 (23.3)	0.004**
Other	67 (54.0)	44 (46.8)	23 (76.7)	

*From chi-square test or independent t-test; ***P < 0.001, **P < 0.01.*

coping was used to collect respondents' demographic characteristics, academic program, stress from COVID-19-related stressors, mental health impacts, resilience, family functioning, and stress coping strategies (13).

Academic Program Characteristics

Respondents were asked to indicate (i) their institution country, (ii) whether they were full-time or part-time students, (iii) whether they were final-year students, (iv) whether their academic program included a practicum component, and (v) whether the program was medical or Z health related.

Coronavirus Disease 2019-Related Stressors

Respondents were asked to indicate how stressful they found nine possible COVID-19-related stressors, under three groups: individual (academic attainment, personal health, and health of friends or family), interpersonal (lack of social support and prejudiced attitude or behavior of others), and environmental (uncertainties about the academic program, changes in

teaching/learning format, the economic impact of COVID-19, and availability of reliable COVID-related information). Responses were made on a five-point Likert scale: "1 = not at all stressful," "2 = mildly stressful," "3 = moderately stressful," "4 = very stressful," and "5 = extremely stressful".

Perceived Stress Scale -10

The ten-item Perceived Stress Scale -10 (PSS-10) was used to assess perceived stress by asking respondents how often they had certain thoughts and feelings during the past month. Scores ranged from 0 to 40, with cutoffs for low (0–13), moderate (14–26), and high (27–40) perceived stress. Cronbach's alpha of 0.83 was reported (14).

Patient Health Questionnaire-4

The four-item Patient Health Questionnaire-4 (PHQ-4) was used as an ultra-brief screening for symptoms of anxiety and depression. Scores ranged from 0 to 12, with cutoffs for normal (0–2), mild (3–5), moderate (6–8), and severe (9–12) anxiety and depression symptoms. Cronbach's alpha of 0.85 was reported (15).

Insomnia Severity Index

The seven-item Insomnia Severity Scale (ISI) was used to assess the severity of insomnia symptoms. Scores ranged from 0 to 28, with cutoffs for no clinically significant insomnia (0–7), subthreshold insomnia (8–14), moderate clinical insomnia (15–21), and severe clinical insomnia (22–28). Cronbach's alpha of 0.83 was reported (16).

Brief Assessment of Family Functioning Scale

The three-item Brief Assessment of Family Functioning Scale (BAFFS) was used to assess respondents' family functioning. Scores ranged from 4 to 12, with higher scores indicating greater family distress. Cronbach's alpha of 0.71 was reported (17, 18).

Connor–Davidson Resilience Scale-2

The two-item Connor–Davidson Resilience Scale-2 (CD-RISC-2) was used to assess adaptability and resilience. Scores ranged from 0 to 8, with higher scores indicating better adaptability and resilience. Cronbach's alpha of 0.79 was reported (19).

Coping Strategies

Respondents were asked to indicate, from a list, the coping strategies they had utilized within the past month to relieve COVID-19-related stress. The items included listening to music, eating or cooking, video or mobile gaming, seeking support from family and friends, browsing the web, positive thinking, exercise, religious support, and meditation.

Statistical Analysis

All quantitative statistical analyses were performed with SPSS for Windows (version 23.0). Chi-square test was used to examine the differences in the demographic characteristics and academic programs of the stayers and the returnees. Respondents who did not complete the questionnaires were excluded.

To control for potential confounders, the analyses were adjusted for sex (male vs. female), age group (18 to 25 vs. 25 years or older), ethnicity (Asian vs. non-Asian), country or region

TABLE 2 | Stress levels from coronavirus disease 2019 (COVID-19)-related stressors in the total student sample and subgroups.

	All $n = 124$	Students with high stress[a]	Return status				Sex			
			Returnees $n = 94$	Stayers $n = 30$	Adjusted[b]		Males $n = 45$	Females $n = 79$	Adjusted[c]	
	Mean ± SD	n (%)	Mean ± SD	Mean ± SD	β (95% CI)	Effect size[d]	Mean ± SD	Mean ± SD	β (95% CI)	Effect size[d]
Individual factors										
Academic attainment	3.19 ± 1.22	50 (40.3)	3.10 ± 1.26	3.47 ± 1.04	0.184 (−0.457, 0.825)	0.12	3.00 ± 1.28	3.29 ± 1.18	0.299 (−0.168, 0.767)	0.24
Personal health	1.85 ± 0.87	2 (1.6)	1.71 ± 0.77	2.27 ± 0.79	0.560 (0.146, 0.975)**	0.57	1.71 ± 0.79	1.92 ± 0.81	0.265 (−0.037, 0.568)†	0.28
Health of family or friends	2.04 ± 0.90	7 (5.2)	1.98 ± 0.92	2.23 ± 0.82	0.342 (−0.134, 0.818)	0.30	1.93 ± 0.86	2.10 ± 0.91	0.232 (−0.115, 0.578)	0.25
Interpersonal factors										
Lack of social support	1.81 ± 1.03	11 (8.9)	1.50 ± 0.65	2.80 ± 1.35	1.206 (0.752, 1.660)***	1.11	1.93 ± 1.1	1.75 ± 0.98	−0.179 (−0.510, 0.152)	0.35
Prejudiced attitude or behavior of others	1.77 ± 0.91	7 (5.6)	1.64 ± 0.80	2.17 ± 1.12	0.413 (−0.058, 0.844)†	0.38	1.82 ± 0.92	1.73 ± 0.92	−0.097 (−0.440, 0.247)	0.10
Environmental factors										
Uncertainties about academic program	2.85 ± 1.28	42 (34.0)	2.74 ± 1.24	3.17 ± 1.37	0.443 (−0.212, 1.099)	0.28	2.51 ± 1.31	3.04 ± 1.22	0.578 (0.099, 1.056)*	0.45
Changes in teaching/learning format	2.45 ± 1.24	28 (22.5)	2.28 ± 1.21	3.0 ± 1.17	0.418 (−0.210, 1.047)	0.28	2.29 ± 1.16	2.54 ± 1.28	0.316 (−0.143, 0.774)	0.26
Economic impact of COVID-19	2.29 ± 1.10	20 (16.1)	2.22 ± 1.09	2.50 ± 1.14	−0.005 (−0.577, 0.566)	0.01	2.16 ± 1.19	2.37 ± 1.05	0.182 (−0.235, 0.599)	0.16
Availability of reliable COVID-19 related information	1.85 ± 0.96	8 (6.5)	1.71 ± 0.81	2.30 ± 1.24	0.426 (−0.034, 0.887)†	0.39	1.96 ± 1.09	1.80 ± 0.88	−0.113 (−0.449, 0.223)	0.13

Higher scores indicate higher stress levels; range: 1 = not at all stressful, 2 = mild stressful, 3 = moderately stressful, 4 = very stressful, and 5 = extremely stressful.

[a]*Students with high stress refers those students rated the stress as either "4 = very stressful" or "5 = extremely stressful".*

[b]*Between-group differences of variables adjusted for sex, age group, ethnicity, country or region of residence, country of study, education program level, program year, and field of study.*

[c]*Between-group differences of variables adjusted for return status, age group, ethnicity, country or region of residence, and country of study, education program level, program year, and field of study.*

[d]*Effect size (Cohen's d): small = 0.20, medium = 0.50, and large = 0.80.*

***P < 0.001, **P < 0.01, *P < 0.05, †P < 0.1.

TABLE 3 | Levels and severity of mental health impacts, resilience, and family functioning in the total student sample and subgroups.

Levels of mental health impacts, resilience, and family functioning	All n = 124	Return status				Sex			
		Returnees n = 94	Stayers n = 30	Adjusted[a]		Males n = 45	Females n = 79	Adjusted[b]	
	Mean ± SD	Mean ± SD	Mean ± SD	β (95% CI)	Effect size[c]	Mean ± SD	Mean ± SD	β (95% CI)	Effect size[c]
Perceived stress level (PSS-10)[1]	19.9 ± 6.3	19.1 ± 6.1	22.6 ± 6.2	4.039 (0.816, 7.261)*	0.52	18.8 ± 6.9	20.6 ± 5.8	2.212 (−0.140, 4.564)[†]	0.35
Anxiety and depression symptoms (PHQ-4)[2]	3.2 ± 1.9	3.1 ± 1.9	3.6 ± 2.0	0.275 (−0.721, 1.272)	0.12	3.0 ± 2.1	3.4 ± 1.8	0.288 (−0.439, 1.016)	0.15
Insomnia symptoms (ISI)[3]	8.6 ± 5.7	7.6 ± 5.2	11.8 ± 6.1	3.087 (0.262, 5.912)*	0.45	7.4 ± 5.8	9.3 ± 5.6	1.223 (−0.838, 3.285)	0.22
Resilience (CD-RISC-2)[4]	5.1 ± 1.6	5.1 ± 1.6	5.0 ± 1.7	0.149 (−0.696, 0.995)	0.07	5.6 ± 1.5	4.8 ± 1.6	−0.717 (−1.334, −0.100)*	0.43
Family functioning (BAFFS)[5]	5.8 ± 1.7	5.9 ± 1.7	5.7 ± 1.7	0.313 (−0.607, 1.233)	0.12	6.1 ± 1.8	5.6 ± 1.6	−0.427 (−1.099, 0.244)	0.23
Severity of mental health impacts	**n (%)**	**n (%)**	**n (%)**	**OR (95% CI)[d]**		**n = 45**	**n = 79**	**OR (95% CI)[d]**	
Perceived stress level (PSS-10)[1]									
Low (reference)	19 (15.3)	16 (17.0)	3 (10.0)			10 (22.2)	9 (11.4)		
Moderate to high	105 (84.7)	78 (83.0)	27 (90.0)	2.12 (0.39, 11.60)		35 (77.8)	70 (88.6)	2.08 (0.72, 5.60)	
Anxiety and depression symptoms (PHQ-4)[2]									
Normal to mild (reference)	109 (87.9)	84 (89.4)	25 (83.3)			39 (86.7)	70 (88.6)		
Moderate to severe	15 (12.1)	10 (10.6)	5 (16.7)	1.41 (0.29, 6.93)		6 (13.3)	9 (11.4)	0.82 (0.25, 2.72)	
Severity of insomnia symptoms (ISI)[3]									
None to threshold (reference)	102 (82.3)	83 (88.3)	19 (63.3)			38 (84.4)	64 (81.0)		
Moderate to severe	22 (17.7)	11 (11.7)	11 (36.7)	2.91 (0.76, 11.10)		7 (15.6)	15 (19.0)	1.03 (0.322, 3.30)	

[1]PSS-10: 10-item Perceived Stress Scale to measure perceived stress level; higher scores indicate higher stress level; range, 0–40; low, 0–13; moderate to high, 14–40.

[2]PHQ-4: 4-item Patient Health Questionnaire to screen for anxiety and depression symptoms; higher scores indicate more severe symptoms; range, 0–12; normal to mild, 0–5; moderate to severe, 6–12.

[3]ISI: 7-item Insomnia Severity Index to assess the severity of insomnia symptoms; higher scores indicate more severe symptoms; range, 0–28; none to threshold, 0–14; moderate to severe, 15–28.

[4]CD-RISC-2: 2-item version of the Connor–Davidson Resilience Scale to assess resilience; higher scores indicate better adaptability; range, 0–8.

[5]BAFFS: 3-item Brief Assessment of Family Functioning Scale to evaluate family functioning; higher scores indicate greater distress; range, 4–12.

[a]Between-group differences of variables adjusted for sex, age group ethnicity, country or region of residence, country of study, education program level, program year, and field of study.

[b]Between-group differences of variables adjusted for return status, age group, ethnicity, country or region of residence, country of study, education program level, program year, and field of study.

[c]Effect size (Cohen's d): small = 0.20, medium = 0.50, and large = 0.80.

[d]OR (95% CI) = odds ratio (95% confidence interval).

*$P < 0.05$, [†]$P < 0.1$.

TABLE 4 | Association between mental health impacts and coronavirus disease 2019 (COVID-19)-related stressors, coping factors, and strategies.

	Perceived stress level (PSS-10)		Severity of anxiety and depression symptoms (PHQ-4)		Severity of insomnia symptoms (ISI)	
	r	*P*-value	*r*	*P*-value	*r*	*P*-value
MENTAL HEALTH						
Perceived stress level (PSS-10)	–	–	0.477	<0.001***	0.489	<0.001***
Severity of anxiety and depression symptoms (PHQ-4)	0.477	<0.001***	–	–	0.444	<0.001***
Severity of insomnia symptoms (ISI)	0.489	<0.001***	0.444	<0.001***	–	–
COVID-19 RELATED STRESSORS						
Individual factors						
Academic attainment	0.532	<0.001***	0.344	<0.001***	0.245	<0.001***
Personal health	0.268	<0.001***	0.356	<0.001***	0.364	<0.001***
Health of family or friends	0.317	<0.001***	0.319	<0.001***	0.277	0.011**
Interpersonal factors						
Lack of social support	0.404	<0.001***	0.332	<0.001***	0.370	<0.001***
Prejudiced attitude or behavior of others	0.276	0.002**	0.297	0.002**	0.200	0.026*
Environmental factors						
Uncertainties about academic program	0.438	<0.001***	0.326	<0.001***	0.278	0.002**
Changes in teaching/learning format	0.477	<0.001***	0.369	<0.001***	0.258	0.004**
Economic impact of COVID-19	0.195	0.03*	0.296	0.001**	0.122	0.18
Availability of reliable COVID-19 related information	0.344	<0.001***	0.379	<0.001***	0.241	0.007**
Coping factors						
Resilience	−0.495	<0.001***	−0.453	<0.001***	−0.297	<0.001***
Family functioning	0.238	0.008**	0.216	0.016*	0.211	0.019*
Coping strategies						
Listening to music	−0.009	0.92	0.061	0.50	−0.093	0.30
Eating or cooking	0.147	0.10	0.218	0.015*	0.215	0.017*
Video/mobile gaming	0.020	0.83	−0.022	0.81	0.062	0.50
Seeking support from family/friends	−0.041	0.65	−0.018	0.84	−0.213	0.018*
Browsing the web	0.017	0.85	0.043	0.639	−0.010	0.910
Positive thinking	−0.176	0.049*	−0.142	0.116	−0.209	0.020*
Exercise	−0.146	0.11	−0.194	0.031*	−0.031	0.73
Religious support	−0.076	0.40	−0.037	0.680	−0.050	0.58
Meditation	0.008	0.93	−0.066	0.47	−0.067	0.46

***$P < 0.001$, **$P < 0.01$, *$P < 0.05$.

of residence (Hong Kong vs. others), country of study (UK vs. USA), education program level (undergraduate vs. postgraduate), program year (final year vs. non-final year), and field of study (medical or health-related vs. others).

Linear regression was used to examine the differences in stress from COVID-19-related stressors, mental health impacts [perceived stress levels (PSS-10), severity of anxiety and depression symptoms (PHQ-4), and severity of insomnia symptoms (ISI)], resilience (CD-RISC-2), and family functioning (BAFFS) between the stayers and returnees and between males and females. Binary multivariable logistic regression was used to examine the differences in the severity of perceived stress ("low" vs. "moderate to high"), anxiety and depression symptoms ("normal to mild" vs. "moderate to severe"), and insomnia symptoms ("none to threshold" vs. "moderate to severe"), between the stayers and returnees and between males and females.

For the total sample, analyses included forced entry of the above potential confounders, and respondents' return status (returnees vs. stayers). The linear relationship of mental health impacts with resilience and family functioning was examined using partial correlation coefficients.

Forward stepwise multiple linear regression was used to identify predictors of students' mental health impacts. First, the interaction effect between students' return status and sex was examined by forcing the return status by sex interaction term into the models. The dependent variables included perceived stress level, severity of anxiety and depression symptoms, and severity of insomnia symptoms. Academic program characteristics, COVID-19-related stressors, resilience, family functioning, and coping strategies were considered as independent variables influencing mental health impacts. If the interaction term (return status by sex) was not statistically significant, forward stepwise regression analysis was performed without the interaction term.

TABLE 5 | Coronavirus disease 2019 (COVID-19)-related stressors as predictors of mental health impacts identified by forward stepwise multiple regression analysis (n = 124).

	Change in adjusted R^2	Estimate (SE)	P-value
Dependent variable 1: perceived stress level (PSS-10)[1]			
Adjusted R^2 = 38.0%			
Sex, age group, ethnicity, country of study, country or region of residence, return status, education program level, program year, and field of study	8.0%	–	–
Academic attainment	23.4%	1.938 (0.452)	<0.001***
Lack of social support	5.0%	1.781 (0.552)	0.002**
Uncertainties about academic program	1.6%	0.871 (0.437)	0.049*
Dependent variable 2: severity of anxiety and depression symptoms (PHQ-4)[2]			
Adjusted R^2 = 23.2%			
Sex, age group, ethnicity, country of study, country or region of residence, return status, education program level, program year, and field of study	3.9%	–	–
Changes in teaching/learning format	9.9%	0.374 (0.141)	0.009**
Health of family/friends	7.1%	0.529 (0.180)	0.004**
Availability of reliable information related to COVID-19	2.3%	0.404 (0.196)	0.041**
Dependent variable 3: severity of insomnia symptoms (ISI)[3]			
Adjusted R^2 = 22.9%			
Sex, age group, ethnicity, country of study, country or region of residence, return status, education program level, program year, and field of study	14.6%	–	–
Personal health	5.7%	1.738 (0.610)	0.005**
Uncertainties about academic program	2.6%	0.846 (0.385)	0.030*

[1]PSS-10: 10-item Perceived Stress Scale to measure perceived stress level; higher scores indicate higher stress level; range, 0–40.

[2]PHQ-4: 4-item Patient Health Questionnaire to screen for anxiety and depression symptoms; higher scores indicate more symptoms; range, 0–12.

[3]ISI: 7-item Insomnia Severity Index to assess the severity of insomnia symptoms; higher scores indicate more symptoms; range, 0–28. Forward stepwise multiple linear regression was used. The interaction effect between students' return status and sex was examined by forcing the interaction term of return status by sex, return status, sex, age group, ethnicity, country or region of residence, country of study, education program level, program year, and field of study into the regression models for adjustment of confounders. If the interaction term (return status by sex) was not statistically significant, the forward stepwise regression analysis was performed without the interaction term.

Considered independent variables included COVID-19-related stressors, including personal health, health of friends or family, academic attainment, prejudiced attitude or behavior of others, lack of social support, changes in teaching/learning format, uncertainties about academic program, availability of reliable information related to COVID-19, and economic impact of COVID-19.

Since the interaction term in the above analyses was not statistically significant, the above-presented models did not include the interaction term, and the change in adjusted R^2 was calculated from removal of each significant variable from the model.

***P < 0.001, **P < 0.01, *P < 0.05.

The change in adjusted R^2 was calculated with the removal of each significant variable from the model. All tests were two-sided, with $P < 0.05$ indicating statistical significance and $P < 0.1$ to $P \geq 0.5$ indicating marginal statistical significance.

RESULTS

Recruitment

A total of 545 students accessed the online survey during study period, and 541 agreed to join; 107 students who did not complete the questionnaire, 300 students not studying in the UK or USA, and 10 students who were not international students were excluded. Thus, the current analysis included 124 full-time international university students studying in the UK or USA who completed the questionnaire (**Figure 1**).

Participants

Of the 124 students included, 36.3% were males, 86.3% were aged 18–25 years, and 41.9% were final-year students; 77.4% were pursuing a bachelor's program, 46.0% were pursuing medical or health-related programs, and 53.2% were in programs with practicum component; 75.8% had returned to their home country or region for reasons related to COVID-19. Among the returnees, 81% had returned to their home country or region on or before the end of March. **Table 1** shows that compared with stayers, more returnees were younger, studying in the UK, undergraduates, from Hong Kong, in their non-final year, and in medical or health-related fields.

Coronavirus Disease 2019-Related Stressors

Table 2 shows that compared with returnees, stayers reported significantly higher levels of stress related to personal health {β [95% confidence interval (CI)]: 0.560 (0.146, 0.975), $P = 0.01$, Cohen's d: 0.57} and lack of social support [β (95% CI): 1.206 (0.752, 1.660), $P < 0.001$, Cohen's d: 1.11], with moderate-to-large effect sizes. Stayers also had marginally significantly higher stress related to the availability of reliable information on COVID-19 [β (95% CI): 0.426 (−0.034, 0.887), $P = 0.07$, Cohen's d: 0.39] and the prejudiced attitude or behavior of others [β (95% CI): 0.413 (−0.058, 0.844), $P = 0.09$, Cohen's d: 0.38] than returnees with small-to-moderate effect sizes.

Compared with males, females reported significantly higher stress related to uncertainties about academic program [β (95% CI): 0.578 (0.099, 1.056), $P = 0.02$, Cohen's d: 0.45] with small effect size and marginally significantly higher stress related to personal health [β (95% CI): 0.265 (−0.037, −0.568), $P = 0.09$ Cohen's d: 0.28].

FIGURE 2 | Coping strategies in response to coronavirus disease 2019 (COVID-19) for the total student sample.
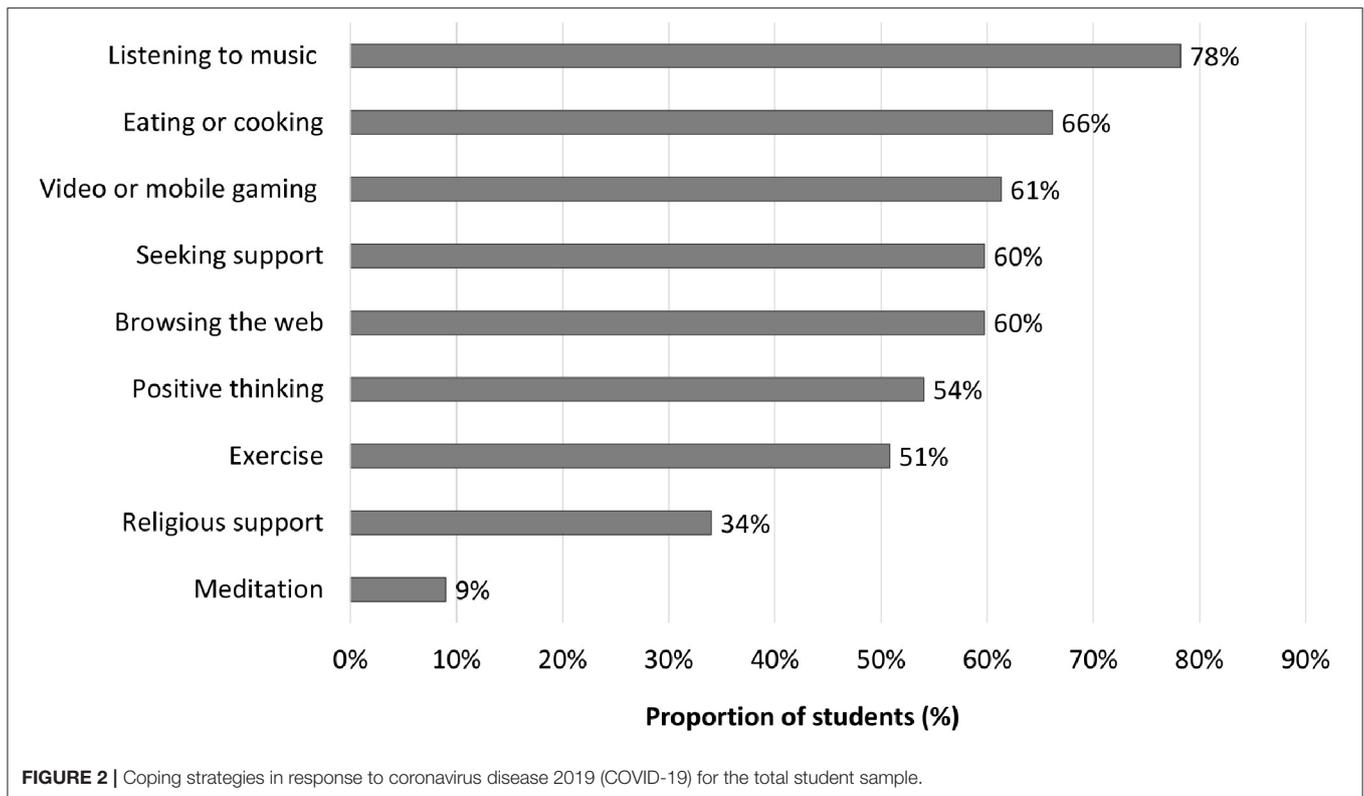
Mental Health Impacts

Of all students, 84.7% had moderate-to-high perceived stress, 12.1% had moderate-to-severe symptoms of anxiety and depression, and 17.7% had moderate-to-severe symptoms of insomnia (**Table 3**). Perceived stress level, severity of symptoms of anxiety and depression, and severity of symptoms of insomnia were significantly associated with each other (all $P < 0.001$) and stress from COVID-19-related stressors (**Table 4**).

Compared with returnees, stayers had significantly higher perceived stress [PSS-10: 22.6 ± 6.2 vs. 19.1 ± 6.1, β (95% CI): 4.039 (0.816, 7.261), $P = 0.02$, Cohen's d: 0.52] and more severe insomnia symptoms [ISIs: 11.8 ± 6.1 vs. 7.6 ± 5.2, β (95% CI): 3.087 (0.262, 5.912), $P = 0.03$, Cohen's d: 0.46], with moderate effect sizes (**Table 3**). No significant difference in severity of anxiety and depression symptoms (PHQ-4) between returnees and stayers was found.

Compared with males, females reported marginally significantly higher perceived stress [PSS-10: 20.6 ± 5.8 vs. 18.8 ± 6.9, β (95% CI): 2.212 (−0.140, 4.564), $P = 0.07$, Cohen's d: 0.35] with small effect size. However, no significant difference in severity of anxiety and depression symptoms and insomnia symptoms between males and females was found.

Coronavirus Disease 2019-Related Stressors Predicting Mental Health Impacts

Table 4 shows that stress from all COVID-19-related stressors was significantly associated with perceived stress level, severity

of anxiety and depression symptoms, and severity of insomnia symptoms (all $P < 0.05$), with the exception of stress from the economic impact of COVID-19, which was not significantly associated with the severity of insomnia symptoms ($r = 0.122$, $P = 0.18$).

For COVID-19-related stressors predicting mental health impacts, no statistically significant interaction effects of return status by sex were found (return status by sex interaction term: PSS-10, $P = 0.18$; PHQ-4, $P = 0.07$; ISI, $P = 0.22$). **Table 5** shows that stress related to academic attainment (adjusted $R^2 = 23.4\%$) was the most important predictor of perceived stress level (PSS-10), followed by lack of social support and uncertainties about academic program. Stress related to the changes in teaching/learning format (adjusted $R^2 = 9.9\%$) was the most important predictor of the severity of anxiety and depression symptoms (PHQ-4), followed by health of family and friends and availability of reliable information on COVID-19. The most important predictor of the severity of insomnia symptoms (ISI) was stress related to personal health (adjusted $R^2 = 5.7\%$), followed by uncertainties about the academic program.

Resilience, Family Functioning, and Mental Health Impacts

Resilience was significantly negatively correlated with lower perceived stress level (PSS-10: $r = -0.526$, $P < 0.001$), severity of anxiety and depression symptoms (PHQ-4: $r = -0.467$, $P < 0.001$), and severity of insomnia symptoms (ISI: $r = -0.328$, $P = 0.001$) (**Table 4**). Compared with males, females reported significantly lower resilience [CD-RISC-2: 5.6 ± 1.5 vs. 4.8 ± 1.6,

TABLE 6 | Resilience and coping strategies as predictors of mental health impacts identified by forward stepwise multiple regression analysis ($n = 124$).

	Change in adjusted R^2	Estimate (SE)	P-value
Dependent variable 1: perceived stress level (PSS-10)[1]			
Adjusted R^2 = 37.8%			
Sex, age group, ethnicity, country of study, country or region of residence, return status, education program level, program year, and field of study	8.0%	–	–
Resilience (CD-RISC-2)	27.0%	−2.058 (0.294)	<0.001***
Positive thinking	2.8%	−2.251 (0.908)	0.015*
Dependent variable 2: severity of anxiety and depression symptoms (PHQ-4)[2]			
Adjusted R^2 = 33.2%			
Sex, age group, ethnicity, country of study country or region of residence, return status, education program level, program year, and field of study	3.9%	–	–
Resilience (CD-RISC-2)	20.6%	−0.538 (0.094)	<0.001***
Eating or cooking	4.1%	0.977 (0.327)	0.003**
Exercise	2.5%	−0.643 (0.293)	0.030*
Positive thinking	2.1%	−0.605 (0.285)	0.036*
Dependent variable 3: severity of insomnia symptoms (ISI)[3]			
Adjusted R^2 = 31.5%			
Sex, age group, ethnicity, country of study country or region of residence, return status, education program level, program year, and field of study	14.6%	–	–
Resilience (CD-RISC-2)	9.5%	−1.097 (0.281)	<0.001***
Seeking support from family/friends	5.3%	−2.218 (0.966)	0.024*
Positive thinking	2.1%	−1.938 (0.912)	0.036*

[1]PSS-10: 10-item Perceived Stress Scale to measure perceived stress level; higher scores indicate higher stress level; range, 0–40.

[2]PHQ-4: 4-item Patient Health Questionnaire to screen for anxiety and depression symptoms; higher scores indicate more symptoms; range, 0–12.

[3]ISI: 7-item Insomnia Severity Index to assess the severity of insomnia symptoms; higher scores indicate more symptoms; range, 0–28. Forward stepwise multiple linear regression was used. The interaction effect between students' return status and sex was examined by forcing the interaction term of return status by sex, return status, sex, age group, ethnicity, country or region of residence, country of study, education program level, program year, and field of study into the regression models for adjustment of confounders. If the interaction term (return status by sex) was not statistically significant, the forward stepwise regression analysis was performed without the interaction term.

Considered independent variables included resilience (CD-RISC-2), family functioning (BAFFS), and coping strategies (listening to music, eating or cooking, video or mobile gaming, seeking support from family and friends, browsing the web, positive thinking, exercise, religious support, and meditation). Since the interaction term in the above analyses was not statistically significant, the above-presented models did not include the interaction term, and the change in adjusted R^2 was calculated from removal of each significant variable from the model.

***$P < 0.001$, **$P < 0.01$, *$P < 0.05$.

β (95% CI): −0.717 (−1.334, −0.100), $P = 0.02$, Cohen's d: 0.43] with small effect size. However, there was no significant difference in resilience between stayers and returnees (**Table 3**).

Family functioning (BAFFS; higher scores indicate greater distress) was significantly correlated with higher perceived stress level (PSS-10: $r = 0.258$, $P = 0.008$), severity of anxiety and depression symptoms (PHQ-4: $r = 0.234$, $P = 0.0161$), and severity of insomnia symptoms (ISI: $r = 0.251$, $P = 0.02$) (**Table 4**). No significant difference in resilience between stayers and returnees, as well as between males and females, was found (**Table 3**).

Resilience and Coping Strategies Predicting Mental Health Impacts

The top three most commonly used coping strategies among students during the COVID-19 pandemic were listening to music (78%), eating or cooking (66%), and video or mobile gaming (61%) (**Figure 2**).

Table 4 shows that eating or cooking was significantly positively associated with severity of anxiety and depression symptoms and insomnia symptoms. Positive thinking was significantly negatively associated with perceived stress and severity of insomnia symptoms. Exercise was significantly

positively associated with severity of anxiety and depression symptoms (all $P < 0.05$).

The return status by sex interaction term was not significant (interaction term: PSS-10, $P = 0.52$; PHQ-4, $P = 0.39$; ISI, $P = 0.52$) and was not included in the forward stepwise multiple regression analysis.

Table 6 shows that resilience was the most important predictor of mental health impacts [perceived stress (PSS-10), adjusted $R^2 = 27.0\%$; severity of anxiety and depression symptoms (PHQ-4), adjusted $R^2 = 20.6\%$; severity of insomnia symptoms (ISI), adjusted $R^2 = 9.5\%$]. Positive thinking, exercise, and seeking support from family and friends were coping strategies that were predictors of less severe mental health impacts.

DISCUSSION

Our study is the first study on stressors, coping strategies, and mental health impacts of COVID-19 in international students studying abroad. The findings showed that more than 80% of the students had moderate-to-high perceived stress. Stayers had higher stress related to personal health and lack of social support, perceived stress (PSS-10), and more ISIs than returnees;

and females had higher stress related to uncertainties about the academic program and lower resilience than males.

In the sample, stress related to academics (e.g., personal academic attainment, uncertainties about the academic program, and changes in teaching/learning format), health (personal health and health of family and friends), availability of reliable COVID-19-related information, and lack of social support were predictive of higher perceived stress level and more severe anxiety and depression symptoms. Resilience and positive thinking were important coping strategies against negative mental health impacts.

A high proportion of students in our sample had moderate-to-severe perceived stress, which is consistent with the fact that university students often fall within the age range when common mental health problems are at their developmental peak (20). Students' stress may be exacerbated by experiences during the COVID-19 pandemic. In particular, Sahu noted that the closure of universities during the pandemic may pose monetary and mental health challenges to international students, among other challenges (21). We also found that females had higher stress related to uncertainties about academic program during the COVID-19 pandemic. This is consistent with other findings in the literature: Liu et al. found significantly greater increases in the prevalence and severity of posttraumatic symptoms in females, compared with males, during the initial phase of COVID-19 (22). Besides, significant bivariate associations were found between female and fear, as well as with mental health consequences (anxiety and depressive symptoms) (23).

In mass media, some international students have reported high stress related to difficulties obtaining air tickets at high prices, travel risks and restrictions, the quarantine process (for those planning to return home), and employment to cope with basic living expenses (for those planning to stay in their institution country) during the pandemic (24). We found that lack of social support was an important predictor of students' mental health. This is consistent with others' findings that social support is negatively correlated with adverse mental health impacts (25). Stayers reported higher stress than returnees. This difference could be explained by differences in the stayers and returnees' experiences: while stayers resided in their institution countries where the pandemic situation was not yet under control, information appeared unreliable, masking was stigmatized, and COVID-19-related policies were criticized as suboptimal, returnees could join their families in their home country or region. Returnees would have felt safer as COVID-19 was perceived to be under better control in their home country or region, while stayers would have experienced greater stress related to social isolation under mandatory lockdown in their institution countries amid unreliable information and controversial policies.

Implications

Our work has important implications for academic institutions, clinical work, and public health. First, academic institutions, particularly those in the UK and USA, should increase their awareness of additional needs and potential mental health problems experienced by their students. International students already face stress related to the acculturation demands of studying abroad (26), and students' stress may be amplified during a public health crisis. Academic institutions should show more understanding and empathy toward these students, especially stayers. Course management needs to consider how best to relieve students' academic-related stress. Education and training for educators and mental health professionals on identifying risk factors and symptoms of mental distress from COVID-19 for better identification and management of students' mental health are advised.

Stayers may hesitate to seek support for emotional problems, fear stigma, and prefer to handle problems alone (27). Even if they are motivated to seek support, the lockdown regulations may have made the usual face-to-face student assistance and counseling services inaccessible. Educators, institutions, and mental health professionals need to proactively reach out to their students to understand their needs and provide assistance. Student support groups or counseling via e-platforms are urgently needed to help students alleviate mental health problems and provide social, psychological, and academic support.

Family functioning and resilience were reported to have a strong association with negative mental health impacts. Family functioning is one of the important aspects of the family environment, which affects the physical, social, and emotional health of individuals (28). Resilience is a protective factor that buffers from the effects of traumatic experience, which enhances individual adaptation and positively influences successful adaptation and coping (29). Besides, resilience, positive thinking, and exercise were identified as important coping strategies that predicted less severe mental health impacts in our study. Online mental health education and mindfulness-based interventions can help students enhance their resilience (30). Academic institutions should enact effective action plans to promote students' resilience through the official academic curriculum or unofficial student extracurricular activities that can be run under a lockdown or social distancing regulations.

In public health, frequent misinformation and rumors about viruses are common causes of distress (31). We have found that the availability of reliable information about COVID-19 was an important stressor for international students during the pandemic. Stronger collaboration between different parties, such as universities and health departments, could help with the timely delivery of precise and easy-to-understand information to the public, helping in turn with disease prevention and the implementation of precautionary measures.

Limitations

Our study had several limitations. First, while snowball sampling was an effective strategy to recruit suitable respondents efficiently and allowed the study to capture valuable data at the height of the pandemic, sampling bias could have arisen from respondents forwarding the survey to peers with similar traits and characteristics (12) and the small sample size. The fact that no incentives were offered to respondents for their participation might explain the limited number of respondents recruited. We also wished to stop recruiting earlier so that our results could raise the alarm and call for remedial actions as soon as possible.

Second and relatedly, the majority of the respondents (95%) were Asian, and our findings may not be applicable to other international students. Specifically, most of our respondents were students from Hong Kong studying in the UK. As the control measures for and the extent of the outbreaks of COVID-19 were different across countries, future studies should include international students across more countries and ethnicities. Finally, although the coping strategies included in our survey were strategies that may be popular among students, the list was not exhaustive, and popular strategies may not necessarily be the most effective strategies to protect against adverse mental health impacts. Further studies should investigate the efficacy of a more expansive series of coping strategies.

To conclude, the mental health impacts of COVID-19 on international students have been overlooked. We call on educators, academic institutions, and mental health professionals to provide appropriate support for their international students, particularly the stayers, during the pandemic.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Institutional Review Board of The University of Hong Kong/Hospital Authority Hong Kong West Cluster (reference number: UW20-298). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

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Psychological Impact of the COVID-19 Outbreak on Nurses in China: A Nationwide Survey During the Outbreak

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Background: The COVID-19 pandemic is a major public health issue and challenge to health professionals. In similar epidemics, nurses experienced more distress than other providers.

Methods: We surveyed both on-duty nurses caring for infected patients and second-line nurses caring for uninfected patients from Hubei and other provinces throughout China.

Results: We received completed surveys from 1,364 nurses from 22 provinces: 658 front-line and 706 second-line nurses. The median (IQR) GHQ-28 score of all nurses was 17 (IQR 11–24). The overall incidence of mild-to-moderate distress (GHQ score > 5) was 28%; that for severe distress (GHQ score > 11) was 6%. The incidence of mild-to-moderate distress in the second-line nurses was higher than that in the front-line nurses (31 vs. 25%; OR, 0.74; 95 CI, 0.58–0.94). Living alone (OR, 0.62; 95% CI, 0.44–0.86) and feeling supported (OR, 0.82, 95% CI, 0.74–0.90) independently predicted lower anxiety.

Conclusions: During the COVID-19 pandemic, the psychological problems of all nurses were generally serious. The interviewed second-line nurses face more serious issues than the front-line nurses.

Keywords: COVID-19, nurses, mental health, infectious disease, pandemic (COVID-19)

INTRODUCTION

The 2019 outbreak of the new coronavirus disease (COVID-19) in China is an epidemic threat and major public health issue (1). The World Health Organization (WHO) declared this outbreak a public health emergency of international concern on January 30, 2020 (2). As of March 4, 2020, COVID-19 had been spread to all provinces and regions of China and to 75 other countries. In some regions, the cumulative number of COVID-19 cases may continue to rise (3). This indicates that the epidemic may continue to worsen in some countries. The Chinese Center for Disease Control and Prevention (CDC) reported on February 17 estimated that more than 3,000 healthcare workers were infected with COVID-19 in China. Studies of Severe Acute Respiratory Syndrome (SARS) (4, 5), Middle Eastern Respiratory Syndrome (MERS-CoV) (6), and COVID-19 (7, 8) have reported that many healthcare workers including nurses caring for patients during these epidemics had distress, anxiety, and other mental health problems (9). Chen et al.'s (4) study showed that the SARS catastrophe affected the stress levels in the emergency department, and Khalid et al. (6) confirmed that the MERS-CoV outbreak was a distressing time for the medical staff. For example, during the SARS outbreak, many healthcare workers were stigmatized and shunned in their neighborhoods as a result of their jobs (10–12). Treating SARS patients led to mental health problems among many emergency department staff, with nurses experiencing the most stress, followed by doctors and healthcare assistants (13). Health workers in many countries involved in the treatment of COVID-19 have been under considerable pressure since the COVID-19 outbreak (14–17). Most of the medical workers fighting COVID-19 are nurses. As of February 9, 2020, an estimated 19,800 health care professionals, including 14,000 nurses, from across China have provided assistance to hospitals in Hubei province, especially Wuhan City (18). Nurses generally have long-term and close contact with suspected and confirmed COVID-19 patients. Under these conditions, the coping ability of many nurses begins to decline, a change often neglected by the healthcare system (6). Consequently, the mental health of nurses working with patients infected with COVID-19 need to be monitored and maintained through an epidemic. However, we have not found any article that focuses specifically on nurses' mental health during the COVID-19 outbreak. Samui et al.'s (19) findings suggested that COVID-19 would persist for a long time. We sought to describe the mental health of nurses in China during the COVID-19 outbreak.

METHODS

Study Design and Participants

Between February 11 and 18, 2020, during the COVID-19 outbreak, we conducted an online survey of nurses who were working during the COVID-19 outbreak in China, whether or not they were treating patients with COVID-19. The survey was approved by the Biomedical Research Ethics Committee, West China Hospital of Sichuan University.

We selected some nurses who we knew according to the inclusion criteria, and then we used snowball sampling in which the initial nurses recommended the survey to other nurses who in turn recommended the survey to more nurses (**Figure 1**). A message about the study and a guarantee of anonymity were sent to all responding nurses. We distributed a questionnaire by SO JUMP (a professional online questionnaire platform) to all invited nurses. The questionnaire was administered directly to the nurses who volunteered via WeChat (a kind of communication software that can forward files), or the questionnaires were given to the nurses by the volunteers (most of them were medical workers) via WeChat. All potential participants were informed about research purposes and good confidentiality. The questionnaire was anonymous and all data were kept confidential by a special researcher. Nurses were told that their participation was voluntary and that they could stop any time. Each received the survey only after verbal informed consent was obtained. To avoid duplicated submissions, the questionnaires were set for only one chance by WeChat. To ensure that respondents were part of the target population, the questionnaire QR code was sent only to those who met inclusion criteria.

The questionnaire could not be submitted until all questions had been answered. To eliminate questionnaires not filled carefully, questionnaires returned within 150 s were excluded from analysis to eliminate ineligible questionnaires.

The Questionnaire

The questionnaire was administered on-line and in Chinese, the native language of all respondents. It consisted of 86 questions in six parts: demographic information, sources of information and degree of concern about the epidemic, perceived sufficiency of information, anxiety-related behavior and perceived support, degree of distress, and coping strategies (**Table 1**). Degree of distress was measured with the validated Chinese version of the General Health Questionnaire-28 (GHQ-28), a 28-item self-report instrument developed to screen for the inability to carry out normal functions and to detect the appearance of new and distressing phenomena. The instrument measures four dimensions: depression, anxiety, social impairment, and somatic symptoms. The minimum clinically important difference and the minimal detectable change have not been determined (20). We ran a predictive test on 10 nurses. The result showed that it took 5 min on average to complete the questionnaire and 3 min at a minimum.

Statistical Methods

Data are summarized with means and standard deviations or medians and interquartile ranges and were analyzed with SPSS software (version 18.0; SPSS Inc., Chicago, Illinois). Alpha was set at 0.05, and all tests were two-tailed. Total GHQ scores can range from 0 to 28 and were calculated with the dichotomous scoring procedure (0–0–1–1). Scores between 5 and 10 defined mild-to-moderate distress, and scores of 11 or above defined severe distress (21). Scores on the four subscales (depression, anxiety, social impairment, and somatic symptoms) were summed to calculate the total score. Chi-square analyses, Wilcoxon rank-sum tests, and two sample two-tailed t-test assessed differences in basic characteristics, concerns, worries,

FIGURE 1 | The flow chart of questionnaires distribution and nurses selection. WeChat is a communication software that can forward files.
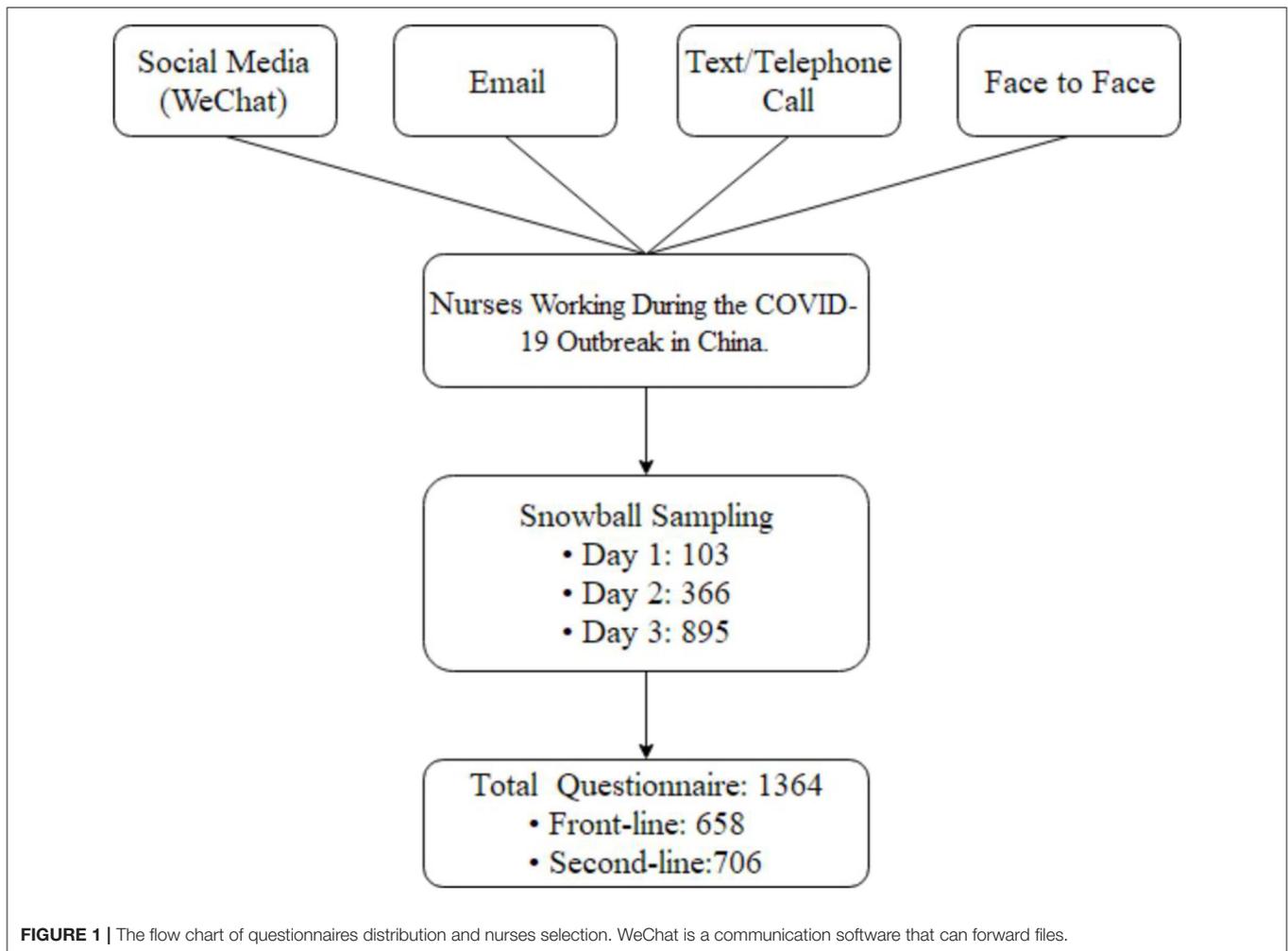
TABLE 1 | Characteristics of the questionnaire used to assess psychological distress.

Part	Dimension	Questions
1	Demographic characteristics	12 questions on age, sex, educational background, professional title, occupation, department, marital status, having children, and living alone)
2	Sources of information and degree of concern about the epidemic	10 questions, 5 dichotomous items, and 5 scored on a 9-point Likert scale (1 low; 9 high) on degree of concern and reasons for the concern
3	Perceived sufficiency of information	8 questions, 7 scored on a 9-point Likert scale (1 low; 9 high) and 1 on a 5-point scale on the degree of information desired about the pandemic (1 low; 5 high)
4	Anxiety-related behavior and perceived support	15 questions, 4 on worry, 11 dichotomous items about the adequacy of various forms of support, 3 of intended behaviors., and 1 about work satisfaction scored on a 9-point Likert scale (1 highly probable; 9 impossible)
5	Participants' level of distress	The Chinese version of the General Health Questionnaire-28 (GHQ-28), a 28-question measure of emotional distress in medical settings. Scores range from zero (no distress) to 84 (maximum distress)
6	Participants' coping strategies	13 questions on the frequency of coping behaviors. Participants endorsed how often they used a particular coping strategy scored on a 4-point Likert scale (0 never; 3 very often)

degree of worry, perceived sufficiency of information, GHQ-28 scores, and social support between front- and second-line nurses. We also reported odds ratios (OR) and 95% confidence intervals for dichotomous data, as well as mean differences and 95% confidence intervals for continuous data when comparing data from front-line and second-line nurses. Chi-square tests,

TABLE 2 | Demographic characteristics of All 1,364 Chinese nurses.

Characteristic	Total N = 1,364	Front-line nurses n = 658	Second-line nurses n = 706	P-value
Age, median (IQR), years	30 (27-34)	31 (2-34)	30 (26-35)	0.051
Women, n (%)	1,072 (79%)	507 (77%)	565 (80%)	0.18
Education background, n (%)				0.02
PhD	6 (0.4%)	4 (0.6%)	2 (0.3%)	
Master	40 (3%)	17 (3%)	23 (3%)	
Bachelor	1,032 (76%)	519 (79%)	513 (73%)	
College degree and others	286 (21%)	118 (18%)	168 (24%)	
Professional Title, n (%)				0.27
Advanced	75 (5%)	27 (4%)	48 (7%)	
Medium-grade	386 (28%)	209 (32%)	177 (25%)	
Primary	903 (66%)	422 (64%)	481 (68%)	
Years of service, median (IQR), years	8 (4-12)	8 (5-12)	7 (3–12)	0.04
Manager, n (%)	268 (20%)	125 (19%)	143 (20%)	0.56
Marital status, n (%)				0.95
Married	868 (64%)	420 (64%)	448 (63%)	
Unmarried	463 (34%)	223 (34%)	240 (34%)	
Divorced	33 (2%)	15 (2%)	18 (3%)	
Living with a child, n (%)	799 (59%)	383 (58%)	416 (59%)	0.79
Lives alone, n (%)	447/917 (33%)	233 (35%)	214/492 (30%)	0.045

Front-line nurses provided care for patients with the COVID-19 infection or suspected COVID-19 infection; second-line nurses did not.

two-sample Wilcoxon rank-sum tests, and Spearman's rank correlation analysis were used to assess associations between intended behaviors and worries and degree of worry about the COVID-19 pandemic. Unadjusted and multiple logistic regression analyses were conducted to explore factors associated with worries and distress (total GHQ scores above and below a score of 5), including demographic variables, participation in treating patients with COVID-19, social support, and coping strategies. Missing data were imputed with the sample mean for the variable.

RESULTS

Sample Description

By February 16, 2020, 1,364 questionnaires had been returned, all of which yielded valid data. There was no missing data. The 658 front-line nurses and 706 second-line nurses represented 22 provinces and regions in China (**Figure 1**). The distribution had no obvious regional concentration. Median age was 30.0 (IQR 28–34) years. About one-fifth were men (n = 292, 21%). Front-line nurses had significantly more years of education than second-line nurses and significantly more years of service (medians of 8 and 7 years, respectively). A third of all nurses lived alone, with significantly more front-line nurses than second-line nurses reporting living alone (**Table 2**).

Degree of Distress

Eighty-eight percent of the nurses worried that COVID-19 might pose a pandemic threat, which contributed to their distress. The

median anxiety score was about seven of nine for all nurses. Their most common concerns were the risk of infection in family members or relatives (92%), the risk of infection (89%), the risk of being isolated from family and society (77%), and the impact of their career planning (31%). Notably, the percentage of second-line nurses reporting distress was higher than that of the front-line nurses for all of these concerns. Similarly, median severity scores for becoming infected and being treated for the infection were significantly higher in second-line nurses than in front-line nurses (**Table 3**). Unadjusted logistic regression analysis showed that spinsterhood (OR = 0.704, P = 0.04), divorce (OR = 0.366, P = 0.02), living alone (OR = 0.605, OR = 0.003), and total support scores (OR = 0.814, P < 0.001) were significantly associated with less anxiety about the pandemic, but in the multivariable analysis, only living alone (OR = 0.616, P = 0.004) and social support (OR = 0.817, P < 0.001) were independently related to anxiety (**Table 4**).

Perceived Adequacy of Epidemic-Related Information

The front-line nurses' median scores estimating information for treatment and prevention were significantly higher. The clarity of the information provided by their departments about infection and prevalence of COVID-19 was scored 9 of 9 (IQR, 7–9), which was higher than the second-line nurses' 8 (IQR, 7–9; P = 0.02). First- and second-line nurses were in desperate need of health-related information. The median score for "your demand on health-related information" was 5 (IQR, 5–5; **Table 5**).

TABLE 3 | Sources of distress reported by 1,364 Chinese nurses during the COVID-19 pandemic.

Source of distress	Front-line nurses	Second-line nurses	P-value
	n = 658	n = 706	
	n (%)	n (%)	
I worry about the COVID-19 pandemic, n (%)	568 (86%)	631 (89%)	0.08
Degree of worry [median (IQR)] 1, low; 9, high	7 (5–9%)	7 (5–8%)	0.21
I mostly worry about			
The disease's danger, **n (%)**	571 (86.8%)	640 (90.7%)	0.02
The risk that family and relatives will be infected, **n (%)**	594 (90.3%)	666 (94.3%)	0.005
Isolation from family or social environment, **n (%)**	488 (74.2%)	557 (78.9%)	0.04
Damage to my future career development, **n (%)**	174 (26.4%)	252 (35.7%)	<0.001
Perceived risk for being infected by the COVID-19 [median (IQR)] 1, very low; 9, high	6 (4–8)	6 (5–7)	0.72
Being infected with the COVID-19 would have major consequences on my health [median (IQR)] 1, low; 9, high	6 (5–8)	7 (5–9)	0.001
The infection is difficult to treat [median (IQR)] 1, low; 9, high	5 (3–7)	5 (4–7)	<0.001
My department is well prepared for the COVID-19 pandemic [median (IQR)] 1, low; 9, high	7.5 (6–9)	7 (5–8)	<0.001

TABLE 4 | Analysis of influencing factors of that nurses are worried about the COVID-19 pandemic.

Variable	Univariate analysis (Logistic regression, Enter)		
	Beta	P	OR (95% CI)
Age, years	0.018	0.19	1.018 (0.991–1.046)
Sex	0.296	0.12	1.345 (0.925–1.956)
Education background			
PhD vs. College degree and others	−0.361	0.75	0.697 (0.079-6.143)
Master vs. College degree and others	−0.024	0.96	0.976 (0.359–2.657)
Bachelor vs. College degree and others	0.021	0.92	1.021 (0.684–1.524)
Professional title			
Advanced vs. primary	0.22	0.57	1.247 (0.584–2.662)
Medium-grade vs. primary	0.253	0.19	1.288 (0.880–1.884)
Service years	0.017	0.18	1.017 (0.992–1.042)
Whether a manager			
(Yes/No) (Yes = 1/No = 0)	0.302	0.18	1.352 (0.869–2.103)
Marital status			
Spinsterhood vs. Married	−0.35	0.04	0.704 (0.502–0.989)
Divorced vs. married	−1.005	0.02	0.366 (0.160–0.835)
Whether have a child (Yes/No) (Yes = 0/No = 1)	−0.298	0.07	0.742 (0.535–1.029)
Whether living alone (Yes/No) (Yes = 1/No = 0)	−0.503	0.003	0.605 (0.434–0.843)
Total support score	−0.206	<0.001	0.814 (0.736–0.899)

Outcomes of multivariate analysis showed that only living alone and social support were independently related to anxiety. [B, P, OR (95%CI)]: Whether living alone [−0.484, 0.004, 0.616 (0.441–0.860)]; Total support score* [−0.202, <0.001, 0.817 (0.739–0.903)].*

Anxiety and Social Support

Thirty-eight percent of nurses reported feeling isolated from family and friends as a result of high-risk exposure. The proportion of nurses feeling isolated was significantly higher in front-line nurses than second-line nurses (42 vs. 34%, OR, 1.45; 95% CI, 1.16–1.80). More than three-quarters of all nurses reported that the high risk of exposure at work limited their socialization. Only 20 (1.5%) nurses said that they might ask for leave from work for fear of infection. The top three sources of sufficient support were team spirit among colleagues (97%), support from friends and family (93%), and new work arrangements and clear guidelines for infection control (90%). The item "Had insurance and was compensated if infected at work" had the lowest sufficient support (74%). The proportion of nurses reporting sufficient support from all sources was higher in front-line than in second-line nurses and significantly higher for six sources. Total support points were significantly lower in second- than in front-line nurses (8.7 vs. 8.2; **Table 6**). Anxiety was significantly associated with "Feeling they were isolated from family and friends because of a high risk of infection" ($P = 0.005$) and to having to limit socialization because of this risk as well ($P < 0.001$; **Table 7**).

Psychological Distress

The incidence of mild-to-moderate distress (GHQ scores > 5) in all nurses was 28%, and the incidence in second-line nurses was higher than that in front-line nurses (31 vs. 25%; OR = 1.35, 95% CI, 1.06–1.71, $P = 0.01$). In addition, the incidence of severe distress (GHQ scores > 11) in all nurses was 6% but did not differ significantly between front- and second-line nurses (**Table 8**). Univariate logistic regression analysis showed that nurses who lived alone (OR, 0.72; 95% CI, 0.56–0.94), had closer first-line contact with COVID-19 infected patients (OR, 0.72; 95% CI, 0.54–0.94), and had higher support scores (OR, 0.77; 95% CI, 0.73–0.81) had lower incidence of mild-to-moderate distress. However, multivariable regression analysis showed that only higher support scores were independently associated with lower distress (OR, 0.77; 95% CI, 0.72–0.82; **Table 9**).

TABLE 5 | Perceived sufficiency of information about the COVID-19 pandemic and general health information needs.

Type of information	Total	Front-line	Second-line	P-value
	Median (IQR)	Median (IQR)	Median (IQR)	
I believe that I have heard sufficient information about (1, strongly disagree; 9, strongly agree)				
COVID-19 symptoms	8 (7-9)	8 (7-9)	8 (7-9)	0.67
COVID-19 prognosis	7 (6-8)	7 (6-8)	7 (5-8)	0.11
COVID-19 treatment	7 (5-8)	7 (6-8)	7 (5-8)	<0.001
COVID-19 infection route	8 (7-9)	8 (7-9)	8 (7-9)	0.79
COVID-19 preventive measures	8 (7-9)	8 (7-9)	8 (7-9)	0.04
I believe that my department provided clear information about the COVID-19 influenza pandemic (1, strongly disagree; 9, strongly agree)	9 (7-9)	9 (7-9)	8 (7-9)	0.26
Overall, the information I have heard about COVID-19 has been clear (1, strongly disagree; 9, strongly agree; five items Cronbach's alpha, 0.89)	8 (7-9)	8 (7-9)	8 (7-9)	0.02
General health-information needs for a disease I might contract (1, I prefer having no more information than needed; 5, I prefer as much information as possible)	5 (5)	5 (5)	5 (5)	0.89

DISCUSSION

On February 13, Hubei province announced 14,840 new confirmed cases of COVID-19 infection, a sharp rise from only a few days before. Sarkar et al.s' (22) study shows that isolation can effectively reduce the number of COVID-19 infections, and that quarantine, isolation, and prevention measures play a vital role in the progress of the epidemic. Therefore, a large number of medical workers are needed for epidemic prevention and control. This first severe wave of the COVID-19 pandemic outbreak led to an acute shortage of nurses. More than 20,000 medical workers from across the country are now coping with COVID-19; three-quarters of them are nurses, and of these, nearly 80% are women. Despite the fact that they regarded COVID-19 as a horrible danger, they continued to treat their patients. Activities to prevent and control coronavirus pneumonia in China are ongoing, which continues to put medical workers under great pressure. In the H1N1 and Ebola outbreaks, nurses were the most vulnerable health care workers (23, 24). Protecting the mental health of nurses is thus important for controlling the epidemic and for their own long-term health (25). Nurses have the most direct contact with COVID-19 patients and also provide direct medical interventions (26). We found that front-line nurses were more highly educated and had more experience than did the second-line nurses. Nurses who preferred going to the front line had higher seniority and education and were more likely to live alone. As a result, the front-line nurses differed from the second-line nurses because they had more experience with infectious diseases, a finding similar to that in Liu et al.s'(27) study of a Chinese medical team working in the Sierra Leone aid mission treating Ebola patients. Nurses in relation to the COVID-19 outbreak were stressed and worried that their friends and relatives might be infected. Both the front-line nurses and the second-line nurses were very worried about the COVID-19 outbreak. This was probably the main reason nurses felt stressed. The stress may change the nurses' career plans. The government

and their organizations had provided separate accommodation for the front-line nurses. But the second-line nurses are stressed more, so some of them chose to live apart from their family or to stay at the hotel after work at their own expense. The second-line nurses thought that their departments were ill-prepared for this new infectious disease. They were more worried about their health and thought the disease was difficult to control. The most frequent concern among 93% of nurses was that their families and friends would become infected, perhaps because their elder relatives might have chronic conditions, which is associated with more severe infections (28, 29). In addition, the pandemic began during the Spring Festival, the most important traditional festival in China, when people return to their hometowns. Many infections were asymptomatic. The second-line nurses were more likely to take care of them. If these patients were infected but asymptomatic, the second-line nurses were at high risk of infection. So, more of them worried about infecting their families and friends. In our survey, more than three-quarters of both first- and second-line nurses reduced their social interactions. The reason might be they did not know whether the patients they treated were infected, and most did not have adequate protective equipment (30). Lack of protective equipment increases the risk of infection and distress of front-line nurses (27, 31). Despite their own lack of protective equipment, some second-line nurses preferred that this equipment go to front-line nurses, who needed them more. Perhaps this might be the reason why the second-line nurses (Median = 7, [IQR 5–9]) were more worried about their health than the front-line nurses (Median = 6, [IQR 5–8]). Compared to the front-line nurses, the second-line nurses thought their departments unprepared for the pandemic, a perception that might be related to the shortage of protective equipment (32). Because avoiding patient contact and wearing personal protective equipment are the most effective ways to reduce the risk of infection (33, 34). Eighty-eight percent of the nurses thought the epidemic was dangerous. This proportion was much higher than 61% of the nurses worried

TABLE 6 | Presence of anxiety-producing behavior and social support among 1,364 Chinese nurses during the COVID-19 pandemic.

Behavior	All nurses	Front-line nurses	Second-line nurses	*P*-value
Isolation (I feel that my family members and friends avoid contacts with me, because I work in a "high-risk" environment), *n* (%)	517 (38%)	279 (42%)	238 (34%)	0.001
Restriction of Social Contacts (I have restricted my social contacts because my work environment is considered "dangerous"), *n* (%)	1,043 (77%)	509 (77%)	534 (76%)	0.46
Intended Work Avoidance (Lately I have been so concerned about the COVID-19 influenza that I would take a leave to avoid going to work), *n* (%)	20 (1.5%)	10 (1.5%)	10 (1.4%)	0.87
Sense of Duty (In an emergency situation due to the COVID-19 pandemic, how possible would it be to avoid your duties? (1, highly possible; 9, not at all possible), **Median (IQR)**	9 (8,9)	9 (8,9)	9 (8,9)	0.001
Support items (inadequate vs. adequate), *n* (%)				
Support from relatives	1257 (92%)	611 (93%)	646 (92%)	0.35
Appreciation from the community	1166 (86%)	587 (89%)	579 (82%)	<0.001
Protective facilities and temporary residential arrangements	1069 (78%)	542 (82%)	527 (75%)	0.001
Insurance and compensation	1011 (74%)	520 (79%)	491 (69%)	<0.001
Sense of coherence and team spirit	1322 (97%)	639 (97%)	683 (97%)	0.69
Gratitude from patients and their relatives	1135 (83%)	561 (85%)	574 (81%)	0.051
Clear infection control guideline	1231 (90%)	607 (92%)	624 (88%)	0.02
Frontline staff feedback reaching administrators	1174 (86%)	581 (88%)	593 (84%)	0.02
Counseling and psychological support from employer	1093 (80%)	547 (83%)	546 (77%)	0.007
Expressing opinions through staff unions or mass media	1090 (80%)	540 (82%)	550 (78%)	0.055
Other behaviors, *n* (%)	1044 (77%)	518 (79%)	526 (75%)	0.07
Total support score, Median (IQR)	10 (8,10)	10 (8,10)	9 (7-10)	<0.001

TABLE 7 | Association between "Worry about the COVID-19 pandemic" and anxiety-producing behaviors among 1,364 Chinese nurses during the COVID-19 pandemic.

Anxiety-Producing Behavior		Worry about the COVID-19 pandemic		*P-value*
		Yes, *n* (%)	**No,** *n* (%)	
Isolation (I feel that my family members and friends avoid contacts with me, because I work in a "high-risk" environment)	Yes	471 (39%)	46 (28%)	0.005
Restriction of Social Contacts (I have restricted my social contacts because my work environment is considered "dangerous")	Yes	942 (79%)	101 (61%)	<0.001
Intended Work Avoidance (Lately I have been so concerned about the COVID-19 that I would take a leave to avoid going to work)	Yes	19 (1.6%)	1 (0.6%)	0.53
Sense of Duty (In an emergency situation due to the COVID-19 pandemic, how possible would it be to avoid your duties?) (1, highly possible; 9, not at all possible)	Mean (IQR)	9 (8–9)	9 (8–9)	0.19

about the H1N1 pandemic (35). This might have something to do with the lack of clarity about the diagnosis and treatment of pneumonia (36). Second-line nurses thought COVID-19 was harder to treat than did the front-line nurses, and more second-line nurses (36%) thought that the epidemic would affect their careers more than did the front-line nurses (26%). This was related to the fact that front-line nurses took direct care of the diagnosed patents. Thus, they had direct access to information on diagnosis and treatment of COVID-19. At the second line, if a patient was suspected to be infected, she/he would be transferred to the front line. They had no contact with those confirmed to have COVID-19; however, they found it difficult to identify infected patients from the general patient population. In general, the second-line nurses were in more distress than we thought. Both front- and second-line nurses want more health information. There was no difference in the perception for symptoms, prognosis, and transmission of COVID-19 between the front-line nurses and the second-line nurses. This may be because the National Health Commission of the People's Republic of China requires all departments to share relevant data (37).

TABLE 8 | Scores on the Chinese version of the general health questionnaire-28 for identifying minor psychiatric disorders completed by 1,364 Chinese nurses during the COVID-19 pandemic.

Dimension	All nurses	Front-line nurses	Second-line nurses	*P*-value
Total score, median (IQR)	17 (11–24)	16 (10–23)	18 (11–24)	0.07
Mild distress (score >5), *n* (%)	378 (28%)	162 (25%)	216 (31%)	0.01
Severe distress (score >11), *n* (%)	75 (5.5%)	35 (5.3%)	40 (5.7%)	0.78

Scores range from zero (no distress) to 84 (maximum distress).

The front-line nurses knew more about the treatment of COVID-19 than did the second-line nurses because they were caring for these patients. And they were informed more about their health than were second-line nurses. But the second-line nurses thought that they knew more about the prevention of COVID-19 than did the front-line nurses. During the outbreak, China strengthened online medical services and telephone follow-up and arranged orderly treatment for non-emergency patients (38). For fear of infection, some people avoided hospitals as much as possible. Some second-line nurses said that they cared for fewer patients during the outbreak, so they spent time to learn more about prevention. They can communicate and share information on the Internet and over the phone, so the second-line nurses can get a lot of information about COVID-19. Therefore, how to share the latest information about the epidemic quickly needs to be addressed in future outbreaks of infectious diseases. The media may be a good choice. Current research suggests that media-induced fear regulation could be used as an important non-pharmaceutical intervention to alleviate the pandemic. And media influence plays an important role in the dissemination of useful information in a variety of ways (39). During the outbreak, almost all of the nurses volunteered to go to the front line to fight the outbreak. Very few nurses (1.5%) thought that they might take time off out of concern for the infection. Most nurses thought their working conditions were dangerous, and 77% limited their social contacts, as did medical workers during the 2003 SARS outbreak (40), and this percentage was much higher than 7% who limited their social contacts during the 2009 influenza virus and A/H1N1 outbreaks (35). In the COVID-19 emergency, nurses had little inclination to evade their duties. Front-line nurses were less likely to avoid their responsibilities than were second-line nurses. About one-third of nurses believed that family and friends avoided contact with them, and front-line nurses reported this avoidance more than did second-line nurses, possibly because they knew they were directly exposed to the virus. This distancing confirms the results of another study that showed spatial and social distance were important predictors of public attention to pandemics (41). The government and communities also restricted frequent visits and large gatherings to prevent the spread of the virus, which also limited the nurse's socialization and contact with family and friends. At the same time, the front-line nurses received more support (42). Especially in terms of "social gratitude," "hospital protection and arrangements of temporary accommodation," "whether to provide insurance and compensation when infected in the workplace," "new

work arrangements and clear guidelines for infection control," "receiving front-line works' feedback by administrative staff," and "psychological counseling for employees organized by superior management departments or hospitals." But there was no difference between front- and second-line nurses in "Support from relatives," "Sense of coherence and team spirit," "Gratitude from patients and their relatives," "Expressing opinions through staff unions or mass media." The front-line nurses got psychological intervention, including face-to-face, over the phone, or online. But we did not find one psychological survey about nurses involved in COVID-19, so we didn't know what evidence these interventions were based on. It was impossible to judge whether these interventions were beneficial to nurses. Medical workers experienced significant stress during infectious epidemics. We found that 28% of nurses reported mild-to-moderate distress and 6% reported serious distress. The proportion of nurses reporting mild-to-moderate stress (24%) was higher than that of nurses during A/H1N1 influenza pandemic. However, this proportion of nurses with severe distress was lower than that of the general hospital staff during the A/H1N1 influenza pandemic (9%) (35). The difference may be explained by the fact that this study was conducted after the A/H1N1 outbreak, whereas ours was conducted during the COVID-19 outbreak. Some of the nurses said that their main focus was on treating patients and had little time to think about other things. Researchers found the opposite in a study in Singapore among medical workers during the SARS outbreak. Whereas 30% of front-line nurses reported mild-to-moderate distress, 26% of second-line nurses reported mild-to-moderate distress (5). This difference may be explained by the higher number of infected patients and the larger size of the affected areas of the COVID-19 outbreak. Distress was mild-to-moderate in 28% of all nurses and severe in 6%. Second-line nurses reported more distress than did first-line nurses. Our analysis showed nurses who were unmarried or divorced, lived alone, and had higher support scores were less worried about the outbreak. So more attention should be paid to the nurses' concerns about a pandemic, who get married or live with their family. Every one-point increase in the total support score reduced the risk of distress by about 25%. Therefore, more support should be given to both front- and second-line nurses to reduce their distress. Some front-line nurses said they paid more attention to the patients than themselves, so we inferred that treating infected patients maybe was protective against distress. After the outbreak is over, the front-line nurses may be at increased risk for distress. Therefore, when the

TABLE 9 | Characteristics associated with psychological distress among 1,364 Chinese nurses during the COVID-19 pandemic.

Characteristic	Univariate analysis (Logistic regression,Enter)		
	B	P	OR (95%CI)
Age, years	0.009	0.33	1.009 (0.991–1.028)
Sex	0.109	0.47	1.115 (0.831–1.495)
Education background	0.359	0.68	1.432 (0.257–7.983)
PhD vs. College degree and others			
Master vs. College degree and others	0.433	0.23	1.543 (0.765–3.111)
Bachelor vs. College degree and others	0.103	0.50	1.109 (0.824–1.493)
Professional Title			
Advanced vs. Primary	0.055	0.84	1.056 (0.625–1.786)
Medium-grade vs. Primary	0.13	0.34	1.138 (0.875–1.482)
Years of experience	0.011	0.17	1.011 (0.995–1.028)
Management position	0.108	0.47	1.114 (0.830–1.495)
Marital status	−0.253	0.054	0.777 (0.601–1.004)
Unmarried vs. married			
Divorced vs. married	−0.446	0.30	0.640 (0.274–1.493)
Has a child (yes = 0/no = 1)	−0.115	0.35	0.892 (0.700–1.136)
Living alone (yes = 1/no = 0)	−0.323	0.02	0.724 (0.558–.940)
Whether to treat COVID-19 patients directly			
Less contact with the COVID-19 patients vs. no	−0.241	0.15	0.786 (0.565–1.093)
Frequent contact with the COVID-19 patients vs. no	−0.335	0.02	0.716 (0.543–0.943)
Support from relatives	−1.035	<0.001	0.355 (0.238–0.530)
Appreciation from the community	−1.132	<0.001	0.322 (0.237–0.439)
Protective facilities and temporary residential arrangements	−0.94	<0.001	0.391 (0.298–0.512)
Insurance and compensation	−1.035	<0.001	0.355 (0.275–0.460)
Sense of coherence and team spirit	−1.499	<0.001	0.223 (0.118–0.421)
Gratitude from patients and their relatives	−0.826	<0.001	0.438 (0.326–0.588)
Clear infection control guideline	−1.307	<0.001	0.271 (0.188–0.390)
Frontline staff feedback reaching administrators	−1.095	<0.001	0.334 (0.244–0.458)
Counseling and psychological support from employer	−1.045	<0.001	0.352 (0.267–0.464)
Expressing opinions through staff unions or mass media	−1.001	<0.001	0.368 (0.279–0.484)
Others	−0.75	<0.001	0.472 (0.362–0.616)
Total support score	−0.267	<0.001	0.766 (0.727–0.807)
Total score of stress coping strategies	−0.009	0.83	0.991 (0.912–1.077)

Only a low total support score was associated with distress on multivariable analysis.

outbreak is over, they may need early intervention to prevent and treat anxiety.

Limitations of the Study

The greatest limitation to our study was the use of snowball sampling. However, although we cannot say that the nurses who responded are a representative sample, the nurses who did respond provided clear evidence of distress and concerns, as well a perceived lack of information and social support. Another limitation but also a strength of the survey was that it was conducted during the COVID-19 outbreak. Our response rate was almost certainly affected by the fatigue and stress that accompanied continuous intensive work, and because the nurses were self-selecting, we cannot rule out response bias. We also had no baseline data against which to compare the outbreak.

CONCLUSION

During the COVID-19 epidemic, the nurses involved were under great psychological pressure and the second-line nurses were more stressed than the front-line nurses. Nurses who lived alone and felt supported had lower levels of anxiety. Nurses should be screened for psychological problems as part of the emergency epidemic prevention and control system, and appropriate interventions should be implemented as soon as possible during the epidemic.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Biomedical Research Ethics Committee, West China Hospital of Sichuan University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JH, LD, and GL designed the study. YLiu, LYe, KT, XA, FZ, XS, and CS recruited the respondents. LD, YLon, QG, YCh, YLin, and LYa collected and analyzed the data. YLiu, YLon, YCh, QG, and LYa drafted the manuscript. LD, JH, CS, YLin, YCa, YJ, and KL undertook a critical revision of the manuscript. All authors contributed to the article and approved the submitted version.

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Prevalence of Depression and Anxiety Symptoms of High School Students in Shandong Province During the COVID-19 Epidemic

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Background: The coronavirus disease 2019 (covid-19) has brought physical risks as well as psychological challenges to the whole world. High school students are a special group suffering from both the academic pressure and the threat of the epidemic. The present study aims to conduct an online survey to investigate the psychological status of high school students in Shandong Province.

Methods: Using a web-based cross-sectional survey, data was collected from 1,018 voluntary high school students assessed with demographic information, the Patient Health Questionnaire-9 (PHQ-9), the Generalized Anxiety Disorder-7 (GAD-7) and a self-designed online-study effect survey. Correlation analysis was performed to explore the relationships between depression symptoms, anxiety symptoms, and study effect.

Result: The prevalence of depressive symptoms, anxiety symptoms, and a combination of depressive and anxiety symptoms was 52.4, 31.4, and 26.8%, respectively, among high school students in Shandong Province during the COVID-19 epidemic. And from moderate to severe severity level, the rates of depressive symptoms and anxious symptoms were 17.6 and 4.6%. Female students exhibited a higher rate and severity of mental symptoms than male, and grade one senior high school students got a higher rate and severity of mental symptoms than the other two grades. Nearly half of the students were not satisfied with their online-study effect. The PHQ-9 score had a strong positive correlation with the GAD-7 score. Both the PHQ-9 score the GAD-7 score had a negative correlation with the study-effect survey score.

Conclusion: Quite a number of high school students suffered from depression and anxiety symptoms during the COVID-19 epidemic. Sufficient attentions should be paid, and necessary supports should be provided, to protect the mental health of this special group.

Keywords: COVID-19, high school students, depression, anxiety, mental health

INTRODUCTION

In January 2020, the coronavirus SARS-CoV-2 was identified as the cause of an outbreak of severe pneumonia, and was officially designated as the coronavirus disease 2019 (covid-19) by the World Health Organization (1). This public health emergency has been escalating and threatening the welfare of society and human beings globally. The spread of COVID-19 pandemic has swept across 210 countries and territories with over 3 million cases and 210 000 deaths reported by April 30th, 2020 (https://covid19.who.int/). Apart from the impact on physical condition, there is also evidence that the direct and indirect psychological and social effects of the COVID-19 pandemic are pervasive and could affect mental health now and in the future (2).

The SARS-CoV-2 may minimally infect children and adolescents (1), and even if get infected, they seem to experience less severe COVID-19 than adults, with few or no symptoms (3, 4). Generally, children and adolescents are healthy and do not require much health care outside of regular checkups and immunizations (5). However, a healthy mental state is very important for children and adolescents. Globally, depression is the fourth leading cause of disease and disability among adolescents aged 15–19 years, and the 15th for those aged 10–14 years (6). A meta-analysis of the prevalence of depressive symptoms in children and adolescents in China indicated that the reported point prevalence of depressive symptoms ranged between 4 and 41%, the pooled prevalence of depressive symptoms was 19.85% (7). In the meantime, anxiety is the ninth leading cause of disease and disability for adolescents aged 15–19 years and sixth for those aged 10–14 years globally (6). Previous Chinese studies have shown that the incidence of anxiety symptoms among Chinese adolescents ranges from 13.7 to 24.5% (8, 9).

High school students (usually aged 15–18 years old) in China are a special group. The Chinese National College Entrance Exam, known as "GaoKao," is the most important and the only criterion for entrance to Chinese universities, generating many depressive and anxious feelings to high school students, especially those grade three students (who are about to undergo this important test). The COVID-19 pandemic may worsen existing mental health problems among children and adolescents because of the unique combination of the public health crisis, social isolation, and economic recession (5). Furthermore, China has implemented country-wide school closures for over 3 months to prevent the spread of the epidemic. Students at all stages were home quarantined and could only accept online-study. Most of the students were more used to studying at school during their whole student career. They were hardly familiar with online study before. The changes of study environment and uncertain online-study effect may affect the students' mentality.

With the epidemic gradually kept under control, as of the start time of this research (May 1st), grade three high school students had been back to school for 2 weeks, while the other two grades were still in quarantine. Though the GaoKao has been postponed from June to July due to the COVID-19, the mental health of grade three students deserves to be concerned. The psychological status of grade one and grade two students should

not be ignored, either. To our best knowledge, few studies have focused on the psychological health of high school students in China during the COVID-19 epidemic. An online mental health survey on ordinary Chinese people indicated that adolescents had a higher incidence of depressive symptoms during COVID-19 than adults. Zhou et al. (10) conducted an online survey among Chinese students aged 12–18 years, and found that the prevalence of depressive symptoms, anxiety symptoms, and a combination of depressive and anxiety symptoms was 43.7, 37.4, and 31.3%, respectively, and female gender and higher grade might be risk factors for depressive and anxiety symptoms. In this present study, we aimed to concentrate our attention on the mental health as well as online-study effect of senior high school students in Shandong Province. We speculated that students with different genders and different grades would exhibit distinct psychological status.

MATERIALS AND METHODS

Subjects

We used a convenience sampling method to collect data in three high schools in Shandong Province from May 1st to May 7th, 2020. An online survey was conducted using a self-administered questionnaire delivered through the internet. The inclusion criterion was: high school students who voluntarily participate in the mental health assessments. Exclusion criteria were as follows: (1) present or previous history of other psychiatric or neurological illness or serious physical disease, (2) not in Shandong Province.

Measurement Tools

By using the questionnaire, we have obtained demographic and neuropsychological data from the respondents.

1. General demographic information: Basic information including grade, age, gender, current residence, and history of close contact to SARS-CoV-2 were acquired. This study was set to anonymous to protect the privacy of the students.
2. The Patient Health Questionnaire 9-item (PHQ-9): The PHQ-9 is used to measure depressive symptoms. PHQ-9 is a simple and efficient self-assessment tool for depression screening based on DSM-IV (11). Participants are asked to report the presence of nine problems, including depressive mood and interest decline. The response options are "not at all," "several days," "more than half the days," and "nearly every day," scored as 0, 1, 2, and 3, respectively. The total score indicates different levels of depressive symptoms: minimal/no depression (0–4), mild (5–9), moderate (10–14), or severe (≥ 15) (11–13).
3. The Generalized Anxiety Disorder scale (GAD-7): The GAD-7 scale is a recently developed 7-item tool based on DSM-IV criteria, which can easily screen anxiety symptoms (14). Participants are asked how often they were bothered by each symptom during the last 2 weeks, with a 4-point scale ranging from "not at all" (0 points) to "nearly every day" (3 points). The GAD-7 scale has been found to have good reliability among Chinese people (Cronbach's alpha = 0.90) (15, 16). The total score indicates different levels of anxious symptoms:

minimal/no anxiety (0–4), mild (5–9), moderate (10–14), or severe ($\geq$15).

4. The self-designed study-effect survey: This survey consists of ten questions, including (1). What do you think of the efficiency of the online-study during home quarantine compared with studying at school? Options: ①Higher; ②Almost the same; ③Lower. (2). How long do you study at home during quarantine every day? Options: ①More than 10 h; ②8–10 h; ③6–8 h; ④ <6 h. (3). Could you finish your homework on time? Options: ①Always; ②Often; ③Only sometimes; ④Never. (4). How is the interaction between you and your teachers during online-study compared with at school? Options: ①More interactive than before; ②Almost the same; ③Less interactive than before; ④Little interaction. (5) Are you disturbed by the external interference when studying at home during quarantine? Options: ①Never; ②Only sometimes; ③Often; ④Always. (6) Do you need parents' supervision on your study during quarantine? Options: ①Never; ②Only sometimes; ③Often; ④Always. (7) How much could you master from the online-study? Options: ①More than 90%; ②65–90%; ③40–65%; ④ <40%. (8). Are you tired of the online-study? Options: ①Never; ②Only sometimes; ③Often; ④Always. (9). Are you eager to study at school in a normal way? Options: ①Never; ②Only sometimes; ③Often; ④Always. (10). How is your relationship with your family during home quarantine? Options: ①Always harmonious; ②Not bad; ③Not quite good; ④Poor. For Question 1, each option represents 2 points, 1 point, 0 point, respectively. The options of remaining questions represent 3 points, 2 points, 1 point, 0 point, respectively, according to their own satisfaction of study-effect. We set the study-effect level based on the total score as follows: Excellent (>20), Good (16–20), Not good (11–15), or Poor ($\leq$10).

Investigation Approach

The Electronic "Questionnaire Star" tool (https://www.wjx.cn/) was used to send questionnaire and collect data from the participants. As a professional online survey platform, the "Questionnaire Star" has strengths in being efficient, costless, easy to learn and use, and has been applied in some investigations related to the Covid-19 Pandemic (10, 17, 18).

Statistical Analysis

The statistical analyses were performed using IBM SPSS Statistics (version 21.0; IBM, Armonk, NY, USA). The categorical variables were expressed as the frequency (%), while the continuous variables were presented as mean $\pm$ SD. Differences in scores between male students and female students were assessed using the Independent samples t-test. Differences in scores among three grades were assessed using the One-way ANOVA. Spearman's correlation coefficient, r, was used to evaluate the association between depression level, anxiety level, as well as study-effect survey scores for exploratory analysis. A two-tailed $P < 0.05$ was considered statistically significant.

TABLE 1 | Demographic characteristics of the sample.

Variables	All	Grade one	Grade two	Grade three
Total number	1,018	496	267	255
Gender				
Male, n (%)	473 (46.5)	232 (46.8)	122 (45.7)	119 (47.7)
Female, n (%)	545 (53.5)	264 (53.2)	145 (54.3)	136 (53.3)
Age (years)	16.61 ± 1.06	15.80 ± 0.68	17.04 ± 0.59	17.76 ± 0.63
Current residence				
City, n (%)	829 (81.4)	406 (81.9)	209 (78.3)	214 (83.9)
Rural areas, n (%)	189 (18.6)	90 (18.1)	58 (21.7)	41 (16.1)
History of close contact to SARS-CoV-2				
Yes, n (%)	8 (0.8)	3 (0.6)	3 (1.1)	2 (0.8)
No, n (%)	1,010 (99.2)	493 (99.4)	264 (98.9)	253 (99.2)

RESULT

Demographic Characteristics

A total of 1,020 senior high school students submitted their questionnaires, but two of them were excluded because the ages were fabricated. Finally, 1,018 qualified questionnaires were obtained, and the final recovery rate was 99.8%. The average age of the respondents was 16.61 ± 1.06 (years), 53.5% of them were female. The respondents all lived in Shandong Province; 81.4% lived in the city. Eight students got a history of close contact to SARS-CoV-2. We also classified the participants by grade. The detailed characteristics of the subjects were shown in **Table 1**.

Depressive Symptoms

In total, the prevalence of depressive symptoms was 52.4% from mild to severe. The rate of all students with moderate-to-severe depressive symptoms was 17.6%. The rate of severe symptoms was 4.4%. From the perspective of gender, the depressed rate and the PHQ-9 mean score of female students were higher than male students (55.6 vs. 48.6%, and 5.82 ± 4.69 vs. 5.12 ± 4.92, respectively). In terms of the grade, grade one students exhibited the highest depression rate (60.1 vs. 45.3% and 44.7%). The PHQ-9 mean score was also higher in grade one students than the other two grades (6.11 ± 4.90 vs. 4.92 ± 4.54 and 4.89 ± 4.75). The detailed results were shown in **Table 2**.

Among the ten depressive symptoms, the most common one is "Feeling tired or having little energy" (59.8%). The least common one is "Poor appetite or overeating" (31.1%). The detailed results were shown in **Supplementary Table 1**.

Anxious Symptoms

The rate of all students with mild-to-severe anxiety symptoms was 31.4%. The prevalence of anxious symptoms was 4.6% from mild to severe. The rate of severe symptoms was 1.1%. From the perspective of gender, female students got a higher rate of anxiety than male (35.0 vs. 27.3%). In terms of the grade, the depressed rate of grade one students was slightly higher than the other two grades (33.1 vs. 31.1% and 28.6%). Grade one students also got

Variables	Gender		P	Grade			P	All
	Male (n = 473)	Female (n = 545)		Grade one (n = 496)	Grade two (n = 267)	Grade three (n = 255)		(n = 1,018)
Mean score	5.12 ± 4.92	5.82 ± 4.69	0.021*	6.11 ± 4.90	4.92 ± 4.54	4.89 ± 4.75	0.0003**	5.49 ± 4.81
Minimal/	243 (51.4)	242 (44.4)		198 (39.9)	146 (54.7)	141 (55.3)		485 (47.6)
No depression								
Mild	158 (33.4)	196 (36.0)		196 (39.5)	82 (30.7)	76 (29.8)		354 (34.8)
Moderate	51 (10.8)	83 (15.2)		73 (14.7)	31 (11.6)	30 (11.8)		134 (13.2)
Severe	21 (4.4)	24 (4.4)		29 (5.8)	8 (3.0)	8 (3.1)		45 (4.4)
Mild to severe	230 (48.6)	303 (55.6)		298 (60.1)	121 (45.3)	114 (44.7)		533 (52.4)

PHQ-9, Patient Health Questionnaire 9-item.
*P < 0.05.
**P < 0.001.

Variables	Gender		P	Grade			P	All
	Male (n = 473)	Female (n = 545)		Grade one (n = 496)	Grade two (n = 267)	Grade three (n = 255)		(n = 1,018)
Mean score	2.90 ± 3.18	3.56 ± 3.28	0.001*	3.48 ± 3.48	3.20 ± 2.88	2.87 ± 3.12	0.048*	3.25 ± 3.25
Minimal/	344 (72.7)	354 (65.0)		332 (66.9)	184 (68.9)	182 (71.4)		698 (68.6)
No depression								
Mild	112 (23.7)	161 (29.5)		134 (27.0)	75 (28.1)	64 (25.1)		273 (26.8)
Moderate	11 (2.3)	25 (4.6)		24 (4.8)	5 (1.9)	7 (2.7)		36 (3.5)
Severe	6 (1.3)	5 (0.9)		6 (1.2)	3 (1.1)	2 (0.8)		11 (1.1)
Mild to severe	129 (27.3)	191 (35.0)		164 (33.1)	83 (31.1)	73 (28.6)		320 (31.4)

GAD-7, Generalized Anxiety Disorder scale.
*P < 0.05.

the highest mean GAD-7 score (3.48 ± 3.48). The detailed results were shown in **Table 3**.

Among the seven anxious symptoms, the most common one is "Being so restless that it is hard to sit still" (60.6%). The least common one is "Becoming easily annoyed or irritable" (26.9%). Nearly half (46.8%) of the students were not able to stop or control worrying. The detailed results were shown in **Supplementary Table 2**.

Comorbid Depression and Anxiety Symptoms

The prevalence of comorbid depressive and anxiety symptoms among the students was 26.8%. Female students got a higher rate than male (30.8 vs. 22.2%). Grade one students got a higher rate than the other two grades (30.6 vs. 24.7% and 21.6%). See **Table 4**.

Online-Study Effect Evaluation

Nearly half (47.4%) of the students were not satisfied with their online-study effect ("poor" or "not good" for the total score). Male students and female students were nearly the same, while grade three students felt better with their study effect than the other grades. More than half (56.9%) of them considered that the efficiency of the online-study during home quarantine was

lower than studying at school (Question 1). Nearly half (45.6%) of the students were always eager to study at school in a normal way (Question 9). Most of the students (85.0%) had a good relationship with their family during quarantine (Question 10). See **Table 5**, and **Supplementary Table 3** for more details.

Correlations Between Depressive Symptoms, Anxious Symptoms and Online-Study Effect

The PHQ-9 score had a strong positive correlation with the GAD-7 score in all students ($r = 0.709$, $P < 0.001$) (**Figure 1A**). The PHQ-9 score had a moderate negative correlation with the study-effect survey score ($r = -0.410$, $P < 0.001$) (**Figure 1B**), and the GAD-7 score had a weak negative correlation with the study-effect survey score ($r = -0.276$, $P < 0.001$) (**Figure 1C**).

DISCUSSION

This epidemiological survey indicated that during the COVID-19 pandemic, the prevalence of depressive and anxious symptoms of high school students in Shandong Province was 52.4 and 31.4% from mild to severe, respectively. The prevalence of comorbid depressive and anxiety symptoms was 26.8%. The PHQ-9 score

TABLE 4 | The rate of comorbid depression and anxiety symptoms in high school students.

Variables	Male (n = 473)	Female (n = 545)	Grade one (n = 496)	Grade two (n = 267)	Grade three (n = 255)	All (n = 1,018)
Comorbid depression and anxiety symptoms (Mild to severe)	105 (22.2)	168 (30.8)	152 (30.6)	66 (24.7)	55 (21.6)	273 (26.8)

TABLE 5 | The self-evaluation of online-study effect in high school students.

Variables	Gender		P	Grade			P	All
	Male (n = 473)	Female (n = 545)		Grade one (n = 496)	Grade two (n = 267)	Grade three (n = 255)		(n = 1,018)
Mean score	15.27 ± 4.67	15.68 ± 4.49	0.158	15.42 ± 4.51	14.92 ± 4.67	16.23 ± 4.54	0.004*	15.49 ± 4.58
Excellent	56 (11.8)	78 (14.3)		59 (11.9)	33 (12.4)	42 (16.5)		134 (13.2)
Good	185 (39.1)	216 (39.6)		201 (40.5)	89 (33.3)	111 (43.5)		401 (39.4)
Not good	160 (33.8)	178 (32.7)		167 (33.7)	97 (36.3)	74 (29.0)		338 (33.2)
Poor	72 (15.2)	73 (13.4)		69 (13.9)	48 (18.0)	28 (11.0)		145 (14.2)

*$P < 0.05$.

FIGURE 1 | Correlations between depressive symptoms, anxious symptoms and online-study effect. (A) Correlation between PHQ-9 and GAD-7. (B) Correlation between PHQ-9 and online-study effect. (C) Correlation between GAD-7 and online-study effect.
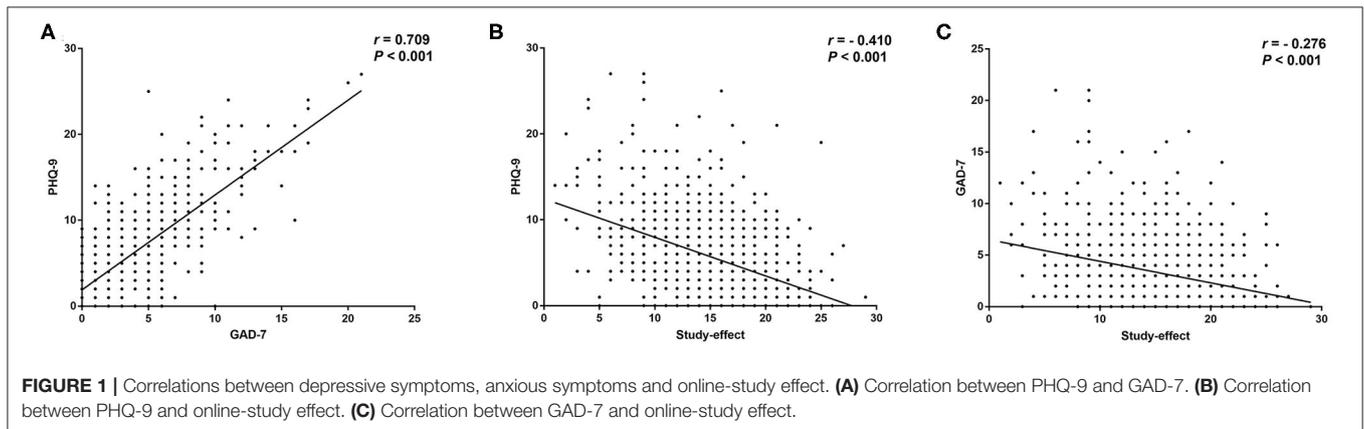
was strongly positively correlated with the GAD-7 score in all students. Girls and grade one students seem to be more likely to suffer from psychological problems. Nearly half of the students were not satisfied with their online-study effect facing with school closures, and were always eager to studying at school in a normal way. Our findings provided supplementary perspective to comprehensively understand the psychological status of Chinese populations during the COVID-19.

The prevalence of depression in this present study is higher than pre-COVID-19 times (7, 19). For students in a state of depression or anxiety, most of them were mild or moderate, and a few of them were severe. All the participants in this study were in Shandong Province, a place located on the east coast of China. As a relatively developed province, Shandong got the second largest population and the third largest gross domestic product (GDP) in China (http://tjj.shandong.gov.cn/). The urban population accounts for 60.58% of the total population (http://www.shandong.gov.cn). The population density is 634 people/square kilometer. The three high schools in this present study lie in the city so most of the students were urban residents.

Though the epidemic has been well controlled in Shandong Province with few confirmed cases and low mortality (787 confirmed cases and 7 deaths as of April 30th) in over one hundred million populations (http://wsjkw.shandong.gov.cn/), it still brings panic and pressure to general people, and fears and stresses might be contagious among family members. According to our GAD-7 results, 46.8% of the students felt "not able to stop or control worrying" and 33.4% felt "worried too much about different things." During the prolonged time of isolation, some families lost their source of income because of the epidemic. Economic downturns are associated with an increase in mental health problems for children and adolescents, which might be affected by the ways that economic downturns affect adult unemployment, adult mental health and child maltreatment (5). Students themselves might feel depressed and anxious about struggling to pay their tuition fees or maintain stability in their life (20). Furthermore, during quarantine, depressive and anxious symptoms are more likely to occur and worsen in the absence of interpersonal communication (21, 22). During adolescence, young people grow in independence and begin to prioritize

connections with peers over parents (23). Normal and healthy social activities are significant to stable emotions and good psychological status.

In our study, 47.4% of all students were not satisfied with their online-study effect at home. Correlation analysis indicated that the study-effect was closely related with their depressive and anxious symptoms. High school students were facing too much academic pressure from the college entrance examination (10, 24). According to our PHQ-9 and GAD-7 results, the most common depression symptom and anxiety symptom were "Feeling tired or having little energy" and "Being so restless that it is hard to sit still." This situation might be worsened due to school closures with unsatisfactory remote learning. As shown in our findings, 56.9% of the students considered that the efficiency of the online-study during home quarantine was lower than studying at school, 57.0% of them studied for <8 h at home every day (less than school days). Most of the students (71.0%) thought that the interactions between student and teacher were less than before or little interaction existed. Nearly half of the students were always eager to study at school in a normal way. The contradiction between pandemic school closures and the demands of studying normally might lead to aggravating mental health problems.

From the perspective of gender, both the depression and anxiety rate and the symptom severity of female students were higher than male students. This is consistent with former studies which found that female students have suffered from greater psychological impact, as well as higher levels of stress, anxiety, and depressive symptoms during the COVID-19 pandemic (10, 25). Previous studies indicated that stress exposure would increase rates of mental problems in adults, particularly in females (26), and females are also more susceptible to insomnia (27). Thus, female gender might be a higher risk factor for depression and anxiety symptoms specific for this study. When it comes to the grade, grade one students got a higher rate of depression and anxiety and severer symptoms than the other two grades. This is inconsistent with a previous study which demonstrated that the higher the grade, the greater the risk of depressive and anxious symptoms (10). This might be due to the heterogeneity of different samples. They conducted their study in March during the early outbreak of COVID-19. At the time we started to collect the data (May 1st), the epidemic had tended to be moderated and had been spread at a much slower pace. High schools in Shandong Province had been partially reopened with grade three students already went back to school normally for 2 weeks, while grade one and grade two students were still in quarantine and studying online. This might lead to a biased result. Besides, with the age growing older, the students could be better at managing pressures and regulating emotions. Some researchers found younger age might be potential risk factors for the psychological problems of the public during COVID-19 (16). This is also in line with the findings that psychiatric morbidities were associated with younger age and increased self-blame during the SARS outbreak (28).

Our findings could provide significant guidance for the development of psychological support strategies in high school students, especially during the period of school reopening.

High-risk groups such as female students and grade one student deserve special concerns. Attentions should also be paid to the potential effects on individuals such as posttraumatic stress disorder. The Ministry of Education of China has promoted several suggestions for protecting mental health in primary school, middle school and high school (http://www.moe.gov.cn/jyb_xwfb), mainly including improving the students' learning ability and adaptability in the new semester; evaluating mental status of teachers and students; identifying the immediate psychological needs for student individually; providing psychological interventions for students with psychological distress; relieving the teachers' pressures and guiding them to carry out teaching in an orderly way; strengthening communications between school and family, and assisting them to establish a harmonious relationship. In a word, the society, school and family should take up their responsibilities to maintain a healthy psychological status of students during the COVID-19 epidemic.

The COVID-19 epidemic brings physical risks and psychological challenges to high school students. Meanwhile, the pandemic offers an opportunity for young people to develop and hone their resilience and adaptability, and appreciate the value of social responsibility and self-sacrifice for the protection of the most vulnerable (23). We should recognize the efforts and contributions of them in this global crisis, and give sufficient attentions to their physical and mental health.

There are some limitations in this study to be addressed. Firstly, the samples were restricted in one province. Shandong is a relatively developed coastal province and most students were city residents. Our findings may not reflect the circumstances in broader regions. Secondly, a self-designed questionnaire for study effect was used, which might have a certain result deviation. Thirdly, due to the limitation of online questionnaire, the results were not always consistent with professional evaluation. Fourthly, it would be more meaningful to explore the students' family characteristics and possible correlation to their psychological status and requirement for high level education, as well as the association between the online study effect and teachers' mental health. Future studies may collect information including parental educational level, socioeconomic status, parental work and the teachers' psychological status to provide a comprehensive perspective. Fifthly, as a convenience sampling study through the internet, we didn't calculate the sample size for a more standard statistic. Last but not least, this was a cross-sectional study. It would be better to follow up the change of the students' psychological status to provide necessary support.

CONCLUSION

Our findings indicated that more than half of the high school students suffered from depressive symptoms, and nearly one-third of them suffered from anxious symptoms. And from moderate to severe severity level, the rates of depressive symptoms and anxious symptoms were 17.6 and 4.6%. Quite a number of them were not satisfied with their online-study effect

during quarantine, and the study effect was correlated with their psychological status. Sufficient attentions should be paid to the mental health of the high school students.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of the Jining Psychiatric Hospital. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2020.570096/full#supplementary-material

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A Key Factor for Psychosomatic Burden of Frontline Medical Staff: Occupational Pressure During the COVID-19 Pandemic in China

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The global outbreak of COVID-19 has severely affected the entire population, especially healthcare staff on the frontline, who bear heavy psychosomatic burdens. A cross-sectional study was conducted with 723 participants in China from April 26 to May 9, 2020. We evaluated the psychosomatic status, including depression, anxiety, quality of life, somatic symptoms, stress, sleep disturbances, and posttraumatic stress symptoms in different exposure groups. We explored the risk factors that affect psychosomatic burdens and analyzed the relationship between psychosomatic problems and medical occupations. We found that the psychosomatic burdens of medical staff were significantly greater than those of non-medical staff ($p < 0.01$) and were positively related with the number of COVID-19 patients they came in contact with. Occupational pressure was a key factor for healthcare staff's psychosomatic problems ($p < 0.01$ for quality of life, somatic symptoms, anxiety, depression, stress; $p = 0.012$ for sleep disturbances), and it had a strong canonical correlation ($p < 0.01$). Workload and time allocation (WTA), one of the subdimensional indicators of occupational pressure, was strongly correlated with psychosomatic indicators. We suggest that rationalization of WTA is a desirable approach for anti-epidemic medical employees to alleviate psychosomatic burdens. Public health interventions should be undertaken to reduce the occupational pressure on this special population, which is critical for mitigation. This study presents results regarding the psychosomatic burdens of the healthcare workforce related to occupational pressure and provides multilevel data with groups of different exposure risks for policymakers to protect medical personnel. These findings draw attention to the working environments of healthcare workers and provide applicable results for clinical practice.

Keywords: COVID-19, psychosomatic health, medical staff, risk factor, occupational health

INTRODUCTION

With the outbreak of coronavirus disease 2019 (COVID-19) in December 2019, China first entered a state of disease resistance in Wuhan, Hubei Province (1). Currently, the epidemic has broken out in more than 210 countries or territories. Globally, as of November 20, 2020, there have been 56 million confirmed cases of COVID-19, including 1.3 million deaths reported to WHO, and the number of cases is still rising (2).

COVID-19 is highly contagious, and no effective drug is currently available. Frontline healthcare providers are facing huge dilemmas with uncontrollably rising numbers, a risk of personally being infected, a lack of medical resources, the suffering of patients, etc. Any of these difficulties can affect their physical and mental health. Numerous articles evaluating the mental health of the general population and healthcare workers have been published, generally focusing on two to three psychological evaluation indicators, such as anxiety and depression (3–9). Some reviews combined samples and mental indicators from different surveys for more general conclusions (10–12). However, there is a paucity of studies identifying the potential sources of psychological problems. There was substantial heterogeneity ($I^2 = 99.7\%$, $p < 0.001$) (11) in the combined analyses of different studies. Comprehensive psychological analysis focusing simultaneously on psychological and somatic symptoms is still lacking.

To identify the major source of the medical staff's psychosomatic problems in order to provide targeted mitigation measures, we systematically and completely compared the degree of seven psychosomatic problems in the different exposure groups, explored the risk factors for psychosomatic burdens, and analyzed the relationship between psychosomatic problems and medical occupation.

METHODS

Study Design

An online questionnaire with the assistance of a questionnaire web platform (wenjuan.com) was completed by the participants (**Supplementary Figure 1**) from April 26 to May 9, 2020. The first part of the questionnaire included informed consent and demographic information, including age, sex, education, marital status, occupation, geographic location, mental problems before the outbreak, and working hours per day. Medical workers needed to answer additional questions including medical work experience, professional title, military personnel or not, department, antiepidemic experience, and hospital category. In the second part, we assessed psychosomatic problems during the peak period of COVID-19 in China using measurements of depression (Patient Health Questionnaire-9; PHQ-9 $\geq$5) (13), anxiety (Generalized Anxiety Disorder-7; GAD-7 $\geq$5) (13), quality of life (QOL; EuroQol visual analog scale; EQ-VAS) (14), somatic symptom load (Somatic Symptom Scale-8; SSS-8 $\geq$4) (15), stress (stress part of Depression Anxiety Stress Scales-21; DASS-stress $\geq$15) (16), sleep quality problems (Pittsburgh Sleep Quality Index; PSQI $\geq$5) (17), and posttraumatic stress

symptoms (Posttraumatic Stress Symptoms Checklist-10; PTSS-10 $\geq$5) (18), while observing medical staff's occupational pressure (adapted from Nurse Job Stressor Questionnaire; NJSQ) (19). These are all proven psychometric instruments, and the scoring standards and grades were also consistent with the routine. In the third part of the questionnaire, we evaluated PTSD during the survey period when the outbreak was basically under control.

This study focused on the occupational pressure of healthcare staff during the epidemic. The NJSQ was produced by adapting the sources of stress inventory developed by H. Wheeler and R. Riding (20), and it is widely used in China (19, 21). It consists of five subscales: professional and career issues (PC; 7 items), workload and time allocation (WTA; 5 items), resource and environment problems (REP; 3 items), patient care and interactions (PCI; 11 items), and interpersonal relationships and management problems (IRMP; 9 items), totaling 35 items (**Supplementary Table 1**). In our survey, the PC part (e.g., "you had little opportunity to further study") that medical staff would not encounter during the outbreak was excluded, and the word "nursing" was replaced with "healthcare service." Cronbach's alpha and Kaiser–Meyer–Olkin (KMO) values were 0.941 and 0.909, respectively. Thus, all of the evaluation tools in this study have high reliability and validity (**Supplementary Table 2**).

Respondents answered the questionnaire anonymously and could choose to quit at any time during the process. Questionnaires with any unfinished questions were not recorded. The questionnaire could only be answered once from each WeChat account, computer, or mobile device to ensure that no one could fill it out repeatedly. The sample size estimation was based on the rule of thumb that logistic models should be used with a minimum of 10 outcome events per predictor variable (10 EPV rule) (22–24). As many samples as possible were collected during the survey period even when the 10 EPV rule were satisfied.

Online informed consent was obtained from participants. The study was approved by the ethics committee of the 980th Hospital of the Chinese PLA Joint Logistics Support Force.

Data Collection

Nationwide participants were divided into medical staff (MS) and non-medical staff (NMS). According to the COVID-19 diagnosis and treatment plan formulated by the Ministry of Health, hospitals across the country were divided into different antiepidemic functions at the beginning of the outbreak by the health institutions in China. To fight against the pandemic, two specialized hospitals had been built in Wuhan to treat confirmed COVID-19 inpatients. Meanwhile, qualified hospitals had been designated as hospitals to treat fever patients, and the unselected hospitals (non-designated hospitals) did not accept fever patients. Therefore, the MS in different hospitals could be divided into three categories according to the number of COVID-19 patients they came into contact with: MS in the specialized hospitals on the frontline were the high-exposure group, MS in the designated hospitals were the low-exposure group, and MS in the non-designated hospitals were the non-exposure group.

To ensure collecting reliable data and valid response rate, the medical participants were mainly invited by researchers. Four types of data quality checks were conducted. First, questionnaires completed in <2 min were excluded from the analysis. Second, participants who had "severe" mental problems before the outbreak were excluded. Third, the questionnaire was set up with two repetitive questions. Participants who had different answers to the repetitive questions and the degree of difference was greater than two levels were excluded. Fourth, participants who were younger than 14 years old were excluded.

Statistical Analysis

The data were analyzed using SPSS version 25 (IBM, Armonk, NY, USA) software. χ^2 tests were used to compare group differences of categorical variables. Mann–Whitney tests or Kruskal–Wallis tests were used to compare two or more independent groups on continuous variables, which are non-normally distributed. Multivariate logistic regression analyses were used to select risk factors for psychosomatic problems. Canonical correlation analyses were used to explore the correlation between two sets of variables in the MS group. Significant difference was defined as two-tailed $p < 0.05$.

RESULTS

Summary of the Study Population

A total of 742 respondents completed the questionnaire, and 19 were excluded after quality control. The sample of this study was from more than 19 provinces in China. Four provinces with sample sizes >50 each were Hubei, Shānxi, Hebei, and Shanghai (**Supplementary Table 3**). Of the 723 participants, the majority were female (59.5%), married (66.9%), had a bachelor's degree (46.9%), lived outside Hubei (73.2%), had no previous mental problems (97.5%), working hours per day <4 (38.3%), and their mean age was 34.71 years (**Supplementary Table 4**).

Psychosomatic Problems in Different Exposure Groups

There was no significant difference in mental problems before the COVID-19 outbreak between the MS and NMS groups ($p > 0.05$) based on the questionnaire (**Supplementary Table 5**). **Table 1** shows that somatic symptoms, anxiety, depression, stress, and sleep disorders had higher scores, and QOL had lower scores in MS than NMS ($p < 0.01$) during the epidemic.

Furthermore, we analyzed the psychosomatic problems of the different categories of the MS. The results showed that the scoring trend was increasing in the assessment of somatic symptoms, anxiety, depression, stress, sleep quality problems, and occupational pressure, and was declining in QOL from the non-exposure group to the high-exposure group (**Table 2**). When compared with the high-exposure group, the non-exposure group showed significant differences in all of the variables above ($p < 0.01$), and the low-exposure group had significant differences in somatic symptoms ($p < 0.01$), anxiety ($p < 0.05$), stress ($p < 0.01$), sleep ($p < 0.01$), occupational pressure ($p < 0.05$), and QOL ($p < 0.01$). The somatic symptoms

($p < 0.01$) and occupational pressure ($p < 0.05$) scores of low-exposure group were significantly higher than those of the non-exposure group. Statistical differences in PTSS were not found among any of the groups.

Risk Factors for Psychosomatic Manifestations

To select independent risk factors from among all of the characteristic variables mentioned in the methods, multiple logistic regression analyses (**Table 3**) were performed. The results showed that occupational pressure was a risk factor for the decline in QOL in the medical group and was inversely related to the QOL scores [$p < 0.01$; odds ratio (OR) = 0.19; 95% CI, 0.07–0.49]. For MS's somatic symptoms, education ($p = 0.02$; OR = 1.77; 95% CI, 1.1–2.85), and occupational pressure ($p < 0.01$; OR = 8.08; 95% CI, 2.96–22.02) were risk factors, while living outside Hubei ($p < 0.01$; OR = 0.33; 95% CI, 0.16–0.66) was a protective factor. Being female ($p = 0.028$; OR = 2.31; 95% CI, 1.09–4.88) and occupational pressure ($p < 0.01$; OR = 10.94; 95% CI, 3.88–30.74) were risk factors for anxiety in MS, and education ($p < 0.01$; OR = 1.27; 95% CI, 1.08–1.5), location ($p < 0.01$; OR = 0.56; 95% CI, 0.4–0.78), and daily working hours (p < 0.01; OR = 1.31; 95% CI, 1.07–1.6) were factors related to anxiety in NMS. In the depression model, lack of prior antiepidemic experience ($p = 0.011$; OR = 2.14; 95% CI, 1.19–3.85) and occupational pressure ($p < 0.01$; OR = 12.43; 95% CI, 4.32–35.8) were risk factors, and living outside Hubei ($p = 0.013$; OR = 0.43; 95% CI, 0.22–0.83) was a protective factor among MS. Daily working hours ($p = 0.023$; OR = 1.28; 95% CI, 1.03–1.57) were a risk factor for depression in NMS. The stress of MS came from daily working hours ($p = 0.033$; OR = 1.65; 95% CI, 1.04–2.62) and occupational pressure ($p < 0.01$; OR = 6.67; 95% CI, 2.31–19.24), while for NMS, the stress came from sex ($p = 0.036$; OR = 1.99; 95% CI, 1.05–3.79). Three independent variables were influencing factors for MS's sleep disturbances: education ($p < 0.01$; OR = 2.29; 95% CI, 1.46–3.61), location ($p < 0.01$; OR = 0.21; 95% CI, 0.11–0.41), and occupational pressure ($p = 0.012$; OR = 3.54; 95% CI, 1.32–9.49).

Relationships Between Occupational Indicators and Psychosomatic Indicators of MS

Canonical correlation analyses (**Figure 1**) were used to explore the correlations between the occupational indicators (WTA, REP, PCI, and IRMP) and the psychosomatic indicators. The correlation between the first pair of canonical variate groups was maximized (correlation coefficient $\lambda_1 = 0.674$, Wilks' lambda = 0.395, $F = 6.190$, $p < 0.01$). The origin variable that has a large absolute value of canonical load (CL > 0.5) means it has a large role in the variable set, and the greater the value, the more its contributions will be. The sign of the variable coefficient determines the direction of the relationship.

The canonical load of the variables indicated that the sequence of contributions to the synthetic variate of the occupational pressure was WTA, REP, PCI, and IRMP (with CL = 0.913, 0.867, 0.810, and 0.591). Besides, the canonical load of anxiety,

TABLE 1 | Comparison of psychosomatic problems between medical staff (MS) and non-medical staff (NMS).

Variables	NMS	MS	Total
	(n = 552)	(n = 171)	(n = 723)
QOL	79.41 ± 24.18	75.57 ± 22.51**	78.5 ± 23.84
Somatic Symptom	1.73 ± 2.70	4.14 ± 4.45**	2.30 ± 3.36
Anxiety	3.77 ± 3.70	5.65 ± 4.31**	4.21 ± 3.93
Depression	3.34 ± 4.09	4.63 ± 4.27**	3.64 ± 4.17
Stress	5.50 ± 7.33	7.85 ± 7.52**	6.06 ± 7.44
Sleep	4.26 ± 3.54	6.73 ± 4.29**	4.84 ± 3.87
PTSS	1.47 ± 2.21	1.47 ± 2.26	1.47 ± 2.22

*Compared with NMS, **p < 0.01.*

TABLE 2 | Comparison of psychosomatic indicators and occupational pressure between different exposure groups in medical staff (MS).

Variables	High-exposure group (n = 72)	Low-exposure group (n = 51)	Non-exposure group (n = 48)
QOL	70.85 ± 21.22	78.90 ± 21.82**	79.13 ± 24.24**
Somatic symptom	6.32 ± 4.65	3.51 ± 4.24**	1.54 ± 2.31**##
Anxiety	7.08 ± 4.23	5.31 ± 4.18*	3.85 ± 3.89**
Depression	5.60 ± 4.21	4.37 ± 4.28	3.44 ± 4.09**
Stress	10.08 ± 7.14	7.02 ± 7.24**	5.38 ± 7.56**
Sleep	8.88 ± 3.94	5.27 ± 3.57**	5.04 ± 4.15**
PTSS	1.22 ± 2.04	1.57 ± 2.54	1.75 ± 2.26
Occupational pressure	8.06 ± 1.91	7.16 ± 2.56*	6.05 ± 2.05**#

*Compared with high-exposure group, *p < 0.05, **p < 0.01.*
Compared with low-exposure group, #p < 0.05, ##p < 0.01.

TABLE 3 | Outcomes of psychosomatic problems.

Variables	NMS		MS	
	p-value	OR(95% CI)	p-value	OR(95% CI)
Models for QOL	No variables were entered			
Occupational pressure		–	<0.01	0.19(0.07, 0.49)
Models for Somatic Symptom	No variables were entered			
Education		–	0.02	1.77(1.1, 2.85)
Location			<0.01	0.33(0.16, 0.66)
Occupational pressure			<0.01	8.08(2.96, 22.02)
Models for Anxiety				
Education	<0.01	1.27(1.08, 1.5)		–
Location	<0.01	0.56(0.4, 0.78)		
Working hours per day	<0.01	1.31(1.07, 1.6)		
Sex		–	0.028	2.31(1.09, 4.88)
Occupational pressure			<0.01	10.94(3.88, 30.78)
Models for Depression				
Working hours per day	0.023	1.28(1.03, 1.57)		
Anti-epidemic experience		–	0.011	2.14(1.19, 3.85)
Location			0.013	0.43(0.22, 0.83)
Occupational pressure			<0.01	12.43(4.32, 35.8)
Models for Stress				
Working hours per day		–	0.033	1.65(1.04, 2.62)
Sex	0.035	1.99(1.05, 3.80)		–
Occupational pressure		–	<0.01	6.67(2.31, 19.24)
Models for Sleep Quality	No variables were entered			
Education		–	<0.01	2.29(1.46, 3.61)
Location		–	<0.01	0.21(0.11, 0.41)
Occupational pressure			0.012	3.54(1.32, 9.49)
Models for PTSS	No variables were entered			

stress, somatic symptoms (SS), sleep disturbances, depression, and QOL showed that they were the primary contributors (with CL = 0.887, 0.838, 0.835, 0.809, 0.774, and 0.556) to the synthetic variate of psychosomatic burdens. All occupational indicators were positively correlated with other psychosomatic indicators except a negative correlation with QOL.

DISCUSSION

COVID-19 has resulted in an unprecedented international public health response and attracted attention around the world. Compared to the general population, healthcare workers are being confronted with dire challenges. Recent studies suggest that the pandemic has caused a high prevalence of anxiety and depression among the adult population, especially among medical workers (3–12). Additionally, some studies have explored the risk factors (e.g., sex, region) of different populations in addition to performing prevalence evaluations (25–28). However, the source of psychological problems and the impact of medical occupation on psychological indicators during the pandemic are not scientifically understood.

Our data showed that the mean QOL scores of the frontline MS and NMS were 70.85 and 79.41, respectively, during the outbreak of COVID-19, both lower than the score of the general population (85.4) (14) before the epidemic. Interestingly, the more COVID-19 patients the MS were exposed to, the higher their scores of somatic symptoms, anxiety, depression, stress, and sleep disorders, and the frontline MS had the highest scores. Compared to the NMS, the stress score nearly doubled in the non-exposure MS, while there was no significant difference for it or for other indicators (**Supplementary Table 6**). Such insignificantly different levels of psychosomatic problems between NMS and non-exposure MS indicate that the occupational difference itself may not result in psychosomatic differences. Future studies with a larger sample size are needed to validate this discovery. In our study, a significant difference in PTSD related to COVID-19 between MS and NMS was not found. However, PTSD should not be ignored, as the proportion of MS with PTSD was 13.5%. A systematic review reported that the prevalence of PTSD ranged from 3% (2–4%) to 16% (15–17%) among healthcare workers (11), similar to the results of our study. A previous study showed that approximately 10% of hospital employees had SARS-related PTSD in Beijing during the 3 year period following the outbreak (29). The prevalence of PTSD varies in different studies and may be related to regions, populations, duration of the pandemic, etc.

FIGURE 1 | The first pair of canonical correlation variables.
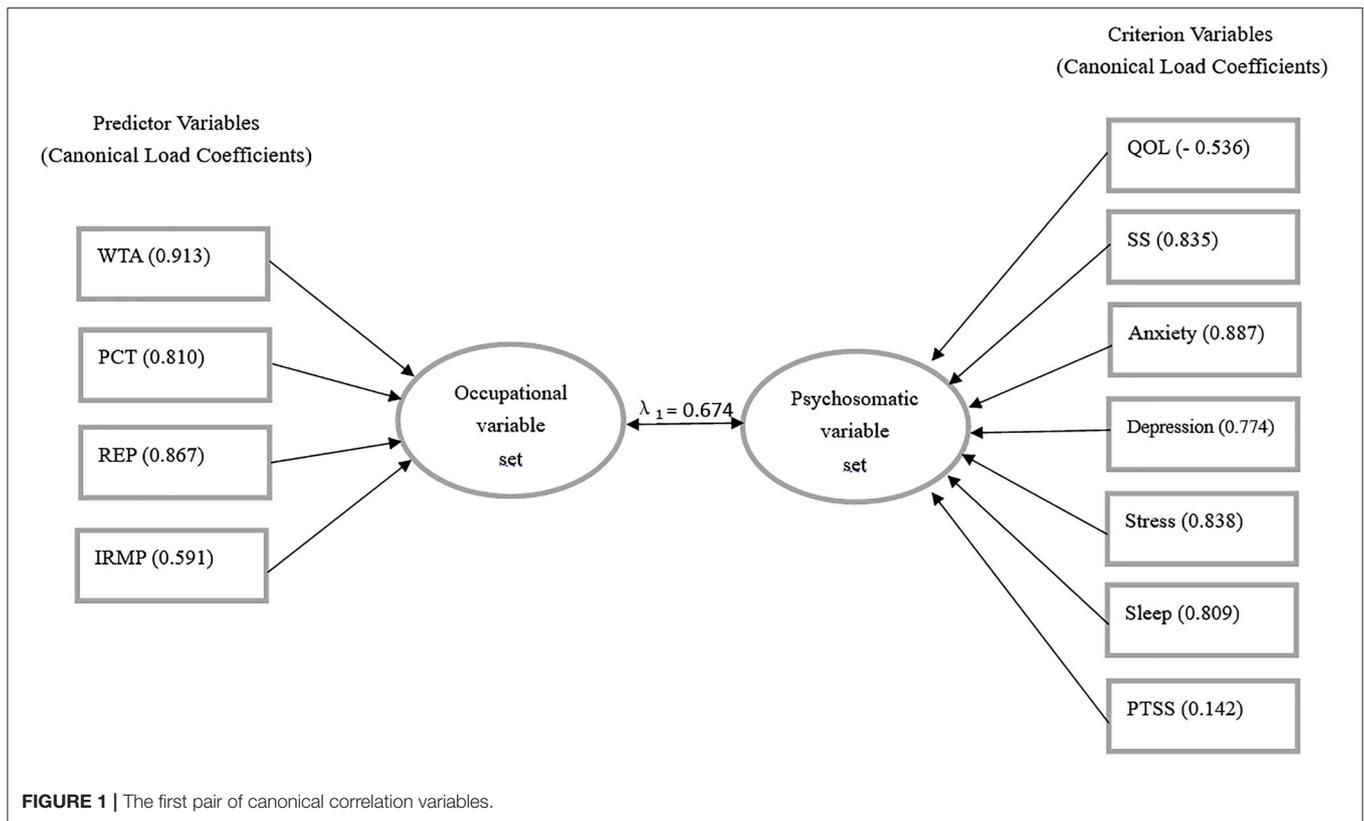
Occupational pressure was the critical risk factor for all statistically significant psychosomatic indicators of MS during the epidemic. Longer working hours per day resulted in a longer exposure to public environments and a higher infection risk, which contributed to NMS's anxiety and depression. Location was a risk factor because Wuhan and other cities in Hubei were the hardest-hit areas. People who are closer to the epidemic center are more likely to bear psychological pressure. Education was a risk factor for somatic symptoms and sleep quality among MS and anxiety among NMS. People with a higher education are more aware of the characteristics (completely unknown, highly contagious, and no available drugs) of COVID-19. Women were more prone to anxiety and stress, which is consistent with a previous research (30). When we carried out an in-depth exploration of the risk factors in the three exposure subgroups of the medical staff, we found that prior antiepidemic experience was also very important for frontline medical staff ($p = 0.046$ for QOL; $p = 0.19$ for somatic symptoms; $p < 0.01$ for depression, **Supplementary Table 7**). That is, the medical staff who have experienced the outbreak of other epidemics were able to deal with the psychosomatic problems better in the harsh environment of frontline health care.

Finally, the results of the canonical correlation analyses validated the evidence of the psychosomatic harms of exposure to occupational pressure. This study also revealed the key variables of the subdimensions of occupational pressure in the

relationship between occupational pressure and psychosomatic well-being. The analytical results showed that the variables of WTA and REP ranked in the top 2 in influencing psychosomatic burdens. However, previous studies usually did not consider these relationships (3–12, 25–28, 31). Our study presented the correlations between four subdimensions of occupational pressure and the degree of seven psychosomatic burdens, which prompted us to seek reliable solutions from WTA and REP: (a) to reduce the workload, (b) to increase the number of frontline medical staff, (c) to give sufficient time for medical work and to reduce other non-medical work, (d) to improve the working environment, (e) to increase the supply of medical equipment, and (f) to reduce congestion in the wards. WTA, REP, and PCI in the high-exposure group were significantly higher than those in the non-exposure group. These subdimensional differences in occupational pressure indicators should be given more attention among frontline medical staff, and the higher WTA in the low-exposure group should not be ignored (**Supplementary Table 8**).

This study divided medical staff into subgroups according to their exposure risk, which is particularly important for the hardest hit countries since the workload of medical staff soars due to the pandemic. Recent meta-analyses found that the prevalence of anxiety and depression was similar between healthcare workers and the general public (11, 28), while other studies revealed that healthcare workers had a higher prevalence of anxiety and depression (9, 31). The contradictions among these studies may

be caused by sampling bias or a failure to properly distinguish exposure groups. The significant difference in psychosomatic indicators between the MS and NMS groups and the insignificant difference in these indicators between the non-exposure MS and NMS groups in our study could reconcile the controversy in previous studies. However, several limitations of this study merit discussion. First, selection bias could exist due to the use of an online survey. Although we carried out very strict *post hoc* quality control in the investigation process, potential sample bias could still exist. Second, the long-term mental health implications can hardly be inferred from our cross-sectional study. Future longitudinal studies would be designed prospectively with follow-up observations of psychological status over time.

In summary, antiepidemic MS all bear heavy psychosomatic burdens in different countries during the COVID-19 epidemic. Our findings demonstrate that the psychosomatic burdens of MS are more serious than those of NMS and increase with the number of COVID-19 patients they take care of. We emphasize that supervisors should not ignore these people's somatic symptoms, anxiety, depression, stress, sleep disorders, and PTSD, especially among the frontline healthcare workers.

Importantly, we also showed that among all risk factors, occupational pressure is a key factor for healthcare staff's psychosomatic problems during the pandemic. Reducing occupational pressure is critical for relief. The variables WTA and REP play the main roles in influencing psychosomatic burdens. Seeking reliable solutions from the findings will be useful to guide public health and professional environment response measures worldwide. It is expected that policymakers will pay attention and provide recovery programs to the MS, especially in this difficult period.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The ethics committee of the 980th Hospital of the Chinese PLA Joint Logistics Support Force. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

JY and LK conceived the research, designed the questionnaire, and wrote the manuscript. JY, LK, and JG promoted the collection of data to ensure the reliability of the data. JY, LK, and JL conducted data analysis. JG and JL supervised the project and revised the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2020.590101/full#supplementary-material

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Perceived Stress, Hope, and Health Outcomes Among Medical Staff in China During the COVID-19 Pandemic

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This study investigated the buffering role of hope between perceived stress and health outcomes among front-line medical staff treating patients with suspected COVID-19 infection in Shenzhen, China. In the cross-sectional study with online questionnaires, medical staff's perceived stress, anxiety, depression, sleep quality, and hope were measured by the 10-item Chinese Perceived Stress Scale, Hospital Anxiety and Depression Scale, the Pittsburgh Sleep Quality Index, and the Locus-of-Hope Scale, respectively. A total of 319 eligible front-line medical staff participated. The prevalence of anxiety (29.70%), depression (28.80%), poor sleep quality (38.90%) indicated that a considerable proportion of medical staff experienced mood and sleep disturbances during the COVID-19 pandemic. Internal locus-of-hope significantly moderated the effects of stress on anxiety, depression, and sleep quality. Moreover, external family locus-of-hope and external peer locus-of-hope significantly moderated the association between perceived stress and depression. The prevalence of symptoms indicates that both mental and physical health outcomes of front-line medical staff deserve more attention. Internal and external locus-of-hope functioned differently as protective factors for medical staffs' health and might be promising targets for intervention.

Keywords: perceived stress, locus-of-hope, anxiety, depression, sleep quality

INTRODUCTION

The Coronavirus Disease 2019 (COVID-19) has been spreading in many parts of the world since December 2019, including in some provinces of China. In January 2020, the government of Guangdong Province launched the level one response toward this major public health emergency. Shenzhen, as a city in Guangdong Province with a large number of migrant workers moving from other cities in China, responded rapidly and formulated emergency plans for epidemic control. Chinese central government further issued a number of documents calling for attention to the mental health of medical staff (1).

Our department of medical humanities had been providing on-site psychological support for front-line medical staff in a tertiary hospital in Shenzhen from the end of January to the end of March of 2020. This tertiary hospital is a designated hospital treating patients with suspected COVID-19 infection in Shenzhen. Once the patients waiting in the quarantine ward were further diagnosed as COVID-19 pneumonia, they would be immediately sent to the only one infectious disease hospital in Shenzhen. Front-line medical staff in this tertiary hospital have been exposed to multiple stress sources, such as the risk of contracting COVID-19, wearing protective equipment for continuously 4–6 h, increased workload, shift work together with social isolation during the rest period.

In interviews with the front-line medical staff in this tertiary hospital, anxiety, depression and poor sleep quality were three main themes reported by most of the staff. This is consistent with previous research that high prevalence rates of depression, anxiety, and poor sleep quality existed among front-line medical staff (2–6). A meta-analysis focusing on depression, anxiety, and insomnia among medical staff during the COVID-19 pandemics extracted thirteen studies, of which twelve were undertaken in China and one in Singapore (7). This study revealed that researchers utilized various measures in evaluating mood and sleep disturbances of medical staff fighting COVID-19 pandemic. A pooled prevalence of anxiety, depression, and insomnia was reported as 23.2% in 12 studies, 22.8% in 10 studies, and 38.9% across four studies, respectively. Based upon the findings of interviews and the COVID-19 related empirical literature, it could be concluded that anxiety, depression, and sleep quality are three common health indicators. Furthermore, we want to explore whether it is stress caused by COVID-19 that predicts depression, anxiety, and sleep.

Both front-line battle and quarantine are stressful life events for healthcare workers (8). Anxiety and depression often develop following stressful life events (9–11). Previous research shows that stressful situations at work contributes to anxiety and depression among hospital staff (12). Therefore, it is logical to speculate that perceived stress will be positively associated with anxiety and depression among the front-line medical staff in the context of COVID-19 pandemic.

Sleep problem has been identified as another health consequence of stress (13, 14). A longitudinal study reveals that reductions in perceived stress correlate significantly with improvements in sleep quality (15). During the COVID-19 pandemic, worldwide researchers focus on sleep quality as an important health indicator [e.g., (5, 16–18)]. Yet, these studies hardly directly tested the correlation between stress and sleep quality in the population of front-line medical staff. We aim to explore the relation between stress and sleep quality among the front-line medical staff. And we posit that perceived stress will predict medical staff's poor sleep quality.

More importantly, it is worth noting that there are also some medical staff who did not report poor sleep quality nor feelings of anxiety/depression. Individual differences in psychological strengths may explain the variability in how medical staff had been coping with the perceived stress and thereby influence their physical and mental health. Of the many psychological strengths,

hope has often been researched in connection with levels of stress (19). In the present research, we examined one important psychological strength, hope (20–22) as a potential moderator of the association between perceived stress and health outcomes (i.e., anxiety, depression, and sleep quality) in front-line medical staff fighting against COVID-19.

Hope has long been considered as a critical trait of people confronting serious life events (23). Snyder's theory of hope has emerged as the most dominant paradigm for understanding individuals' hope (24, 25). According to Snyder (26), trait hope is an enduring cognitive-motivational and goal-oriented construct composed of two distinct yet related elements, that is agency and pathways. Agency refers to one's initiating and sustaining the motivation toward goal attainment, and pathways refer to one's sense of being able to make plans to achieve goals. Snyder's hope theory suggests that low hope persons yield more easily to stressors; whereas high hope persons view stressors as motivating challenges that enable them to achieve their goals (26).

However, scholars critically pointed out that a limitation of this theory is its individualistic origin (20). In collectivist cultures, agency may refer to the commitment and support of external agents; pathways to goal attainment may involve action of external agents (20, 27). Bernardo (20) proposed the locus-of-hope theory as an extension of Snyder' hope theory through integrating external locus-of-hope dimensions (i.e., family, peer, spiritual). External-family locus-of-hope refers to positive thoughts related to how goals can be achieved through the help of family. External-peers locus-of-hope pertains to thoughts that the degree to which friends or peers may operate as catalysts of goal attainment.

Higher levels of internal locus-of-hope was associated with less depression and anxiety (24, 28). Longitudinal studies also find statistically significant long term effect of internal locus-of-hope on future anxiety and depression (29). The protective effect of hope in attenuating the relationship between negative life events and depressive symptoms was attested to in an ethnically diverse sample of college students (30). Similar stress-buffering effects of internal locus-of-hope were demonstrated in adult patients (31). Internal locus-of-hope also reduced the effects of various adverse factors on anxiety and depression in adolescents (32), young adults (33), and adults (34). Consistent with conservation of resources theory of stress (35), these results show how hope functions like a resource and that the maintenance of this resource protects individuals for experiencing high levels of stress and its consequences; it is when hope is low, that individuals are driven to experiences the negative syndromes of stress. While there has been evidence for the role of internal locus-of-hope in reducing symptoms of anxiety and depression, there have not been studies inquiring into its relationship with physical symptoms like sleep quality.

There has also not been direct evidence of this stress-buffering effect related to external locus-of-hope, as external locus-of-hope is a relatively new construct. The evidence so far is that external locus-of-hope dimensions predict measures of coping (36, 37) and well-being in adolescents (38, 39), university students (40), and adults (41). One recent study found consistently negative associations between external locus-of-hope dimensions and

anxiety during the COVID-19 pandemic (42). But no prior research has investigated how external locus-of-hope moderates the relationship between perceived stress and mental health (i.e., depression, anxiety) or physical health (i.e., sleep quality), although there is some research on the buffering effect of external locus-of-hope on stressors and positive psychological outcome (43, 44). External locus-of-hope can also be considered a resource that protects individuals from stress and its psychological and physical consequence, but the direct evidence for the stress-buffering role of external locus-of-hope is not yet established.

In summary, this study examines whether hope serves as a protective moderator in the association between perceived stress and health outcomes (i.e., anxiety, depression, and sleep quality). Bernardo (20) posited that the internal and external dimensions are required for the full realization of hope under the context of collectivist cultures. Based upon previous work, the present research proposes that internal locus-of-hope might buffer the relationship between stress and health outcomes of front-line medical staff in China (see the hypotheses below). Moreover, the role of external locus-of-hope as a potential moderator is explored as well.

Hypothesis 1: Perceived stress will be positively associated with anxiety/depression.
Hypothesis 2: Perceived stress will be negatively associated with sleep quality.
Hypothesis 3: Internal locus-of-hope will moderate the relationship between perceived stress and anxiety/depression.
Hypothesis 4: Internal locus-of-hope will moderate the relationship between perceived stress and sleep quality.

MATERIALS AND METHODS

Participants and Procedure

Participants were 319 medical staff (age range: 22–54 years old, M_{age} = 30.42 years, SD = 5.16; 37.90% men) from a tertiary hospital designated treating suspected patients with COVID-19 in Shenzhen, China. These medical staff included 113 doctors (35.40%), 57 medical technicians (17.90%; i.e., pharmacist, radiation technician, and clinical laboratory examiner), and 149 nurses (46.70%). They all had college degree or above, and their working years ranged from 0.5 to 31 years ($M_{workingyears}$ = 6.66 years, SD = 5.40). All participants provided informed consent before completing the measures.

Participants were asked to complete the online questionnaires during their spare time. In the introduction of survey, they were told that they were engaging in a psychological investigation in which there were no correct or incorrect answers. Data collection was from mid-February to late March 2020, the most serious period of the COVID-19 in China. The participants must be the medical staff who worked in the quarantine ward. Administration staff and medical staff who continued working in their own wards were excluded from this study. The survey was distributed via the hospital's online communication platform (i.e., Enterprise Wechat). In total, 385 front-line medical staff were approached, and the response rate was 83.5%. As there were emergencies during the pandemic period, some medical staff's rest time was

irregular, and they reported that it was impossible to estimate their sleep time. In such cases, sleep time was encoded as missing data. There was <0.1% missing data and the missing data were estimated with regression procedure in SPSS. The research procedures were approved by the Sun Yat-sen University ethics committee (Approval Number: I0RG0003827).

Measures

Perceived Stress

Perceived stress is measured using the Chinese version (45) of the 10-item Perceived Stress Scale (CPSS) (46). Items are rated from 0 (*never have*) to 4 (*have a lot*). To reflect the perceived stress triggered by the pandemic, each item emphasizes that all the responses are based on the feelings since the outbreak of COVID-19 (e.g., "Since the COVID-19 has occurred, how often have you been upset because of something that happened unexpectedly?") Scale scores were the sum of items with reverse coding of relevant items. Higher scores reflected a higher perceived stress brought by the pandemic (Cronbach α = 0.75).

Locus-of-Hope

Locus-of-Hope Scale [LOHS; example items are "My parents have lots of ways of helping me attain my goals" and "I have been able to meet my goals because of my friends' help," (20)] was used to measure the trait hope of medical staff. Three of its four sub-scales were used for the current study: internal, external-family, and external-peer LOH. The external-spiritual LOH was not included as a majority of the population in China have no religious affiliation. Each sub-scale comprises eight items, with a four-point Likert-type scale ranging from 1 (*definitely false*) to 4 (*definitely true*) for scoring each item. The Chinese version has been validated previously (27, 47). For the present study, the Cronbach α were 0.90 for internal LOH, 0.91 for external-family LOH, and 0.90 for external-peer LOH.

Anxiety and Depression

Hospital Anxiety and Depression Scale [HADS; (48)] was used to measure anxiety and depression. This scale includes 14 items making up two 7-item sub-scales, one measuring anxiety (HADS-A) and the other depression (HADS-D). Items are rated from 0 (*not a problem*) to 3 (*high level of problems*). A higher total score ranging from 0 to 21 of each sub-scale represents higher levels of anxiety and depression. A score of 7 or lower indicates no signs of anxiety or depression, 8–10 a borderline case of anxiety or depression, 11 or higher a definite case of anxiety or depression (49). The Chinese version of HADS has been validated (50, 51). Cronbach α in this sample were 0.81 for anxiety and 0.80 for depression.

Sleep Quality

Sleep quality during the latest 1 month was assessed by the Chinese version of Pittsburgh Sleep Quality Index (PSQI) (52, 53). It includes 19 items, which are combined into seven clinically-derived component scores-subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, sleep medication and daytime dysfunction. The score of each component ranges from 0 (*no difficulty*) to 3 (*severe*

TABLE 1 | Univariate and bivariate statistics for all study variables ($N = 319$).

Variables	M (SD)	1	2	3	4	5	6	7	8	9
1 Sex	0.62 (0.49)									
2 Age	30.42 (5.16)									
3 Work years	6.66 (5.40)	−0.03	0.90***							
4 Stress	15.35 (5.40)	0.17**	−0.04	0.02						
5 INT	24.54 (3.53)	−0.07	−0.01	0.00	−0.50***					
6 EXF	23.42 (4.28)	−0.03	0.00	0.02	−0.33***	0.69***				
7 EXP	22.88 (3.88)	−0.08	−0.03	−0.01	−0.24***	0.65***	0.74***			
8 Anxiety	5.62 (3.63)	0.06	0.04	0.04	0.66***	−0.46***	−0.31***	−0.29***		
9 Depression	5.08 (3.77)	0.08	0.08	0.09	0.66***	−0.49***	−0.30***	−0.28***	0.76***	
10 Sleep	6.66 (3.49)	0.12*	−0.01	0.03	0.49***	−0.37***	−0.19***	−0.15**	0.54***	0.54***

Sex was dummy coded such that 0 = male, 1 = female. INT, internal locus-of-hope; EXF, external-family locus-of-hope; EXP, external-peer locus-of-hope; Sleep, sleep quality. *$p <$ 0.05, **$p < 0.01$, ***$p < 0.001$.

difficulty). A total score is produced by summing the seven component scores, with a higher score indicating worse sleep quality. Previous research [e.g., (6)] has suggested a cut-off of the total score at 8 or above for the signs of poor sleep quality. Cronbach α in current study was 0.76.

Demographic Variables

In addition to the above research instruments, participants completed a questionnaire soliciting information about sex, age, and work years.

Data Analysis

We hypothesized that locus-of-hope would moderate the associations between stress and health (i.e., anxiety, depression, sleep quality). To test the moderation hypotheses, we used the PROCESS macro for SPSS [Model 1; (54)]. PROCESS calculates bias-corrected and accelerated bootstrapped confidence intervals (10,000 re-samples) for the size of each direct or conditional effect, with a significant effect indicated by a confidence interval that does not contain zero. To yield standardized coefficients, all variables (excluding sex) were converted to z-scores prior to analysis.

RESULTS

Preliminary Analyses

The prevalence of anxiety (HADS-A score ≥8) was 29.70%, and depression (HADS-D score ≥8) was 28.80%; 38.90% had poor sleep quality (PSQI score≥8). **Table 1** presents the descriptive statistics for all variables in this study. Perceived stress was negatively correlated with each dimension of locus-of-hope, and positively correlated with health outcomes (i.e., anxiety, depression, and sleep quality) of medical staff. Dimensions of locus-of-hope were negatively correlated with anxiety, depression and sleep quality. There were no significant differences in perceived stress, each dimension of locus-of-hope and health outcomes ($Fs = 0.03\sim1.55$, $ps > 0.05$) among the three types of medical staff (doctors, medical technicians, nurses). Among the demographic variables, only sex was significantly related to stress ($M_{male} = 14.18$, $SD = 5.47$; $M_{female} = 16.06$, $SD = 5.23$;

$t = -3.05$, $p < 0.01$) and sleep quality ($M_{male} = 6.15$, $SD = 3.23$; $M_{female} = 6.98$, $SD = 3.61$; $t = -2.06$, $p < 0.05$), so sex was included as control variable in subsequent analyses.

Test of Moderation Model

For the present purposes, moderation was established if the interaction effect of stress and locus-of-hope existed (54). Following the principles of selecting control variables (55) when testing the interaction effect of stress and each locus-of-hope dimension, the other two dimensions were included as covariates due to the significant associations between each dimension of hope and health outcomes of the medical staff. As **Table 2** shows, only internal locus-of-hope moderated the association between perceived stress and anxiety. Perceived stress was positively associated with anxiety among medical staff with different levels of internal locus-of-hope. But simple effects analysis showed that for medical staff with low internal locus-of-hope, this positive relationship was stronger as indicated by the higher beta ($B_{simple} = 0.50$, $t = 11.62$, $p < 0.001$), compared to medical staff with high internal locus-of-hope, where the beta ($B_{simple} = 0.33$, $t = 8.56$, $p < 0.001$) was still positive but smaller. The comparison of the relationship between perceived stress and anxiety for low and high internal locus-of-hope medical staff is shown in **Figure 1A**.

Internal locus-of-hope, external-family locus-of-hope, and external-peer locus-of-hope moderated the association between perceived stress and depression. Perceived stress was positively associated with depression among medical staff with different levels of internal and external locus-of-hope. But simple effects analysis showed that for medical staff with low internal locus-of-hope, this positive relationship was stronger as indicated by the high beta ($B_{simple} = 0.54$, $t = 12.35$, $p < 0.001$), while for those with high internal locus-of-hope, the beta was still positive but weaker ($B_{simple} = 0.28$, $t = 7.43$, $p < 0.001$). The comparison of the relationship between perceived stress and depression for low and high internal locus-of-hope medical staff is shown in **Figure 1B**. For medical staff with low external-family locus-of-hope, this positive relationship was stronger as indicated by the higher beta ($B_{simple} = 0.48$, $t = 11.00$, $p < 0.001$), while for those with high external-family locus-of-hope,

TABLE 2 | Testing the moderation models of stress on health outcomes ($N = 319$).

Outcomes	Predictors	R^2	F	β	T	95% CI
Anxiety	Sex			−0.08	−0.93	[−0.25, 0.09]
	EXF			0.06	0.98	[−0.07, 0.20]
	EXP			−0.10	−1.53	[−0.23, 0.03]
	Stress			0.61	12.71***	[0.52, 0.71]
	INT			−0.15	−2.38*	[−0.28, −0.03]
	Stress × INT	0.49	49.01***	−0.12	−3.32**	**[−0.20, −0.05]**
	Sex			−0.08	−0.88	[−0.25, 0.10]
	INT			−0.14	−2.16*	[−0.27, −0.01]
	EXP			−0.07	−1.11	[−0.20, 0.06]
	Stress			0.60	12.33***	[0.50, 0.69]
	EXF			0.03	0.43	[−0.10, 0.16]
	Stress × EXF	0.47	46.40***	−0.06	−1.63	[−0.14, 0.01]
	Sex			−0.08	−0.88	[−0.25, 0.10]
	INT			−0.15	−2.31*	[−0.28, −0.02]
	EXF			0.06	0.90	[−0.07, 0.19]
	Stress			0.60	12.32***	[0.50, 0.69]
	EXP			−0.10	−1.47	[−0.23, 0.03]
	Stress × EXP	0.47	46.38***	−0.06	−1.61	[−0.13, 0.01]
Depression	Sex			−0.04	−0.45	[−0.20, 0.13]
	EXF			0.09	1.42	[−0.04, 0.22]
	EXP			−0.08	−1.23	[−0.20, 0.05]
	Stress			0.59	12.40***	[0.49, 0.68]
	INT			−0.23	−3.66***	[−0.36, −0.11]
	Stress × INT	0.50	52.90***	−0.18	−4.89***	**[−0.25, −0.11]**
	Sex			−0.03	−0.34	[−0.20, 0.14]
	INT			−0.21	−3.23**	[−0.34, −0.08]
	EXP			−0.04	−0.60	[−0.17, 0.09]
	Stress			0.57	11.83***	[0.48, 0.66]
	EXF			0.04	0.54	[−0.10, 0.17]
	Stress × EXF	0.46	56.74***	−0.11	−2.94**	**[−0.18, −0.04]**
	Sex			−0.04	−0.42	[−0.21, 0.14]
	INT			−0.23	−3.50***	[−0.36, −0.10]
	EXF			0.08	1.24	[−0.05, 0.22]
	Stress			0.57	11.65***	[0.47, 0.66]
	EXP			−0.07	−1.09	[−0.21, 0.06]
	Stress × EXP	0.45	58.10***	−0.08	−2.05*	**[−0.15, −0.003]**
Sleep	Sex			0.07	0.65	[−0.13, 0.27]
	EXF			0.11	1.41	[−0.04, 0.27]
	EXP			0.02	0.32	[−0.13, 0.18]
	Stress			0.41	7.27***	[0.30, 0.52]
	INT			−0.27	−3.54***	[−0.42, −0.12]
	Stress × INT	0.29	20.78***	−0.10	−2.23*	**[−0.19, −0.01]**
	Sex			0.06	0.55	[−0.15, 0.26]
	INT			−0.27	−3.50***	[−0.42, −0.12]
	EXP			0.05	0.59	[−0.10, 0.20]
	Stress			0.40	6.94***	[0.28, 0.51]
	EXF			0.10	1.21	[−0.06, 0.25]
	Stress × EXF	0.27	19.64***	0.004	0.08	[−0.08, 0.09]
	Sex			0.07	0.71	[−0.13, 0.27]
	INT			−0.27	−3.48***	[−0.42, −0.12]
	EXF			0.11	1.42	[−0.04, 0.27]

(Continued)

TABLE 2 | Continued

Outcomes	Predictors	R^2	F	β	T	95% CI
	Stress			0.40	7.13***	[0.29, 0.52]
	EXP			0.02	0.20	[−0.14, 0.17]
	Stress × EXP	0.25	27.38***	−0.07	−1.54	[−0.15, 0.02]

CI, bootstrapped confidence interval; INT, internal locus-of-hope; EXF, external-family locus-of-hope; EXP, external-peer locus-of-hope; Sleep, sleep quality; Stress × INT/EXF/EXP, interactions of stress and INT/EXF/EXP. The bolded 95% CI indicated significant interaction effects. *p < 0.05, **p < 0.01, ***p < 0.001.

the beta was still positive but weaker ($B_{simple} = 0.32$, $t = 8.31$, $p < 0.001$). The comparison of the relationship between perceived stress and depression for low and high external family locus-of-hope medical staff is shown in **Figure 1C**. For medical staff with low external-peer locus-of-hope, this positive relationship was stronger as indicated by the higher beta ($B_{simple} = 0.45$, $t = 10.40$, $p < 0.001$), while for those with high external-peer locus-of-hope, the beta was still positive but weaker ($B_{simple} = 0.34$, $t = 8.76$, $p < 0.001$). The comparison of the relationship between perceived stress and depression for low and high external peer locus-of-hope medical staff is shown in **Figure 1D**.

Only internal locus-of-hope moderated the association between perceived stress and sleep quality. Perceived stress was positively associated with sleep quality among medical staff with different levels of internal locus-of-hope. But simple effects analysis showed that for medical staff with low internal locus-of-hope, this positive relationship was stronger as indicated by the higher beta ($B_{simple} = 0.33$, $t = 7.21$, $p < 0.001$), compared to medical staff with high internal locus-of-hope, where the beta ($B_{simple} = 0.20$, $t = 5.16$, $p < 0.001$) was still positive but smaller. The comparison of the relationship between perceived stress and sleep quality for low and high internal locus-of-hope medical staff is shown in **Figure 1E**.

DISCUSSION

This was the first study to directly investigate the relationship between perceived stress and health outcomes (i.e., anxiety, depression, and sleep quality) among front-line medical staff from the perspective of positive psychology during the outbreak of COVID-19 in China. The prevalence of anxiety (29.70%), depression (28.80%), poor sleep quality (38.9%) is high and similar to the result of a meta-analysis study focusing on front-line medical staff during COVID-19 pandemic, that is 23.2% for anxiety, 22.8% for depression, and 38.9% for insomnia (7). Furthermore, the perceived stress was significantly associated with anxiety, depression, and sleep quality. The deleterious effects of stress on anxiety, depression, and sleep quality have been documented by abundant research [e.g., (9, 11, 12, 56)].

Recently published research has focused on the psychological impacts of COVID-19 on medical staff yet ignoring one's personal agency in improving one's own psychological well-being [e.g., (2, 3, 6)]. Our research paid attention to the protective role of hope in both mental and physical health of front-line medical staff during

FIGURE 1 | (A,B,E) Illustrate internal locus-of-hope as a moderator of relationships between stress and anxiety, depression, and sleep quality, respectively. **(C,D)** Illustrate external family locus-of-hope and external peer locus-of-hope, respectively, as moderator of the relationship between stress and depression. INT, internal locus-of-hope; EXF, external-family locus-of-hope; EXP, external-peer locus-of-hope.

the COVID-19 pandemic. In line with our assumptions and also consistent with past research, internal locus-of-hope was shown to buffer the effect of perceived stress on anxiety and depression (24, 28–30). Furthermore, internal locus-of-hope moderated the relationship between perceived stress and sleep quality.

Maintaining hope during times of stress may promote medical staff to perceive such stressful events as challenges to be addressed or goals to be attained. Ultimately, this may reduce anxiety, depression, and improve sleep quality. Due to the nature of public health emergency, front-line medical staff had to work and rest in the isolated environment. Working in the closed medical ward, wearing protective equipment, and self-isolating in the designated hotel resulted in medical staff's being alone for most time. Under this specific circumstance, medical staff have to rely more on themselves than on external agents to alleviate perceived stress. Medical staff may also be accustomed to being self-reliant (e.g., relying on his or her own medical knowledge) instead of relying on their family members or friends to achieve medical goals as decreasing the risk of getting infected.

Moreover, external locus-of-hope (i.e., family and peer) buffered the effect of perceived stress on depression, but not anxiety. One possible explanation might be that hopelessness constitutes a major part of depression (57), thus both internal

and external locus-of-hope significantly buffered the effect of perceived stress on depression. Anxiety represents anticipatory concerns regarding the negative outcome of a stressful event (58). In this study, medical staff's anxiety may be mainly manifested as worries regarding the risk of infection when treating patients with suspected COVID-19 pneumonia. Social support had been proven to buffer the effect of perceived stress on anxiety [e.g., (59, 60)]. Yet, medical staff are likely to be away from family during this period, which could mitigate the possible role of family as sources of hope; similarly, as one's medical staff peers are also under stress, they may not be potent hope sources, too. As such, internal locus-of-hope, that is relying on oneself (e.g., medical knowledge and clinical practice) rather than relying on the support of external agents (i.e., family and peer) may better mitigate the anxiety response to risk infection as one source of perceived stress. Further research is needed to explore the reason external locus-of-hope functions differently from internal locus-of-hope in its moderation role between perceived stress and various health outcomes.

This study contributes to our knowledge of hope by confirming its moderation role between perceived stress and health outcomes. In particular, the study reveals the difference between internal and external locus-of-hope in moderating the

relationships between perceived stress and health outcomes. This study also has implications for interventions: medical staff who experienced mood and sleep disturbances may benefit from hope-focused preventive interventions. The interventions would be to help foster in medical staff both internal locus-of-hope and external locus-of-hope. A single-session 90 min hope intervention (61), could be applicable to the front-line medical staff without occupying too much of their rest time. Medical staff could benefit from this short-term hope intervention by reconsidering their personal goals, potential obstacles and alternative pathways for goal attainment in the workplace. Our department should also encourage medical staff to call their family members and interact with their peers online as routine tasks after work. Acquiring support from peers or family members in achieving goals could prevent medical staff from developing depressive mood. Future research should examine how best to foster both external and internal locus-of-hope in the population of front-line medical staff.

Our findings should be interpreted in light of several limitations. First, the present study was exploratory and employed a cross-sectional design, which prohibited causal conclusions. Prospective research is necessary to determine the causal interrelationships between the variables in our study. Second, all medical staff were from one tertiary hospital, so caution should be exercised when generalizing our results to medical staff in other regions of China. Third, as we used self-report measures for all model variables, a common-method bias might exist which may impact validity. Multiple data collecting methods should be used in further research to improve internal validity.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Sun Yat-sen University ethics committee (Approval Number: I0RG0003827). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

XZ made all the contacts with the participants and distributed the questionnaires via the hospital's online communication platform. RZ led the analytic process and analyzed the results. XZ, RZ, XL, AB, HD, YC, and YH contributed to the study design. ZW verified the findings of the analysis. All authors contributed to writing the paper.

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The Combined Impact of Gender and Age on Post-traumatic Stress Symptoms, Depression, and Insomnia During COVID-19 Outbreak in China

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The mental health problems might have been increased owing to the COVID-19 pandemic with the commencement of the year 2020, therefore, an epidemiological survey appraising the burden of mental health issues among the general population is imperative. This cross-sectional study attempts to reveal the underlying mental health conditions, such as Post-Traumatic Stress Symptoms (PTSS), depression, and insomnia, relating to the pandemic situation, and to further examine the combined effects of gender and age on the COVID-19 related mental health consequences. An online survey was conducted among 2,992 adults in China from February 1st 2020 to February 10th 2020. The study uses binary logistic regression to analyze the potential factors associated with PTSD, depression, and insomnia. The results indicate that the prevalence of PTSS, depression, and insomnia are 19.5, 26.9, and 19.6% respectively during the COVID-19. Men and women show different rates of PTSS and depression, whereas no insomnia is found in both males and females. The females above 50 years of age have a lower level of depressive symptoms (OR = 0.448, 95%CI: 0.220–0.911, Cohen's d = −0.443) as compared with females aged 18–25; while the highest effect sizes for PTSS (OR = 2.846, 95%CI: 1.725–4.695, Cohen's d = 0.537) and the depression (OR = 2.024, 95%CI: 1.317–3.111, Cohen's d = 0.314) are seen in males aged 26 to 30. Besides gender, education, living conditions, direct exposure to COVID-19, the post mental and the physical health condition is related to PTSS, depression, and insomnia. Our study suggests that high-risk groups, especially those having two or more related factors and young men, should be the focus of mental health intervention.

Keywords: PTSD, depression, insomnia, age, gender, China

INTRODUCTION

Detected by the end of 2019, Corona Virus Disease, known as COVID-19, has become a global pandemic now after affecting millions of people worldwide. The outbreak and the spread of COVID-19 caused multiple challenges relating not only to political management, economic growth, and healthcare delivery on the macro-level but also to the psychological well-being of individuals (1, 2).

Recently, anxiety, depression, insomnia, denial, anger, and fear among medical workers in Wuhan can be observed, associated with excessive work burden and intensive dangers of contagious infection (3, 4). However, as a new form of a stressor for mental health (5), the COVID-19 pandemic affects populations beyond healthcare workers. Unlike natural disasters that have specific regional impacts in a given time (6), the impact of this global crisis is profound and lasting. The social risks in the COVID-19 pandemic are not as recognizable as those in wars or international mass conflicts (7). One meta-analysis study suggests over one-in-five people experienced post-traumatic stress symptoms (PTSS) and psychological stress (8). Another systematic review indicates that the general population in many countries reported a relatively high prevalence of depression, posttraumatic stress disorder, psychological distress during the COVID-19 pandemic (9). Thus, it is rational to assume that this epidemic is sweeping across the population, and an epidemiological survey of the general population is essential for evaluating the actual mental health burden of the COVID-19 crisis.

For mental health studies, gender and age are primarily considered as demographic variables and get less attention as such. Neither gender nor age is the main area to focus on within most mental health studies. As early as Freud, gender differences were recognized in mental health because women were believed to be stunted in both ego and superego development, further resulting in passivity as a gender characteristic (10). This idea was later criticized by Rosenfield and Smith, claiming that there were no differences in the overall rates of psychopathy between genders, but admitted that males and females differ in the type of psychopathology experiences (11). Females develop more internalizing disorders, even though they are less subjected to potentially traumatic events (12). However, male counterparts have higher rates of externalizing problems. The variation in the extent of gender differences on mental health varies between trauma types (13). However, it should be noted that the evidence during the pandemic context is lacking.

Moreover, as noted by gender-roles theory, males and females show differences in the age distribution of mental health issues during their life course (14). Additionally, gender is found to be a significant biomarker of brain development and behavioral development throughout the lifespan so that it has further interactions with the mental health of individuals (15). But, how exactly gender and age affect mental health under traumatic circumstances is not clear. Taking post-traumatic stress disorder (PTSD) as an internalizing disorder, Kessler's study demonstrates that there is no age difference for men across age groups, despite a tendency for PTSD symptoms to decline as women get older

(16). On the contrary, another study suggests that females of 25–35 and males between 45 and 55 years might suffer the highest level of PTSS (17), possibly due to changes in sympathetic or noradrenergic systems (18). Besides, the study of Norris shows that women aged between 55 and 64 years old are most possibly to suffer PTSD symptoms (19). Some other studies claim that it is more likely for individuals aged between 18 and 24 years to get PTSD symptoms (20). The inconsistency in these studies could be attributed to methodological or cultural differences, and this situation, therefore, suggests urgency for more evidence highlighting how epidemics in a social setting may affect the mental health risk evaluation as an important factor.

Influenced by ancient Confucian traditions and current market expansion, "males are considered the main breadwinners while females are the primary caretakers" in China (21). Chinese men as the primary supporter for the family may undergo more stress facing higher psychological symptoms owing to the economic ebb and the higher COVID-19 related mortality rate (22). According to the life course theory, there is an inverted U-shape between mental health symptoms and age. The highest symptoms may be in young adulthood and decrease after midlife (23). The stress about the job, parenting young children, and marriage is very common in early adulthood but it diminishes with time, however, health problems are a major cause of stress in late adulthood (24). Therefore, Chinese young adults with jobs and married status may have the highest psychological symptoms during the pandemic. Combining the gender role theory and life course theory, we expect that young males may have higher financial stress regarding supporting their family as compared with young females.

During the COVID-19 crisis, especially with social distancing measures and policies to slow the spreading speed, PTSD, depression, and insomnia are the three most prevalent psychiatric disorders affecting the individuals' mental health (25, 26). In addition to gender and age relationship with PTSS, depression, and insomnia, previous studies on pandemics have found other potential factors including the personal characteristics, the traumatic exposure, the individuals' physical health and the psychological states, and so on (9). However, the significance of those factors varies in different psychiatric studies. One study estimates the prevalence of PTSD which is 7% in COVID-19 hard-hit areas in China, while gender, exposure history, and sleep quality also matter (27). Other studies suggest a 16.5–17.7% prevalence of depression, while the predictions from gender, age, educational levels, and professions are significant (28, 29). However, none of these studies focus on the related factors of PTSS, depression, insomnia simultaneously. To identify the shared factors and the specific factors of PTSS, depression, and insomnia, this study, therefore, attempts to discuss three typical symptoms in unison to allocate the limited resources more effectively.

For the reasons discussed above, the objectives of this study are (1) to estimate the prevalence of PTSD symptoms, depression, and insomnia among the general population during the COVID-19 outbreak; (2) to examine the combined effect of gender and age on PTSD symptoms, depression, and insomnia respectively; (3) to figure out the shared factors and the specific factors which

are associated with PTSS, depression, and insomnia. Based on the reviewed literature, three hypotheses are proposed for the current study. First, we expected that males may have higher symptoms of PTSD, depression, and insomnia than females in china during the COVID-19 outbreak. Second, we assumed that young adults may experience higher PTSS, depression, and insomnia symptoms. Third, we proposed that age may have a significant interaction effect with the gender on PTSS, depression, and insomnia. Lastly, we expected that there exist other factors like the living conditions, the direct exposure to COVID-19, the post mental, and the physical health condition associated with PTSS, depression, and insomnia.

METHODS

Data Source, Procedure, and Participants

This survey was conducted online from February 1st to February 10th in 2020, and all questionnaires were given out and retrieved through a web-based platform (https://www.wjx.cn/app/survey.aspx). In total, 2,992 participants across 31 Chines provinces participated in the survey. A snowball sampling was used to select participants and Chinese citizens aged ≥ 18 years old were invited. To reach more subjects from groups with high exposure to COVID-19 and low social-economic status, we sent out questionnaires to some specific citizens. After excluding 134 questionnaires of low quality (excluding criteria including finishing in shorter than 10 min or having some logical problem et al.), we finally got 2,858 subjects, including medical workers ($N = 421$, 14.7%), nonprofessional employees ($N = 259$, 9.1%), social service workers ($N = 230$, 8.0%), teachers and faculties ($N = 648$, 22.7%), workers and farmers ($N = 388$, 13.6%), students ($N = 424$, 14.8%), unemployed and others ($N = 488$, 17.1%). All participants gave their consent and joined this research voluntarily after being informed about the nature of the study. This study was approved by the Ethics Committee of the Peking University Medical Center.

Measures

Depression was assessed with the help of a 20-item scale used by the Center for Epidemiological Studies Depression (CESD) to measure depressive symptoms in the general population (30). Previous studies have proved that this scale has high reliability and validity among Chinese (31). Respondents reported the frequency of each symptoms item on a four-point scale: 0 (rarely or none of the time; <1 day), 1 (some of the time; 1–2 days), 2 (much or a moderate amount of the time; 3–4 days), or 3 (most or all of the time; 5–7 days). The total score ranges from 0 to 60, with a higher score indicating a higher level of depressive symptoms. With a cut-off point at 21, respondents were divided into two categories, "depressed" or "no depressive symptoms." Cronbach's alpha was 0.93 in this study.

PTSS was assessed by a 20-item self-report PCL-5 (PTSD Checklist for DSM-5) scale, estimating the degree to which individuals have been disturbed in the past month using PTSD symptoms (32). Respondents answered 20 items on a four-point scale rating from 0 (not at all) to 4 (extremely). Items were summed for a total score ranging from 0 to 80,

with higher scores indicating a higher level of PTSS. Each item rated at least 2 (moderate) could be regarded as PTSD symptoms. And 20 items were divided into four DSM-5 PTSD symptoms clusters: intrusions (items 1–5), avoidance (items 6–7), negative alterations in mood and cognition (items 8–14), alterations in reactivity, and arousal (items 15–20). The diagnostic criteria of DSM-5 required at least 1 "*intrusions-symptom*," 1 "*avoidance-symptom*," 2 "*negative alterations in the mood and the cognition-symptoms*," and 2 "*alterations in reactivity and arousal-symptoms*." The Cronbach's alpha was 0.97 in this study.

Insomnia was estimated with The Pittsburgh Sleep Quality Index (PSQI) (33). The PSQI (Chinese Version) was translated and validated by Liu and associates (34). The PSQI is constitutive of 19 self-reported items including various factors about sleep quality consisting of estimation of sleep latency, duration, disturbances, and the severity and frequency of other sleep problems. The total PSQI scale is grouped into seven 0–3 subscales, with the total score ranging from 0 to 21 and higher scores indicating worse sleep quality. With a cut-off point at 7, respondents were divided into two categories, "insomnia" or "no insomnia." The Cronbach's alpha in this study was 0.86.

Exposure items included Wuhan exposure ("1" refers to lived or had Wuhan travel history, "0" refers to none Wuhan travel history), prior exposure (yes, no), media exposure (frequently, sometimes, less, very less), impact on livelihood (none, some, relatively large, very large) and direct exposure to COVID-19 ("1" includes self, family, friend, and neighborhood exposure to COVID-19, "0" refers to none exposure).

Gender in this study was divided into males and females, and age was categorized as 18–25, 26–30, 31–40, 41–50, 51, and over comprehensively considering the basic age distribution and the internal variation between age groups. Also, socioeconomic covariates in this study include ethnicity (Han, else), marriage (have no spouse, have a spouse), education (junior high school and below, high school/technical school, junior college, undergraduate, postgraduate and above), job (medical workers, nonprofessional employees, social service workers, teachers and operators, students, workers and farmers, unemployed and others) and income (poor, not poor). Health-related variables contained prior and post psychological problems (yes, no), chronic diseases (yes, no), and 2-week illness (yes, no). These variables are included in the study according to previous studies (23, 24).

Statistical Analyses

Descriptive analysis was conducted to describe the characteristics of the sample. In the analyses, PTSS, depression, and insomnia were used as binary variables. χ^2 or *t*-test was used to examine the binary correlation between independent variables with PTSS, depression, insomnia respectively. Then, three logistic regression models were used to examine the factors linked to PTSS, depression, and insomnia. Finally, another two logistic regression models were designed to examine the combined effect of gender and age on PTSS and depression. All potentially confounding variables including socio-demographic variables

(consisted of ethnicity, marriage, education, job, and income), health-related factors (contained prior and post psychological problems, chronic diseases, and 2-week illness), were controlled in the above models. We set the alpha at 0.05 for statistical significance in all the tests. SPSS 22.0 was used to carry out these analyses.

RESULTS

Descriptive Analyses

As shown in **Table 1**, about 95.8% of the total 2,858 participants belong to the Han ethnicity, and the proportion of men and women is nearly equal (46.4% as male and 53.6% as female). The distribution of age groups is presented as following: participants aged 31–40 years constitute the most (about 31.2%), followed by those aged 18–25 years (about 24.2%), aged 26–30 years (about 22.6%), and aged 41–50 years (about 14.0%); participants above 50 years of age contribute to merely 8.1% of the sample. Besides, 60.2% of the participants are married and nearly 60% of them are well-educated (undergraduate or above). When it comes to the traumatic exposure, there are 85.5% of participants considering themselves as being free of the Wuhan exposure and about 92.1% of the samples are out of prior traumatic exposures. However, nearly 83% of the participants are under indirect exposure to COVID-19, occasionally or frequently through media in particular. In general, the health condition of most participants is good, as the proportion for participants having the prior psychological problem, the post psychological problem, the chronic diseases, and the 2-week illness are 14.6, 29, 12, and 7% respectively. More detailed, among all 2,858 participants, 19.5% are found of PTSS, 26.9% of depression, and 19.6% of insomnia. More details could be seen in **Table 1**.

To identify possible factors associated with mental disorders, this study further conducts binary analysis, where results are presented in **Table 2**. Findings indicated that PTSS, depression, and insomnia share some factors in common, including gender, age, education, profession, income, psychological health conditions, and the 2-week illness, as well as impacts of COVID-19 on livelihood and traumatic exposure experiences. However, there are some characteristics with partial significance. For example, the different marital status affects PTSS and insomnia only, and suffering from chronic diseases is related only to higher depressive symptoms. Also, people who live in Wuhan or even have been to Wuhan within 2 weeks before the outbreak of COVID-19 would reflect the higher level of insomnia, but prior exposure experiences are insignificantly related. More details are presented in **Table 2**.

Logistic Regression Analyses

As shown in **Table 3**, the prevalence of PTSS is generally higher among males than females (OR = 1.824, 95%CI: 1.477–2.251, Cohen's d = 0.331). In comparison with single and above 50-year-old participants, those aged between 26 and 30 years and married possibly suffer from higher PTSS (OR = 1.796, 95%CI: 1.103, 2.925, Cohen's d = 0.323). Essential service jobs, direct exposure to COVID-19, negative impact on livelihood, post psychological problems, 2-week illness are significantly associated with a higher level of PTSS. Counter-intuitively,

participants with higher education, the Wuhan contact, and sometimes media exposure are less likely to be diagnosed with PTSD.

Factors correlated with depression are mostly similar to those for PTSS, however, a few differences ought to be noted. Firstly, significant differences exist between all age groups. Take people aged over 51 as a reference, those aged 18–50 are more likely to be depressed. In detail, the Cohen's d effect size is highest in the 26–30 age group, followed by the 18–25 age group and 31–40 age group, while is lowest in the 41–50 age group. And the Cohen's d values of all these age groups are over 0.2 and below 0.5, indicating a medium association with depression. Secondly, participants with prior psychological problems, high school/technical school education, post psychological problems, and 2-week illness incline to a higher level of depression. And the Cohen's d effect sizes of all these variables are medium (over 0.2 and below 0.5).

When it comes to insomnia, there exists a significant gender variation in the PTSS prevalence (OR = 1.390, 95%CI: 1.131–1.707, Cohen's d = 0.182), but no age differences. Compared with medical workers who are intensively exposed, individuals in essential service jobs and those being unemployed are less possibly to experience PTSS, and both the Cohen's d effect sizes of them were medium. And people suffering from chronic diseases may be more prone to have high insomnia symptoms (OR = 1.412, 95%CI: 1.058–1.884, Cohen's d = 0.190), although Cohen's d effect size is small.

Since age has an insignificant association with insomnia, this study further examines the combined effect of gender and age on PTSS and depression. Although no significant differences are found among other age groups, men aged 18–50 may experience a high degree of PTSS, compared with females aged 18–25 years old. At the same time, the age distribution of depressive prevalence is different (see **Figure 2**). Despite no differences exist between females aged 18–25 and other groups, those aged over 50 years old are less likely to suffer depression (OR = 0.448, 95%CI: 0.220–0.911, Cohen's d = −0.443). In comparison with young women, young men are more likely to develop depression. For example, compared with women aged 18–25, the prevalence of depression for men at the same age is higher (OR = 1.766, 95%CI: 1.219–2.560, Cohen's d = 0.314), peaking during their late 20s (OR = 2.024, 95%CI: 1.317–3.111, Cohen's d = 0.389) and then declining. For more details, **Table 4** is demonstrated below. Sensitivity analysis was conducted by linear regression, and the results were consisted with the above (more detail can be seen in **Figures 1, 2** and **Table 5**).

DISCUSSION

This study attempted to reveal the mental health conditions among the population during the initial stage of the COVID-19 pandemic, and further to identify the combined effect of gender and age on the COVID-19 related mental health effects. Most importantly, this study found that the prevalence of PTSS, depression, and insomnia were 19.5, 26.9, and 19.6% respectively. Although no significant combined effect of gender and age was found in insomnia, PTSS, and depression closely related to gender-age interaction. Men in the late 20s were with relatively

TABLE 1 | Descriptive analysis of sample characteristics.

	Total		Male		Female		P-value
	N	%	*N*	%	*N*	%	
PTSS							p < 0.001
Yes	558	19.5	334	25.2	224	14.6	
No	2,300	80.5	992	74.8	1,308	85.4	
Depression							p < 0.001
<21	2,088	73.1	897	67.6	1,191	77.7	
≥21	770	26.9	429	32.4	341	22.3	
Sleep quality							0.001
≤7	2,297	80.4	1,030	77.7	1,267	82.7	
>7	561	19.6	296	22.3	265	17.3	
Ethnicity							0.070
Han	2,738	95.8	1,280	96.5	1,458	95.2	
Else	120	4.2	46	3.5	74	4.8	
Gender							
Male	1,326	46.4					
Female	1,532	53.6					
Age							0.027
18–25	691	24.2	309	23.3	382	24.9	
26–30	645	22.6	272	20.5	373	24.3	
31–40	891	31.2	425	32.1	466	30.4	
41–50	400	14.0	200	15.1	200	13.1	
≥51	231	8.1	120	9.0	111	7.2	
Marriage							0.672
Not have a spouse	1,137	39.8	552	41.6	615	40.1	
Have a spouse	1,721	60.2	804	60.6	917	59.9	
Education							p < 0.001
Junior high school and below	268	9.4	127	9.6	141	9.2	
High school/Technical school	387	13.5	231	17.4	156	10.2	
Junior College	488	17.1	247	18.6	241	15.7	
Undergraduate	1,257	44.0	559	42.2	698	45.6	
Postgraduate and above	458	16.0	162	12.2	296	19.3	
Job							p < 0.001
Medical workers	421	14.7	88	6.6	333	21.7	
Nonprofessional employees	259	9.1	174	13.1	85	5.5	
Social service workers	230	8.0	129	9.7	101	6.6	
Teachers and operators	648	22.7	304	22.9	344	22.5	
Students	424	14.8	169	12.7	255	16.6	
Workers and farmers	388	13.6	244	18.4	144	9.4	
Unemployed and others	488	17.1	218	16.4	270	17.6	
Income							p < 0.001
Poor	327	11.4	200	15.1	127	8.3	
Not poor	2,531	88.6	1,126	84.9	1,405	91.7	
Wuhan exposure							0.002
Yes	413	14.5	163	12.3	250	16.3	
No	2,445	85.5	1,163	87.7	1,282	83.7	
Impact on livelihood							0.055
None	825	28.9	358	27.0	467	30.5	
Some	975	34.1	454	34.2	521	34.0	
Relatively large	611	21.4	284	21.4	327	21.3	
Very large	447	15.6	230	17.3	217	14.2	

(Continued)

TABLE 1 | Continued

	Total		Male		Female		P-value
	N	%	N	%	N	%	
Prior exposure							0.229
Yes	227	7.9	114	8.6	113	7.4	
No	2,631	92.1	1,212	91.4	1,419	92.6	
Media exposure							0.125
Frequently	1,608	56.3	759	57.2	849	55.4	
Sometimes	762	26.7	328	24.7	434	28.3	
Less	259	9.1	131	9.9	128	8.4	
Very less	229	8.0	108	8.1	121	7.9	
Prior psychological problems							0.292
Yes	418	14.6	184	13.9	234	15.3	
No	2,440	85.4	1,142	86.1	1,298	84.7	
Post psychological problems							0.003
Yes	828	29.0	348	26.2	480	31.3	
No	2,030	71.0	978	73.8	1,052	68.7	
Chronic disease							0.701
Yes	342	12.0	162	12.2	180	11.7	
No	2,516	88.0	1,164	87.8	1,352	88.3	
Two-week illness							0.359
Yes	201	7.0	87	6.6	114	7.4	
No	2,657	93.0	1,239	93.4	1,418	92.6	
	Mean	SD	Mean	SD	Mean	SD	
Direct exposure	0.6	1.2	0.5	1.1	0.6	1.3	0.035

high PTSD symptoms, while the lowest prevalence of depression was found in women in the early 50s. At the same time, men aged 26–30 were more likely to get PTSS and depression. Besides, other factors related to PTSS, depression, and insomnia, in common or in particular, were confirmed either. Our findings identified factors associated with higher mental health symptoms so that they could be used to formulate psychological interventions to improve the mental health of vulnerable populations during the COVID-19 pandemic.

This study suggests that the public should pay greater attention to mental health conditions, as about one-fifth of the population (or over) has shown psychological symptoms. In the absence of traumatic events, the all-age prevalence for PTSS, depression, and insomnia in China are <1, 3.99, and 15% respectively (34–36). With the presence of disaster, the sweeping extent of the mental disorders also varies across traumatic types. An early review concludes the prevalence of PTSD at 5–10% among the general population after disasters (37), and later studies underline it as 8% in the Wenchuan earthquake (38), 8.6% after the flood (39), and <4% after terrorist attacks (40). The uncertain possibility of being infected leads to more PTSD symptoms among the general population, as 27% of individuals in Ebola-affected countries meet levels of clinical concerns for PTSD (41). Due to its huge disease burden in the general population, depression is the most prevalent mental disorder during the COVID-19 pandemic, and the number of people getting depression increases faster than after Hurricane Ike (42)

and the 9–11 attack (43). It has to be noted that we estimate a slightly higher prevalence of PTSS and depression than prior studies, which were conducted about 10 days ahead (27, 28). Apart from the variance in sample distribution, the possible reason goes to the accumulative exposure under this pandemic. Communities continued to lockdown and almost all citizens were required to keep social distancing, especially people who could not return to their workplaces at the end of the New Year Holiday. Taking all the above comparisons, it is reasonable for this study to suggest that more attention is needed for mental health conditions under the COVID-19 pandemic.

Moreover, this study indicates an interesting reversal in the gender distribution of mental disorders. As noted by most trauma studies, women have higher incidence rates of mental health problems like PTSS and depression than their male counterparts (44, 45), explained partially by physiological differences or distinguished psychological mechanism (46). On the contrary, the evidence from this study supports that males are more possibly diagnosed with psychological disorders under the pandemic situation. An analogous conclusion could be seen in recent literature on COVID-19 (22) since the traditional gender roles and division is still prevalent in China (47). Chinese men as families' pillars have to take more psychological pressures for ensuring adequate supplies and the safety of the family during the COVID-19 pandemic, such as taking on family affairs with high exposure risk. In the meantime, the lack of strategies for men to cope with stress exacerbates

TABLE 2 | Binary correlations of risk factors with PTSS, depression, sleep quality.

	PTSS N (%)			Depression N (%)			Insomnia N (%)		
	Yes	No	P-value	Yes	No	P-value	>7	≤7	P-value
Ethnicity									
Han	538 (19.6)	2,200 (80.4)	0.420	739 (27.0)	1,999 (73.0)	0.780	538 (19.6)	2,200 (80.4)	0.896
Else	20 (16.7)	100 (83.3)		31 (25.8)	89 (74.2)		23 (19.2)	97 (80.8)	
Gender									
Male	334 (25.2)	992 (74.8)	$p < 0.001$	429 (32.4)	897 (67.6)	$p < 0.001$	296 (22.3)	1,030 (77.7)	0.001
Female	224 (14.6)	1,308 (85.4)		341 (22.3)	1,191 (77.7)		265 (17.3)	1,267 (82.7)	
Age									
18–25	124 (17.9)	567 (82.1)	0.006	190 (27.5)	501 (72.5)	$p < 0.001$	113 (16.4)	578 (83.6)	0.003
26–30	143 (22.2)	502 (77.8)		184 (28.5)	461 (71.5)		112 (17.4)	533 (82.6)	
31–40	193 (21.7)	698 (78.3)		266 (29.9)	625 (70.1)		207 (23.2)	684 (76.8)	
41–50	68 (17.0)	332 (83.0)		94 (23.5)	306 (76.5)		76 (19.0)	324 (81.0)	
≥51	30 (13.0)	201 (87.0)		36 (15.6)	195 (84.4)		53 (22.9)	178 (77.1)	
Marriage									
Not have a spouse	194 (17.1)	943 (82.9)	0.007	292 (25.7)	845 (74.3)	0.217	188 (16.5)	949 (83.5)	0.001
Have a spouse	364 (21.2)	1,357 (78.8)		478 (27.8)	1,243 (72.2)		373 (21.7)	1,348 (78.3)	
Education									
Junior high school and below	45 (16.8)	223 (83.2)	$p < 0.001$	62 (23.1)	206 (76.9)	$p < 0.001$	52 (19.4)	216 (80.6)	$p < 0.001$
High school/Technical school	111 (28.7)	276 (71.3)		139 (35.9)	248 (64.1)		99 (25.6)	288 (74.4)	
Junior College	108 (22.1)	380 (77.9)		135 (27.7)	353 (72.3)		110 (22.5)	378 (77.5)	
Undergraduate	240 (19.1)	1,017 (80.9)		337 (26.8)	920 (73.2)		235 (18.7)	1,022 (81.3)	
Postgraduate and above	54 (11.8)	404 (88.2)		97 (21.2)	361 (78.8)		65 (14.2)	393 (85.8)	
Job									
Medical workers	66 (15.7)	355 (84.3)	$p < 0.001$	103 (24.5)	318 (75.5)	0.002	102 (24.2)	319 (75.8)	0.005
Nonprofessional employees	80 (30.9)	179 (69.1)		96 (37.1)	163 (62.9)		52 (20.1)	207 (79.9)	
Social service workers	44 (19.1)	186 (80.9)		57 (24.8)	173 (75.2)		48 (20.9)	182 (79.1)	
Teachers and operators	131 (20.2)	517 (79.8)		164 (25.3)	484 (74.7)		127 (19.6)	521 (80.4)	
Students	64 (15.1)	360 (84.9)		105 (24.8)	319 (75.2)		60 (14.2)	364 (85.8)	
Workers and farmers	91 (23.5)	297 (76.5)		119 (30.7)	269 (69.3)		89 (22.9)	299 (77.1)	
Unemployed and others	82 (16.8)	406 (83.2)		126 (25.8)	362 (74.2)		83 (17.0)	405 (83.0)	
Income									
Poor	88 (26.9)	239 (73.1)	$p < 0.001$	109 (33.3)	218 (66.7)	0.006	84 (25.7)	243 (74.3)	0.003
Not poor	470 (18.6)	2,061 (81.4)		661 (26.1)	1,870 (73.9)		477 (18.8)	2,054 (81.2)	
Wuhan exposure									
Yes	69 (16.7)	344 (83.3)	0.118	116 (28.1)	297 (71.9)	0.571	96 (23.2)	317 (76.8)	0.046
No	489 (20.0)	1,956 (80.0)		654 (26.7)	1,791 (73.3)		465 (19.0)	1,980 (81.0)	
Impact on livelihood									
None	90 (10.9)	735 (89.1)	$p < 0.001$	148 (17.9)	677 (82.1)	$p < 0.001$	131 (15.9)	694 (84.1)	$p < 0.001$
Some	160 (16.4)	815 (83.6)		231 (23.7)	744 (76.3)		170 (17.4)	805 (82.6)	
Relatively large	177 (29.0)	434 (71.0)		224 (36.7)	387 (63.3)		143 (23.4)	468 (76.6)	
Very large	131 (29.3)	316 (70.7)		167 (37.4)	280 (62.6)		117 (26.2)	330 (73.8)	
Prior exposure									
Yes	59 (26.0)	168 (74.0)	0.010	78 (34.3)	149 (65.6)	0.009	50 (22.0)	177 (78.0)	0.343
No	499 (19.0)	2,132 (81.0)		692 (26.3)	1,939 (73.7)		511 (19.4)	2,120 (80.6)	
Media exposure									
Frequently	346 (21.5)	1,262 (78.5)	0.005	451 (28.0)	1,157 (72.0)	0.035	346 (21.5)	1,262 (78.5)	0.029
Sometimes	119 (15.6)	643 (84.4)		184 (24.1)	578 (75.9)		126 (16.5)	636 (83.5)	
Less	54 (20.8)	205 (79.2)		82 (31.7)	177 (68.3)		49 (18.9)	210 (81.1)	
Very less	39 (17.0)	190 (83.0)		53 (23.1)	176 (76.9)		40 (17.5)	189 (82.5)	

(Continued)

TABLE 2 | Continued

	PTSS N (%)			Depression N (%)			Insomnia N (%)		
	Yes	**No**	**P-value**	**Yes**	**No**	**P-value**	**>7**	**≤7**	**P-value**
Prior psychological problems									
Yes	126 (30.1)	292 (69.9)	$p < 0.001$	204 (48.8)	214 (51.2)	$p < 0.001$	137 (32.8)	281 (67.2)	$p < 0.001$
No	432 (17.7)	2,008 (82.3)		566 (23.2)	1,874 (76.8)		424 (17.4)	2,016 (82.6)	
Post psychological problems									
Yes	247 (29.8)	581 (70.2)	$p < 0.001$	355 (42.9)	473 (57.1)	$p < 0.001$	244 (29.5)	584 (70.5)	$p < 0.001$
No	311 (15.3)	1,719 (84.7)		415 (20.4)	1,615 (79.6)		317 (15.6)	1,713 (84.4)	
Chronic disease									
Yes	61 (17.8)	281 (82.2)	0.401	113 (33.0)	229 (67.0)	0.007	100 (29.2)	242 (70.8)	$p < 0.001$
No	497 (19.8)	2,019 (80.2)		657 (26.1)	1,859 (73.9)		461 (18.3)	2,055 (81.7)	
Two-week illness									
Yes	63 (31.3)	138 (68.7)	$p < 0.001$	96 (47.8)	105 (52.2)	$p < 0.001$	75 (37.3)	126 (62.7)	$p < 0.001$
No	495 (18.6)	2,162 (81.4)		674 (25.4)	1,983 (74.6)		486 (18.3)	2,171 (81.7)	
	Mean (SD)		P value	Mean (SD)		P value	Mean (SD)		P-value
Direct exposure	0.8 (1.6)	0.5 (1.1)	$p < 0.001$	0.9 (1.6)	0.5 (1.0)	$p < 0.001$	1.0 (1.7)	0.5 (1.0)	$p < 0.001$

their mental health disorders in COVID-19 scenarios. Previous studies find that men incline to reduce their pressure by resolving problems caused by stressors, while women turn to psychological adaptation (11, 48). However, with a universal lockdown policy, men who worry about their income could hardly find a way to solve the problem and thus experiencing high financial and living stress. Based on the prevalence of traditional gender role attitudes in China and the males' special strategy coping with stress, it is reliable for this study to claim that men express more mental health symptoms than women during the COVID-19 outbreak in China, therefore, releasing pressures on income and living is important to improve mental health.

Furthermore, a combined effect of gender and age is found upon PTSS and depression, indicating a different life-course expectation between men and women. Accordingly, previous studies show that women aged 26–30 may have the greatest depression and PTSD symptoms for the role burden and role conflict (49). For example, the responsibilities for taking care of families and troubles to balance work and family serve as a major source of psychological stress for young women. Greater psychological symptoms are assumed for women aged over 50, and the reasons are that changes in their reproductive ability, hormonal levels, and sympathetic responses tend to be risky (50). However, this study finds that them having the lowest level of depression. Perhaps, elderly women have stronger social support, lighter economic worries, and are under minimal media exposure. Comparatively, men suffer more from PTSD and depression in their early life in consideration of the family role and economic responsibility (51). Their mental health should be recognized as a social issue, with special attention paid to social problems such as unemployment, the familial disruption. Because of the similarities in the age distribution of psychological symptoms, we confirm that the income disruption raises the greatest negativity for both males and females, and

figure out the age groups which should be concerned with priority. And the results also indicated that the gender difference in PTSS and depression could be amplified in young adulthood during the COVID-19, which partly supported our hypothesis. According to life course theory, younger adults usually enter into more new roles and statuses such as beginning marriage and becoming parents than elders, most of them have relative higher job strain and financial stress than older people who would exit from these roles and status (24). Therefore, young adults with these role transitions naturally suffer more financial pressure induced by the COVID-19 pandemic and lockdown, compare to older people. By combining the above explanation about gender difference that Chinese males as breadwinners usually had to bear most of these economic pressures, it could explain that the gender variation in PTSS and depression was magnified in the young adults. Therefore, policymakers should pay attention to these young males who suffer greater pressure because of their social roles and financial burden during this crisis.

Also, this study identifies the shared factors and the specific factors linked to PTSS, depression, and insomnia. Consistent with prior studies (52, 53), people with lower socioeconomic status and poorer health conditions, under more traumatic exposure, are found with greater vulnerabilities to PTSS, depression, and insomnia. Social support can help individuals mitigate PTSS and depression (54, 55). However, living with spouses may lead to greater mental health symptoms and it could be attributed to two aspects. On the one hand, married people are concerned not only for their own health but also for the health of their spouse in a pandemic, indicating an approximately 2-fold higher prevalence in mental disorders (56). Also, negative emotions may spread across individuals in a context full of unknown fears (57). On the other hand, married individuals have more concerns about the health of their families than their single counterparts (47). Besides, the

TABLE 3 | Logistic regression analysis for risk factors of PTSS, depression and insomnia.

Variables	Model 1-PTSS		Model 2-Depression		Model 3-Insomnia	
	OR (95% CI)	Cohen's d	OR (95% CI)	Cohen's d	OR (95% CI)	Cohen's d
Wuhan exposure (No)						
Yes	**0.694* (0.501, 0.961)**	−0.201	0.883 (0.668, 1.168)	−0.069	0.995 (0.739, 1.340)	−0.003
Impact on livelihood (None)						
Some	**1.499** (1.123, 1.999)**	0.223	**1.393** (1.089, 1.781)**	0.183	1.146 (0.882, 1.490)	0.075
Relatively large	**3.054*** (2.275, 4.101)**	0.616	**2.482*** (1.914, 3.218)**	0.051	**1.579** (1.193, 2.089)**	0.252
Very large	**2.590*** (1.879, 3.571)**	0.525	**2.255*** (1.693, 3.003)**	0.448	**1.632** (1.202, 2.216)**	0.270
Prior exposure (No)						
Yes	1.204 (0.851, 1.705)	0.102	1.068 (0.772, 1.477)	0.036	0.789 (0.548, 1.134)	−0.131
Direct exposure	**1.186** (1.069, 1.315)**	0.094	**1.187** (1.077, 1.308)**	0.095	**1.257*** (1.138, 1.389)**	0.126
Media exposure (Frequently)						
Sometimes	**0.768* (0.601, 0.981)**	−0.146	0.941 (0.758, 1.168)	−0.034	0.793 (0.625, 1.007)	−0.128
Less	0.936 (0.656, 1.333)	−0.036	1.298 (0.947, 1.778)	0.144	0.863 (0.605, 1.231)	−0.081
Very less	0.813 (0.546, 1.210)	−0.114	0.915 (0.638, 1.312)	−0.049	0.807 (0.547, 1.191)	−0.118
Ethnicity (Han)						
Else	0.919 (0.546, 1.545)	−0.047	1.005 (0.918, 1.101)	0.003	0.969 (0.590, 1.591)	−0.017
Gender (Female)						
Male	**1.824*** (1.477, 2.251)**	0.331	**1.698*** (1.405, 2.052)**	0.292	**1.390** (1.131, 1.707)**	0.182
Age (≥51)						
18–25	1.471 (0.846, 2.559)	0.213	**2.245** (1.348, 3.739)**	0.446	0.714 (0.432, 1.179)	−0.186
26–30	**1.796* (1.103, 2.925)**	0.323	**2.369*** (1.500, 3.739)**	0.476	0.718 (0.465, 1.106)	−0.183
31–40	1.419 (0.894, 2.253)	0.193	**2.166*** (1.407, 3.333)**	0.426	0.965 (0.652, 1.430)	−0.020
41–50	1.124 (0.679, 1.860)	0.064	**1.631** (1.024, 2.597)**	0.270	0.761 (0.493, 1.174)	−0.151
Marriage (None spouse)						
Have a spouse	**1.368** (1.022, 1.831)**	0.173	1.212 (0.931, 1.577)	0.106	1.050 (0.789, 1.398)	0.027
Education (Postgraduate and above)						
Junior high school and below	1.540 (0.933, 2.540)	0.238	1.251 (0.807, 1.939)	0.123	1.471 (0.912, 2.371)	0.213
High school/Technical school	**2.373** (1.573, 3.581)**	0.476	**1.818** (1.268, 2.607)**	0.330	**2.028*** (1.364, 3.016)**	0.390
Junior College	**1.940** (1.305, 2.885)**	0.365	1.379 (0.979, 1.943)	0.177	**1.901** (1.304, 2.773)**	0.354
Undergraduate	**1.679** (1.193, 2.363)**	0.286	1.309 (0.985, 1.739)	0.148	1.351 (0.978, 1.867)	0.166
Job (Medical workers)						
Nonprofessional employees	**1.721* (1.129, 2.621)**	0.299	1.421 (0.967, 2.089)	0.194	**0.643* (0.421, 0.982)**	−0.243
Social service workers	1.488 (0.938, 2.358)	0.219	1.175 (0.777, 1.777)	0.089	0.978 (0.641, 1.492)	−0.012
Teachers and operators	1.335 (0.927, 1.921)	0.159	1.032 (0.747, 1.426)	0.017	0.757 (0.544, 1.054)	−0.153
Students	1.231 (0.752, 2.017)	0.115	1.030 (0.669, 1.587)	0.016	0.647 (0.402, 1.042)	−0.240
Workers and farmers	1.346 (0.890, 2.037)	0.164	1.290 (0.890, 1.871)	0.140	0.804 (0.546, 1.182)	−0.120
Unemployed and others	1.036 (0.699, 1.535)	0.019	1.108 (0.787, 1.559)	0.057	**0.629* (0.438, 0.903)**	−0.256
Income (Not poor)						
Poor	1.276 (0.953, 1.709)	0.134	1.098 (0.834, 1.447)	0.052	**1.377* (1.028, 1.846)**	0.176
Prior psychological problems (No)						
Yes	1.316 (0.992, 1.745)	0.151	**1.930*** (1.498, 2.486)**	0.363	**1.572** (1.199, 2.062)**	0.249
Post psychological problems (No)						
Yes	**2.026*** (1.609, 2.552)**	0.389	**2.168*** (1.762, 2.668)**	0.427	**1.658*** (1.321, 2.080)**	0.279
Chronic disease (No)						
Yes	0.741 (0.528, 1.039)	−0.165	1.204 (0.904, 1.602)	0.102	**1.412* (1.058, 1.884)**	0.190
Two-week illness (No)						
Yes	**1.554* (1.074, 2.248)**	0.243	**1.829*** (1.303, 2.566)**	0.333	**1.766** (1.249, 2.497)**	0.314

*The values of coefficients and 95% confidence interval in bold represent statistically significant at 0.05 level. *p < 0.05, **p < 0.01, ***p < 0.001.*

significant variance in insomnia is not found in different age groups, while it is found in PTSS and depression. Possibly, greater hyper-arousal and sleep reactivity of young adults during the trauma counteracts the natural increasing prevalence of insomnia with age (58). The findings of this study implicate that interventions to improve mental health conditions of the

TABLE 4 | Logistic regression analysis for the combined effect of gender and age on PTSS and depressive symptoms.

Variables	Model 4-PTSS		Model 5-Depression	
	OR (95% CI)	Cohen's d	OR (95% CI)	Cohen's d
Gender*age [Female (18–25)]				
Female (26–30)	1.505 (0.904, 2.505)	0.225	0.971 (0.630, 1.495)	−0.016
Female (31–40)	1.403 (0.835, 2.359)	0.187	1.004 (0.645, 1.563)	0.002
Female (41-50)	0.863 (0.450, 1.655)	−0.081	0.861 (0.506, 1.466)	−0.083
Female (≥51)	1.118 (0.521, 2.401)	0.061	**0.448* (0.220, 0.911)**	−0.443
Male (18–25)	**2.647*** (1.711, 4.097)**	0.537	**1.766** (1.219, 2.560)**	0.314
Male (26–30)	**2.846*** (1.725, 4.695)**	0.577	**2.024** (1.317, 3.111)**	0.389
Male (31–40)	**1.962** (1.181, 3.259)**	0.372	**1.620* (1.050, 2.500)**	0.266
Male (41–50)	**1.880* (1.050, 3.364)**	0.348	1.101 (0.658, 1.843)	0.053
Male (≥51)	1.323 (0.644, 2. 717)	0.154	0.777 (0.411, 1.467)	−0.139

*The combine effect of gender and age was not significant in logistic regression analysis for insomnia, thus the results are not presented in this table; all confounding variables were controlled in the above models. The values of coefficients and 95% confidence interval in bold represent statistically significant at 0.05 level. *p < 0.05, **p < 0.01, ***p < 0.001.*
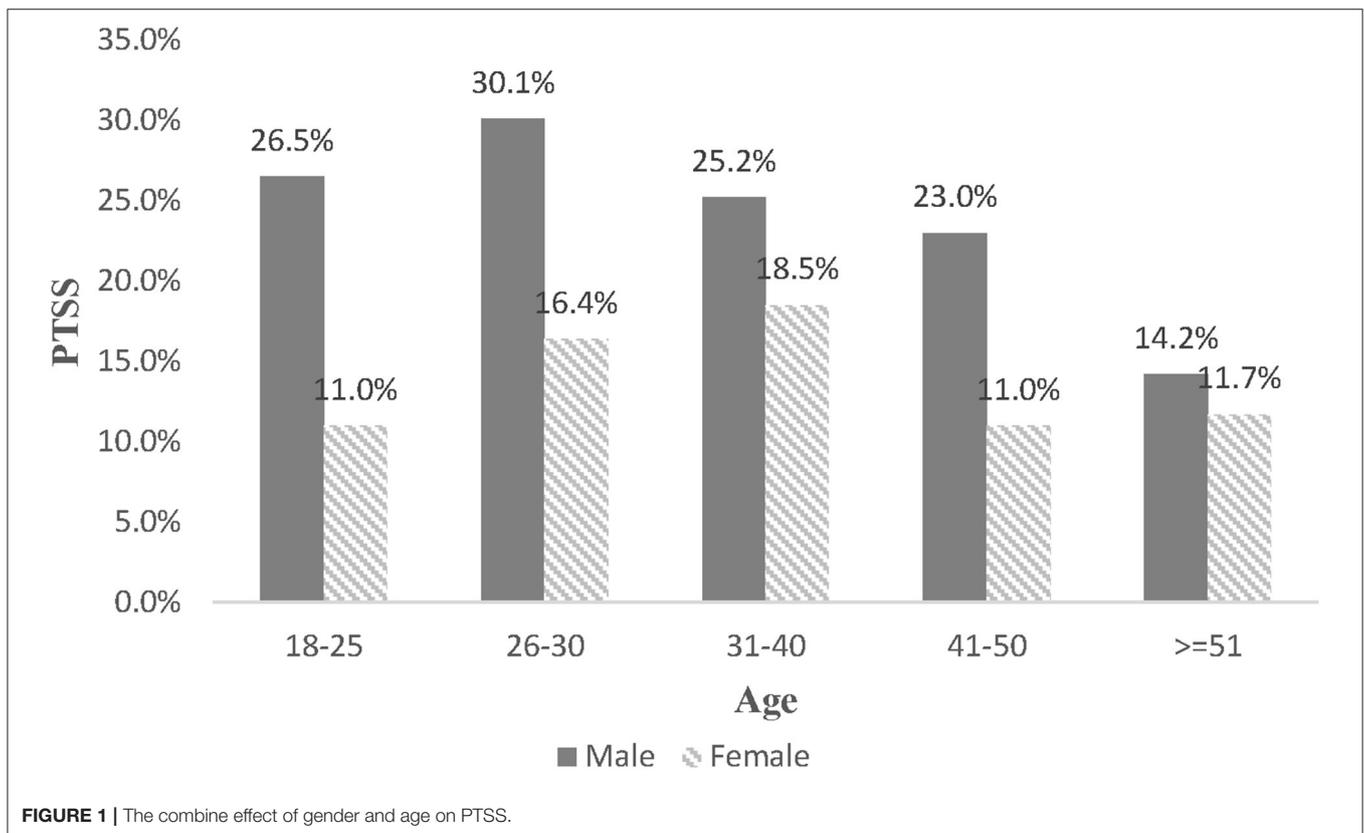
FIGURE 1 | The combine effect of gender and age on PTSS.

population could be adapted with the types of psychopathologies and different sub-groups. It should be noted that health-related behaviors are also demonstrated to correlate with mental health conditions in the period of COVID-19 confinement, specifically, mental health symptoms could be mitigated by physical activity (59) or exacerbated through longer screen time (60). Also a study found that physical activity decreased while screen exposure time increased during the COVID-19 confinement (61). So we should consider reducing individuals' psychological

symptoms by increasing their health-related behaviors in the mental health program during the lockdown and further control the variables related to health-related behaviors in future relevant studies.

LIMITATIONS AND IMPLICATIONS

It has to be noted that there are several limitations to this study. First, this study is based on a cross-sectional survey, indicating

FIGURE 2 | The combine effect of gender and age on depression.
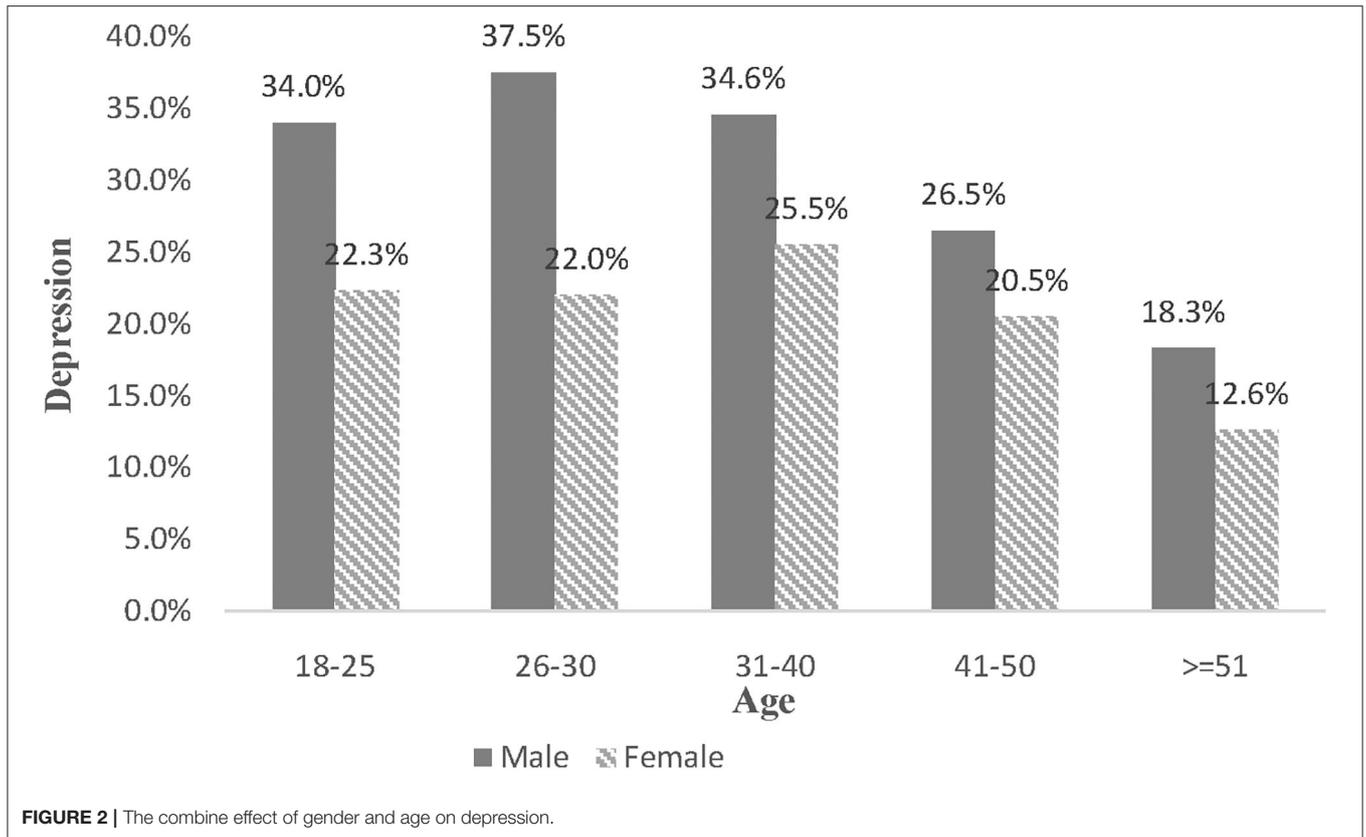
TABLE 5 | Sensitivity analysis for the combined effect of gender and age on PTSS and depressive symptoms.

Variables	Model 6-PTSS		Model 7-Depression	
	Coef. (Sta.Err)	Beta	Coef. (Sta.Err)	Beta
Gender*age [Female (18–25)]				
Female (26–30)	0.521 (1.384)	0.010	−0.492 (0.920)	−0.014
Female (31–40)	−0.372 (1.456)	−0.008	−0.564 (0.968)	−0.017
Female (41–50)	−2.026 (1.711)	−0.029	−1.622 (1.138)	−0.035
Female (≥51)	−3.401 (2.025)	−0.037	**−3.151 (1.346)***	−0.052
Male (18–25)	**4.502 (1.251)*****	0.079	**1.766 (0.832)***	0.047
Male (26–30)	**5.017 (1.458)*****	0.083	**3.545 (0.969)*****	0.089
Male (31–40)	2.266 (1.460)	0.045	**2.066 (0.971)***	0.063
Male (41–50)	0.7225 (1.715)	0.010	0.379 (1.140)	0.008
Male (≥51)	−1.976 (1.985)	−0.022	−2.313 (1.320)	−0.040

The combined effect of gender and age was not found significant in logistic regression analysis for insomnia, thus the results are not presented in this table; All confounding variables were controlled in the above models. The values of coefficients and 95% confidence interval in bold represent statistically significant at 0.05 level. *p < 0.05, ***p < 0.001.

that only correlations rather than causal relationships between variables could be revealed. More longitudinal studies are needed to focus on causal relationships. Second, the representativeness of this sample to the general population may be biased. Since this study was conducted online and the elderly who did not have a smartphone might be excluded, the proportion of elderly respondents in this study is lower than it should be in the normal situation. With the adoption of snow-ball sampling, there may be a selection bias, leading to the underrepresentation of the general public and overrepresentation of individuals with specific status such as medical workers, students, and faculties. Overall, a community-based survey could be implemented in the future to avoid these limitations. Thirdly, PTSS, depression, and Insomnia are based on self-report scales. We used PCL-5

without a Criterion A component to assess PTSD symptoms. Clinical diagnosis should be used to increase the veracity of future research in this area.

Despite these limitations, this study is one of the few studies that focus on the interaction effect of age and gender on PTSS, depression, and insomnia among the Chinese general population during the early period of the COVID-19 outbreak. The findings of this study can help to examine the factors associated with the greatest mental health symptoms and provide implications for formulating psychological interventions. On one hand, mental health intervention programs, available psychological support resources, and the necessary economic grant should focus on groups with several special features, especially those who are likely to show two or more kind of mental health problems, such as people with post psychological problems, being male, suffering large impact on livelihood and with high exposure risks. On the other hand, young men take excessive stress because of their social roles and financial burden, which contribute more to mental health problems than exposure experiences. Thus, policy efforts must guarantee people's return to a safe and prejudice-free working environment and work efficiently with the necessary protective equipment.

CONCLUSION

This study estimates that more or less one-fifth of the population have psychological symptoms during the COVID-19 outbreak. It has to be noted that males, especially young males suffer more from PTSS and depression. Additionally, people with lower socioeconomic status, poorer health conditions, and under extra traumatic exposure were found to be more susceptible to PTSS, depression, and insomnia. These findings are much supportive to screening the significant reasons linked with more mental health symptoms in current and future pandemic.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Peking University Medical Center. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JG designed the study and conceived the manuscript. CL, DL, MF, JG, and YZ drafted the manuscript. XW, JFA, MS, and YW were involved in revising the manuscript. All authors were involved in writing the manuscript and approve of its final version.

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The Resilience of Social Service Providers and Families of Children With Autism or Development Delays During the COVID-19 Pandemic—A Community Case Study in Hong Kong

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Background: Hong Kong is one of the earliest cities to have hampered by the COVID-19. When preventive public health measures are enforced, specific groups, who have already been facing inequality before the outbreak, are likely to become more overlooked and vulnerable.

Aim: This community case study aims to describe the additional needs of families of children with autism spectrum disorder and other developmental issues, as well as unexpected difficulties and challenges social service professionals encountered when delivering service and their solutions toward these challenges.

Methods: A focus group with 10 professionals providing the Caregiver Skills Training Program was conducted.

Results: Poor families of vulnerable children were found to be challenged, more than average, in finding daily necessities during the initial stage of the outbreak. Most vulnerable children displayed additional problematic behaviors and emotional problems during the quarantine. The social service professionals addressed the family needs by providing tangible resources and offering online training, workshops, and programs to meet their needs. Several important lessons were learned. First, technology know-how on conducting online training, workshop, and program could be a challenge to some social service professionals and the parents. Second, the professionals reported that they made huge efforts to produce guidelines in protecting services users' privacy, to equip themselves with necessary skills in executing privacy-protection measures, and to keep exploring for safer alternatives. Third, providing tele-services in online mode represented a different interaction pattern between social service professionals and service users, especially in the recruitment processes and group dynamics.

Conclusion: In comparison with other cities, Hong Kong has responded to the COVID-19 efficiently and effectively based on the citizen's strict adherence to behavioral advice and the innovative altruistic efforts from the multi-sectors in the community.

Keywords: children with autism or development delays, Hong Kong, COVID-19 pandemic, social service providers, service needs

INTRODUCTION

As of May 13, the coronavirus disease 2019 (COVID-19) has infected more than 4 million people and claimed almost 300,000 lives worldwide (1–3). Hong Kong's first COVID-19 case was announced on January 23, 2020 (4). The experience of the avian influenza in 1997, severe acute respiratory syndrome (SARS) in 2003, particularly, and influenza A (H1N1) pandemic in 2009 has reinforced policy makers and the public to quickly adapt to many preventive public health measures to combat the COVID-19 pandemic. As one of the earliest cities to have hampered by the COVID-19, Hong Kong has been very successful in reducing community transmission by 44%, measured by the average number of people each infected person infects, or R (5), and among the 7.5 million people, the number of confirmed cases remained at 1,047 with four deaths as of May 13, 2020. As the world emerges from the COVID-19 pandemic, a key lesson to be learned is the "slow burn of injustice," with avoidable health inequalities exposed by epidemics (6). Specific groups who have already been facing inequality before the outbreak are likely to become more overlooked and vulnerable. The aim of this community case study is to describe the contextual factors that foster the development of the resilience of the social service providers in helping vulnerable families and their children with special learning needs during the pandemic. As stated by many epidemiologists, there will be more pandemics to come, and this case study may have important prevention implications in the future pandemics.

BACKGROUND AND RATIONALE

The Pathways of Hong Kong in Becoming an "Experienced" City in Dealing With the Virus Outbreak

Hong Kong is an international and affluent city with an area of 1,106.8 km^2 sustaining a total population of more than 7.5 million. The population density of Hong Kong stood at 6,930 persons per km^2, and the most populous district achieved a density of 61,560 persons per km^2 in 2019 (7, 8). Albeit having $382,046 GDP per capita, the Gini coefficient of 0.539 indicates that there is a significant wealth gap within the community (9, 10). Hence, >20% of the population are living under the poverty line (7). With such disparity, many of the poor families who are single parent and with lower education level have to rely solely on governmental resources and nongovernment organizations (NGOs) for various health and social services (7–14).

Health and Social Services in Hong Kong Before the Pandemic

In Hong Kong, it was estimated that the incidence of autism spectrum disorder (ASD) is at 5.49 per 10,000, and the prevalence rate of ASDs is at 16.1 per 10,000 for children <15 years old (15). According to the government's recent mental health review, ASD was the main type of mental disorders among young children, comprising >60% of caseload of the child and adolescent services in public hospitals in 2015–2016, and the number of children

with ASD seeking medical services from public hospitals had doubled between 2011 and 2016 (12).

Generally, the government has provided various support from early diagnosis to medical intervention and education. Through allying various institutions such as child assessment center, social welfare department, and education bureau (EDB), the government aims to improve the well-being of children and adolescents through developing a holistic support system. According to the EDB, the services for children with ASD cover assessment and identification, training and intervention, family support services, home-school cooperation, cross-sector collaboration, public education, and counseling and consultation (13). Many of these services are in "face-to-face" format, and the waiting time to receive any assessment through certified governmental agencies is, on average, 13–19.6 months (13).

Health and Social Services in Hong Kong During the Pandemic

In January 25, 2020, the Hong Kong Government had raised the response level under the "Preparedness and Response Plan for Novel Infectious Disease of Public Health Significance (the Plan, hereafter)" to the emergency level. This plan was developed after the SARS epidemic in 2003 to allow Hong Kong to be much more prepared for future epidemics (16). The main goal of the plan is to ensure that a well-planned and fully integrated emergency management response can be implemented by all bureaus of the Hong Kong government with the support of the multisectors in the society.

The plan includes three response levels: alert, serious, and emergency. These response levels are based on risk assessment of the novel infectious disease that may affect Hong Kong and its health impact on the community. Emergency response level corresponds to a situation where the risk of health impact caused by the novel infection on local population in Hong Kong is high and imminent. Generally, it depicts a high risk of serious human infections caused by the novel infectious agent in Hong Kong, and serious infections may be widespread. It generally applies to situation when there is evidence or imminent risk of sustained community level outbreaks.

Accordingly, since late January, several preventive public health measures including surveillance, quarantine, social distancing, the use of face masks, and school closures have been implemented to suppress the transmission of COVID-19. On January 25, the education bureau announced the deferral of class resumption after Chinese New Year holiday for all schools, which marked the beginning of school suspension in response to the COVID-19 development in Hong Kong until further notice (16). Many nonurgent health care and social services were delayed or reduced.

The Psychological Impact of Pandemic

Previous studies found that the outbreak of a novel virus was associated with the onset of psychiatric symptoms in mentally healthy individuals, exacerbated conditions of individuals with mental illness, and elevated burden for caregivers (17). The anxiety, fear, and stress experienced by the general public was associated with strong sense of insecurity, triggering off

widespread panic buying of food and other basic necessities in at least two international cities (2). The prolonged closure of public services, quarantine, and impaired economic and social activities at the later stage further worsen the situation. A worry for further spread of COVID-19, distrust toward the government in their ability to contain the outbreak, anticipated economic downturn, and increased unemployment rate are associated with intensified negative emotions in the society (18–20).

Families of Children With Special Education Needs Under the COVID-19 Outbreak

Under such a problematic situation, parents had to handle multiple stressors simultaneously. Many parents struggle to secure enough resources, such as food and masks, to ensure home schooling of their children, taking care of the elderly, and going to work without contamination of their household (21). Limited data in the United States suggested the COVID-19 outbreak negatively affected vulnerable families more, including lower-income families and families of children with ASD (22).

Under the COVID-19 outbreak, families of children with ASD might face a particular difficult situation for at least three reasons. First, because of the ASD condition of their children, the parents might not be able to obtain enough tangible necessities. In particular, the closure of schools and child day-care centers shifted back the day-to-day caretaking role back to the parents while they were running here and there to fetch all kinds of daily necessities (2). Having limited patience and various vulnerabilities, children with ASD could not line up in the queue for long. As a result, these families often failed to get the necessities. The constant lack of resources causes stress and tension within families of children with ASD. Second, numerous research already showed that parents of children with ASD often suffered from elevated stress (23, 24), lowered quality of life (25), and heightened psychological distress (26). Third, because of the rigidity nature of people with ASD, the heavily disrupted daily routine has negatively affected their well-being (21).

Realizing the needs of parents of children with ASD, social service professionals fight against the odds to offer continued support and services for these families. Theoretically, social service professionals underwent the processes of resiliency as service providers (27–29). Resiliency of social service professionals can be conceptualized as the dynamic process in which social service professionals work with service users in encompassing positive adaptation within the context of significant adversity (29). In the time of COVID-19, Hong Kong social service professionals adopted a strength-based approach to mobilize community resources and empower service users to address their needs (27). It is necessary to document and summarize Hong Kong social service professionals' innovation, practice wisdom, and lessons learned for at least four reasons. First, "COVID-19 is not the first virus to threaten humanity, and it will not be the last" (30). The Hong Kong social service professionals' experiences can help to develop the practice guide and conceptual model for the future. Second, studies on social service professionals' view on the families of children with ASD under the period of COVID-19 pandemic are scarce (21). The document fosters the understanding of experiences of the families of children with ASD and serves as an expression of concern of academia toward these families in the time of uncertainty. Third, some service users mistakenly perceived that social service professionals might not be able to provide any kind of services in the period of COVID-19 outbreak. Our documentation helps to make social service professionals' work and the related challenges more visible and accountable (31). Fourth, up to date, parenting-related studies under the period of COVID-19 pandemic only present scholars' views [e.g., (21, 30)]. Little is known from frontline practitioners' perspectives. The current study can address this gap.

Based on a focus group interview with the social service professionals serving families of children with ASD, the current study aims to address the following research questions:

1) What are the needs of families of children with ASD and other developmental issues under the period of COVID-19 pandemic?
2) What are the services provided to families of children with ASD and other developmental issues under the period of COVID-19 pandemic?
3) What are the challenges social service professionals encountered?
4) What are the solutions to these challenges?

METHODOLOGICAL ASPECTS

Study Design

The current study adopts a descriptive qualitative research approach. Ten social work and psychological professionals were invited to join a semistructured interview. From their sharing, the needs of families of children with ASD as well as social service professionals' innovative response, practice wisdom, and lessons learned in the period of COVID-19 outbreak were summarized.

Participants

The participants were mostly female (90%) and comprised clinical psychologists (30%), educational psychologists (10%), senior social workers (30%), registered nurses (20%), and early childhood educators (10%) from five local NGOs and two hospitals and the University of Hong Kong. Regarding education level, one (10%) completed a bachelor's degree, six (60%) completed a master's degree, and three (30%) completed a doctorate degree. All of whom have 7–15 years of experience serving families of children with ASD and developmental issues (**Table 1**).

All of the participants were the master trainers from the World Health Organization Caregiver Skills Training Program (WHO-CST, or CST) in Hong Kong. The program, which was adopted to the context of Hong Kong in 2018, aims to train caregivers of children 2–6 years of age with developmental disorders or delays, to provide better care for themselves and their children. To deliver CST locally, master trainers participated in training conducted by WHO. Four days were spent on learning the theoretical content of the program, and more hours have been spent on real-life practices in delivering program content, in order to reach the fidelity standards of the program. The

TABLE 1 | Background information of master trainers in Hong Kong.

Profession	Gender	Years of experience	Education Level
Clinical Psychologist	M	15	Doctor of Psychology (Clinical)
Clinical Psychologist	F	9	PsyD in Clinical Psychology
Clinical Psychologist	F	7	MSSc in Clinical Psychology Master of Philosophy in Psychology
Counselling Psychologist	M	6	MSSc (Counselling) in Social Work
Counselling Psychologist	F	2.5	MSSc (Counselling) in Social Work
Educational Psychologist	F	Unknown	PhD. with specialization in Educational Psychology
Registered Social Worker	F	15	Master in Applied Psychology (Special Learning Needs)
Registered Social Worker	F	5	MSSc in Social Work
Registered Social Worker	F	12	Bachelor of social work
Nurse	F	11	Master of Nursing
Nurse	F	Unknown	Master of Nursing
Early Childhood Educator	F	7	Master in Early Childhood Education

program was originally designed for master trainers to deliver nine sessions and conduct three home visits in person, with each session comprising taught content, discussion, and role-play, lasting for 3 h on average. Each home visits involves observing play and home interaction between parent and child as well as master trainers demonstrating CST skills to enhance the interaction. Each visit lasts for about 1 h.

The master trainers from CST are chosen as the participants in this interview for several reasons. First, the implementation of CST in Hong Kong belongs to a large-scale community-based research program. The first phase of the research program reviewed the family needs and existing services for families of children with ASD in Hong Kong. Therefore, the master trainers are familiar with the situation of the families of children with ASD and the social services available for these families. Second, the master trainers are representatives from large leading NGOs and hospital authority from the government. The master trainers represent a wide range of social service professionals serving families of children with ASD in Hong Kong. Third, each master trainer supervises several facilitators, including parents of children with ASD, nurses, social workers, teachers, medical doctors, and occupational therapists. They are well-informed of the different aspects of life of families of children with ASD in Hong Kong. Fourth, the COVID-19 outbreak, especially the quarantine, discourages the open recruitment of participants for the program because the social service professionals are busy with restructuring their services. The master trainers from CST are the available experts ready for addressing research questions stated.

Data Collection Process

The focus group interview was conducted through a teleconferencing application, during which participants were prompted to discuss the general effects that the pandemic poses on the parents and children with ASD and other developmental issues, services delivered and challenges they currently face, and their plans for providing services if the pandemic lasts for more than 3 months (see Appendix I in **Supplementary Material**). Responses were video recorded, transcribed by a research assistant, and sent to participants for checking accuracy.

Analysis

For the current study, the second author read through the transcript of the focus group several times and summarized the initial themes generated from the transcript. The initial themes, then, was cross-checked by the first author to ensure the objectivity of these themes (see Appendix II in **Supplementary Material** for the list of themes). A trained research assistant coded the transcripts by using the coding scheme developed by the second author. The interrater reliability for the focus group was 0.91. The research assistant then counted the raw codes of each theme to further ensure that the data presented social service professionals' innovative response, practice wisdom, and lessons learned (32).

RESULTS AND DISCUSSION

Needs of Families of Children With ASD—Tangible Resources

To facilitate the understanding of social service professionals' innovative response, practice wisdom, and lessons learned during the period of the COVID-19 outbreak, it is essential to introduce the needs of families of children with ASD as the basic context of the services provided. Based on the data from the semistructured interview, there were two major needs identified—(a) tangible resources and (b) intangible services. Nearly all the participants mentioned that many families of children with ASD needed tangible resources. Parents were desperate for surgical masks and alcohol-based hand rub in the initial stage of the outbreak. In February 2020, a panic buying of surgical masks has gone unresolved for more than 30 days (33). The panic buying of surgical masks could affect families of children with ASD more than the general public because many of these parents could not queue up for buying masks because of their children's conditions (22). As one of the professionals recalled: "…in the first week, they really would in the first week. Lining up everywhere like crazy."

Also, the professionals also mentioned that some families of children with ASD required electronic devices in order to participate in online learning activities during school closure because of the spirit of "suspending classes without suspending learning" (34). However, many poor families of children with ASD did not have any electronic devices to support online learning. In response, the professional advocated for donation of electronic devices from the general public and passed the donated electronic devices to these families so that children with ASD in

lower-income families could attend online classes and completed their assignments.

Needs of Families of Children With ASD—Intangible Services

In addition, professionals also reported that children with ASD in Hong Kong displayed more problematic behaviors and emotional problems during the quarantine. This was consistent with previous literature on health emergencies. Rothe et al. (35) found that violence in children increased when schools were closed. An increase in problematic behaviors and emotional problems could be attributed partially to four reasons. First, according to stress-diatheses models (36), the outbreak was an additional stressor to children with ASD and other developmental issues, eliciting more problematic behaviors and emotional problems. Second, quarantine reduced social interaction. Without social stimulation, children with ASD might regress on the social skills and self-control skills they previously learned (37). With lower level of social skills and self-control skills, children with ASD and other developmental issues might display more problematic behaviors in interpersonal contexts. Third, the energy spent was reduced during the social distancing period, causing lower sleeping quality. Lower sleeping quality, in turn, magnified problematic behaviors and emotional problems (38). Fourth, children felt extremely boring, and parents exhausted with means to stimulate and occupy children.

On the other hand, parents told the professionals that they concerned a lot about their children's academic performance because of school closure. In most Chinese societies, parents always emphasize on exceling in schooling and examinations as their children's top responsibility (39–41). Parents of children with ASD spent a significant amount of time on keeping their children's learning in progress. Adolescents with ASD who needed to attend a public examination faced a lot of stress because the schedule of the public examination and resumption of school were uncertain.

Corresponding to the above needs, the social service professionals provided intangible services to address these needs. For instance, the professionals offered an emotional coaching program based on (42) model to parents of children with ASD (42). The program aims to train parents' skills in managing their children's emotional problems. In particular, to ensure smooth implementation and delivery of the program, social service professionals would ensure that service users have functional electronic devices available and stable internet connection, and the smooth installation and a test run of the teleconferencing software prior to the program. In addition, shortening the session time was suggested as parents were often torn between roles at home. For example, one coaching session shrunk from 2-h duration to 1 h. A self-compassion practice has been conducted. Information about being aware of child's emotion has been taught. Besides the main teaching content, more online viable interactive activities, such as polling and group discussions, were incorporated to keep participants engaged. Online parenting workshop was also conducted to share with parents how to schedule children's learning and occupy their time. Similarly,

the social service professionals provided online training, phone counseling, and reaching out service for children with ASD in different developmental stages.

On the other hand, the professionals also noticed that children with ASD had unexpected positive experiences during the quarantine. As children with ASD did not need to go to school, they were free from problems of school bullying (43). They experienced more positive affect and could concentrate on their study. Some of the professionals had to provide individual counseling to help them make sense of such unexpected experiences.

Suggestions for Providing Services for Families of Children With ASD in the Period of the COVID-19 Outbreak

Through trial and error, the professionals summarized a procedure to provide services for families of children with ASD. They suggested that social service professionals should concentrate on providing tangible resources at the early stage of outbreak. It is because providing tangible resources served several important functions in the period of the COVID-19 outbreak. First, based on the literature of community work, providing tangible resources are the important mechanism to approach the potential services users and promote available and future services (44, 45). Second, the COVID-19 outbreak created social distancing, which in turn increased loneliness (18–20). Providing tangible resources is a way to show concerns and build rapport with families of children with ASD. This could raise the willingness of families of children with ASD to receive services and increase their compliance in the future. Besides, providing electronic devices was the essential step for serving families of children with ASD with lower income in a "non–face-to-face mode."

After addressing the needs of tangible resources, the professionals tried to relieve the issues brought forth by the children's special needs using "non–face-to-face mode." As mentioned, the professionals offered online emotional coaching program, online parenting workshop, online special needs training, and phone counseling. With experiences, the professionals started to realize that the timing of offering services is important, especially for children with ASD in preschool ages and their parents. The professionals recommended offering online physical exercise training for the children with ASD in preschool ages during the morning and offering online parenting workshop or parenting program for their parents in the afternoon.

Because of class suspension and social distancing, children with ASD in preschool ages did not need to spend a lot of energy in the daytime. Some of them skipped the afternoon nap, and thus, they might demand more attention from their parents than before. Their parents then became unavailable for online parenting workshop or parenting program. Offering online physical exercise training for the children with ASD in preschool ages could use up part of their energy, increasing the likelihood of afternoon nap. Also, previous literature suggested physical exercises could lower the stereotypical behavioral

patterns of children with ASD (46, 47), reduce self-stimulation behaviors (48), and increase social behavior (49) and academic engagement (50).

The professionals also suggested consolidating tips and recommendations for parents of children with ASD and other developmental issues onto a single source (e.g., a government web). Otherwise, these parents could be overloaded by excessive information. Consistent with literature on information overload, parents could not process too much information and automatically filter information when they are overloaded, causing biased decision-making (51, 52).

Difficulties and Lessons Learned

Our professionals encountered several difficulties and lessons learned in serving families of children with ASD in the COVID-19 outbreak. The difficulties and lessons learned included technology know-how, privacy issues, and adjustment in non–face-to-face mode of services.

Technology Know-How

Although tele–social service might not be a new practice to many practitioners (53), the "technology know-how" on conducting online training, workshop, and program continued to be a challenge (54). During the COVID-19 outbreak, many services turned into online mode. The professionals reported that they had to consult the Information Communication Technology (ICT) experts in their NGOs or self-learn to master the knowledge and skills in setting up online services. Similarly, they had to design and produce guidelines in written and video format to teach the services users how to use electronic devices. This phenomenon echoed the application of information technology in social service services as a challenge to practitioners (55).

The relatively low level of competency in using ICT in social services might root in the understanding that humanity has been deemed as a essential to the sector, and empathy is a core quality of the helping professionals; therefore, education emphasizes on humanity training while offsetting ICT skills education. Limited studies indicated that only small portion of programs in undergraduate and postgraduate levels incorporated training in the use of electronic communications for social service professional trainees [e.g., Reamer (56)]. Similarly, current research focused on application of ICT in distance learning of the social work or mental health professional program. Little was done on developing guideline and conceptual model of how to deliver psychosocial services using information technology.

To be better prepared in responding to future challenges, in-house training courses and mental health professional education at university should include information technology course as compulsory subject without offsetting the humane side and empathy of the helping professionals. Researchers should also spend effort in investigating theoretical model of online mental health services by referring to literature on online interpersonal interaction [e.g., Jones et al. (57)].

Privacy Consideration

In relation to providing services in online mode, social service professionals had the ethical responsibility to protect services users' privacy (56). The professionals reported that they spent significant efforts to produce guidelines in protecting services users' privacy, to equip themselves with necessary skills in executing privacy-protection measures, and to keep exploring various safer software and resources. All these works became more salient when new reports stating serious privacy violation increased; for example, the BBC reported on an incident where a university lecturer's Zoom session had been interrupted by footages of child abuse (58).

Past studies indicated that individuals might be more ready to self-disclose their personal details online than face-to-face interaction (59, 60). However, online psychosocial services could be risky for electronic breaches or hacking. Also, unscrupulous or insensitive group mates might record the interaction in the online program and share with others.

In term of practices, services heads or supervisors in NGOs should develop a detailed guideline in protecting services users' privacy before launching online services. Also, social service professionals should educate their services users the potential risks and importance of privacy when receiving online services. Besides, social service professionals should proactively protect services users' privacy and confidentiality in online services contexts (56).

Adjustment in Non–Face-to-Face Mode of Services

Providing services in online mode represented a different interaction pattern between social service professionals and service users. The first difference was in the recruitment process. There was self-selection in the recruitment process. Families with lower socioeconomic status who did not have an electronic device or did not feel comfortable in using technology would not join their services. The self-selection process might violate the concepts of fair access and equal opportunity of receiving services (56).

To ensure the fair access and equal opportunity, social service professionals should proactively reach out to potential service users, express empathy and concern to isolated families, equip potential service users with necessary devices and skills for online services. They could also plan and recruit participants for face-to-face services in advance before the quarantine ended.

The second difference was in group dynamics (61). Group mate interactions and professional-service user interaction could be different between face-to-face and online format (57). For instance, some service users lost their focus in paying attention with online services than face-to-face one. Practitioners needed to assign participants who were familiar with each other to a group rather than all unfamiliar participants to facilitate mutual exchange in the online parenting program (62). All these implied conducting online services requires additional skill sets. Peer coaching and continued professional development should be encouraged within NGOs to sharpen social service professionals' micro skills in conducting online services.

Evidence-Based Practice

Another issue was about evidence-based practice. The COVID-19 outbreak forced social service professionals to deliver services in online settings. For instance, the professionals organized

online parenting workshop and program as well as individual counseling. However, effectiveness of these services in online format in Hong Kong is underresearched.

Social service professionals are professionally and ethically obligated to provide evidence-based services. Practitioners should cooperate with researchers to conduct more action research to provide initial evidences for delivering services in online format (63). The COVID-19 outbreak then could be perceived as an opportunity in to advancing evidence-informed online services for families of children with ASD and other developmental issues.

Limitations of the Study

The current study faced several major limitations. First, the current study adopted a nonprobability sampling method. The participants were social services professionals in Hong Kong who were limited to the master trainers from CST in Hong Kong. Our results could be biased toward families of children with ASD, who have voluntarily come in contact with the professionals. Our results might not be generalized to other service users (e.g., elderly) and to other societies. Second, some findings were bounded to be culturally relevant and might not be applicable to non-Chinese contexts; for example, some parents may be overly concerned about children's academic performance and afternoon nap. Third, the COVID-19 outbreak has not ended yet in Hong Kong. The current study could not document further service needs, innovation, and lessons learned for helping families of children with ASD readjustment to nonquarantine life.

CONCLUSION

In 2003, during the SARS outbreak, the WHO commented that Hong Kong was one of the hardest cities in the world to control an epidemic because of the territory's immense population density and fluid boundaries with neighboring areas. It was because it was the first time that an infectious disease hit Hong Kong in such pace and scale, many of us underestimated its risk, and the government was trying too hard to contain public's panic at that time, which led to delayed decisions on enforcing territory-wide preventive public health measures. Eventually, 299 people were killed by the virus due to the absence of contingency planning, poor interagency coordination, unclear chain of command, and unsatisfactory resource and supplies support contributed to confusion and hindered effective implementation of infection control (64).

The government had since rolled out regulations, enhanced preparedness and response plans, with strengthened precautionary mechanisms. The mobilization of the public health and hospital systems, coordination of interdepartmental responses, information dissemination, quarantine requirements, school closures, and efforts to reduce close contact in public spaces have all benefited from the SARS and swine flu experiences. In this COVID-19 pandemic, according to one

of the commentaries published in *Nature*, it says "Hong Kong seems to have given the world a lesson in how to effectively curb COVID-19" (65). We believe that the success of the current situation in Hong Kong is not a coincidence. The past experiences of the virus outbreak in Hong Kong has made the policy makers; civil servants of all government departments; charitable organizations; professionals in health, education, social welfare, and business sectors; multiple sectors; and all citizens here much more resilience to such a worldwide natural disaster.

Inevitably, some vulnerable groups would still be overlooked and experienced additional difficulties more than the public. In view of the crisis situation to fulfilling the unmet needs of the vulnerable families, many NGOs and large companies have been providing vulnerable families with tangible supports, i.e., giving out masks, food, and financial aids; giving out second-hand computers and tablets with free Wi-Fi-access cards; and intangible supports, i.e., developing free resourceful psychosocial–educational materials and distributing through both the traditional media and social media platforms and conducting online peer-support groups for the caregivers. Some of the materials and groups are delivered in other Asian languages so that families with ethnic minority backgrounds could benefit as well.

The main lessons learned from this experience are to defend a highly transmittable disease in an overcrowded city efficiently and effectively. It seems that (1) individuals can adhere to behavioral advices with the sense of protecting the well-being of self and others; (2) communities with a wide range of business, education, health, religious, social welfare, and voluntary sectors can pull together tangible and intangible resources quickly, identify the most vulnerable correctly, and distribute the resources efficiently and sometimes innovatively; (3) when the city's top leadership can enforce policies forcefully but flexibly, a silver lining can exist; and (4) both community and the government should consolidate useful information onto on webpage, so not to overload the parents when they are already stressed out. Learning from our master trainers, the social service sector has tried their best to deliver their assistances, whether it is educational or therapeutic, through any means even if the mean, i.e., ICT, was unfamiliar to them.

Since June 2019, the mental health burden of the Hong Kong people during the social unrest had already been documented with the increased prevalence rates of suspected depression and posttraumatic stress disorder at 11.2 and 12.8%, respectively (66). The additional impacts of the pandemic on the psychosocial well-being on the community are yet to be examined. Both incidents have severely impacted the young people and their families in Hong Kong, especially those who were arrested during the social unrest, those who are graduating from schools or transiting to higher levels of education or to the workforce, and those who have special learning and health needs. In these challenging times, investments in youth mental health and supporting their caregivers may be the most cost-effective ones for the future of Hong Kong.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Human Research Ethics Committee of the University of Hong Kong. The patients/participants provided their written informed consent to participate in this study (EA1912063).

AUTHOR CONTRIBUTIONS

PW, YL, JL, and HF substantially contributed to the conception of the work, drafting different components of the manuscript and revising other components. All authors approved the submitted version of the manuscript and agreed to be accountable for all aspects of the work.

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SUPPLEMENTARY MATERIAL

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Gratitude and Adaptive Coping Among Chinese Singaporeans During the Beginning of the COVID-19 Pandemic

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We report results of a cross-sectional survey conducted during March–April 2020 which marked the start and escalation of the COVID-19 crisis in Singapore. Our purpose was to examine whether reported feelings of gratitude among Chinese Singaporeans ($N = 371$; 124 males, 247 females; $M_{age} = 22.54$, $SD_{age} = 3.63$, age range: 18–53 years) could be linked to adaptive responses to the pandemic. The results revealed that gratitude was associated with stronger endorsement of virus-prevention measures ($\beta = 0.25$, $p = 0.001$) that are necessary for protecting the physical health of oneself and others but disruptive to daily lives. Gratitude was also positively related to the tendency to perceive meaningful benefits in the crisis ($\beta = 0.25$, $p = 0.002$). Importantly, demonstrating the uniqueness and robustness of gratitude as a predictor of positive coping in response to the pandemic, these relationships remained significant when controlling for other protective psychological factors (resilience and optimism), emotions, and key demographic variables. Among the emotions measured, gratitude was also reported the most strongly. The findings support theoretical models that gratitude facilitates prosocial inclinations and openness to different ways to support the well-being of others and suggest that in a collectivistic culture, gratitude could be a key resource enabling adaptation to a crisis.

Keywords: gratitude, COVID-19, coping, health behavioral intention, Chinese

INTRODUCTION

Gratitude is a positive emotional response to receiving a positive outcome from another person. It inspires the recipient to be prosocial [1, 2] and brings about positive outcomes such as lower maladjustment and higher well-being [3]. However, much less is known about the roles that gratitude might play in a major crisis such as the current COVID-19 pandemic, which as of this writing has infected over 44 million people worldwide and taken the lives of over a million victims [4]. A question in emotion research is whether positive emotions, and gratitude in particular, could continue to function as a protective factor to support adjustment and maintain well-being in a calamity of this severity. In this paper, we report the first study that examined the relationships between gratitude and endorsement of virus-prevention measures and benefit-finding in the early stages of the COVID-19 pandemic among a sample of Chinese Singaporeans.

Why might investigating the protective function of gratitude specifically (1) during early stages of the pandemic and (2) among the Chinese be important? Gratitude is known to predict better

coping and adjustment (5, 6). For instance, it predicted adjustment among Vietnam War veterans with post-traumatic stress disorder (PTSD) symptoms (7). Among Israeli survivors of missile attacks, gratitude was negatively associated with PTSD symptoms 2.5 months after the attacks (8). Studies have also shown that gratitude is associated with lower burnout (9), suicide risk (10), and depression (6) in non-crisis contexts. However, none of these studies have examined an international calamity like the COVID-19 pandemic. When it emerged in the first half of 2020, scientists and laypersons did not fully comprehend the virus other than that it appeared highly infectious and more fatal than the common flu. There was the ominous foreboding that the virus would put not only the lives of millions worldwide at dire risk but also their livelihood at jeopardy, with no end in the form of a vaccine in sight. Exacerbating the uncertainty is misinformation concerning the virus and alternative practices (11). It is pertinent to ask whether or not the usual protective factors (including gratitude) known to enable adjustment under normal contexts would function just as effectively in a poorly understood crisis that COVID-19 still is.

Chinese people refer to those associated with China based on ancestry, ethnicity, or nationality. Chinese nationals and ethnic Chinese born outside of China comprise about 18% of the world population (12–14). Yet, few studies have been done on how the Chinese—the largest ethnic group in the world—respond to the pandemic. Furthermore, controlling the pandemic would minimally require people to behave responsibly by practicing safe health behaviors to reduce spreading of the virus. If gratitude—a positive socially oriented emotion—has any effect in promoting these other-focused behaviors, it should be found among the Chinese who tend to endorse collectivistic values. Focusing on Chinese samples is thus a major first step to test the protective function of gratitude in response to an impending crisis.

Theoretical grounds for understanding the protective functions of gratitude can be based on Fredrickson's (15) broaden-and-build theory, which states that positive emotions broaden cognitive and behavioral abilities in the short-run and build them into stable tendencies in the long-run. Her model posits a similar process for gratitude (16). Gratitude could have two short-term effects. It may inspire prosocial responses on a daily basis, nudging one to be sensitive to others and motivating helpful behavior. There is robust evidence that gratitude facilitates prosociality (17). In addition, gratitude may regularly enhance the ability to make mental shifts. Researchers have theorized that grateful people could be driven by their prosocial desires toward thinking of different ways to help people (16, 18), thus promoting an agile mindset that is receptive to diverse ideas. Temporal accumulation of these momentary broadening of prosocial motives and mental shifting can build over time to create stable prosocial tendencies and cognitive openness. That is, individuals who experience gratitude on a regular basis may become socially conscious individuals with flexible processing capacities that are open to new ways of helping others and supporting the community (16).

We posit that gratitude plays a role in enabling adaptive responses during early stages of the COVID crisis because managing the pandemic then demanded virus-prevention measures that require prosocial proclivity and cognitive openness (16, 18). These measures included regular hand washing, mask wearing, disinfecting belongings, avoiding hand-face contact, and social distancing. They are meant not just to protect oneself from the virus, but also to prevent an infected person from spreading the virus to others. They are not unusual practices—we observe them when having the common cold. However, as the crisis unfolded, it became increasingly clearer that the measures would have to be engaged habitually for a protracted period. This would mean upending daily routine, curtailing social activities, and even compromising businesses and careers because of social distancing. Hence, stopping the virus requires each person to behave responsibly to keep everyone else safe when doing so brings personal costs. Accordingly, those with greater prosocial intention should be more willing to adhere to the measures (1). At the same time, a good degree of openness and flexibility is needed. Some people resisted these measures given the major disruptions of lifestyle and livelihood they could bring. Demonstrations happened in some nations after their government mandated some of these measures. In addition, in the initial phase of the pandemic, it was not clear to some people whether some of these measures are effective and necessary. For instance, WHO encouraged mask-wearing for the general public only in mid-2020 because it was only then that scientific evidence for it became clear (19). Hence, individuals who are more open should be more willing to endorse the health-protecting but difficult measures. Given that gratitude facilitates prosocial motives and cognitive openness, we hypothesized gratitude to be positively related to the willingness to endorse these virus-prevention measures in early stages of the pandemic.

In addition, research has shown that gratitude is associated with an enhanced ability to find meaning and purposes even in abject situations. This relationship could be due to the greater cognitive flexibility posited of gratitude. For instance, gratitude prospectively predicted greater sense of coherence, mediated by positive reappraisal (20). Positively appraising events explained the negative association between gratitude and depression (21). Gratitude interventions have also been found to enable disengagement from negative cognitions (22). However, again, many studies were conducted in fairly normal circumstances, and whether gratitude will have similar effects in a pandemic is unknown. We hypothesized that gratitude should be positively associated with benefit-finding.

In sum, we predicted that gratitude should be associated with greater willingness to endorse socially responsible virus-prevention measures and benefit-finding during the early stages of COVID-19 pandemic. We report a study to test these hypotheses that was conducted in Singapore among ethnic Chinese Singaporeans during March–April 2020 when the pandemic began to escalate. Importantly, we also tested whether gratitude would robustly predict these outcomes over and above other potential predictors. Resilience and optimism have been found to predict mental health and the use of health-protective behavior (23–25). Hence, it is critical to examine whether gratitude would remain independently predictive of the outcomes controlling for them. They also included other emotions (specifically anger, sadness, anxiety, joy, pride, and

care) which served the overall purpose of testing the uniqueness of gratitude. There is no direct relationship between negative emotions and health outcomes as much depends on how the negative feelings are regulated (26). Hence, we made no prediction on whether anger, sadness, anxiety would predict endorsement of virus-prevention measures and finding benefits. Controlling for joy would rule out the possibility that any protective function of gratitude is due only to its positive valence. Pride can elicit self-determined responses such as persistence (27) and hence might enable better coping. An ensuing question was whether gratitude might predict the outcomes independently of pride. Finally, care refers to general positive feelings of concern. Like gratitude, it is a positive emotion that is socially focused. However, it is unclear whether care also engenders the cognitive openness as gratitude does that encourages the use of new behavioral responses. If gratitude predicts endorsement of virus-prevention measures and benefit-finding independently of care, it would suggest that gratitude is unique among positive social emotions as a protective resource in handling the crisis. Finally, we included several demographic variables available in our dataset (namely, age, gender, education, household income, and household size) as predictors. We also coded the number of cumulative infections on the day of participation to account for whether the severity of the pandemic would affect how people respond. Whether or not these variables would predict endorsement of virus-prevention measures and benefit-finding is interesting in itself—to which we make no prediction of—but the pertinent issue is whether gratitude would remain predictive of the outcomes independently of these variables.

MATERIALS AND METHODS

Participants
Four hundred and seventeen Chinese participants from Singapore were examined in this study. The survey was open to any Singaporean citizens above 18 years of age. Online advertisements were used to recruit participants, who were told that the study was interested in examining how they were managing the pandemic and which advertised a lucky draw of two $100 Singapore Dollar (SGD) prizes. The study consists of a cross-sectional survey which was conducted in Singapore between 26th March (683 cumulative infections) and 20th April (8,014 cumulative infections), during a time when the pandemic was increasingly escalating. Participants provided informed consent and were assured that their responses would be confidential and anonymized—identifying information (names and email addresses) was collected only on a separate survey for administering the lucky draw and was delinked from the main survey. Forty-six participants were excluded for failing attention checks, giving a final sample of 371 participants (124 males, 247 females; $M_{age} = 22.54$, $SD_{age} = 3.63$, age range: 18–53 years). Excluded participants generally did not differ from included ones in age, income, and education level ($ps > 0.30$) but were more likely to be male ($r = 0.15$, $p = 0.002$). Exclusion was also uncorrelated with any of the key predictor or outcome variables ($ps > 0.05$) except anger ($r = 0.13$, $p = 0.006$). Overall, included and excluded participants generally did not differ substantially,

and any differences that did occur are relatively small and unlikely to affect the analyses. This study is approved by the National University of Singapore Institutional Review Board.

Measures
Emotions
Participants were asked to refer to the ongoing COVID-19 virus outbreak and were given the following prompt: "Over the past two weeks, to what extent have you felt the following emotions as a result of this outbreak?" They rated several emotion items presented in randomized order on a seven-point scale, with the following anchors: 1 ("Did not feel the emotion at all"), 4 ("Felt the emotion moderately"), and 7 ("Felt the emotion very much"). Four positive emotions and three negative emotions were assessed. *Gratitude* was measured by two items ("Grateful," "Thankful"; $\alpha = 0.86$); pride was measured by two items ("Proud," "Confident"; $\alpha = 0.59$); care was measured by two items ("Love," "Compassion"; $\alpha = 0.64$); and joy was measured by two items ("Joyful," "Happy"; $\alpha = 0.82$). Sadness was measured by four items ("Sad," "Lonely," "Helpless," "Hopeless"; $\alpha = 0.75$); anger was measured by four items ("Angry," "Hostile," "Irritated," "Contempt"; $\alpha = 0.73$), and anxiety was measured by two items ("Fearful," "Anxious"; $\alpha = 0.78$). The internal consistency of several subscales were only moderate due to the small number of items, for which Cronbach's alpha often underestimates reliability (28, 29), and factor analytic evidence is recommended to provide stronger evidence of scale reliability (30). Confirmatory factor analyses supported the above emotion classifications; model fit was strong, $\chi^2 (114) = 303.54$, $p < 0.001$, CFI = 0.93, RMSEA = 0.067, SRMR = 0.054, and all items loaded into their respective factors strongly (standardized $\lambda s > 0.40$)[1].

Resilience
Six items adapted based on the Brief Resilience Scale [BRS (31)] assessed participants' resilience with regard to the COVID-19 outbreak ("I believe that I will bounce back quickly from the current crisis," "I will have a hard time making it through the current crisis," "It will not take me long to recover from the current crisis," "It will be hard for me to snap back from the effects of the current crisis," "I will come through this difficult crisis with little trouble," "I will take a long time to get over the setback caused by the current crisis.") on a seven-point scale from 1 ("Strongly Disagree") to 7 ("Strongly Agree"). Three items were reverse-coded, and the six items were then averaged ($\alpha = 0.86$).

Optimism
Four items measured the extent to which participants were optimistic about the COVID-19 outbreak ("I believe the COVID-19 outbreak will be resolved successfully," "I am confident that life will go back to normal soon," "I am certain that the COVID-19 outbreak is manageable," "I trust that we will be able to overcome the COVID-19 outbreak.") on a seven-point scale

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[1]Participants rated the emotion items without a specific target. Hence, general forms of the emotions including gratitude were measured. Accordingly, the ensuing findings are of greater generalizability because they describe how gratitude in general (rather than specific forms of gratitude) is related to the outcomes.

from 1 ("Strongly Disagree") to 7 ("Strongly Agree"). The four items were averaged ($\alpha = 0.85$).

Virus-Prevention Measures

Participants were asked to rate how much they intend to follow seven virus-prevention measures involving social distancing and maintaining personal hygiene (e.g., "Wash your hands with soap or hand sanitizer frequently," "Avoid touching your face," "Avoid leaving your house except when necessary (e.g., when groceries run out)," "Regularly disinfect your belongings," "Shower upon arriving home from outside," "Minimize unnecessary social contact, such as social gatherings or sharing food with others," "Wear a surgical mask if going out.") which help to minimize the risk of being infected. The items were rated on a seven-point scale, with the following anchors: 1 ("Not at all likely to do this"), 4 ("Somewhat likely to do this"), and 7 ("Very likely to do this"). The seven items were averaged ($\alpha = 0.77$).

Benefit-Finding

Five items adapted from Fredrickson et al. (32) measured benefit-finding from a crisis ("Do you feel that anything good would come out of dealing with the crisis?" "Do you feel that you might find benefit from this crisis in the long-term?" "Do you think it is likely that there is something to learn from this crisis?" "Do you think you would try to see the good side of the crisis?" "Do you think the crisis could change your life in a positive way?") on a seven-point scale from 1 ("Not at all") to 7 ("Very Much"). The five items were averaged ($\alpha = 0.82$).

Covariates

We controlled for demographical variables, including age, gender (1 = "male," 0 = "female"), education level (1 = "No school or some grade/primary school" to 11 = "Advanced degree beyond a Master's Degree"), annual household income (1 = "<\$10,000" to 8 = "\$150,000 or more"), and household size. We also coded the cumulative number of infections on each participant's day of participation to control for the increasing severity of the crisis over time—due to the large numerical value of this variable, we further divided it by 100 to improve the interpretability of all regression coefficients.

Social Desirability

To control for the possibility that responses to some of the measures could be influenced by presentational concerns, we measured socially desirable tendencies using eight items from the Balanced Inventory of Desirable Responding [BIDR-16 (33)], of which four were reverse-coded. The items were rated on a seven-point scale from 1 ("Strongly Disagree") to 7 ("Strongly Agree"). Following Hart et al. (33), each item was scored such that "6" or "7" were scored "1" while ratings below "6" were scored "0." The eight scores were summed.

Checks

Two attention checks were administered to detect inattentive responses (e.g., "Maintaining good hygiene, but for this question select the option "2" to show that you are paying attention").

TABLE 1 | Descriptive statistics for all key variables.

	M	*SD*	Range
Number of cases during participation	1,436.00	1,292.34	683–8,014
Age	22.54	3.63	18–53
Gender	–	–	247 females (66.58%), 124 males (33.42%)
Education level	5.09	1.12	3–10
Household income	3.56	2.23	1–8
Household size	4.28	1.18	1–9
Social desirability	1.55	1.69	0–8
Resilience	4.96	1.08	1.67–7
Optimism	5.21	1.20	1.50–7
Gratitude	4.31	1.60	1–7
Joy	2.49	1.25	1–6.5
Pride	3.01	1.38	1–7
Caring	3.53	1.39	1–7
Sadness	3.19	1.26	1–7
Anxiety	3.95	1.43	1–7
Anger	2.96	1.19	1–7
Virus-prevention measures	4.86	1.21	1.29–7
Benefit-finding	4.85	1.16	1–7

Education level was measured in continuous increasing order, with 1 representing "No school/some primary school" and 11 representing "Advanced degree beyond a Master's degree". The mean of 5.09 approximates "Some undergraduate education, no degree (college or university)." Household income was measured in continuous increasing order with 1 representing "<SGD\$10,000" and 8 representing "SGD\$150,000 or more." The mean score of 3.56 approximates the range between "SGD\$25,000–SGD\$34,999" and "SGD\$35,000–SGD\$49,999".

RESULTS

These descriptive statistics are summarized in **Table 1**. Reported resilience ($M = 4.96$) and optimism ($M = 5.21$) were generally high, indicating that the sample on average was coping adaptively at the time of the study. Of note as well, specific emotions appeared to be more strongly activated. Unsurprisingly given the uncertainties of the crisis, anxiety ($M = 3.95$) is the most prevalent negative emotion reported. Interestingly, among the positive emotions, gratitude was the most strongly reported ($M = 4.31$), at above the midpoint of the scale (4 = "Felt the emotion moderately"). Joy ($M = 2.49$), pride ($M = 3.01$), and caring ($M = 3.53$) were not reported strongly.

The correlation matrix is provided in **Table 2**. As shown in **Table 2**, gratitude correlated positively with both endorsement of virus-prevention measures and benefit-finding and the effect sizes were medium. Next, to test whether gratitude predicted the outcome variables independently, we performed two hierarchical linear regressions predicting endorsement of virus-prevention measures and benefit-finding, with gratitude as the focal predictor which was entered at the second step. Resilience, optimism, anger, anxiety, sadness, joy, pride, and caring were included as comparisons to gratitude at the first step. Number of cases, age, gender, education level, household income, household size, and social desirability were controlled for in the first step as

TABLE 2 | Correlation matrix for all key variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Cases	–																
2. Age	0.06	–															
3. Gender	−0.03	0.21**	–														
4. Education	0.08	0.32***	0.01	–													
5. HH income	−0.02	0.13*	−0.07	0.04	–												
6. hh size	−0.05	−0.04	−0.06	−0.12*	0.08	–											
7. SDS	0.05	0.06	0.04	0.08	−0.05	−0.04	–										
8. Resilience	−0.08	0.11*	0.07	0.07	0.11	−0.05	0.23***	–									
9. Optimism	−0.03	0.07	0.08	0.08	0.09	0.05	0.03	0.38***	–								
10. Gratitude	0.09	0.02	−0.01	0.02	0.07	0.06	−0.03	0.15**	0.20***	–							
11. Joy	0.11*	0.03	0.05	0.12*	0.04	−0.04	−0.02	0.03	0.15**	0.40***	–						
12. Pride	−0.01	0.03	0.17**	0.06	0.04	0.03	−0.08	0.12*	0.18***	0.58***	0.44***	–					
13. Caring	0.08	0.05	−0.01	0.09	0.17**	0.03	−0.02	0.05	0.10	0.61***	0.45***	0.52***	–				
14. Sadness	0.07	0.04	−0.11*	0.12*	0.05	0.06	−0.13*	−0.32***	−0.08	0.16**	0.15**	0.05	0.27***	–			
15. Anxiety	0.10	−0.01	−0.13*	0.08	0.04	0.08	−0.14**	−0.33***	−0.10	0.25***	0.08	0.08	0.27***	0.62***	–		
16. Anger	−0.01	−0.05	−0.04	−0.04	0.08	0.01	−0.11*	−0.27***	−0.04	0.18***	0.16**	0.17**	0.27***	0.53***	0.50***	–	
17. VPM	0.22***	0.02	−0.08	0.04	0.01	−0.02	0.06	−0.11	−0.01	0.23***	0.01	0.04	0.19***	0.21***	0.36***	0.15**	–
18. BF	0.01	0.02	−0.02	−0.01	0.10	−0.04	0.01	0.22***	0.28***	0.39***	0.20***	0.25***	0.30***	0.07	0.12*	0.03	0.18**

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Gender was coded with "1" representing males and "0" representing females. HH, household; SDS, social desirability; VPM, virus-prevention measures; BF, benefit-finding.

well. No evidence of multicollinearity emerged in any analyses (VIFs < 2.5), and *post-hoc* power analyses indicated very strong power of 0.90 for detecting small-to-medium effect sizes.

At the first step, the control variables explained significant variance in virus-prevention measures ($R^2 = 0.21$, $p < 0.001$), but gratitude nevertheless explained additional variance when entered in the second step ($\Delta R^2 = 0.03$, $p = 0.001$). The full model significantly explained variance in virus-prevention measures, $F(16, 264) = 5.23$, $p < 0.001$, Adjusted $R^2 = 0.20$. As shown in **Table 3**, gratitude remained predictive of greater endorsement of virus-prevention measures controlling for other predictors and the demographic variables. Optimism and resilience did not significantly predict the endorsement of these behaviors. Among the other emotions, only anxiety independently and positively predicted higher endorsement, while joy predicted lower endorsement. Anger, sadness, pride, and caring were not significant predictors. As shown in **Table 2**, there were significant positive relationships between anger, sadness, and care and endorsement but these relationships were not robust when controlling for gratitude and other predictors. None of the demographic predictors was associated with endorsement of the measures, but as the number of cases increased, participants were more likely to endorse the measures.

Repeating the analyses on benefit-finding, the control variables explained significant variance in the first step ($R^2 = 0.23$, $p < 0.001$), but gratitude significantly explained additional variance when entered in the second step ($\Delta R^2 = 0.03$, $p = 0.002$). The full model significantly explained variance in benefit-finding, $F(16, 253) = 5.36$, $p < 0.001$, Adjusted $R^2 = 0.21$. Gratitude was again found to be an independent significant predictor of greater benefit-finding. Resilience and optimism both predicted greater benefit-finding. Anxiety significantly predicted greater benefit-finding whereas anger and sadness did not. Joy, pride, and care correlated positively with benefit-finding (**Table 2**), but these relationships were reduced to non-significant levels controlling for gratitude and other predictors. None of the demographic variables predicted benefit-finding.

DISCUSSION

Gratitude directs attention to the good things in one's life and widens our priorities to focus on others. As a result, it reduces the tendency to narrowly focus on a threat and the undesirable aspects in one's life. We hypothesized that gratitude should be associated with physically and psychologically beneficial responses during early stages of the COVID-19 pandemic, and report in this article likely the first empirical evidence consistent with our predictions. Chinese Singaporeans completed a survey during an uncertain period (March and April 2020) in which COVID-19 first emerged and escalated sharply in Singapore. The results showed that to the extent that the Chinese participants experienced gratitude, they were more likely to support virus-prevention measures and perceive meaningful benefits out of an adverse development. Another important finding is that these relationships held up even when controlling for known predictors of well-being and adjustment (resilience and optimism) and several other emotions, indicating the distinctiveness of gratitude in supporting healthy responses to the COVID-19 crisis. Social desirability was controlled for and a large sample of 417 participants were recruited, boosting the reliability of the findings. Several demographic variables that

TABLE 3 | Regression coefficients predicting virus-prevention measures and benefit-finding.

	Virus-prevention measures					Benefit-finding				
	b	*SE*	*p*	*β*	95% CI	*b*	*SE*	*p*	*β*	95% CI
Cases	0.02**	0.01	0.001	0.18	[0.01, 0.03]	−0.002	0.01	0.59	−0.03	[−0.01, 0.01]
Age	0.004	0.02	0.84	0.01	[−0.03, 0.04]	−0.02	0.02	0.36	−0.05	[−0.05, 0.02]
Gender	−0.05	0.15	0.72	−0.02	[−0.34, 0.24]	−0.11	0.14	0.44	−0.04	[−0.38, 0.16]
Education level	0.01	0.06	0.82	0.01	[−0.11, 0.14]	−0.10	0.06	0.10	−0.10	[−0.21, 0.02]
Household income	0.01	0.03	0.78	0.02	[−0.05, 0.07]	0.02	0.03	0.51	0.04	[−0.04, 0.08]
household size	−0.05	0.06	0.42	−0.04	[−0.16, 0.07]	−0.07	0.06	0.19	−0.07	[−0.19, 0.04]
Social desirability	0.12**	0.04	0.004	0.16	[0.04, 0.21]	−0.004	0.04	0.91	−0.01	[−0.08, 0.07]
Resilience	−0.15	0.08	0.052	−0.13	[−0.30, 0.001]	0.14*	0.07	0.050	0.13	[<0.001, 0.28]
Optimism	0.07	0.06	0.22	0.07	[−0.05, 0.19]	0.19**	0.06	0.001	0.21	[0.08, 0.30]
Gratitude	0.19**	0.06	0.001	0.25	[0.08, 0.31]	0.17**	0.06	0.002	0.25	[0.06, 0.28]
Joy	−0.13*	0.06	0.037	−0.14	[−0.26, −0.01]	0.002	0.06	0.97	0.003	[−0.12, 0.12]
Pride	−0.06	0.07	0.38	−0.07	[−0.19, 0.07]	−0.01	0.06	0.90	−0.01	[−0.13, 0.12]
Caring	0.04	0.07	0.62	0.04	[−0.10, 0.18]	0.08	0.07	0.20	0.10	[−0.05, 0.22]
Sadness	0.03	0.07	0.68	0.03	[−0.11, 0.17]	0.01	0.07	0.94	0.01	[−0.12, 0.14]
Anxiety	0.22**	0.07	0.001	0.26	[0.10, 0.35]	0.15*	0.06	0.010	0.19	[0.04, 0.27]
Anger	−0.05	0.07	0.48	−0.05	[−0.19, 0.09]	−0.11	0.07	0.10	−0.11	[−0.24, 0.02]

Adjusted R^2 of full model = 0.20, p < 0.001.
Adjusted R^2 of full model = 0.21, p < 0.001.
ΔR^2 due to gratitude = 0.03, p = 0.001.
ΔR^2 due to gratitude = 0.03, p = 0.002.
*p < 0.05, **p < 0.01. Gender was coded with "1" representing males and "0" representing females.

could predict the outcomes were also controlled for, indicating that the relationships are not attributable to them.

The findings suggest that gratitude could be a protective resource among Chinese people. Chinese people largely endorse collectivistic values that emphasize the inter-connectedness and the importance of serving not just the self but also others. Prior studies have found that attributes that are valued in a particular culture can be expected to produce stronger effects in that culture (34). Hence, we expected gratitude—a socially oriented positive emotion—to be uniquely associated with adaptive responses to the COVID-19 pandemic among the Chinese and the results support this contention in different ways. The relationships between gratitude and endorsement of virus-prevention measures and benefit-finding were not trivial but moderate in magnitude and remained robust controlling for a wide range of other potentially protective factors, emotion predictors, and demographic variables. In addition, among all emotions measured, gratitude was reported the most strongly. This finding was unexpected. Why were our participants more mindful of the good in their lives during the pandemic is unclear and deserves investigation in future research.

The finding concerning endorsing virus-prevention measures is consistent with the perspective that gratitude broadens and builds prosocial proclivities and openness to different prosocial methods (16). It suggests that gratitude can predict prosociality in a major crisis where many around the world are apprehensive about their own lives and livelihood. While the measures protect the self, they are fundamentally also meant to prevent the spread of an infectious virus and hence supporting them reflects a

communal motivation to safeguard the physical well-being of others at some cost to the self. Further, the measures require a degree of openness to making significant changes in daily habits and personal preferences. The measures were difficult to accept when the pandemic started, when many people were not entirely convinced about their necessity or effectiveness. Hence, the finding is consistent with the idea that gratitude may prompt an openness to different and even untested ways to support the well-being of others (1, 16, 18). Note that prior research has rarely (if at all) tested whether gratitude may encourage the motivation to use unproven prosocial behavioral strategies in uncertain conditions—past studies that found links between gratitude and prosociality were largely conducted in crisis-free contexts and there is no research that directly demonstrated a link between gratitude and prosocial openness. In addition, the finding concerning benefit-finding further strengthens the idea that gratitude is associated with a flexible mindset that is open to different construals of events (18). It conceptually replicates prior findings that gratitude is linked to perceived coherence and positive appraisals of events (20), but also add to the literature in suggesting that gratitude is related to the ability to generate positive appraisals in highly adverse events.

While the other psychological predictors were included for testing the independent predictive power of gratitude, a short discussion on them is warranted. Resilience and optimism independently predicted greater benefit-finding but not stronger endorsement of the virus-prevention measures. There is replicable evidence that resilience is associated with stronger mental health (24), whereas evidence of a link between

trait resilience and health-protecting behaviors appears sparse. In contrast, there is strong evidence that optimism is linked to both psychological well-being and engaging in positive health behavior (23). Hence, our finding on benefit-finding conceptually replicates past work but more research is needed on whether resilience and optimism are linked to health-protecting responses to the COVID-19 pandemic. With the exception of anxiety, the other emotions did not independently predict both outcomes positively, casting doubts on whether they could be psychological resources that enable crisis coping. It could be that the anxious participants were more willing to use preventive measures because they helped to reduce the uncertainty that COVID-19 elicits and protect themselves from getting infected, which is consistent with the function of anxiety to avoid threats. Strangely, anxiety also predicted greater benefit finding. We speculate that this is because to the more anxious participants, perceiving the crisis in more positive angles was a useful coping strategy that enabled them to manage their distress. However, recent studies found that anxiety due to COVID-19 predicted the use of both negative and positive coping mechanisms (35) and impaired daily work functions and relationships (36). Hence, it is still unclear whether anxiety is linked to positive or negative coping responses to the COVID-19 crisis.

The findings suggest that gratitude does not merely predict prosociality. Rather, gratitude may predict a greater form of prosociality that makes the grateful person open to a range of means to help others and serve the community, including means that may compromise personal needs and wants (1, 16). The findings may also suggest that gratitude can increase receptiveness to advices to health experts on the scientifically supported ways to reduce spread of the virus. A key next step is to test the robustness of our findings. Another step is to test the extent of self-sacrificial prosocial behavior that gratitude might encourage in a health crisis—e.g., would it prompt individuals to make money, time, and blood donations? Furthermore, considering the greater openness of grateful individuals, it is also pertinent key to test whether they would be receptive to wrong advices, given the volume of misinformation circling in the media today.

Limitations

First, the findings are cross-sectional and we make no causal claims. The gratitude items referenced past feelings and the virus-prevention measures directed participants' attention to the future, and hence an argument could be made that the direction of causality should be from gratitude to virus-prevention measures. Hence, there is still a need for studies that manipulate and test the causal effects of gratitude on the current outcomes. Second, meta-analytic research found only small effects of gratitude interventions and the effects varied with specific outcomes and control conditions (37, 38). Hence, even if experimental evidence of the effects of gratitude becomes available, much additional work would be required to validate its

effectiveness as an intervention strategy in enabling individuals to cope with the COVID-19 pandemic. Third, another limitation is that it is unclear what might mediate the relationship between gratitude and the outcome variables. Based on the theoretical considerations outlined in this article, we expect that prosocial intention and cognitive openness are likely mediators—future studies may test these mediators. Fourth, the current study was conducted when the pandemic started. More research is needed on whether gratitude continues to play protective functions now when people around the world have lived with the pandemic and all its negative effects for months. Finally, more research would be needed to test whether the findings replicate in non-Chinese samples and also other Chinese groups.

CONCLUSION

Given the limitations, we take a circumspect approach to interpreting the generalizability of the finding. However, the findings suggest that gratitude could be a valuable coping resource among Singaporean Chinese. Specifically, gratitude is linked to a greater intention to use protective measures that can slow the spread of COVID-19 to support community health and finding constructive meaning during the crisis. It is also unique among other emotions and protective factors in supporting these responses. Implications for policy-makers and practitioners would be to encourage individuals to avoid focusing excessively on the threats and losses that the pandemic brings and direct their attention toward positive things in their lives that they can be grateful for.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found in: https://osf.io/k793q/?view_only=8757f08d2e354c76a857de1b052694ef.

ETHICS STATEMENT

This study has been approved by the IRB of the National University of Singapore. All participants provided consent before participating in this study.

AUTHOR CONTRIBUTIONS

ET conceptualized the research. Both authors wrote the paper. VO collected and analyzed the data. Both authors contributed to the article and approved the submitted version.

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Media Exposure to COVID-19 Predicted Acute Stress: A Moderated Mediation Model of Intolerance of Uncertainty and Perceived Social Support

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Background: Previous studies have found that disaster-related media exposure could predict acute stress responses. However, few studies have investigated the relationship between media exposure to COVID-19 and acute stress, and less is known about the mechanisms that translate media exposure to COVID-19 into acute stress. The current study explored the impact of media exposure to COVID-19 on acute stress, and examined the mediating role of intolerance of uncertainty (IU) and the moderating role of perceived social support (PSS).

Methods: A total of 1,483 Chinese participants (M_{age} = 27.93 years, SD = 8.45) completed anonymous online questionnaires regarding media exposure to COVID-19, IU, PSS, and acute stress during the COVID-19 outbreak in China.

Results: Media exposure to COVID-19 was positively related to acute stress, and IU partially mediated this relationship. The direct effect of media exposure to COVID-19 on acute stress, and the relationship between IU and acute stress, were both moderated by PSS. The impacts of both media exposure to COVID-19 and IU on acute stress were stronger for individuals with low PSS.

Limitations: This study collected data in a shorter timeframe, and no assessments occurred during the follow-up, which may prevent us from detecting the changes of the relationships between variables over time. Meanwhile, the self-report method limited the validity of the data due to subjective reporting bias.

Conclusions: These findings contribute to a better understanding of how and when pandemic-related media exposure affects acute stress, and provide new perspectives for the prevention to reduce psychological problems following traumatic events.

Keywords: COVID-19, media exposure, acute stress, intolerance of uncertainty, perceived social support

INTRODUCTION

COVID-19, as a novel Coronavirus was first reported in Wuhan, China, and has rapidly spread into a global pandemic, causing huge numbers of hospitalizations and deaths (1, 2). The Chinese government executed preventative and control measures, including the lockdown of cities, travel bans, and home quarantine, to curb the spread of the virus (3, 4). During the COVID-19 outbreak, the public had a great need for the latest information about COVID-19 from the media to make clear of the situation and protect their health (5, 6). However, the over-reliance on media can cause long term and repeated exposure to the pandemic, which may put the public under psychological distress.

Previous empirical studies have found that media-based indirect exposure to disaster-related events was linked to poor psychological outcomes (7–10). Meanwhile, some studies also indicated that pandemic-related media exposure was positively associated with stress-related symptoms, such as anxiety, depression and worry (5, 6, 11, 12). One study even showed that media exposure was more closely correlated with acute stress than direct exposure (13). Therefore, media exposure to COVID-19 may be an important factor contributing to individuals' acute stress responses. However, less is known about the mechanisms that translate media exposure to COVID-19 into acute stress responses.

Some research suggested that media-related consumption was positively related to intolerance of uncertainty (IU) (14), and IU could lead to poor mental health (15–17). Thus, IU may mediate the relationship between media exposure to COVID-19 and acute stress. According to the stress-buffering model, perceived social support (PSS) may buffer individuals from the adverse effects of stressful events (18). Numerous empirical studies indeed revealed that PSS could moderate the relation between traumatic experiences or stress situations and their influences on people (19–21). Therefore, PSS may affect the relationship between media exposure to COVID-19 and acute stress. To this end, the present study attempted to investigate the relationship between media exposure to COVID-19 and acute stress, and to explore the mechanisms underlying the association by testing the mediating effect of IU and the moderating effect of PSS. The findings would advance our understanding of how and when media exposure to COVID-19 could impact acute stress.

THEORETICAL BACKGROUND AND HYPOTHESES

Media Exposure to COVID-19 and Acute Stress

According to the risk factor model of the post-traumatic stress response, disaster-related exposure is the primary factor affecting the physical and mental health after traumatic events (22–24). Being one of the disaster-related exposure, disaster-related media exposure can also lead to negative mental health outcomes (9, 25, 26). For instance, Yeung et al. (7) found that frequent exposure to distressing media information could predict PTSD symptoms several months after indirect exposure to the 2008 Wenchuan Earthquake. More importantly, a meta-analysis also demonstrated that media exposure to disasters or large-scale violence had far-reaching effects on poor psychological consequences (27).

Acute stress response refers to a series of physiological and psychological reactions, which is usually triggered by a stressful and life-threatening event (28). Previous empirical research has confirmed the relation between disaster-related media exposure and acute stress responses (10, 29, 30). For example, accumulated evidence indicated that frequently engaging with trauma-related media contents could extend acute stress experiences and increase stress-related symptoms following the Boston Marathon bombings (9, 10, 13). The COVID-19 pandemic, as a public health event, was featured by its rapid transmission, uncertainty about future, considerable mortality rate and serious impacts (31). Facing such an unpredictable and uncontrollable stressful event, the general public are under unprecedented pressure and are experiencing severe psychological distress, including COVID-19-related acute stress responses (32, 33). Correspondingly, some research has also found that the COVID-19 pandemic could induce acute stress responses among the public (33–35). The stressful experiences from either the outbreak itself or the subsequent government responses to the outbreak (e.g., lockdown, travel restrictions) occurred in a very short time period following the COVID-19 outbreak, which may lead to COVID-19-related acute stress responses (28). Besides, the ongoing perceived threats, inconsistent information and uncertainty about the future, accompanied by the pandemic may constitute a risk for mental health (36). When faced with the ambiguous situation and continued threats induced by COVID-19 pandemic, individuals tend to consume information form media to guide them (33). However, media coverage about COVID-19 may amplify the perception of risk, and lead to an exacerbation of stress-related symptoms (5, 6). Therefore, it can be inferred that pandemic-related media exposure could predict COVID-19-related acute stress responses.

Moreover, emotional contagion model indicates that negative emotions can be contagious to each other in crisis events (37, 38). Accordingly, widespread media coverage about disasters may extend the boundary of disaster itself and disseminate passive emotions among the population, thereby increasing psychological distress (39). In fact, the mere exposure of distressing media content is sufficient to provoke negative emotions (5, 6, 40, 41). During the COVID-19 outbreak, media coverage usually contained numerous stress-inducing contents, such as rumors, misrepresentation, and fear messages, especially media-based graphic images (e.g., diagnosed patients with ventilators), all of which would result in huge psychological stress on the public. Thus, it is reasonable that pandemic-related media exposure can promote the formation and development of COVID-19-related acute stress responses. Based on the theoretical and empirical grounds, we hypothesized that media exposure to COVID-19 would be positively correlated with acute stress (Hypothesis 1).

The Mediating Role of Intolerance of Uncertainty

IU is defined as a relatively broad construct representing cognitive, emotional, and behavioral reactions to uncertainty in everyday life situations, which can be seen as a dispositional tendency (42, 43). According to uncertainty reduction theory, individuals with high IU tend to seek information about the potential threat to reduce anxiety and uncertainty after disasters (44). However, seeking information via the media may backfire when individuals are exposed to disaster-related media content, thereby exacerbating their distress and uncertainty (10, 14). Meanwhile, IU is in general sustained by the associated perception of uncertainty, and the uncertainty comes largely from uncertain situations and life events (43, 45). Given that many aspects of life were full of uncertainty due to the COVID-19 outbreak, pandemic-related media exposure can be seen as an important source of uncertainty. Thus, IU may also emerge in response to "uncertain" media exposure related to COVID-19. Indeed, a few studies have indicated that media-related consumption was positively associated with IU. For example, a meta-analysis showed that increased mobile phone penetration and Internet usage were positively correlated to the rising IU levels (46). Furthermore, broad evidence has showed that IU can be changed by a series of experimental manipulations, in which the uncertainty about the outcome of events was manipulated to induce high or low degrees of IU (47–49). Therefore, we inferred that media exposure to COVID-19 was positively related to IU.

Moreover, IU plays a significant role in the development and maintenance of distress (16, 50). There is increasing evidence to support that IU is closely associated with mental health problems. For instance, ample empirical evidence has shown that IU was a risk factor for affective disorders, such as generalized anxiety disorder (51), obsessive-compulsive disorder (52), major depressive disorder (53). Similarly, some studies have also demonstrated that IU was highly linked with anxiety, depression and worry (17, 54, 55). Furthermore, previous research has also found that IU was related to elevated post-traumatic stress symptoms (PTSS) (56–58). Individuals with high IU are prone to respond negatively to uncertain or ambiguous situations, which may lead to negative psychological responses over time (58, 59). Hence, it is reasonable to infer that IU could affect acute stress. Taken together, we speculated that IU may act as a mediating role between media exposure to COVID-19 and acute stress (Hypothesis 2).

The Moderating Role of Perceived Social Support

Although disaster-related media exposure may increase the risk of acute stress through IU, it seems impossible that all individuals would experience an equivalent level of acute stress. PSS may moderate the effect of pandemic-related media exposure on acute stress.

PSS refers to an individual's confidence that sufficient support can be available during times of need (60). It can help individuals manage stressful life events by providing a sense of feeling valued and accepted and by prompting appropriate coping responses (18). Several studies suggested that social support was negatively associated with passive emotions, such as anxiety, depression and stress (61–63). According to the stress-buffering model, PSS can buffer individuals from the passive impacts of stressful events (18, 64). As such, individuals with high levels of PSS may present better psychological adjustment (65). Numerous empirical studies have supported this model. For instance, some studies found social support had a potential moderating effect in the relationship between trauma exposure and psychological health outcomes, such as depression and PTSD (66, 67). The risk-buffering hypothesis also holds that one protective factor can mitigate the association between environmental risk factors and negative outcomes (68). Therefore, we inferred that PSS may moderate the relationships between media exposure to COVID-19 and IU, as well as between media exposure to COVID-19 and acute stress.

Moreover, PSS may buffer the negative effects of psychological distress (18, 68). Some research has found that social support could attenuate the relationships between personal risk factors and health outcomes and behaviors (69–71). For example, it was found that PSS moderated the relation between depression and adolescent problematic smartphone use (72), and the relation between psychological insecurity and depression (73). IU is, understandably, a personal risk factor that may cause negative psychological outcomes (e.g., anxiety, depression) (54, 55). Therefore, PSS may act as a moderator in the relationship between IU and acute stress. To some extent, PSS can be seen as a protective factor for stress-related outcomes (74–76), and may contribute to enhancing individuals' internal mental resources (77). As a result, individuals perceiving more social support would be less likely to have psychological problems in response to stressful events or other psychological distress (78, 79). Based on the theoretical views and empirical evidence, we deduced that PSS would moderate the direct and indirect relations between media exposure to COVID-19 and acute stress (Hypothesis 3).

The Present Study

The present study aimed to examine the impact of media exposure to COVID-19 on acute stress and its underlying mechanisms. First, we examined whether media exposure to COVID-19 would directly affect acute stress. Second, we tested the mediating role of IU in the relation between media exposure to COVID-19 and acute stress. Third, we tested whether the direct and indirect relations between media exposure to COVID-19 and acute stress through IU would be moderated by PSS. Therefore, we proposed a moderated mediation model (see **Figure 1**).

METHODS

Participants and Procedure

This survey was conducted from February 7 to February 28, 2020, during the COVID-19 outbreak in China. Participants were required to finish Internet-based questionnaires via social media (WeChat, Tencent). A total of 1,626 participants from 32 provinces or political areas participated in our research. The final sample consisted of 1,483 participants after removing participants who gave uniform answers to all items in the
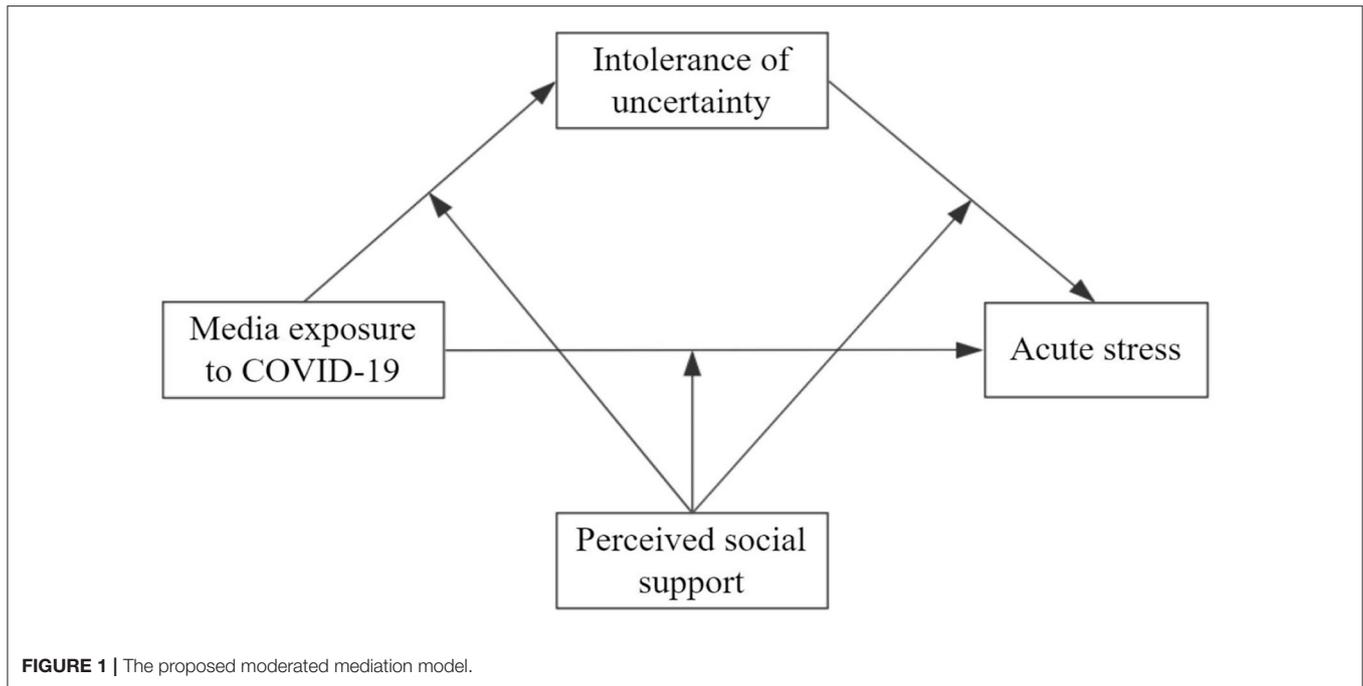
FIGURE 1 | The proposed moderated mediation model.

questionnaire and those who were directly exposed to COVID-19 (e.g., close contacts, confirmed cases). Among the participants, 466 (31.42%) were males and 1,017 (68.58%) were females, with a mean age of 27.93 years ($SD = 8.45$; range: 18–87 years), and 932 (62.85%) were single. Nearly half of respondents lived in city (46.66%), and more than half of participants were undergraduate (55.02%). Detailed demographic characteristics are presented in **Table 1**. All participants signed an electronic informed consent prior to their participation, and they could withdraw at any time if they wished. All procedures performed in this study involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Measures

Media Exposure to COVID-19

Media Exposure Questionnaire (MEQ) was developed to test media exposure to COVID-19 following previous research (13, 14). Nine items were used to assess the media exposure to COVID-19 by asking participants how many hours per day (0–24 h) they spent engaged with information about COVID-19 from the nine most common media sources separately (e.g., television, online news, social media). An example item is "How many hours per day did you spend watching TV to know about COVID-19 in the latest week." Total media exposure scores were calculated based on the accumulated continuous number of hours across types of media, with higher scores indicating higher levels of media exposure to COVID-19. The Cronbach's α in this study was 0.82.

Intolerance of Uncertainty

Intolerance of Uncertainty Scale-12 (IUS-12) is a 12-item self-report scale that assesses reactions and desired control over

TABLE 1 | Demographic characteristics ($n = 1,483$).

Variables	Group	N	%
Gender	Male	466	31.42
	Female	1,017	68.58
Age	18–25 years	759	51.18
	26–44 years	651	43.90
	45 years and above	73	4.92
Marital status	Single	932	62.85
	Married	524	35.33
	Divorced or widowed	27	1.82
Place of residence	City	692	46.66
	Town	277	18.68
	Village	514	34.66
Education	High school and below	263	17.73
	Undergraduate	816	55.02
	Graduate and above	404	27.24

ambiguous or uncertain situations (80). The measure uses a 5-point scale scored from 1 (strongly disagree) to 5 (strongly agree). The total scores can range from 12 to 60, with higher scores indicating more serious IU. The Cronbach's α in current study was 0.88.

Perceived Social Support

Perceived social support was tested by Perceived Social Support Scale (PSSS) (81). The PSSS is a 12-item self-report scale, and each item uses a 7-point scale (1 = strongly disagree; 7 = strongly agree). The total scores can range from 12 to 84, with higher

scores indicating better social support the participants perceived. In this study, the Cronbach's α was 0.94.

Acute Stress

Stanford Acute Stress Reaction Questionnaire (SASRQ) is usually used to measure acute stress and acute stress disorders (ASD) (82). The Chinese version of SASRQ was revised by Jia and Hou (83) through standard translation and back-translation procedure. Many empirical results have showed that the Chinese version of SASRQ has a good reliability and validity (84–86). In present study, some items were modified to ensure that the scale could be suitable to assess COVID-19-related acute stress responses by reference to previous research (9, 10, 13). An example item is "The COVID-19 pandemic made it difficult for me to perform work or other things I needed to do." The SASRQ is a self-report questionnaire with 30 items including dissociation (10 items), reexperiencing of trauma (six items), avoidance (six items), anxiety and hyperarousal (six items), and impairment in functioning (two items). The measure uses a 6-point scale scored from 0 (not experienced) to 5 (very often experienced). The total scores can range from 0 to 150, with higher scores indicating higher levels of acute stress. The Cronbach's α in current study was 0.95.

Data Analysis

In this study, all statistical analyses were performed using SPSS 25.0. First, a factor analysis was used to test common method biases. Second, descriptive statistics and Pearson correlations were calculated among the study variables. Third, independent t-test and one-way ANOVA were used to compare the differences of study variables in gender, age and marital status. Next, we used Model 4 of the PROCESS macro for SPSS to examine the mediating effect of IU (87). Finally, Model 59 of the PROCESS macro was used to test the moderating effects of PSS in the direct and indirect relationships between media exposure to COVID-19 and acute stress (87). The bootstrapping method (5,000 bootstrapping samples) with 95% confidence intervals (CIs) was conducted to detect the significance of the effects (87). All study variables, except gender and marital status, were standardized in Model 4 and Model 59 before data analyses. Since previous studies reported that gender, age and marital status could influence psychological health following traumatic events (29, 88, 89), we added gender, age and marital status as control variables in the models.

RESULTS

Common Method Bias Test

Given that the data were obtained by self-report questionnaires, we conducted a Harman's single factor test to examine the common method biases (90). The results indicated that 10 factors with eigenvalues > 1 were extracted, which explained 62.28% of the total variance. The first principal factor explained 24.75% of the variance. These results showed that no common method bias existed in current study.

TABLE 2 | Descriptive statistics and intercorrelations between variables ($n = 1,483$).

Variables	$M \pm SD$	1	2	3	4
Media exposure to COVID-19	6.98 ± 5.54	1			
Intolerance of uncertainty	32.89 ± 8.41	0.17***	1		
Perceived social support	62.35 ± 13.84	−0.02	−0.10***	1	
Acute stress	22.37 ± 21.34	0.26***	0.35***	−0.24***	1

***$p < 0.001$.

Descriptive Statistics and Correlation Analyses

Means, standard deviations and correlations between main variables are provided in **Table 2**. Media exposure to COVID-19 was positively correlated with IU ($r = 0.17$, $p < 0.001$) and acute stress ($r = 0.26$, $p < 0.001$), and the Hypothesis 1 was supported. IU was positively correlated with acute stress ($r = 0.35$, $p < 0.001$). However, PSS was negatively correlated with IU ($r = −0.10$, $p < 0.001$) and acute stress ($r = −0.24$, $p < 0.001$).

Comparison of Study Variables on Gender, Age and Marital Status

As shown in **Table 3**, t-tests showed that there were significant gender differences in PSS ($t = −4.30$, $p < 0.001$) and acute stress ($t = −2.02$, $p < 0.05$). Females reported higher levels of both PSS and acute stress than males. One-way ANOVAs indicated that age and marital status had significant effects on PSS (both $p < 0.01$). Individuals aged 26–44 and married people had higher levels of PSS.

Testing for Mediating Effect

In Hypothesis 2, we deduced that IU would mediate the relationship between media exposure to COVID-19 and acute stress. The hypothesis was examined with Model 4 of the PROCESS macro after controlling for gender, age and marital status (87). As **Table 4** shows, media exposure to COVID-19 was positively associated with IU [$\beta = 0.17$, $t = 6.60$, $p < 0.001$, 95% CI = (0.12, 0.22)], and IU was positively associated with acute stress [$\beta = 0.32$, $t = 13.13$, $p < 0.001$, 95% CI = (0.27, 0.36)]. Moreover, when the mediator (IU) was included in the model, media exposure to COVID-19 was also positively associated with acute stress [$\beta = 0.20$, $t = 8.43$, $p < 0.001$, 95% CI = (0.16, 0.25)]. This indicated that IU partially mediated the relationship between media exposure to COVID-19 and acute stress. The bootstrapping results also indicated that the conditional indirect effect of media exposure to COVID-19 on acute stress through IU was significant [indirect effect = 0.05, Boot SE = 0.009, Boot 95% CI = (0.036, 0.073)]. The mediation effect accounted for 21.38% of the total effect.

TABLE 3 | Comparison of study variables on gender, age and marital status.

Variables	N	MEC	t/F	IU	t/F	PSS	t/F	AS	t/F
		M ± SD		M ± SD		M ± SD		M ± SD	
Gender									
Male	466	6.85 ± 5.59	−0.63	33.46 ± 8.92	1.78	60.01 ± 14.55	−4.30***	20.72 ± 21.30	−2.02*
Female	1017	7.04 ± 5.52		32.62 ± 8.16		63.43 ± 13.38		23.13 ± 21.33	
Age									
18–25 years	759	7.08 ± 5.73	0.32	33.12 ± 8.09	2.24	61.26 ± 13.85	4.99**	23.62 ± 21.73	2.95
26–44 years	651	6.92 ± 5.40		32.82 ± 8.64		63.58 ± 13.78		21.27 ± 21.00	
45 years and above	73	6.61 ± 4.80		30.96 ± 9.47		62.74 ± 13.57		19.25 ± 19.70	
Marital status									
Single	932	7.08 ± 5.72	0.57	33.00 ± 8.27	0.69	61.46 ± 13.68	7.22**	23.09 ± 21.51	2.03
Married	524	6.85 ± 5.29		32.77 ± 8.50		64.13 ± 13.62		20.92 ± 20.85	
Divorced or widowed	27	6.22 ± 4.23		31.19 ± 11.43		58.81 ± 19.60		25.52 ± 24.44	

MEC, Media exposure to COVID-19; IU, Intolerance of uncertainty; PSS, Perceived social support; AS, Acute stress. t/F, t or F, $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

TABLE 4 | Testing the mediation effect of intolerance of uncertainty on acute stress.

Predictors (IV)	Model 1 (DV: Acute stress)			Model 2 (DV: Acute stress)			Model 3 (DV: IU)			Model 4 (DV: Acute stress)		
	β	SE	t	β	SE	t	β	SE	t	β	SE	t
Gender	0.10	0.06	1.83	0.09	0.05	1.74	−0.12	0.06	−2.19*	0.13	0.06	2.58**
Age	−0.05	0.04	−1.19	−0.04	0.04	−1.17	−0.08	0.04	−2.19*	−0.02	0.04	−0.48
Marital status	0.00	0.07	0.01	0.01	0.07	0.12	0.08	0.07	1.08	−0.02	0.07	−0.24
MEC				0.26	0.03	10.23***	0.17	0.03	6.60***	0.20	0.02	8.43***
IU										0.32	0.02	13.13***
R^2		0.01			0.07			0.03			0.17	
F		2.41			28.10***			13.18***			59.56***	

IV, Independent variable; DV, Dependent variable; MEC, Media exposure to COVID-19; IU, Intolerance of uncertainty. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Testing for Moderated Mediation

To test moderated mediation (Hypothesis 3), we adopted Model 59 of the PROCESS macro for SPSS after controlling for gender, age and marital status (87). As presented in **Table 5**, the interaction between media exposure to COVID-19 and PSS had a significant predictive effect on acute stress [$\beta = -0.08$, $t = -3.32$, $p < 0.001$, 95% CI = $(-0.12, -0.03)$], but not on IU [$\beta = -0.02$, $t = -0.83$, $p > 0.05$, 95% CI = $(-0.07, 0.03)$]. The interaction between IU and PSS had a significant predictive effect on acute stress [$\beta = -0.07$, $t = -3.40$, $p < 0.001$, 95% CI = $(-0.10, -0.03)$]. The results suggested that PSS moderated the relationships between media exposure to COVID-19 and acute stress, and between IU and acute stress.

To better interpret the moderating effects of PSS, we examined the simple effects of both media exposure to COVID-19 on acute stress and IU on acute stress, at different levels of PSS (1 SD below the mean and 1 SD above the mean). Simple slope tests showed that the association between media exposure to COVID-19 and acute stress was stronger for individuals with low PSS ($\beta_{simple} = 0.27$, $t = 8.59$, $p < 0.001$) than for individuals with high PSS ($\beta_{simple} = 0.12$, $t = 3.57$, $p < 0.001$) (see **Figure 2**). Similarly, the association between IU and acute stress was stronger for individuals with low PSS ($\beta_{simple} = 0.36$, $t = 12.20$, $p < 0.001$)

than for individuals with high PSS ($\beta_{simple} = 0.22$, $t = 7.04$, $p < 0.001$) (see **Figure 3**).

Moreover, we further examined whether the moderated direct and indirect effects of media exposure to COVID-19 on acute stress were statistically significant. First, the moderated direct effect showed that the association between media exposure to COVID-19 and acute stress was stronger for individuals with low PSS [$\beta = 0.27$, $t = 8.59$, $p < 0.001$, 95% CI = $(0.21, 0.33)$] than for individuals with high PSS [$\beta = 0.12$, $t = 3.57$, $p < 0.001$, 95% CI = $(0.05, 0.19)$]. Second, the bootstrapping results indicated that the indirect effect of media exposure to COVID-19 on acute stress via IU was moderated by PSS [the index of moderated mediation = −0.01, Boot SE = 0.004, Boot 95% CI = $(-0.020, -0.004)$]. The indirect effect of media exposure to COVID-19 on acute stress via IU was stronger for individuals with low PSS [indirect effect = 0.06, Boot SE = 0.011, Boot 95% CI = $(0.040, 0.084)$] than for individuals with high PSS [indirect effect = 0.04, Boot SE = 0.008, Boot 95% CI = $(0.023, 0.055)$]. In addition, the pairwise contrasts between conditional indirect effects (Effect1 minus Effect2) were all significant: Contrasts effect 1 (0.05–0.06) = −0.01, Boot SE = 0.004, Boot 95% CI = $(-0.020, -0.004)$; Contrasts effect 2 (0.04–0.06) = −0.02, Boot SE = 0.008, Boot 95% CI = $(-0.040, -0.008)$; Contrasts effect 3 (0.04–0.05) =

Predictors (IV)	Model 1 (DV: IU)			Model 2 (DV: Acute stress)		
	β	SE	t	β	SE	t
Gender	−0.10	0.06	−1.83	0.17	0.05	3.35***
Age	−0.08	0.04	−2.04*	−0.01	0.03	−0.23
Marital status	0.08	0.07	1.11	−0.01	0.06	−0.08
MEC	0.17	0.03	6.47***	0.20	0.02	8.39***
PSS	−0.08	0.03	−3.22**	−0.21	0.02	−9.25***
MEC × PSS	−0.02	0.03	−0.83	−0.08	0.02	−3.32***
IU				0.29	0.02	12.34***
IU × PSS				−0.07	0.02	−3.40***
R^2		0.04			0.23	
F		10.74***			54.65***	

*IV, Independent variable; DV, Dependent variable; MEC, Media exposure to COVID-19; IU, Intolerance of uncertainty; PSS, Perceived social support. *p < 0.05, **p < 0.01, ***p < 0.001.*

FIGURE 2 | The interaction between media exposure to COVID-19 and perceived social support on acute stress. MEC, Media exposure to COVID-19; PSS, Perceived social support.
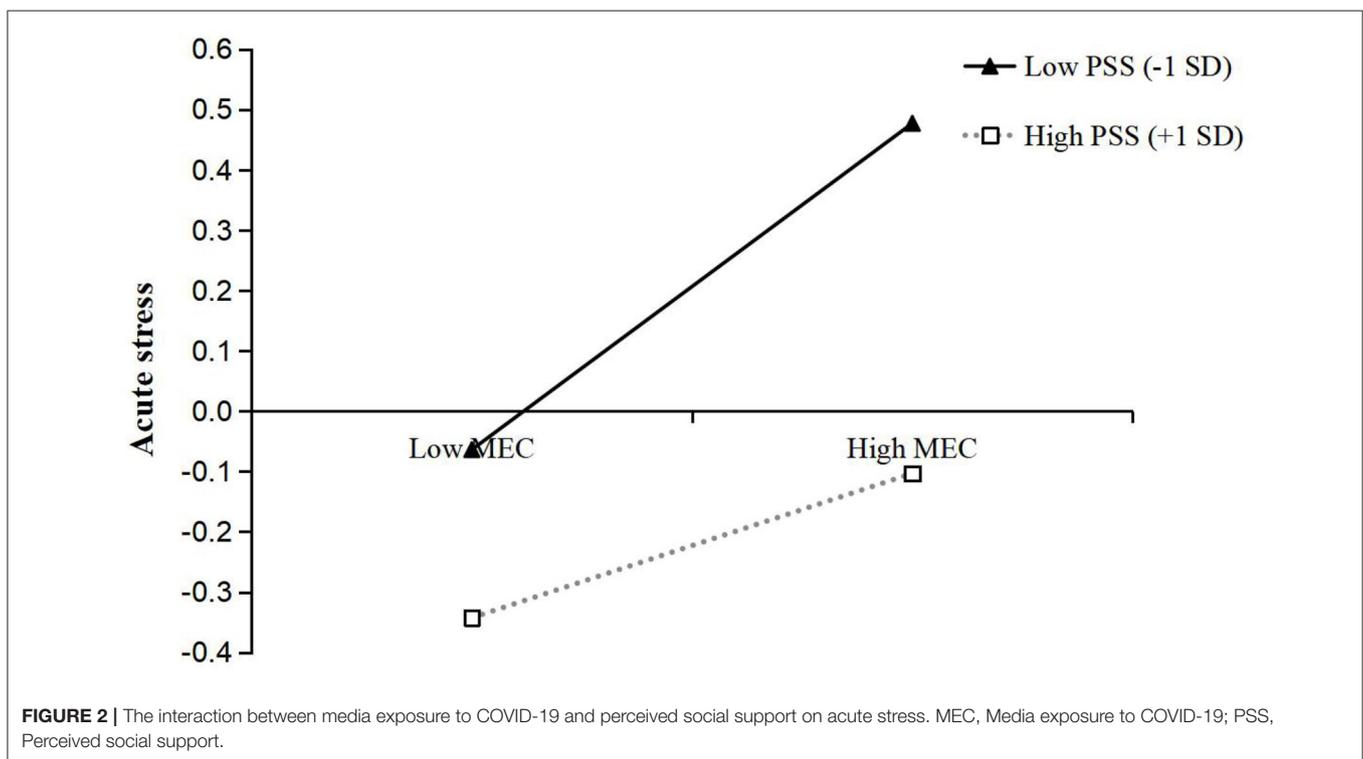
−0.01, Boot SE = 0.004, Boot 95% CI = (−0.020, −0.004). In sum, these results indicated that PSS moderated the relationship between media exposure to COVID-19 and acute stress via IU.

DISCUSSION

In current study, we investigated the influence of media exposure to COVID-19 on acute stress during the COVID-19 outbreak in China, and built a moderated mediation model with IU as a mediating variable and PSS as a moderating variable. Results showed that media exposure to COVID-19 could directly affected acute stress, which supported previous studies that pandemic-related media exposure could lead to stress-related responses

(5, 6, 11, 12). Moreover, this study further extended previous research by confirming that media exposure to COVID-19 could affect acute stress indirectly through the mediator of IU, and PSS moderated the relationships between media exposure to COVID-19 and acute stress, as well as between IU and acute stress.

Comparison of Perceived Social Support and Acute Stress on Demographic Variables

The demographic variable tests on PSS showed that there were significant differences in gender, age and marital status. In particular, the females, the age group of 26–44 years and being

FIGURE 3 | The interaction between intolerance of uncertainty and perceived social support on acute stress. IU, Intolerance of uncertainty; PSS, Perceived social support.
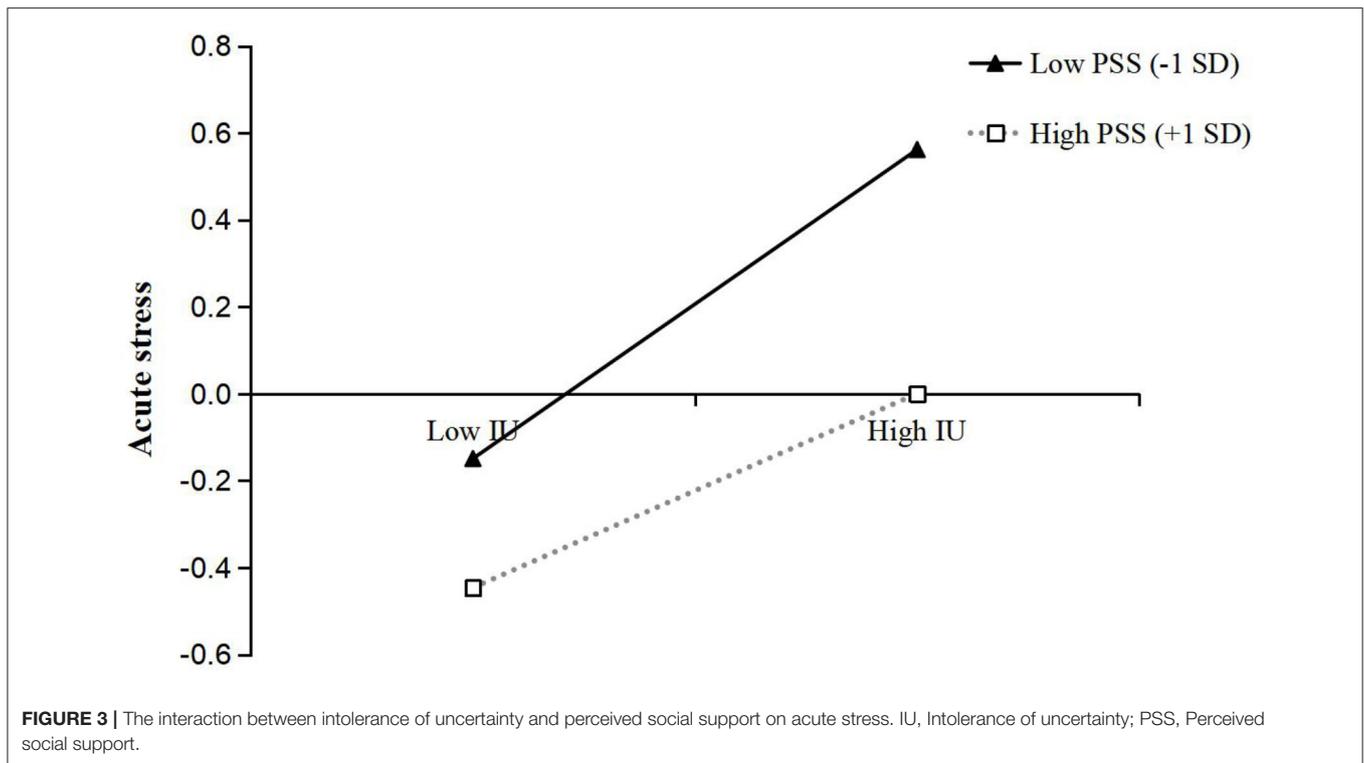
married had higher levels of PSS than other groups. Actually, the differences of PSS in the demographic variables of gender, age, marital status are controversial in previous studies against the background of COVID-19 outbreak. For example, Zmete and Pak (91) found the differences of PSS only in marital status but not in gender and age. Contrarily, another study suggested that there were significant differences of PSS in gender and age (36). Therefore, further research is warranted to explore the differences of PSS in the demographic variables. Moreover, we found that females had higher levels of acute stress than males during the COVID-19 outbreak, which supported the most previous studies demonstrating that females generally have more serious psychological symptoms than males following disaster-related events (88, 92). One possible explanation is that as a special group with delicate perception and emotional vulnerability, females are more susceptible to negative outcomes following disasters, thus experiencing higher acute stress. Furthermore, females are vulnerable to multiple stresses in that they are often more sensitive to the guarantee of family stability in China, which may render females more prone to psychological problems during the pandemic.

Media Exposure to COVID-19 Predicted Acute Stress

The present study discovered that media exposure to COVID-19 was positively correlated with acute stress, even after controlling for demographics. That is, individuals engaging in more pandemic-related information were more likely to show higher acute stress. Our results supported the

risk factor model of the post-traumatic stress response (23, 24), suggesting that pandemic-related media exposure was a potential risk factor for mental health. Meanwhile, this further indicated that trauma-related media exposure could predict negative psychological outcomes in different traumatic events (e.g., natural disasters, man-made accidents, public health emergencies). In addition, our results were in line with emotional contagion model (37, 38). This may suggest that emotional contagion is an interactive process between individuals, and the negative emotions induced by COVID-19 pandemic could be contagious to each other. As a result, individuals with more media exposure to COVID-19 were more vulnerable to acute stress.

Furthermore, our findings echoed the previous empirical studies, which stated that disaster-related media exposure was predictably related to acute stress (9, 10, 13). Besides, the present study further supported recent research suggesting that media exposure to COVID-19 could result in stress-related symptoms (5, 6, 11). In the period of COVID-19 outbreak in China, the rapid spread of pandemic caused social isolation of an entire nation, and people also had a great craving for information to figure out the situation and to reduce potential risks and uncertainties. In this situation, media became the main source of pandemic-related information for the majority of people in China. However, prolonged and uncontrolled media exposure could reinforce rumination and intrusive thoughts, activate fear circuitry (13, 93), and enhance autonomic activation and affecting physiologic systems (94–96), thus leading to the increase of acute stress.

The Mediating Role of Intolerance of Uncertainty

As predicted, IU partially mediated the relationship between media exposure to COVID-19 and acute stress. Therefore, IU may be not only an outcome of media exposure to COVID-19, but also a predictor of acute stress. To our knowledge, this is the first study that tests the mediating effect of IU in the relation between media exposure and acute stress following stressful events.

For the first path of the mediation process, we found that media exposure was positively linked to IU, which coincided with one prior study (14). Media coverage usually contains ambiguous, exaggerated and even dramatic information, which may lead to more information-seeking behaviors aimed at reducing uncertainty and relieving discomfort. However, these information-seeking behaviors could provide new entries to exposure to more pandemic-related information by all kinds of media, in turn causing people to experience more uncertainty. That is, pandemic-related media exposure could provide necessary psychological basis for the generation of IU. Besides, given that COVID-19 is a highly contagious virus without effective treatment and adequate protective materials (2), people with frequent media exposure to COVID-19 are more likely to hold a negative expectation for the future and thus cannot tolerate uncertainty. The findings also supported prior studies revealing that IU could be subject to change in response to uncertainty information or scenes (47–49). Moreover, given that individuals high in IU are more likely to seek information from media to reduce uncertainty, future research is needed to explore the influence of IU on media exposure related to stressful events.

For the second path of the mediation process, this study indicated that IU was positively related to acute stress, which supported the previous research showing that IU could lead to negative psychological outcomes (54, 97, 98). There are two possible explanations for this finding. First, individuals with higher levels of IU may display an exaggerated perception of threat and engage in increased avoidance following a traumatic event due to the uncertainty (57, 80, 99). They usually evidence a greater likelihood to interpret uncertain information as unacceptable and threatening (100, 101). Thus, those high in IU may display increased acute stress. Second, IU, as a tendency to response negatively to uncertain situations and events, essentially reflects the worry about the uncertainty in the future (59). And repeated experiencing such feeling may also contribute to other stress-related psychological symptoms, such as anxiety, depression and PTSD (17, 55, 56). Therefore, it is not difficult to explain that IU can affect acute stress.

The Moderating Role of Perceived Social Support

Our study further found that PSS weakened the associations between media exposure to COVID-19 and acute stress, as well as between IU and acute stress. This means that the influences of both media exposure to COVID-19 and IU on acute stress got weaker when individuals had higher levels of PSS.

First, we found that PSS could moderate the relation between media exposure to COVID-19 and acute stress. As the stress-buffering model (18) suggests, PSS could buffer individuals from the impact of negative situations. Thus, people with high levels of PSS tend to perceive warmth, and get love and help from their family and friends when they encounter stressful life events (89, 102). These supports can contribute to enhancing positive mental resources and self-efficacy to cope with adversity effectively (77). Accordingly, they are less likely to experience acute stress compared with people with low levels of PSS, when indirectly exposing to stressful events. Consistent with previous studies (74, 76, 77), our findings indicated that PSS could be regarded as a protective factor to promote the positive development of mental health, and to help individuals flexibly adapt to adversity. As the media exposure to COVID-19 prolonged, people could suffer continuously increasing acute stress. In this situation, social support is an important protective resource to produce beneficial psychosocial changes and attenuate the detrimental effects of pandemic-related media exposure on acute stress.

Just as PSS could buffer the negative effects of pandemic-related media exposure on acute stress, PSS also moderated the relation between IU and acute stress. The result supported the stress-buffering model and the risk-buffering hypothesis (18, 68), and further indicated that PSS was a critical protective factor in mitigating the passive effects of personal risk factors on mental health. Similarly, this finding was in line with previous research, suggesting that PSS could buffer the negative effects of personal risk factors (70, 71). Therefore, PSS could to some extent protect the public from a series of adverse impacts caused by IU during the COVID-19 outbreak. This means that although IU could produce negative influences on mental health, the individuals who perceived more social support from their families and friends would be less affected by IU during the COVID-19 pandemic. Additionally, individuals with high levels of social support could take full use of coping strategies to deal with psychological distress (78, 79, 103), thus contributing to reducing their vulnerability to acute stress. Therefore, PSS acted as a stress-buffering factor in the second link of the mediation chain.

Contrary to our hypothesis, PSS did not moderate the link between media exposure to COVID-19 and IU. One possible explanation is that the influence of pandemic-related media exposure on IU is direct, fast and stable, and this process is less susceptible to external factors. Hence, more media exposure to COVID-19 was associated with more serious IU regardless of the level of PSS. Meanwhile, this result also revealed that PSS may not always act as a protective factor to reduce IU in uncertain conditions. Some prior studies supported this view of point as well (104, 105). Therefore, further studies are needed to better clarify the role of PSS in the relation between media exposure and IU following stressful events.

Limitations and Implications

There are several limitations that should be noted. First, the self-report method limited the validity of the data due to subjective reporting bias. Thus, future research could take various measures to obtain more objective and comprehensive information. Second, we collected data in a shorter timeframe,

and no assessments occurred during the follow-up, which may prevent us from detecting the changes of the relationships between variables over time. In future research, we could collect data at different stages of the pandemic to examine the temporal stability of these relationships. Third, we only examined the impacts of overall media exposure to pandemic on acute stress, and did not distinguish different media contents or types. Future studies should further explore the associations between different media contents or types and acute stress responses. Fourth, the present study focused on the passive impacts of pandemic-related media exposure on mental health, but neglected its positive effects. Future research could explore the positive implications of media exposure following public health events. Last, given that the COVID-19 pandemic is not a typical traumatic event, the application of the SASRQ in current study may be limited. Thus, further studies are needed to explore the applicability of the SASRQ in the pandemic-related events.

Despite these limitations, the current study has some theoretical and practical implications. First, this study further extends previous research by confirming the mediating role of IU and the moderating role of PSS. This could contribute to a better understanding of how and when pandemic-related media exposure can influence acute stress. Second, our findings revealed that PSS could help protect individuals from the development of acute stress related to IU. This indicates that it is critical to empower social support networks and minimize uncertain situations for the public, thereby reducing their acute stress responses. Third, our study confirmed the negative impacts of media exposure to pandemic, which could remind the public that appropriate use of media is necessary to maintain psychological health during the pandemic. Similarly, governments and relevant agencies should consider implementing the effective prevention and intervention to reduce negative psychological effects following traumatic events.

CONCLUSION

In summary, this study found that increased media exposure to COVID-19 was associated with higher acute stress during the COVID-19 outbreak in China. This association was partially mediated by IU. In particular, increased media exposure to COVID-19 was associated with higher IU, which in turned was associated with higher acute stress. Moreover, PSS can buffer the relationships between media exposure to COVID-19 and acute stress, as well as between IU and acute stress. Specifically, the effect of media exposure to COVID-19 on acute stress was stronger for individuals with low levels of PSS. Similarly, the effect of IU on acute stress was stronger for individuals with low levels of PSS.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethical Committee of Guizhou Normal University. All participants provided electronic informed consent prior to their participation.

AUTHOR CONTRIBUTIONS

XH designed the research and wrote up the manuscript. YZ analyzed data and wrote up the original draft. MC performed the research. JZ designed the structure and performed the calculations. WZ reviewed literature and revised manuscript. YL reviewed manuscript and supervised the project. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2020.613368/full#supplementary-material

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Psychological Profiles of Chinese Patients With Hemodialysis During the Panic of Coronavirus Disease 2019

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Background: Hemodialysis patients not only suffer from somatic disorders but are also at high risks of psychiatric problems. Early this year, the outbreak of coronavirus disease 2019 (COVID-19) has caused great panic and anxiety worldwide. The impact of this acute public health event on the psychological status of hemodialysis patients and its relationship with their quality of life have not been fully investigated.

Methods: This study comprised two parts. The initial study enrolled maintenance hemodialysis patients treated in Ruijin Hospital for more than 3 months from March to May 2020 during the ongoing COVID-19 pandemic. Patients completed three questionnaires including the Impact of Events Scale–Revised (IES-R), General Health Questionnaire-28 (GHQ-28), and Kidney Disease Quality of Life (KDQOL) Short Form (SF). Follow-up study was performed from December 2020 to January 2021, when the pandemic of COVID-19 has been effectively contained in China. Only patients enrolled in the initial study were approached to participate in the follow-up study.

Results: There were 273 maintenance dialysis patients enrolled in the initial study and 247 finished the follow-up study. For the initial study, the estimated prevalence of nonspecific psychiatric morbidity was 45.8% (125/273) by GHQ-28. By IES-R, 53/273 (19.4%) patients presented with total scores above 24 that reflected clinical concerns. We found a significant difference regarding KDQOL scores between patients with different stress response (IES-R) groups ($p = 0.026$). Our follow-up study showed that KDQOL and SF-36 scores were significantly improved in comparison with those in the initial study ($p = 0.006$ and $p = 0.031$, respectively). Though total scores of GHQ-28 and IES-R did not change significantly, some subscales improved with statistical significance. Furthermore, gender, education background, and duration of hemodialysis were three factors that may affect patients' mental health, quality of life, or health status while dialysis duration was the only variable that correlated with those parameters. However, these correlations were combined effects of the COVID-19 pandemic and the dialysis itself.

Conclusions: We found a correlation between changes in the mental health status of dialysis patients and changes in their quality of life. These responses were also mediated by patients' psychosocial parameters. Our results urge the necessity of psychotherapeutic interventions for some patients during this event.

Keywords: hemodialysis, quality of life, mental health, psychological profiles, stress, COVID-19

INTRODUCTION

Chronic kidney disease (CKD) is now a global health problem that affects one out of 10 adults worldwide (1, 2). In China, the overall prevalence of CKD was about 10.8% in 2012 (3) and the figure is still increasing. Regardless of the pathogenesis of the disease, the progression of CKD would ultimately lead to end-stage renal disease (ESRD)—a devastating disease that requires dialysis or transplantation in some patients. The impact of ESRD is huge not only in terms of its repercussions on patients but also its burden on the health resources.

In addition to somatic disorders caused by the disease and its complications, ESRD patients also experience high prevalence of psychiatric problems (4, 5). Anxiety or depression occurs in ~10–45% of patients with hemodialysis (6–8). These mental disorders would cause not only non-compliance to treatment but also severe consequences. Consequently, mental health problems in these patients are closely associated with their morbidity and mortality (9, 10). Moreover, psychological variables and aspects of the social environment add much difficulty to the management of their psychological disorders because these factors are intersecting and complex. Given this background, investigating psychosocial factors affecting ESRD patients would provide us with knowledge to identify and manage psychiatric problems in this population.

Psychosocial factors are a vast number of intersecting variables that include individual demographic features, psychologic and behavioral characteristics, social or environmental factors, and patient-level variables. Any factors causing failure of these variables to return to normal would lead to abnormality of the allostatic system and result in psychological disorders in patients. In early 2020, the outbreak of the novel coronavirus disease 2019 (COVID-19) has caused great panic and anxiety worldwide. The pandemic nature of the disease makes vulnerable populations at high risk of infection and causes great stress among patients with hemodialysis. However, the impact of this acute public health event on the psychological status of those patients has not been fully investigated. In this study, we focus on the psychological profiles of patients with hemodialysis in this event to provide a better understanding of the influence of psychosocial factors on the mental health of this population.

MATERIALS AND METHODS

Patients

The initial study was performed between March and May 2020 in the hemodialysis center of Ruijin Hospital affiliated to Shanghai Jiaotong University School of Medicine to study the psychological profiles of the patients during ongoing COVID-19 pandemic. All patients under hemodialysis therapy for at least 3 months were approached to participate in the initial study. The follow-up study was performed between December 2020 and January 2021 to compare the psychological profiles of the patients after COVID-19 pandemic. Only patients enrolled in the initial study were approached to participate in the follow-up study.

Measure

Patients completed three validated questionnaires, including the revised version of Impact of Events Scale, General Health Questionnaire-28, and Kidney Disease Quality of Life Short Form.

Impact of Events Scale–Revised

The Impact of Events Scale–Revised (IES-R) is a 22-item self-report instrument assessing subjective distress resulting from everyday trauma or acute stress. We adapted IES-R to assess the presence and severity of psychological symptoms experienced by subjects at any time during the current acute public events. Likert rating scale from 0 to 4 was used for each item of IES-R, and the total score was 0 to 88. Total scores of IES-R that exceed 24 reflect clinical concern (11), scores above 33 reflect a probable diagnosis of post-traumatic stress disorder (PTSD) (12), and scores above 37 reflect suppression of immune system function (13). The IES-R has been translated into Chinese and validated in literature (14, 15).

General Health Questionnaire-28

The General Health Questionnaire-28 (GHQ-28) is a 28-item screening tool to detect non-specific psychiatric disorders among individuals in primary care settings (16, 17). GHQ-28 is designed to measure mental health disorders and could be grouped into four subscales: somatization, anxiety, social dysfunction, and depression. Each item is assessed using the 0-0-1-1 scoring method. The total score on the GHQ-28 ranges from 0 to 28 (18). We adopted a cutoff score of 12 out of 28 (those who answered positively to 12 questions would be considered a "case") (18).

Kidney Disease Quality of Life Short Form

The Kidney Disease Quality of Life Short Form (KDQOL-SF), which has been used in ESRD patients widely, assesses the quality of life of patients with kidney diseases (19). KDQOL-SF comprises 43 disease-specific items (symptoms/problem list, effects of kidney disease, burden of kidney disease, work status, cognitive function, quality of social interaction, sexual function, sleep, social support, dialysis staff encouragement, and patient's satisfaction), 36 generic items (physical functioning, role—physical, pain, general health, emotional well-being, social

FIGURE 1 | Flow diagram of study design.
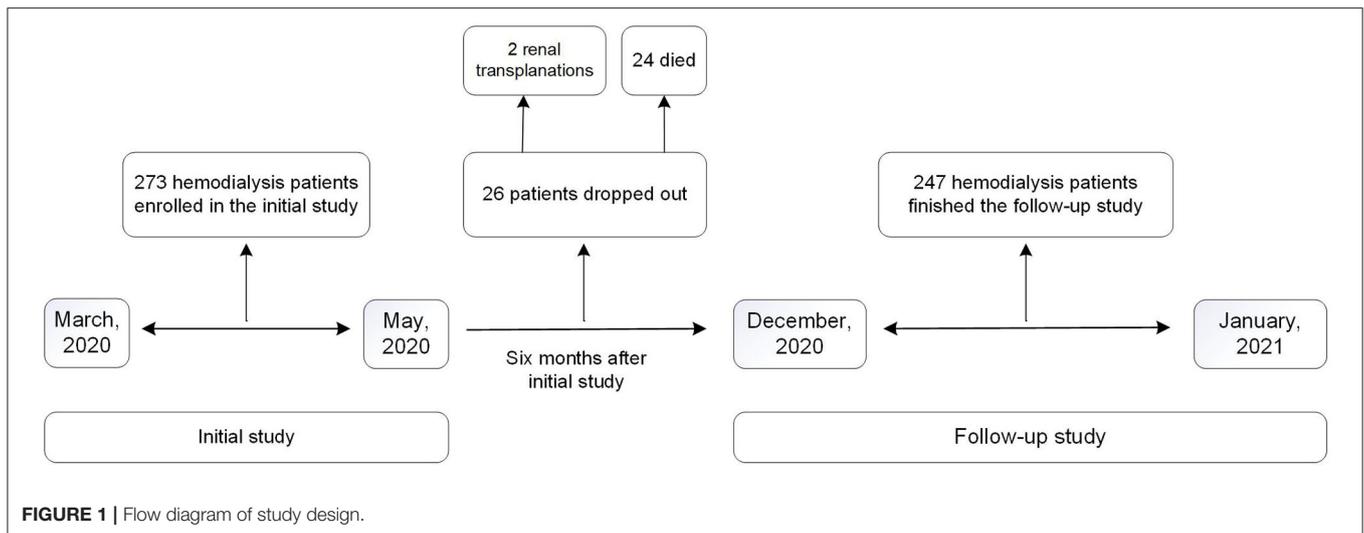
function, and energy/fatigue), and background information. KDQOL-36 has been translated and validated in Chinese population (20).

Statistical Analyses

Statistical analysis was performed using SPSS 13.0 (SPSS Inc.). Data with normal distribution were summarized as mean ± SD. Data without normal distribution were summarized as median. Comparisons were made using the Student t-test or one-way ANOVA for continuous variables and the χ^2-test for categorical variables as required. Pearson correlations were derived, and tests of significance were set at 0.05. Multiple regression analysis was used to analyze association between different variables.

RESULTS

Demographic Features

The flow diagram of study is demonstrated in **Figure 1**. There were 273 maintenance dialysis patients enrolled in the initial study. Male patients composed 58.6% of all the patients, and primary glomerulonephritis was the most common cause (71.8%) of ESRD. Majority of the patients (70.3%, 192/273) received education of secondary or less. At the time of survey, only 16.1% (44/273) of the patients had full or part time job. The baseline characteristics are summarized in **Table 1**. During follow-up, two patients received renal transplantation and 24 died; the remaining 247 patients finished the follow-up study.

Mental Health and Quality of Life

Table 2 summarizes the psychological profiles (GHQ-28, IES-R) and quality of life of the patients (KDQOL and SF-36) during the initial study and follow-up study.

The initial study, which was performed in the ongoing COVID-19 pandemic, showed the total score of GHQ-28 was 13.1 in our patients. A higher score signifies a greater number of symptoms, and details of GHQ subscales are summarized in **Table 2**. By adopting a cutoff score of 12 out of 28 (18), we found an estimated prevalence of non-specific psychiatric morbidity

TABLE 1 | Baseline characteristics of the patients.

Characteristics	Hemodialysis patients (n = 273)
Age (years, mean ± SD)	59.9 ± 14.4
Gender (female/male)	113/160
Duration of hemodialysis (months, mean ± SD)	78.7 ± 60.5
Marital status (n, %)	
Married	219 (78.5%)
Divorced or widowed	23 (8.2%)
Single	31 (11.1%)
Education background (n, %)	
Primary or less	19 (7.0%)
Secondary	173 (63.4%)
University or higher	81 (29.7%)
Etiology of end-stage kidney disease (n, %)	
Diabetic kidney disease	32 (11.7%)
Primary glomerulonephritis	196 (71.8%)
Renal vascular disease	20 (7.3%)
Others	25 (9.2%)

of 45.8% (125/273). Furthermore, the mean scores for social dysfunction and somatic symptoms were higher compared with the mean scores for anxiety and insomnia and for depression.

Total score and scores of subscales of IES-R are also shown in **Table 2**. In our study, 53/273 (19.4%) patients presented with total scores above 24, which reflected clinical concerns. Among those patients, 5/273 (1.8%) patients had a probable diagnosis of post-traumatic stress disorder (PTSD) with score >33, and 29/279 (10.6%) patients had scores above 37, which reflected the suppression of immune system functioning.

The follow-up study showed that KDQOL and SF-36 scores significantly improved compared with those in the initial study (p = 0.006 and p = 0.031, respectively), which suggested the improved quality of life after COVID-19 pandemic in our patients. We also compared the total GHQ-28 score and IES-R

TABLE 2 | Psychological profiles, metal health, and quality of life of the patients.

Variables	Initial study (n = 273)	Follow-up study (n = 247)	p
Quality of Life (KDQOL) (mean, 95% CI)	60.2 (59.0–61.3)	63.4 (61.9–65.0)	0.006
Health status (SF-36) (mean, 95% CI)	59.6 (57.4–61.8)	62.8 (60.5–65.1)	0.031
GHQ-28 score (mean, 95% CI)	13.1 (12.0–14.2)	12.2 (11.2–13.1)	NS
Somatic symptoms	3.7 (3.5–4.0)	3.1 (2.8–3.4)	0.006
Anxiety and insomnia	2.8 (2.4–3.1)	1.9 (1.7–2.2)	0.005
Social dysfunction	4.5 (4.2–4.8)	4.7 (4.4–5.1)	NS
Depression	2.2 (1.8–2.5)	2.4 (2.0–2.7)	NS
IES-R score (mean, 95% CI)	13.4 (11.8–15.0)	13.1 (11.4–14.8)	NS
Intrusion score	5.0 (4.4–5.6)	4.8 (4.2–5.5)	0.049
Avoidance score	4.8 (4.2–5.4)	4.4 (3.7–5.1)	NS
Hyperarousal score	3.6 (3.2–4.1)	3.9 (3.2–4.1)	NS

KDQOL, Kidney Disease Quality of Life; SF-36, Short Form-36; 95% CI, 95% confidence interval; GHQ-28, General Health Questionnaire-28; IES-R, Impact of Event Scale–Revised.

KDQOL-SF comprises 43 disease-specific items (KDQOL) and 36 generic items (SF-36). GHQ-28 consists of four subscales: somatic symptoms, anxiety and insomnia, social dysfunction, and depression. The score range of each subscale is 0–7 and the total GHQ-28 score range is 0–28. The higher score represents more severe mental health disorders. IES-R consisted of three subscales: avoidance (range 0–28), intrusion (0–32), and hyperarousal (0–24). The total score of IES-R ranged from 0 to 88. Total scores of IES-R that exceed 24 reflect clinical concern (11), scores above 33 reflect a probable diagnosis of PTSD (12), and scores above 37 reflect suppression of immune system function (13).

score. Though total scores of these two scales showed no significant difference, improved somatization symptoms, anxiety and insomnia, and intrusion subscales were found in the follow-up study ($p = 0.006$, $p = 0.005$, and $p = 0.049$, respectively).

Comparison of Quality of Life Between Different Psychiatric Diagnostic Groups During Ongoing COVID-19 Pandemic

We divided the patients into different psychopathology groups according to their IES-R scores or GHQ-28 scores to investigate the interplay between psychiatric diagnosis and quality of life during ongoing COVID-19 pandemic.

By adopting a cutoff of 12 out of 28 by GHQ-28, we did not find any significant difference regarding KDQOL or SF-36 between patients with non-specific psychiatric disorders (GHQ-28 score ≥12) and those without ($p > 0.05$, data not shown). If we divided patients based on IES-R scores, we found a significant difference regarding KDQOL between different groups ($p = 0.026$) (**Table 3**). Furthermore, four subscales of KDQOL (work status, cognitive function, quality of social interaction, and sleep) were found significantly different ($p = 0.027$, $p = 0.022$, $p = 0.010$, and $p = 0.039$, respectively). However, we did not find a significant difference regarding SF-36 and its subscales between different groups.

Effects of Demographic and Exposure Variables on Mental Health and Quality of Life During Ongoing COVID-19 Pandemic

Table 4 summarizes the effects of demographic factors on patients' mental health status and quality of life. We presented

the results of GHQ-28, IES-R, KDQOL, and SF-36 total score as measures in relation to various demographic experiences. Our results showed that gender, education background, and duration of hemodialysis were three important factors that may affect patients' mental health, quality of life, or health status.

Utility of Mental Health and Quality of Life

In our study, GHQ-28 was correlated to IES-R, which suggested patients' mental health status was correlated to their stress response (**Table 5**). Similarly, KDQOL was also correlated to SF-36, suggesting quality of life and health status were both correlated. Furthermore, IES-R was negatively correlated with KDQOL with statistical significance, which suggested patients' quality of life was negatively affected by their distress from acute events.

We also analyzed the results of total scores of GHQ-28, IES-R, and KDQOL-SF in relation to various demographic variables. Our results showed KDQOL and SF-36 were both intercorrelated. Furthermore, dialysis duration was the only variable that correlated patients' mental health status (GHQ-28), response to stress (IES-R), and health status (SF-36). The correlation of other variables is summarized in **Table 6**.

DISCUSSION

Psychological disorders among dialysis patients are not simply a consequence of short-term adjustment reaction to regimens but a long-term concomitant of coping with chronic dialysis and ESRD complications. In a recent cohort study, 22% of patients receiving maintenance hemodialysis had anxiety symptoms and 42% had depressive symptoms. In our study, the estimated prevalence of non-specific psychiatric morbidity was 45.8% by GHQ-28. Furthermore, the psychological disorders are closely associated with all-cause mortality and prolonged hospitalizations (21). Both our results and data from the literatures suggest the mental health disorders among dialysis patients are prevalent, which require timely diagnosis and adequate intervention so as to reduce mortality and improve prognosis.

Many factors contribute to poor mental health status among dialysis patients. Psychosocial parameter is one of such key factors. According to definition, it refers to a group of psychological variables and aspects of social environment that are central to individual's perception of quality of life (9). By adding burden of existing mental health status, psychosocial parameter could worsen patients' psychological status. Meanwhile, patients' perception accompanying the stressor could influence their functional status and eventually affect their prognosis (9). In our study, the average score of KDQOL and SF-36 was higher than those reported by Spain and US (22, 23). Such difference might reflect the influence of current acute public events on patients' quality of life. By further comparison of initial study, our follow-up study demonstrated that KDQOL and SF-36 scores as well as some subscales of GHQ-28 and IES-R were significantly improved after pandemic of COVID-19. Since disease itself and mitigation strategies during COVID-19 pandemic like home isolation, intense health monitoring, and many others would greatly affect dialysis patients' daily lives and access to dialysis therapy, our results thus suggest patients' quality of life and

TABLE 3 | Effects of acute stress on quality of life of the patients during ongoing COVID-19 pandemic.

Indicators	No psychopathology*		Required clinical concerns**		Probable diagnosis of PTSD or worse***		p
	Mean (95% CI)		Mean (95% CI)		Mean (95% CI)		
ESRD target areas (KDQOL)	60.8	(59.5–62.1)	60.1	(56.0–64.3)	55.8	(52.9–58.8)	0.026
Symptom/problem list	78.0	(76.3–79.8)	78.0	(71.1–84.9)	76.9	(71.5–82.3)	NS
Effects of kidney disease	61.4	(59.1–63.8)	52.3	(42.1–62.5)	56.0	(49.0–62.9)	NS
Burden of kidney disease	44.7	(42.0–47.3)	37.8	(29.6–46.0)	40.8	(32.1–49.5)	
Work status	41.1	(37.3–44.8)	52.2	(40.0–64.3)	31.3	(20.3–42.2)	0.027
Cognitive function	76.0	(73.7–78.4)	76.8	(66.8–86.8)	67.5	(60.3–74.7)	0.022
Quality of social interaction	68.1	(66.0–70.2)	71.0	(63.8–78.3)	61.7	(56.3–67.1)	0.010
Sexual function	6.7	(3.4–10.0)	5.4	(2.5–13.4)	6.2	(0.2–12.3)	NS
Sleep	62.0	(59.9–64.1)	54.9	(48.9–60.9)	57.4	(52.9–61.9)	0.039
Social support	68.5	(65.3–71.7)	66.7	(55.6–77.7)	60.9	(53.2–68.7)	NS
Dialysis staff encouragement	83.1	(80.8–85.5)	83.2	(76.3–90.0)	78.9	(70.9–87.0)	NS
Patient satisfaction	79.4	(76.3–82.4)	83.3	(75.5–91.2)	76.6	(67.9–85.2)	
36-item health survey (SF-36)	60.4	(58.0–62.8)	56.0	(47.7–64.3)	57.1	(50.3–63.8)	NS
Physical functioning	59.4	(55.9–62.8)	52.8	(39.7–65.9)	59.5	(49.4–69.6)	
Role physical	56.3	(50.3–62.3)	56.5	(38.0–75.0)	56.3	(39.4–73.1)	
Pain	68.3	(65.4–71.2)	62.1	(52.2–71.9)	60.4	(53.9–66.9)	
General health	46.9	(44.8–49.1)	42.4	(36.4–48.4)	43.6	(37.3–49.9)	NS
Emotional well-being	66.0	(63.9–68.1)	65.2	(57.9–72.5)	61.3	(55.9–66.6)	
Role emotional	68.0	(62.1–74.0)	58.0	(36.6–79.4)	63.5	(46.2–80.9)	
Social function	64.4	(62.0–66.9)	64.1	(55.9–72.3)	62.1	(56.8–67.4)	
Energy/fatigue	53.5	(51.7–55.2)	47.2	(41.9–52.4)	50.2	(45.4–54.9)	

ESRD, end-stage renal disease; PTSD, post-traumatic stress disorder; KDQOL, Kidney Disease Quality of Life; SF-36, Short Form-36; 95% CI, 95% Confidence interval.
*Patients with IES-R ≤24 (11).
**Patients with IES-R >24 but IES-R <33 (11, 12).
***Patients with IES-R ≥33 (12).

their mental health is greatly influenced by social environmental factors. It was also shown in the current study that gender and education background were two parameters associated with patients' mental health status as well as kidney disease quality of life. Education background determines patients' knowledge and perception to social environmental variables and compliance to renal replacement therapy, while gender is closely associated with other psychosocial factors like employment, income, education, and more; these intersected variables would consequently affect patients' mental health status and their physical well-being. Studies pointed out that psychosocial factors could affect patients' outcome by several mechanisms, which included access to health care, compliance with the dialysis therapy, and their health status (24). Our results thus suggest patient-level psychosocial parameters should receive special attention especially during stressing events as they could affect patients' mental health status as well as their kidney disease quality of life.

Though the prevalence of mental health disorders among dialysis patients is high, they are difficult to identify especially in patients with the backdrop of chronic dialysis. Overlap between uremic symptoms resulted from inadequate dialysis, and depressive symptoms add much difficulty to distinguish and manage dialysis patients with psychological disorders. One possible way to differentiate between psychiatric illness and medical illness is to delineate differences in thinking styles

(25). By using professional tools like Diagnostic and Statistical Manual of Mental Disorders (DSM), patient's psychological disorders could be differentiated from mental health problems stemming from medical illness (25, 26). However, these tools are professional and sophisticated, which prevent them from being widely used in clinical practice. An alternative method to evaluate patients' psychological status is to use self-reporting screening tool that does not require professional knowledge to interpret. In our study, we adopted GHQ-28 to detect non-specific psychiatric morbidities among our patients. Results showed scores of social dysfunction and somatic symptoms were higher than anxiety or depression in our patients. Though the subscales of GHQ-28 are not designed to make a psychiatric diagnosis, these scores provide information for somatic, anxiety, social dysfunction and severe depression symptoms. Our results thus imply more attention should be paid to patients' social deficits as they may require more clinical concerns.

We also investigated patients' psychological response to acute stress during the current pandemic event. Stress indicates the change in the physical condition, environment, or psychosocial setting of an organism. It refers to the ability to achieve stability through changes. Failure of levels of stress mediator to return to baseline after challenge would cause abnormality of stress response. Since stressor and functional status of the subjects are two fundamental determinants of stress outcome

TABLE 4 | Effects of demographic and exposure variables on mental status and quality of life of the patients during ongoing COVID-19 pandemic.

Variable	Non-specific psychiatric disorders (GHQ-28)		Life stress (IES-R)		Quality of life (KDQOL)		Health status (SF-36)	
	Mean (95% CI)	p	Mean (95% CI)	p	Mean (95% CI)	p	Mean (95% CI)	p
Gender								
Male	12.2 (10.9–13.6)	0.047	13.3 (11.2–15.5)	NS	60.2 (58.7–61.8)	NS	59.1 (56.3–62.0)	NS
Female	14.4 (12.6–16.1)		13.4 (11.0–15.9)		60.1 (58.4–61.9)		60.3 (56.9–63.6)	
Marital status								
Single	14.8 (11.3–18.3)		15.0 (9.3–20.7)		63.6 (59.3–67.8)		67.2 (61.1–73.3)	
Married	12.9 (11.7–14.1)	NS	13.1 (11.4–14.9)	NS	59.9 (58.6–61.1)	NS	58.7 (56.3–61.2)	NS
Divorced or widowed	12.7 (8.0–17.5)		13.4 (7.3–19.5)		58.4 (54.2–62.6)		57.6 (50.1–65.2)	
Education background								
Primary or less	11.2 (7.1–15.2)		7.3 (3.3–11.2)		56.6 (52.4–60.9)		45.2 (38.2–52.2)	
Middle school/high school	13.4 (12.0–14.8)	NS	13.9 (11.8–16.1)	0.047	59.3 (57.9–60.7)	0.022	59.7 (56.9–62.4)	<0.001
University or postgraduate	13.0 (11.1–14.9)		13.7 (11.0–16.4)		62.9 (60.5–65.3)		62.8 (59.1–66.6)	
Age (years)								
<65	13.2 (11.9–14.7)	NS	13.7 (11.7–15.7)	NS	60.2 (58.6–61.8)	NS	61.0 (58.4–63.7)	NS
≥65	12.8 (11.2–14.5)		13.0 (10.4–15.6)		60.1 (58.5–61.8)		57.8 (54.2–61.4)	
Duration of hemodialysis (years)								
<1	15.5 (11.0–19.9)		12.2 (7.1–17.3)		59.7 (55.8–63.5)		52.3 (43.4–61.2)	
1–10	13.8 (11.5–16.1)	0.032	13.4 (9.9–16.9)	0.016	58.5 (56.1–60.9)	NS	57.5 (53.2–61.8)	NS
11–20	12.3 (11.0–13.6)		12.9 (11.0–14.8)		60.8 (59.3–62.3)		61.1 (58.4–63.7)	
>20	21.5 (15.6–27.4)		32.5 (22.3–42.7)		59.5 (50.8–68.2)		61.6 (47.3–75.9)	

GHQ-28, General Health Questionnaire-28; IES-R, Impact of Event Scale–Revised; KDQOL, Kidney Disease Quality of Life; SF-36, Short Form-36; 95% CI, 95% confidence interval.

TABLE 5 | Correlation coefficients for the GHQ-28, IES-R, KDQOL, and SF-36 during ongoing COVID-19 pandemic.

	GHQ-28	IES-R	KDQOL	SF-36
GHQ-28	–	0.584*	−0.056	0.013
IES-R		–	−0.119**	−0.078
KDQOL			–	0.596*
SF-36				–

*p < 0.001; **p < 0.05.
GHQ-28, General Health Questionnaire-28; IES-R, Impact of Event Scale–Revised; KDQOL, Kidney Disease Quality of Life; SF-36, Short Form-36.s.

TABLE 6 | Multiple regression of dependent variables and related factors during ongoing COVID-19 pandemic.

Variable	r^2	t	Final β	p
Dependent variables: SF-36 score (constant)		−0.850		0.396
Dialysis duration of hemodialysis	3.202	2.376	0.116	0.018
KDQOL score	1.036	11.005	0.556	<0.001
Dependent variable: KDOQL score (constant)		8.960		<0.001
SF 36 score	0.304	11.005	0.565	<0.001
Dependent variable: GHQ-28 (constant)		2.095		0.037
Gender	1.879	2.011	0.102	0.045
Dialysis duration of hemodialysis	−1.473	−2.034	−0.107	0.043
Dependent variable: IES-R (constant)		1.265		0.207
SF-36 pain	−0.117	−2.455	−0.186	0.015
Dialysis duration of hemodialysis	2.297	2.221	0.113	0.027

GHQ-28, General Health Questionnaire-28; IES-R, Impact of Event Scale–Revised; KDQOL, Kidney Disease Quality of Life; SF-36, Short Form-36.

(9), any changes in patient's status in personal or social contexts could result in depression, anxiety, or development of other mental health problems. By using IES-R, we investigated the psychological symptoms relating to various types of event exposure. Our results indicated that exposure to current acute stress and related events like home isolation, being quarantined, contact tracing, and many others contributed to the psychological symptoms of the patients with dialysis. Similar results were also reported by Wu and colleagues (14) who investigated psychological status of healthcare workers exposed to SARS-related events and found post-traumatic stress (PTS) symptom levels were closely associated with the outbreak of the disease and people's perception levels of the events were related to symptom levels.

We found that IES-R score was negatively correlated to KDQOL score in the current study. IES-R score was adopted for subjective distress from acute stress, and the higher score represented for the more severe psychological symptoms. The way patients respond to the stress would affect their perception and consequently influence their medical outcomes. Therefore, patients with higher IES-R score would have lower level of kidney quality of life. In a recent multicenter study, García-Martínez

and colleagues (23) found that patients' resilience to stress was associated with their quality of life. Their results are consistent with our findings, which suggest patients' response to stress would have an impact on different aspects of their quality of life. In light of the important role of patients' response to acute stress, improving their resilience and coping capability with acute stress would help to increase quality of life and decrease the frequency of hospitalization in patients with hemodialysis (27–29).

There are several limitations that must be acknowledged in the current study. First, we did not provide historical profiles of the patients as controls because many patients began their dialysis therapy long before current evaluating tools were introduced in China. We therefore performed the follow-up study when COVID-19 pandemic was effectively contained and made the comparison. Second, our hospital is located in the downtown of the city and most of our patients are from urban areas. Considering social economic status, education background, and some other variables are different between urban and rural areas, data in the current study might not fully represent those from rural areas. Third, the cross-sectional nature of the study made it difficult to establish causal relationship between risk perception and mental health disorders. Last, the subjects' self-reports in the current study were subject to recall bias.

Regardless of the mentioned limitations, our data do provide information regarding psychological impact of acute public events on dialysis patients. Our results urge the necessity of psychotherapeutic interventions for some patients during the current public health event.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

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

AUTHOR CONTRIBUTIONS

Z-HY wrote the manuscript. X-TP, YC, LW, Q-XC, YZ, and Y-JZ collected the data. Y-XC and Z-HY designed the study and analyzed the data. X-NC and Y-XC reviewed the manuscript and approved the submission. All authors contributed to the article and approved the submitted version.

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Adjustment to a "New Normal:" Coping Flexibility and Mental Health Issues During the COVID-19 Pandemic

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The Coronavirus Disease 2019 (COVID-19) pandemic is an unprecedented health crisis in terms of the scope of its impact on well-being. The sudden need to navigate this "new normal" has compromised the mental health of many people. Coping flexibility, defined as the astute deployment of coping strategies to meet specific situational demands, is proposed as an adaptive quality during this period of upheaval. The present study investigated the associations between coping flexibility and two common mental health problems: COVID-19 anxiety and depression. The respondents were 481 Hong Kong adults (41% men; mean age = 45.09) who took part in a population-based telephone survey conducted from April to May 2020. Self-report data were assessed with the Coping Flexibility Interview Schedule, COVID-19-Related Perception and Anxiety Scale, and Center for Epidemiological Studies Depression Scale. Slightly more than half (52%) of the sample met the criteria for probable depression. Four types of COVID-19 anxiety were identified: anxiety over personal health, others' reactions, societal health, and economic problems. The results consistently revealed coping flexibility to be inversely associated with depression and all four types of COVID-19 anxiety. More importantly, there was a significant interaction between perceived likelihood of COVID-19 infection and coping flexibility on COVID-19 anxiety over personal health. These findings shed light on the beneficial role of coping flexibility in adjusting to the "new normal" amid the COVID-19 pandemic.

Keywords: coronavirus disease, resilience, coping, stress, psychological well-being, adaptation, Chinese, epidemic

INTRODUCTION

The emergence of an atypical coronavirus, SARS-CoV-2, instigated a global outbreak of Coronavirus Disease 2019 [COVID-19; e.g., (1)]. Following identification of the earliest cases of COVID-19 in December 2019, the World Health Organization (2) declared the viral outbreak a health emergency of international concern on January 30, 2020, and then a global pandemic < 2 months later. The escalating pandemic has induced anxiety and panic reactions in the general public, and the emotional responses bear some resemblance to those observed amid the severe acute respiratory syndrome (SARS) outbreak in 2003 [e.g., (3, 4)]. For instance, the panic sell-off

of stocks led to a plunge in the global stock market (5), and long lines for food and the irrational stockpiling of personal protection equipment such as facemasks and hand sanitizers have been widely seen (6, 7).

Despite such resemblances, the COVID-19 pandemic is an unprecedented crisis in terms of the scope of its influence on both physical and mental health [e.g., (8, 9)]. To curb the transmission of this hitherto unknown virus, governments all over the world have enforced strict epidemic-control measures such as nationwide school closures, stay-at-home orders, and physical distancing regulations in public areas (10). Also, myriad public and private organizations have adopted teleworking policies mandating that their employees work from home (11). Although employees hold generally favorable attitudes toward home-based teleworking, the sudden drastic change in work mode left many unprepared (12). Previous research on the office-home transition has revealed major changes in the work environment to induce the most stress and anxiety in employees who feel the least prepared for this alternative work mode (13). Devastating problems arising from stressful life changes have been documented not only in adults but also in youngsters, with recent studies revealing a significant proportion of children and adolescents to have experienced psychological distress during the school-closure period (14, 15). The COVID-19 pandemic has confronted people of all ages with fundamental life changes [e.g., (16, 17)].

To grapple with the "new normal" and deal with the considerable challenges brought about by the pandemic, individuals need a considerable degree of flexibility. Psychological resilience is a widely recognized mechanism underlying the adjustment process, with coping flexibility a core component [e.g., (18)]. The theory of coping flexibility postulates that effective coping entails (a) sensitivity to the diverse situational demands embedded in an ever-changing environment and (b) variability in deploying coping strategies to meet specific demands (19). More specifically, psychological adjustment is a function of the extent to which individuals deploy problem-focused coping strategies (e.g., direct action) in controllable stressful situations and emotion-focused coping strategies (e.g., distraction) in uncontrollable ones. Inflexible coping, in contrast, has been linked to psychological symptoms. For example, individuals with heightened anxiety levels are characterized by an illusion of control [e.g., (20, 21)]. They tend to perceive all events in life as being under their control, and thus predominantly opt for problem-focused coping regardless of the situational characteristics. In contrast, individuals with depression are characterized by a sense of learned helplessness [e.g., (22, 23)]. They tend to view all events as beyond their control, and thus predominantly deploy emotion-focused coping across stressful events. Coping flexibility has been identified to foster adjustment to stressful life changes, which is indicated by a reduction in symptoms of anxiety and depression commonly experienced in stressful life transitions (24).

Applying these theories and findings to psychological adjustment during the COVID-19 pandemic, individuals higher in coping flexibility are predicted to experience lower levels of anxiety and depression than those lower in coping flexibility.

Clinical trial findings on COVID-19 offer a mixture of promise and disappointment regarding the efficacy of SARS-CoV-2 vaccine candidates [e.g., (25)], and the absence of a thorough understanding of the etiology and treatment of this atypical virus has elicited widespread public panic responses. According to the theory of psychological entropy (26), uncertainty is a crucial antecedent of anxiety. In accordance with that theory, studies conducted during the pandemic have revealed unusually high prevalence rates of mental health problems such as anxiety and depression, rates ∼3-fold higher than both their pre-pandemic prevalence and lifetime prevalence over the past two decades (27, 28).

In light of the transactional theory of stress and coping that highlights the importance of primary and secondary appraisals in the coping process (29), coping flexibility (secondary appraisal) is predicted to explain the association between context-specific health beliefs (primary appraisal) and mental health. Instead of perceiving the COVID-19 pandemic as aversive and uncontrollable, resilient copers tend to espouse a more complex view by recognizing both controllable and uncontrollable aspects of the pandemic. For instance, these individuals tend to take such positive actions as acquiring new information technology and digital skills to meet the demands of home-based teleworking, but engage in meditation to cope with the unpleasant emotions brought about by mandatory stay-at-home orders. Accordingly, coping flexibility is hypothesized to be inversely associated with anxiety and depression during the pandemic.

As individuals high in coping flexibility are characterized by cognitive astuteness in making distinctions in an array of stressful events (30, 31), coping flexibility is also predicted to interact with context-specific health beliefs to have a conjoint influence on mental health in the pandemic context. Although COVID-19 shares similar characteristics with other atypical coronaviruses of SARS and Middle East respiratory syndrome (MERS), the case fatality rate of COVID-19 is much lower than the others (32). Among individuals high in coping flexibility, those who tend to perceive such differences may experience lower COVID-19 anxiety than their counterparts who do not hold this perception. In this respect, mental health experienced during the pandemic is a function of both context-specific health beliefs and coping flexibility.

The present study was conducted during the "second wave" of COVID-19 infections in Hong Kong. Although the first confirmed COVID-19 case was identified on January 23, 2020, with the first death recorded 2 weeks later (33), Hong Kong remained largely unscathed by the first wave, with only sporadic cases reported and a relatively flat epidemic curve (i.e., fewer than 100 confirmed cases). However, there was a sudden surge in confirmed cases in March, when the viral outbreak swept the globe (34). The Government of the Hong Kong Special Administrative Region (HKSAR) responded to the health emergency by enacting a travel ban on non-residents, issuing compulsory quarantine orders for residents returning from overseas, and tightening various physical distancing measures in late March and early April [e.g., (35, 36)]. Special work arrangements for government employees were also implemented, and many organizations followed suit. The psychosocial impact

was thus so pervasive that all sectors of society were affected. A population-based survey was therefore deemed the most appropriate method for investigating the psychological reactions to the pandemic among residents of Hong Kong. The method yields heterogeneous community samples, which maximizes representativeness and minimizes sampling errors.

MATERIALS AND METHODS

Sample Size Determination and Power Analysis

The statistical power analysis showed that the minimum sample size was 276 in order to identify statistically significant associations among the study variables, but a larger sample size was recruited to meet the requirements for conducting principal component analysis (PCA). Considering the general rule of thumb of having at least 50 cases per factor and a maximum number of nine factors to be identified in the PCA, the pre-planned minimum sample size was 450.

Participants and Procedures

The respondents were 481 Hong Kong adults (41% men; mean age = 45.09, SD = 23.42), who were recruited from a population-based telephone survey conducted by a survey research center at the first author's university. Random digit dialing was used for identifying eligible households, and then the most recent birth day method was employed to select a household member. To be eligible for participation, respondents had to be aged 18 or older, a resident of Hong Kong, able to understand Cantonese, and willing to give consent. Participation was voluntary, and all respondents who completed the survey were entered into a lucky draw for a chance to win gift certificates worth 500 Hong Kong dollars (about 65 U.S. dollars).

Trained interviewers conducted the telephone interviews using a structured questionnaire with standard questions. To foster interviewer calibration and minimize measurement bias, the survey was piloted in a small group of respondents from April 2 to 10, 2020. The final set of survey questions was amended to enhance the clarity of a few items, and then the full survey was administered from April 20 to May 19, 2020.

The study was conducted according to the ethical research standards of the American Psychological Association, and the study protocol was reviewed and approved by the human research ethics committee of the first author's university before the survey began (approval number: EA1912046 dated March 4, 2020). All respondents gave verbal consent in accordance with the Declaration of Helsinki.

Instruments
Coping Flexibility
Coping flexibility was assessed by the revised Coping Flexibility Interview Schedule (37). This interview schedule was originally developed based on clinical samples (38), and was adjusted for use with heterogeneous non-clinical populations. In the pilot phase, some respondents reported difficulty in understanding the terms of primary and secondary approach coping that was currently used in our interview schedule. The interview questions

were revised by combining the terms of primary and secondary approach coping into problem-focused coping and converting the term of avoidant coping style into emotion-focused coping. Problem-focused and emotion-focused coping were originally used in the transactional theory of coping (39) from which the Coping Flexibility Interview Schedule was derived. The respondents were asked to report their deployment of problem-focused (e.g., information seeking, monitoring) and emotion-focused (e.g., acceptance, relaxation) coping in controllable and uncontrollable stressful situations over the past month.

To obtain a composite score of coping flexibility indicating strategy-situation fit, the individual coping items were subsequently coded by two independent raters according to a coding scheme (40, 41) based on coping theories (39, 42). One point was given to the deployment of problem-focused coping strategies to handle controllable stressful events and/or the deployment of emotion-focused coping strategies to handle uncontrollable stressful events. Zero points were given otherwise. All of these scores were aggregated, and then averaged to obtain a composite score. Inter-rater agreement was evaluated using Krippendorff alpha coefficients (43), and the results showed no discrepancies because no subjective codings were required (Krippendorff alpha = 100%).

COVID-19-Related Perceptions
Both perceived likelihood and impact of COVID-19 infection were measured by a modified measure developed and validated during the SARS outbreak (44). To make this measure relevant to the present pandemic context, the context was altered from "SARS outbreak" to "COVID-19 pandemic." Respondents gave four-point ratings to indicate their perception of the likelihood of contracting COVID-19 (1 = $very$ $unlikely$, 4 = $very$ $likely$) and the impact of having it (1 = no $impact$ at all, 4 = a $large$ $impact$). The measure has been found to display both criterion and predictive validity (44, 45).

COVID-19 Anxiety
As the events that have occurred during the COVID-19 pandemic are unprecedented, our team conducted a qualitative study in March 2020 asking participants to list all of the issues that had made them feel anxious during the pandemic. Content analysis of the results revealed 16 distinct themes regarding anxiety-provoking issues experienced amid the pandemic (see **Table 1** for details). These items were compiled into a context-specific measure for assessing COVID-19 anxiety. Respondents rated each item on a scale ranging from 1 (*not worried at all*) to 4 (*very worried*).

Depression
Depression was measured by the short form of the Center for Epidemiological Studies Depression Scale (46), which contains 10 items. The translated Chinese version was used in this study (47). Respondents rated each item on a four-point scale (0 = *rarely or none of the time*, 3 = *most or all of the time*). In this study, we applied the recommended cut-off score of 10 as the classification scheme [e.g., (46, 48)].

TABLE 1 | Four-factor promax-rotated factor solution for COVID-19 anxiety ($n = 481$).

Pandemic-specific anxiety itemPers	Factor			
	Personal health	Others' reactions	Societal health	Economic problems
Health of elderly people in my community	0.72			
Health of children in my community	0.72			
COVID-19 infection in my friends/social network members	0.71			
COVID-19 infection in myself and my family members	0.69			
Contact with a COVID-19 carrier	*0.57*	*0.50*		
Discrimination		0.80		
Quarantine stigma		0.74		
Stockpiling of basic groceries		0.68		
Stockpiling of personal protection equipment		0.53		
Government's lack of effort/ability to handle the pandemic			0.81	
Breakdown of local healthcare system			0.67	
No effective treatment for COVID-19			0.63	
Progress of my work			0.50	
Pandemic's economic implications (e.g., recession, stock market crash)				0.78
Widening of health-wealth gap in society				0.73
My financial situation				0.64
Eigenvalues	6.15	1.58	1.22	1.15
% of variance	38.41	9.87	7.60	7.22
Cronbach's alpha	0.83	0.76	0.72	0.71

Extraction method is principal component analysis with varimax rotation with Kaiser normalization. Factor loadings below the 0.45 threshold were omitted from the table. The item with double loading (in italics) was removed from the statistical analyses.

Statistical Analysis

All statistical procedures were conducted using SPSS version 26.0 for Windows (IBM Corporation, 2019, Armonk, NY). Before hypothesis testing, PCA was performed to identify the factorial structure underlying the 16 anxiety-provoking issues. The components were rotated using the varimax method with Kaiser normalization to increase the interpretability of the findings. The number of factors extracted was determined by the Kaiser rule, with factors retained when the eigenvalue exceeded one. The total amount of variance accounted for by the factors needed to exceed 60%, a minimum criterion for factor selection widely adopted in PCA research (49). Both the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were first examined to check the appropriateness for analyzing the dataset, with appropriateness indicated if the KMO index was >0.50 and the test of sphericity was significant. For PCA, items with a factor loading <0.45 or double loading were removed. Cronbach alpha was used to indicate internal consistency for the items within each factor, with an alpha >0.70 considered adequate.

The potential differences among demographic groups were examined. Differences in sex were detected using an independent-samples *t*-test, and age differences using Pearson zero-order correlation analysis. In addition to testing age as a continuous variable, we also adopted a generational approach proposed by the Pew Research Center that makes comparisons across four age cohorts: (a) Millennials, who were born in 1981 or after; (b) Generation X-ers, who were born between 1965 and 1980; (c) Baby Boomers, who were born between 1946 and

1964; and (d) Silent Gen'ers, who were born before 1946 (50). A general linear model (GLM) was employed to investigate the differences among the four generations, with *post hoc* Bonferroni tests conducted if generational differences were found in any of the study variables.

Pearson zero-order correlation analysis was conducted to obtain an overview of the inter-relationships among the study variables. The hypothesized beneficial role of coping flexibility on mental health was then tested using three-step hierarchical regression analysis. First, the two demographic variables (i.e., sex and age) were entered to control for their potential effects on the criterion in question. Second, the variables of perceived likelihood of COVID-19 infection, perceived impact of COVID-19 infection, and coping flexibility were entered simultaneously. Third, the Perceived Likelihood of COVID-19 Infection × Coping Flexibility interaction and the Perceived Impact of COVID-19 Infection × Coping Flexibility interaction were entered. To address the potential multicollinearity problem, all of the variables were centered before conducting these analyses. The procedures were identical for each mental health problem included as the criterion variable. To unpack significant interaction effects, *post hoc* simple effects analysis was employed to examine the effects of COVID-19-related perception on a criterion at each level of coping flexibility.

RESULTS

PCA was performed because the KMO index was high (.87) and Bartlett's test of sphericity was significant ($\chi^2 = 3379.31$,

$p < 0.0001$). The results with the principal component weights of the 16 anxiety-provoking issues are presented in **Table 1**. A four-factor solution was yielded, accounting for 63% of the total variance, with 38% explained by the first factor, personal health issues (e.g., "*COVID-19 infection in myself and my family members*"); 10% by the second factor, other people's undesirable reactions (e.g., "*discrimination*"); 8% by the third factor, societal health issues (e.g., "*government's lack of effort/ability to handle the pandemic*"); and 7% by the fourth factor, economic problems (e.g., "*pandemic's economic implications*"). It is noteworthy that one item (i.e., "*contact with a COVID-19 carrier*") had a double loading with a difference of <0.10, and was thus discarded. All four factors displayed internal consistency (Cronbach alphas > 0.70), and were thus included in the subsequent analyses as indicators of COVID-19 anxiety.

The GLM results revealed a significant cross-generational difference only for anxiety over societal health, $F_{(3, 477)} = 33.92$, $p < 0.0001$, partial eta squared = 0.18. *Post hoc* Bonferroni tests indicated that Silent Gen'ers aged over 74 ($M = 2.02$, $SD = 0.62$) reported significantly less anxiety over societal health than did Millennials aged 18–39 ($M = 2.87$, $SD = 0.66$) or Generation X-ers aged 40–55 ($M = 2.71$, $SD = 0.68$), $ps < 0.0001$. However, there were no other differences regarding sex, generation, or the Sex × Generation interaction, $ps > 0.05$.

The descriptive statistics of and inter-relationships among the study variables are presented in **Table 2**. The average depression score was 9.85, which was very close to the cut-off score for probable depression. Adopting the standard cut-off criterion of 10, slightly more than half (52%) of the respondents were categorized as having probable depression. The probable depression group ($M = 2.67$, $SD = 0.75$) generally experienced a higher anxiety level over societal health issues than the no depression group ($M = 2.48$, $SD = 0.73$), $t = 2.72$, $p = 0.007$. In addition, the probable depression group ($M = 0.50$, $SD = 0.21$) also reported a generally lower degree of coping flexibility than the no depression group ($M = 0.58$, $SD = 0.21$), $t (479) = -3.95$, $p < 0.0001$. However, no other significant differences in depression level were found for sex or generation, $ps > 0.21$.

Table 3 summarizes the results of hierarchical regression analysis for various mental health problems. As shown in the table, the pattern of results was highly consistent across the four types of COVID-19 anxiety; that is, all four types were positively associated with both the perceived likelihood and impact of COVID-19 infection and inversely associated with coping flexibility. There was also a significant interaction between perceived likelihood of COVID-19 infection and coping flexibility, and the results are presented in **Figure 1**. For individuals higher in coping flexibility, those who perceived a lower likelihood of contracting COVID-19 reported less anxiety over their own health than their counterparts who perceived a greater likelihood of such contraction. For individuals lower in coping flexibility, however, such individual differences were absent and they generally reported greater anxiety over their own health than those higher in coping flexibility. In addition, the results revealed depression to also be inversely associated with coping flexibility, although its associations with the two types of COVID-19-related perception were non-significant. In short,

these findings provide support for the hypothesized beneficial role of coping flexibility in dealing with mental health issues experienced during the COVID-19 pandemic.

In addition to evaluating strategy-situation fit using composite coping flexibility scores, nuanced analysis was conducted to further examine the deployment of individual coping strategies and their associations with mental health problems. Most of the respondents (61%) reported deploying problem-focused coping to handle controllable stressful events during the pandemic, whereas just under half (45%) reported deploying that strategy to deal with uncontrollable stressful events. Fewer respondents said they had used emotion-focused coping to deal with controllable and uncontrollable stressful events (39 and 37%, respectively). Moreover, the deployment of problem-focused coping in controllable stressful events was inversely associated with anxiety over personal health and others' reactions, $ps < 0.0001$, whereas the deployment of emotion-focused coping in controllable stressful events was positively associated with all four types of COVID-19 anxiety and depression, $ps < 0.0001$. However, neither problem-focused nor emotion-focused coping deployed in uncontrollable stressful events were significantly associated with any of the mental health problems, $ps > 0.14$.

DISCUSSION

The present study has investigated coping responses and mental health issues among the general public in Hong Kong amid the second wave of the COVID-19 pandemic. Recent studies have identified high prevalence rates of anxiety and depression among residents of COVID-19-affected regions all over the world [e.g., (28, 51)]. Our study expands this growing body of research by specifying four major factors of COVID-19 anxiety: personal health, others' reactions, societal health, and economic problems. Although the third factor is characterized primarily by societal health issues, it is interesting to note that a seemingly unrelated item "*progress of my work*" also loaded onto this factor. This perplexing finding may reflect the fact that employees' work progress has been affected more by societal factors (e.g., implementation of prevention and control disease regulations for business and premises, home-based teleworking policy) than personal factors during the pandemic.

A similar phenomenon is found for the fourth factor, economic problems. Most of the items loading onto it involved broad societal issues (e.g., economic recession, widening of health-wealth gap), but an item related to personal financial problems also did so. This finding similarly indicates that individuals' personal financial condition during the pandemic may be influenced to a great extent by the wider economy. Taken together, these interesting findings reflect the intricate interactions between the individual and society in times of crisis, thus attesting to the necessity of identifying anxiety-provoking issues specific to the pandemic in addition to assessing generic mental health issues that are context-free.

In addition to anxiety, our findings also show depression to have been prevalent among Hong Kong adults during the second wave of the pandemic, with slightly more than half the

TABLE 2 | Descriptive statistics of study variables ($n = 481$).

Variable	M	SD	2	3	4	5	6	7	8	9	10
1. Sex[a]			0.023	−0.036	0.101*	0.037	0.020	0.053	0.049	0.115*	−0.034
2. Age	45.09	23.42		−0.049	−0.035	0.092*	−0.089	−0.063	−0.366**	0.0003	−0.018
3. Likelihood of infection	2.31	0.70			0.214**	−0.057	0.249**	0.215**	0.226**	0.174**	0.006
4. Impact of infection	3.12	0.84				−0.156**	0.377**	0.301**	0.391**	0.275**	0.106*
5. Coping flexibility	0.54	0.21					−0.299**	−0.215**	−0.212**	−0.165**	−0.195**
6. Anxiety over personal health	2.57	0.76						0.546**	0.500**	0.463**	0.105*
7. Anxiety over others' reactions	2.07	0.80							0.457**	0.422**	0.116*
8. Anxiety over societal health	2.58	0.75								0.493**	0.144**
9. Anxiety over economic problems	2.54	0.77									0.135**
10. Depression	9.85	2.96									

[a] Point-biserial correlation coefficients were reported instead of the typical Pearson's product-moment correlation coefficients because sex was dummy coded (0 = men, 1 = women).
*$p < 0.05$; **$p < 0.01$.

TABLE 3 | Summary of hierarchical regression analysis by mental health problems ($n = 481$).

	Anxiety over personal health		Anxiety over others' reactions		Anxiety over societal health		Anxiety over economic problems		Depression	
	B	SE	B	SE	B	SE	B	SE	B	SE
Step 1	$R^2 = 0.007$		$R^2 = 0.004$		$R^2 = 0.131$		$R^2 = 0.012$		$R^2 = 0.002$	
Sex	0.033	0.070	0.074	0.075	0.084	0.065	0.174*	0.072	−0.210	0.277
Age	−0.003	0.001	−0.002	0.002	−0.011**	0.001	0.000	0.002	−0.004	0.006
Step 2	$R^2 = 0.225$		$R^2 = 0.141$		$R^2 = 0.297$		$R^2 = 0.110$		$R^2 = 0.046$	
Sex	0.007	0.063	0.053	0.070	0.048	0.059	0.154*	0.069	−0.236	0.274
Age	−0.001	0.001	−0.001	0.001	−0.010**	0.001	0.001	0.001	−0.001	0.006
Likelihood of infection	0.182**	0.045	0.176**	0.050	0.142**	0.042	0.139**	0.049	−0.103	0.196
Impact of infection	0.270**	0.038	0.224**	0.043	0.287**	0.036	0.195**	0.041	0.309	0.166
Coping flexibility	−0.827**	0.147	−0.641**	0.164	−0.412**	0.137	−0.457**	0.160	−2.539**	0.638
Step 3	$R^2 = 0.243$		$R^2 = 0.150$		$R^2 = 0.302$		$R^2 = 0.113$		$R^2 = 0.046$	
Sex	0.014	0.062	0.057	0.070	0.053	0.059	0.157*	0.069	−0.237	0.275
Age	−0.001	0.001	0.000	0.001	−0.010**	0.001	0.001	0.001	−0.001	0.006
Likelihood of infection	0.165**	0.045	0.163**	0.050	0.136**	0.042	0.131**	0.049	−0.099	0.198
Impact of infection	0.256**	0.038	0.211**	0.043	0.284**	0.036	0.189**	0.042	0.314	0.167
Coping flexibility	−0.826**	0.145	−0.642**	0.163	−0.410**	0.137	−0.457**	0.160	−2.539**	0.640
Likelihood of infection × Coping flexibility	0.571**	0.212	0.248	0.238	0.338	0.200	0.245	0.233	−0.056	0.932
Impact of infection × Coping flexibility	0.210	0.180	0.352	0.202	−0.091	0.170	0.095	0.209	−0.128	0.793

*$p < 0.05$; **$p < 0.01$.

sample identified as having probable depression. Compared with respondents without depression, those with probable depression tended to experience greater anxiety related to societal health issues but not economic problems or personal health issues. These findings indicate that the unusually high prevalence of depression reported during the pandemic is largely related to health-related problems at the societal level (e.g., governmental actions to combat COVID-19, possible breakdown of local healthcare system) rather than personal health issues.

More importantly, the present study is the first to apply the theory of coping flexibility to the context of the COVID-19 pandemic, and the findings provide support for the hypothesized beneficial role of coping flexibility in relieving heightened anxiety and depression when handling the vicissitudes emerged during the pandemic. Astute strategy deployment to meet the specific demands of an ever-changing environment is essential for adjustment to the "new normal," and a better strategy-situation fit is found to be inversely associated with

FIGURE 1 | Simple effects analysis for significant interaction between perceived likelihood of COVID-19 infection and coping flexibility ($n = 481$).
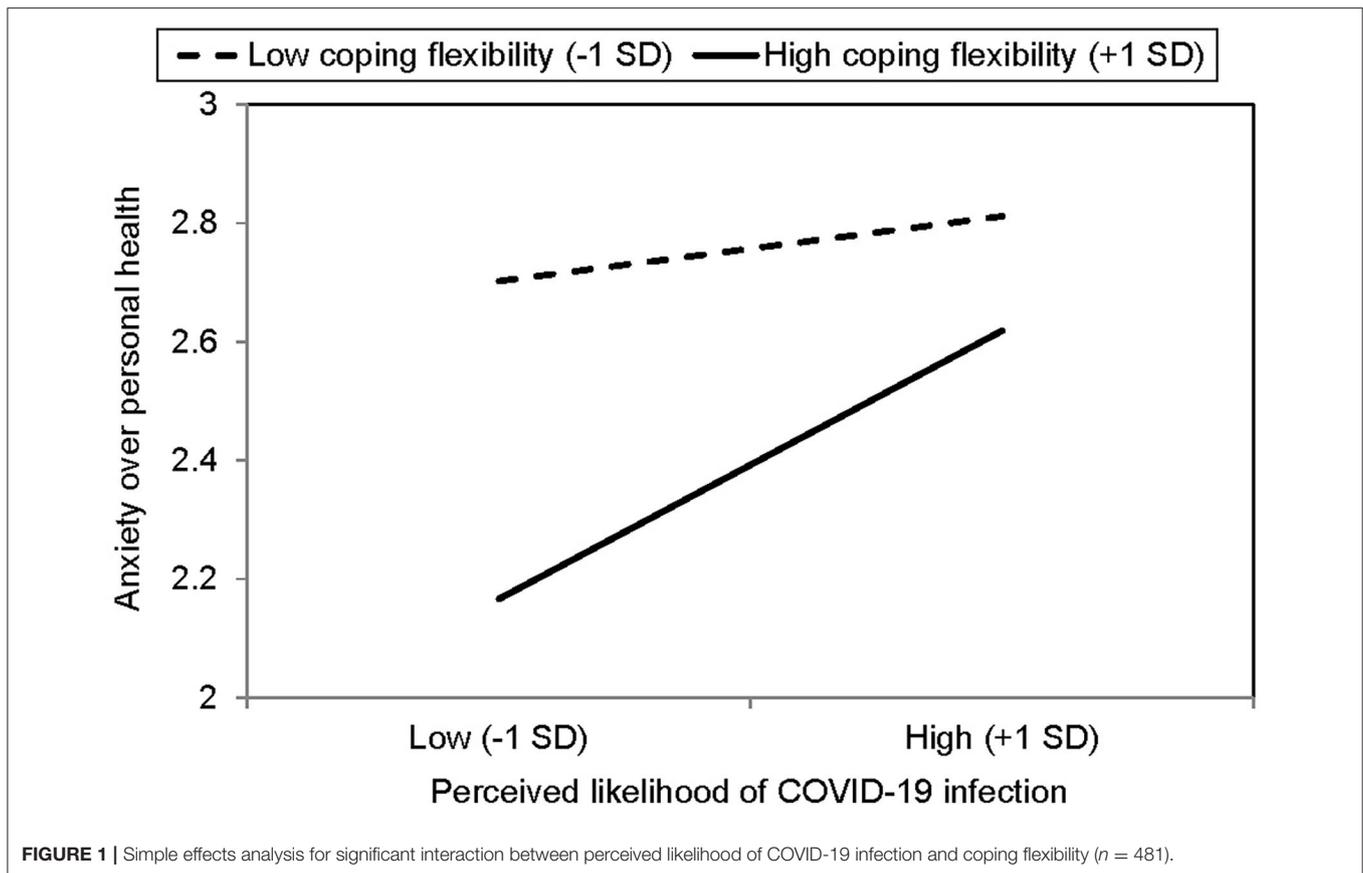
both COVID-19 anxiety and depression. It is noteworthy that coping flexibility interacts with perceived susceptibility to COVID-19 infection to have a conjoint influence on COVID-19 anxiety. Even within individuals having a higher level of coping flexibility, those tend to experience fewer symptoms of COVID-19 anxiety over personal health if they display cognitive astuteness in assessing their possibility of contracting COVID-19. These novel findings provide support for the notion that the anxiety-buffering role of coping flexibility is highly context-specific (24), which is confined to infection susceptibility and anxiety over personal health in this stressful encounter. Such context-specificity is not surprising because subjective appraisals of the possibility of contracting a novel virus should be directly linked with concerns over personal health rather than other anxiety-provoking events related to non-health issues or to the society at large. Moreover, these findings further demonstrate that COVID-19 anxiety is not a unidimensional construct and should thus be studied using a multidimensional approach.

We further found the use of problem-focused coping to deal with controllable stressful events to be related to lower levels of anxiety over personal issues (i.e., personal health and others' reactions) rather than broader societal issues (i.e., societal health, economic problems). It is also noteworthy that the use of emotion-focused coping to handle controllable rather than uncontrollable stressful events was related to higher

COVID-19 anxiety and depression, a finding consistent with previous studies on clinical samples of depression (22). Although the unprecedented COVID-19 pandemic is objectively an uncontrollable stressor due to its uncertain nature, the theory of coping flexibility highlights the importance of identifying aspects of life that are controllable and distinguishing these aspects from most other uncontrollable ones in a stressful encounter. For example, when a person high in coping flexibility fails to buy facemasks after visiting many stores, this person still regards the problem as controllable and keeps trying a variety of alternative means (e.g., placing orders in overseas online stores, seeking advice from members of WhatsApp groups). It is the cognitive astuteness in distinguishing between controllable and uncontrollable life aspects that fosters adjustment to stressful life changes.

Such situational differences in coping effectiveness indicate that neither problem-focused nor emotion-focused coping is inherently adaptive or maladaptive. The role of effective coping in mitigating mental health problems depends largely on the extent to which a deployed strategy meets the specific demands of the stressful encounter concerned. For instance, playing online games or browsing social network sites can be stress-relieving during leisure time (52, 53), but prolonged gameplay or social media use can impair work or academic performance while working or studying from home (54). These findings are in line with the theory of coping flexibility, highlighting the beneficial

role of flexible coping in soothing mental health problems experienced during the pandemic.

The present findings also have practical implications. Given the beneficial role of coping flexibility, clinicians may work with clients to enhance coping effectiveness with regard to strategy-situation fit. Stress management intervention may involve sharpening clients' skills for (a) distinguishing the key demands stemming from an array of stressful events; (b) assessing whether or not such demands are amendable to a change in effort (i.e., controllable or uncontrollable); (c) applying the meta-cognitive skill of reflection to evaluate strategies that best match the specific demands of diverse stressful situations; and (d) subsequently deploying the most appropriate strategy to handle each stressor. Such flexible coping skills are especially useful for dealing with the psychological distress elicited by a pandemic involving an assortment of stressful events.

Coping flexibility may also be valuable at a broader level because the unpredictable progression of the COVID-19 pandemic across successive waves presents varying challenges for public health authorities worldwide. For instance, the shortage of personal protection equipment aroused immense public anxiety in Hong Kong during the first wave owing to the sudden surge in demand for facemasks and hand sanitizer. After the supply of such equipment had been stabilized, however, new societal problems emerged. For example, during the second wave, public commitment to observing physical distancing measures began to wane owing to "pandemic fatigue" (55). Public health authorities may need to adopt a certain degree of flexibility in monitoring and identifying emerging issues to allow the timely adjustment of extant disease-control measures or the formulation of new ones to mitigate changing public health threats.

Despite its important findings, several study limitations must be noted. The survey was conducted during the second wave of the pandemic, when the epidemic curve climbed to a high level and then leveled off for a few months before reaching a further peak in the third wave in July and August, 2020 (34). As the COVID-19 pandemic continues to evolve in an unpredictable manner, some of the anxiety-provoking issues identified in this study may no longer elicit anxiety to the same extent in future waves. The list of issues eliciting COVID-19 anxiety should thus be updated in future research. Given the time sensitivity of these issues, pilot testing is essential to evaluate their relevance in particular phases of the pandemic.

Further, although our findings offer robust support for the hypothesized beneficial role of coping flexibility amid the pandemic, previous meta-analysis indicated that that beneficial role is more prominent in collectivist than individualist regions (19). A fruitful direction for future research would thus be to replicate the present design in individualist countries, allowing cross-cultural comparisons to be made. In addition to cultural differences, there may also be considerable variations among Chinese adults residing in different regions, as the epidemic trajectory has varied greatly among cities in the Greater Bay Area, such as Guangzhou and Macau (56). Greater effort can be made to compare the prevalence of psychological disorders and coping processes among Chinese residents of diverse regions.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the study protocol was reviewed and approved by the Human Research Ethics Committee of the University of Hong Kong (approval number: EA1912046 dated March 4, 2020). Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

CC contributed to project design and administration, coordinated the data collection, performed the statistical analysis, and wrote the first draft of the manuscript. H-yW contributed to project design, survey creation, statistical analysis, and data interpretation. OE contributed to data interpretation and writing parts of the manuscript. All authors contributed to the article and approved the submitted version.

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The Psychological Effect of COVID-19 on Home-Quarantined Nursing Students in China

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Coronavirus disease 2019 (COVID-19) has significantly caused socioeconomic impacts. However, little is known about the psychological effect of COVID-19 on home-quarantined nursing students. The present study aimed to identify the prevalence and major determinants of anxiety, depression and post-traumatic stress symptoms (PTSS) in Chinese nursing students during the COVID-19 pandemic quarantine period. An online survey was conducted on a sample of 6,348 home-quarantined nursing students. Mental health status was assessed by the Generalized Anxiety Disorder 7-Item Scale (GAD-7), the Patient Health Questionnaire 9-Item Scale (PHQ-9) and the Post Traumatic Stress Disorder Check List-Civilian version (PCL-C), respectively. Logistic regression analyses were performed to identify risk factors of anxiety, depression and PTSS. The overall prevalence of anxiety was 34.97%, and the rates of "mild," "moderate," and "severe" anxiety were 26.24, 7.04, and 1.69%, respectively. Depression was detected in 40.22% of the nursing students, and the prevalence of "mild," "moderate," "moderately severe," and "severe" depression was 27.87, 7.18, 4.08, and 1.09%, respectively. The overall prevalence of PTSS was 14.97%, with the prevalence of "mild" and "moderate-to-severe" PTSS reported at 7.04 and 7.93%, respectively. Male gender and insufficient social support were common risk factors for anxiety, depression and PTSS. In conclusion, about one-third, two-fifths, and one-seventh of Chinese nursing students had anxiety, depression and PTSS during the period of home quarantine, respectively. Timely and appropriate psychological interventions for nursing students should be implemented to reduce the psychological harm caused by COVID-19 pandemic.

Keywords: anxiety, depression, post-traumatic stress symptoms, COVID-19, nursing students, China

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is a respiratory infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which was first detected in early December 2019 in Wuhan, China (1). As a major public health emergency, China defines COVID-19 as a category B infectious disease, and adopts the prevention and control measures of category

A infectious disease. At present, China has achieved periodical results in the prevention and control of COVID-19, but the situation is still serious due to the increase of imported cases and asymptomatic cases.

As of April 18, 2020, novel coronavirus has affected more than 2 million individuals, and caused nearly 150,000 deaths worldwide. In addition to causing physical damage, COVID-19 also affects the mental health of the public. One study found that the rates of mental health symptoms among Chinese general population during the COVID-19 pandemic were 27.9% for depression and 31.6% for anxiety (2). A recent meta-analysis including 21 psychological studies showed that during this pandemic, mental health problems such as fear, anxiety and depression are common among the medical isolation population, patients with COVID-19 and front-line medical staff (3). However, researches on the psychological status of nursing students undergoing long-term home quarantine were limited. Nursing students are an important part to promote the sustainable development of the medical industry. Healthy psychology is crucial for them to complete their studies and be competent for clinical work. Individuals being in quarantine may experience psychological distress in the form of anxiety, confusion and stress symptoms (4). In addition, many previous studies showed that psychological problems of medical students may affect the choice of medical career and even lead to students' suicide (5–7). Currently, only several studies have reported nursing students' sleep quality and their stress levels before and during lockdown due to the COVID-19 pandemic (8–10).

In China, university students have left school since mid-January 2019 and been quarantined at home because of the COVID-19 pandemic. Until the end of this investigation, no students were allowed to return to school, and the government or colleges did not tell them when the new term began. To our knowledge, studies regarding psychological status and related risk factors among home-quarantined nursing students in China are still lacking. Therefore, the aim of the present study was to estimate the prevalence of anxiety, depression and post-traumatic stress symptoms (PTSS) and identify the associated factors in Chinese nursing students during the COVID-19 pandemic quarantine period. The findings would contribute to formulate effective interventions on psychological health, so as to improve the mental health level of nursing students.

METHODS

Ethics Statement
The study was approved by the Research Ethics Committee in Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China (IORG0003571).

Participants and Sampling
This cross-sectional survey was conducted from March 8, 2020, to March 24, 2020. We selected 18 colleges using a convenient sampling method, and recruited nursing students in each college to participate in this survey. The inclusion criteria for the participants were: (1) full-time nursing students, and (2) willingness to participate in this study. The exclusion criterion

was: (1) those with a history of past mental illness diagnoses. Data were collected through Questionnaire Star (https://www.wjx.cn) with an anonymous, self-rated questionnaire that was distributed to all selected colleges over the internet. All participants provided informed consent electronically prior to registration. The informed consent page presented two options (yes/no). Only participants who chose "yes" were taken to the questionnaire page. The online questionnaire was distributed to 6,500 nursing students. Finally, 6,348 students responded, with a response rate of 97.66%.

Measurement
Anxiety was measured using the Generalized Anxiety Disorder 7-Item Scale (GAD-7) (11). The scale consists of seven items asking the respondents how often, during the period of home isolation, they were bothered by each symptom. For example, "Feeling nervous, anxious, or on edge." The answer options were "not at all," "several days," "more than half the days," and "nearly every day" scored from 0 to 3 points. Possible range of scores is from 0 to 21, with the higher scores indicating the presence of more symptoms. The GAD score, based on the severity of anxiety symptoms, is categorized as "no anxiety" = 0–4, "mild anxiety" = 5–9, "moderate anxiety" = 10–14, and "severe anxiety" = 15–21 (11, 12). In this study, Cronbach's alpha for the scale was 0.93, indicating good internal consistency.

Depression was assessed using the Patient Health Questionnaire 9-Item Scale (PHQ-9) (13). The PHQ-9 contains nine items asking the respondents how often they were bothered by each symptom during the period of home isolation. For instance, "Little interest or pleasure in doing things." Response options included "not at all," "several days," "more than half the days," and "nearly every day" scored from 0 to 3 points. The maximum score of PHQ-9 is 27 points, and a minimum score is 0 points. The scores are classified as: 0–4 (no depression), 5–9 (mild depression), 10–14 (moderate depression), 15–19 (moderately severe depression), and 20–27 (severe depression) (13). In the present study, the PHQ-9 demonstrated high internal consistency (Cronbach's α = 0.93).

PTSS was measured using the Post Traumatic Stress Disorder Check List-Civilian Version (PCL-C) (14). The scale consists of 17 items asking the respondents how much they had been bothered by a symptom during the period of home isolation. For example, "Feeling jumpy or easily startled?" Each item is scored on a five-point Likert scale, ranging from "not at all" to "extremely" coded with values from 1 to 5. Total scores range from 17 to 85, with the higher scores indicating the presence of more symptoms. The score of PCL-C is categorized as "no PTSS" = 17–37, "mild PTSS" = 38–49 and "moderate to severe PTSS" = 50–85 (15). Cronbach's alpha for the PCL-C was 0.95 in this study.

To identify the factors which may be associated with nursing students' mental health, information on demographic characteristics (gender, grade, residence, self-perceived family economic status, exercise status during the COVID-19 pandemic, whether you are the only-child or not, whether participate in clinical practice in the past, whether your parents are medical personnel or not) and social support was collected.

Social support was measured using the Multidimensional Scale of Perceived Social Support (MSPSS) (16). The scale contains 12 items scored on a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree), measuring the extent to which each item was experienced. MSPSS has three dimensions as family, friend, and special person support which represent the support sources. Each dimension involves 4 items. The 3, 4, 8, and 11 items measure the family support, 6, 7, 9, and 12 items measure friend support, and 1, 2, 5, and 10 items measure a special person's support (17). The MSPSS score of 12–36 suggests "low-level social support," 37–60 suggests "medium-level social support," whereas 61–84 suggests "high-level social support" (18). Cronbach's alpha for the scale was 0.96 in this study.

Statistical Analysis

All analyses were performed using the Statistical Analysis System (SAS) 9.4 for Windows (SAS Institute Inc., Cary, NC, USA). Participants' sociodemographic characteristics and the levels of anxiety, depression and PTSS were described using frequency and percentage. Cutoff scores of 5 for the GAD-7 (2), 5 for the PHQ-9 (2), and 38 for the PCL-C were adopted to detect probable symptoms of anxiety, depression, and PTSS for all remaining analyses (19). The Chi-square test was conducted to compare the prevalence of anxiety, depression and PTSS across groups defined by demographic data and social support levels. Where significant differences were noted, Phi/Cramer's V was used to measure the magnitude of the differences. Three separate logistic regression models, where the dependent variables were anxiety, depression, and PTSS, were performed to identify the associated factors. All comparisons were two-tailed, and p-values < 0.05 were considered statistically significant.

RESULTS

Sociodemographic Characteristics of Respondents

Participant characteristics are presented in **Table 1**. The majority of the respondents (90.37%) were females, and 35.66% resided in urban areas. Most respondents were juniors (30.01%), followed by freshmen (27.80%), and sophomores (25.41%). A good self-perceived family economic status was reported by 6.68% of the participants, while 22.89% reported poor economic status. Approximately 40% of the nursing students exercised regularly during the COVID-19 pandemic. Less than half of the students (48.90%) had participate in clinical practice in the past.

Prevalence of Anxiety, Depression, and PTSS

The overall prevalence of anxiety was 34.97% (2,220/6,348), among which the prevalence of "mild," "moderate," and "severe" anxiety was 26.24, 7.04, and 1.69%, respectively. The overall prevalence of depression was 40.22% (2,553/6,348), and the prevalence of "mild," "moderate," "moderately severe," and "severe" depression was 27.87, 7.18, 4.08, and 1.09%, respectively. The overall prevalence of probable PTSS was 14.97% (950/6,348),

TABLE 1 | Sociodemographic characteristics of respondents.

Characteristic	N	%
Gender		
Male	611	9.63
Female	5,737	90.37
Grade		
Freshman	1,765	27.80
Sophomore	1,613	25.41
Junior	1,905	30.01
Senior	920	14.49
Intern	56	0.88
Postgraduate	89	1.40
Residence		
Urban	2,264	35.66
Rural	4,084	64.34
Self-perceived family economic status		
Good	424	6.68
Fair	4,471	70.43
Bad	1,453	22.89
Exercise status during the COVID-19 pandemic		
Exercise regularly	2,376	37.43
Lack of exercise	3,972	62.57
Whether you are the only-child or not		
Yes	1,579	24.87
No	4,769	75.13
Whether participate in clinical practice in the past		
Yes	3,104	48.90
No	3,244	51.10
Whether your parents are medical personnel or not		
Yes	193	3.04
No	6,155	96.96

with the prevalence of "mild" and "moderate-to-severe" PTSS reported at 7.04 and 7.93%, respectively (**Table 2**).

The prevalence of anxiety, depression and PTSS was significantly higher in males than in females. The rates of anxiety and depression in nursing students lacking of physical exercise were significantly higher than those in students who exercised regularly during the COVID-19 pandemic. Compared with nursing students without undergoing clinical practicum, those who had participated in clinical practice in the past had a higher rate of anxiety. Nursing students who reported high-level social support had lower prevalence of anxiety, depression and PTSS compared to those with middle-level and low-level social support. More information is showed in **Table 3**.

Influencing Factors of Anxiety, Depression, and PTSS

Table 4 presents the results of the multivariate logistic regression analysis, where the dependent variables were anxiety, depression and PTSS. Factors significantly associated with anxiety among nursing students included male gender (OR = 1.28, 95% CI: 1.08–1.53), bad family economic status (OR = 1.31, 95% CI:

Scale	Categories	N	%
GAD-7[a]			
	No anxiety	4,128	65.03
	Mild anxiety	1,666	26.24
	Moderate anxiety	447	7.04
	Severe anxiety	107	1.69
PHQ-9[b]			
	No depression	3,795	59.78
	Mild depression	1,769	27.87
	Moderate depression	456	7.18
	Moderately severe depression	259	4.08
	Severe depression	69	1.09
PCL-C[c]			
	No PTSS	5,398	85.03
	Mild PTSS	447	7.04
	Moderate to severe PTSS	503	7.93

[a]GAD-7, Generalized Anxiety Disorder 7-Item Scale.
[b]PHQ-9, Patient Health Questionnaire 9-Item Scale.
[c]PCL-C, Post Traumatic Stress Disorder Check List – Civilian version.

1.03–1.67) and insufficient social support (OR = 2.06, 95% CI: 1.42–3.00 for low-level and OR = 1.83, 95% CI: 1.64–2.03 for medium-level). Compared to freshman, sophomore (OR = 1.23, 95% CI: 1.06–1.42), junior (OR = 1.20, 95% CI: 1.02–1.41) and senior (OR = 1.28, 95% CI: 1.04–1.57) had higher odds for anxiety. Respondents lacking of physical exercise were more likely to show anxiety compared to those who exercised regularly during the COVID-19 pandemic, and the OR was 1.14 (95% CI: 1.02–1.27).

Factors significantly associated with depression among nursing students included male gender (OR = 1.32, 95% CI: 1.11–1.58), bad family economic status (OR = 1.66, 95% CI: 1.30–2.11), and insufficient social support (OR = 2.46, 95% CI: 1.69–3.58 for low-level and OR = 2.02, 95% CI: 1.81–2.24 for medium-level). Compared with students who exercised regularly during the COVID-19 pandemic, those lacking of physical exercise had higher odds for depression (OR = 1.42, 95% CI: 1.27–1.58).

Respondents who were male (OR = 2.26, 95% CI: 1.84–2.77), and those who reported insufficient social support (OR = 3.19, 95% CI: 2.08–4.90 for low-level and OR = 2.47, 95% CI: 2.13–2.86 for medium-level) showed a higher likelihood of having PTSS.

DISCUSSION

The outbreak of COVID-19 in China has a direct or indirect impact on all areas of society. In order to curb the outbreak and protect students from COVID-19, all schools have been closed till the epidemic is under control. Students facing long-term home quarantine and online learning are prone to a series of stress emotional response such as a higher level of anxiety and other negative emotions (20). Our study assessed the prevalence of anxiety, depression and PTSS among home-quarantined Chinese nursing students and explored the related risk factors. The results suggested that the pandemic of COVID-19 had a certain impact on the psychology of Chinese nursing students.

In the present study, the prevalence of anxiety and depression was about 35 and 40%, respectively. Rates of mental health problems among nursing students were reported ranging from 13.8 to 26% for anxiety (21–24) and 21.2 to 56.4% for depression (21–25). Compared with studies conducted in a normal period (21, 22, 24, 25), a much higher rate of anxiety was observed in our study. Chang et al. (20) found that during the COVID-19 pandemic, the prevalence of anxiety was 26.6%, 21.2% for depression among college students, and pointed that the rate of mental health problems was related to students' professional background. Usually, medical students are more concerned about the COVID-19 and its further consequences. At early stages of this pandemic, people have little information about nature, treatment, fatality rate, etc., which could aggravate their fear about the infectious disease (26). With the rapid spread of COVID-19, students receiving a large amount of negative information is in more risk of psychological maladjustment (20).

Nursing is historically a female-dominated profession. However, increasing numbers of male students have chosen nursing major in recent decades, narrowing the gender gap. Our study found that the prevalence of anxiety, depression and PTSS in male nursing students was significantly higher than that in female nursing students. A study conducted by Ji et al. (23) showed that there was no significant gender difference in anxiety and depression rates among college students during the COVID-19 pandemic. In the present study, male nursing students had higher odds for anxiety, depression and PTSS, while a study conducted in Italian general population found that female gender was associated with higher levels of depression, anxiety, and stress (27). The reason may be attributable to biopsychosocial factors such as traditional beliefs, social prejudice, and professional characteristics, which may cause male nursing students to face great social pressure and psychological pressure. After the COVID-19 pandemic, further studies with larger samples are needed to verify whether male nursing students are at increased risk for mental health problems.

Social support is an important environmental resource for individuals in social life, and is closely related with the individual's mental health (28). An earlier study indicated that social support was an important variable that have been shown to be negatively associated with anxiety and depression among nursing students (24). In this study, nursing students with low-level and medium-level social support accounted for ∼40%, and these students had higher risk for anxiety, depression and PTSS compared with students with high-level social support. Therefore, we should attach importance to the role of social support for maintaining students' mental health. On the one hand, parents should enhance communication with their children to give full play to the role of family psychological support. On the other hand, colleges should set up online mental health courses about the COVID-19 pandemic to improve the students' psychological adaptability.

TABLE 3 | Anxiety, depression, and PTSS among nursing students with different sociodemographic characteristics and social support levels.

Characteristic	Total N	Anxiety n (%)	P-value	Phi/Cramer's V	Depression n (%)	P-value	Phi/Cramer's V	PTSS[†] n (%)	P-value	Phi/Cramer's V
Gender										
Male	611	241 (39.44)	0.0148	0.03	280 (45.83)	0.0029	0.04	160 (26.19)	<0.0001	0.10
Female	5,737	1,979 (34.50)			2,273 (39.62)			790 (13.77)		
Grade										
Freshman	1,765	552 (31.27)[a]	0.0021	0.05	697 (39.49)	0.8173	–	252 (14.28)	0.7317	–
Sophomore	1,613	574 (35.59)*			635 (39.37)			234 (14.51)		
Junior	1,905	688 (36.12)[b]			780 (40.94)			302 (15.85)		
Senior	920	343 (37.28)[b]			378 (41.09)			137 (14.89)		
Intern	56	25 (44.64)*			24 (42.86)			9 (16.07)		
Postgraduate	89	38 (42.70)*			39 (43.82)			16 (17.98)		
Residence										
Urban	2,264	757 (33.44)	0.0562	–	901 (39.80)	0.6109	–	316 (13.96)	0.0924	–
Rural	4,084	1,463 (35.82)			1,652 (40.45)			634 (15.52)		
Self-perceived family economic status										
Good	424	128 (30.19)[a]	<0.0001	0.07	136 (32.08)[a]	<0.0001	0.09	60 (14.15)*	<0.0001	0.06
Fair	4,471	1,503 (33.62)[a]			1,720 (38.47)[b]			611 (13.67)[a]		
Bad	1,453	589 (40.54)[b]			697 (47.97)[c]			279 (19.20)[b]		
Exercise status during the COVID-19 pandemic										
Exercise regularly	2,376	760 (31.99)	0.0001	0.05	807 (33.96)	<0.0001	0.10	345 (14.52)	0.4419	–
Lack of exercise	3,972	1,460 (36.76)			1,746 (43.96)			605 (15.23)		
Whether you are the only-child or not										
Yes	1,579	526 (33.31)	0.1106	–	606 (38.38)	0.0856	–	219 (13.87)	0.1590	–
No	4,769	1,694 (35.52)			1,947 (40.83)			731 (15.33)		
Whether participate in clinical practice in the past										
Yes	3,104	1,146 (36.92)	0.0015	0.04	1,260 (40.59)	0.5507	–	475 (15.30)	0.4609	–
No	3,244	1,074 (33.11)			1,293 (39.86)			475 (14.64)		
Whether your parents are medical personnel or not										
Yes	193	58 (30.05)	0.1455	–	79 (40.93)	0.8369	–	26 (13.47)	0.5546	–
No	6,155	2,162 (35.13)			2,474 (40.19)			924 (15.01)		
Social support level										
Low	118	55 (46.61)[a]	<0.0001	0.15	67 (56.78)[a]	<0.0001	0.19	32 (27.12)[a]	<0.0001	0.17
Medium	2,608	1,125 (43.14)[a]			1,316 (50.46)[a]			561 (21.51)[a]		
High	3,622	1,040 (28.71)[b]			1,170 (32.30)[b]			357 (9.86)[b]		

[†]PTSS, post-traumatic stress symptoms.
*No significant differences in frequency/% compared to the rest categories after bonferonni correction.
[a,b,c]Different letters indicate significant differences in frequency/% after bonferonni correction; the same letter indicates no significant difference after bonferonni correction.

Family economic status was an important influencing factor of anxiety and depression in our study. Nursing students who reported poor financial status were more likely to experience anxiety and depression than those who reported good family economic status. The finding is in line with previous studies. Teris et al. (29) found that nursing students in financial difficulties were 2.3 times and 2.6 times more likely to experience anxiety and depression than those without. Andrews and Wilding (30) showed that financial vulnerability may exacerbate anxiety and depression among university students. Other researchers found that higher family income was inversely associated with a lower prevalence of depression (31–35). In order to control the spread of COVID-19 pandemic, many companies and factories have postponed their operation, which inevitably affected the

economic income of some families. Under such circumstances, it may be hard for students to maintain a healthy mentality.

In this study, sophomore, junior and senior were more likely to develop anxiety and depression than freshman. This may be related to the School of Nursing curriculum design. Freshmen are not required to undertake any clinical practicum. Exemption from the clinical practicum may relieve some anxiety, depression, and stress (29). Moreover, the academic pressure of high-grade students is greater, and some of them were facing graduation, employment, and clinical practice, etc., but the progress of various things is inevitably affected by the outbreak of COVID-19.

Compared with nursing students who exercised regularly during the pandemic of COVID-19, those lacking

Characteristic	Anxiety			Depression			PTSS[d]		
	OR[b]	95% CI[c]	P	OR	95% CI	P	OR	95% CI	P
Gender (Ref.[a] = Female)									
Male	1.28	1.08–1.53	0.0057	1.32	1.11–1.58	0.0015	2.26	1.84–2.77	<0.0001
Grade (Ref. = Freshman)									
Sophomore	1.23	1.06–1.42	0.0060	1.00	0.87–1.16	0.9793	1.12	0.92–1.36	0.2780
Junior	1.20	1.02–1.41	0.0291	1.07	0.92–1.25	0.3929	1.24	1.00–1.54	0.0539
Senior	1.28	1.04–1.57	0.0197	1.12	0.92–1.37	0.2697	1.21	0.91–1.60	0.1874
Intern	1.57	0.90–2.74	0.1099	1.04	0.59–1.82	0.8928	1.13	0.53–2.40	0.7577
Postgraduate	1.57	0.99–2.47	0.0533	1.21	0.77–1.91	0.4152	1.42	0.78–2.56	0.2510
Residence (Ref. = Rural)									
Urban	0.97	0.86–1.09	0.6149	1.08	0.96–1.21	0.1804	0.97	0.82–1.13	0.6694
Self-perceived family economic status (Ref. = Good)									
Fair	1.06	0.85–1.32	0.6059	1.20	0.96–1.50	0.1042	0.90	0.82–1.13	0.4639
Bad	1.31	1.03–1.67	0.0298	1.66	1.30–2.11	<0.0001	1.18	0.86–1.63	0.3032
Exercise status during the COVID-19 pandemic (Ref. = Exercise regularly)									
Lack of exercise	1.14	1.02–1.27	0.0249	1.42	1.27–1.58	<0.0001	0.97	0.84–1.13	0.6928
Whether you are the only-child or not (Ref. = No)									
Yes	0.95	0.84–1.09	0.4768	0.92	0.82–1.05	0.2212	0.89	0.75–1.06	0.1822
Whether participate in clinical practice in the past (Ref. = No)									
Yes	1.07	0.93–1.23	0.3491	0.94	0.82–1.08	0.4031	0.97	0.80–1.17	0.7239
Whether your parents are medical personnel or not (Ref. = No)									
Yes	0.83	0.60–1.14	0.2573	1.09	0.80–1.47	0.5773	0.91	0.59–1.41	0.6761
Social support level (Ref. =High)									
low	2.06	1.42–3.00	0.0001	2.46	1.69–3.58	<0.0001	3.19	2.08–4.90	<0.0001
Medium	1.83	1.64–2.03	<0.0001	2.02	1.81–2.24	<0.0001	2.47	2.13–2.86	<0.0001

[a]Ref, reference; [b]OR, odds ratio; [c]CI, confidence interval; [d]PTSS, post-traumatic stress symptoms.

of physical exercise had higher odds for anxiety and depression. Similarly, a study conducted by Feng et al. (36) showed that physical inactivity was independently associated with a higher risk of depression and poor sleep. This may suggest that regularly physical exercise is a protective factor for students' mental health. However, university students usually spend long hours studying online during the period of home quarantine, which means they exercise less.

Several limitations of our study should be mentioned. First, since this was a cross-sectional study, causal relations between the presence of anxiety, depression, and PTSS and variables cannot be determined. Second, self-rating scales were used to assess anxiety, depression, and PTSS, thus response bias may exist. However, a face-to-face in-depth interview was impossible to conduct due to the whole country under lockdown. Third, most of the nursing students are female (23), therefore, the research results may not be extended to students in other majors. Fourth, knowledge and behaviors regarding the COVID-19 pandemic are important factors that may affect individual mental health. A study involving 2,125 Italian undergraduate students showed an acceptable level of knowledge regarding this pandemic and the control measures adopted (37). Our study did not investigate the knowledge and behaviors about the COVID-19 pandemic. Further research was needed to explore the impact of these factors on psychology. Fifth, we consulted experts on the used scales, but a pilot-test among nursing students was not conducted to evaluate the face validity of these scales.

In conclusion, about one-third, two-fifths, and one-seventh of Chinese nursing students had anxiety, depression, and PTSS during the COVID-19 pandemic quarantine period, respectively. Nursing students who were male, who reported bad family economic status, who obtained insufficient social support, and those lacking of physical exercise were more prone to psychological problems. The COVID-19 pandemic is still ongoing, and many students remain isolated at home. Timely and appropriate psychological interventions for nursing students should be implemented to reduce the psychological harm caused by the pandemic.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

AUTHOR CONTRIBUTIONS

SC and JM conceived and designed the study. WF participated in the acquisition of data. DL and LZ analyzed data and drafted the manuscript. ZZ, PZ, and JZ revised the manuscript. SC, JM, and WF are the guarantors of this work and have full access to all the data in the study and take responsibility for its integrity and the accuracy of the data analysis. All authors read and approved the final manuscript.

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Factors Associated With Healthcare Workers' Insomnia Symptoms and Fatigue in the Fight Against COVID-19, and the Role of Organizational Support

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Background: Healthcare workers (HCWs) have been exposed to increased risks of insomnia and fatigue during the COVID-19 pandemic. In this study, we identify important risk factors associated with insomnia symptoms and fatigue among HCWs, and evaluate the effect of organizational support on insomnia and fatigue symptoms.

Methods: This is an online cross-sectional survey of HCWs in China administered during the COVID-19 epidemic (from February 27, 2020 to March 12, 2020). We employed the AIS-8 scale for insomnia screening, and a self-reported ten-point scale to evaluate subjects' degrees of fatigue. We also designed a four-point scale to assess the degree of social support provided on an organizational level. Additionally, we conducted logistic regression analysis to identify risk factors.

Results: This study included a total of 3,557 participants, 41% of which consisted of non-frontline HCWs and 59% of which was frontline HCWs. Of the non-frontline HCWs, 49% reported insomnia symptoms, and 53.8% reported a moderate to high degree of fatigue. Meanwhile, among the frontline HCWs, the percentages for insomnia and moderate to high fatigue were 63.4% and 72.2%, respectively. Additionally, frontline HCWs and HCWs employed at Centers for Disease Control and Prevention (CDCs) had elevated risks of insomnia and fatigue. However, with increased organizational support, insomnia symptoms decreased among frontline HCWs. Also, organizational support mitigated the positive correlation between daily working hours and degree of fatigue among HCWs.

Conclusion: Frontline HCWs and staff in Chinese CDCs have been at a high risk of insomnia symptoms and fatigue during the fight against COVID-19. This study provides evidence for the positive effects of organizational support in relation to insomnia and fatigue among HCWs. This sheds light on government responses to the COVID-19 epidemic for other countries.

Keywords: COVID-19, healthcare workers, insomnia, fatigue, organizational support

INTRODUCTION

The 2019 coronavirus (COVID-19) pandemic has been characterized by high transmissibility. As of April 3, 2020, it has caused 9.76 million infections and 50,414 deaths worldwide (1). To contain the epidemic within its borders, the Chinese government has declared the highest level of public health emergency alert, and has taken rapid and comprehensive action to limit its spread. This has included enacting strict quarantine measures, improving case identification, patient diagnosis, treatment, and psychological interventions, and improving the training of healthcare workers (HCWs), as well as strengthening logistical support and establishing units and hospitals for quarantined patients (2–5). Nationwide, these policies have resulted in millions of clinical staff, public health workers and other HCWs working consecutive days on the front lines during this period (6).

Front line HCWs have faced tremendous challenges during the COVID-19 epidemic. This has included an ever-increasing suspected and confirmed COVID-19 caseload, excessive workloads, isolation from friends and families, feelings of inadequate support, and discrimination (7). In such an unprecedented stressful situation, insomnia, feelings of fatigue, and even burn-out have been common. Insomnia has been the earliest and most prominent symptom reported by patients coping with stress (8), and fatigue has been the most common and persistent symptom caused by insomnia (9). These symptoms can result in daytime exhaustion, medical and psychiatric disorders, and lowered immune response among HCWs. Consequently, this elevates their risk of infection, and even death (10–12). Although only a few studies have reported data concerning insomnia and degree of fatigue among HCWs during the COVID-19 epidemic, these studies have identified several putative factors associated with both of these ailments.

For example, it has been documented that high levels of social support attenuate insomnia and fatigue symptoms associated with stress (13–15). In particular, previous studies have reported that organizational support improves job satisfaction for HCWs with high burnout levels (16). To help front line HCWs combat the challenges of this stressful situation, the Chinese government has launched a series of measures designed to support HCWs and their families. These measures have included providing protective equipment and training, improving subsidies, offering incentives, guaranteeing adequate daily necessities for HCWs and their families, shifting work schedules and providing psychological interventions (2). However, to date, no studies have examined the effect of organizational support on insomnia and fatigue among HCWs during the COVID-19 epidemic.

In addition, work-related factors and mental factors were also reported to be associated with insomnia and fatigue. For example, previous study shows that doctors whose inter-shift interval <10 h were more likely to be sleepless and fatigued (17). In Leblanc's study, psychological factors (include depression and anxiety) were found to the most important risk factors of new onset insomnia (18). Williamson et al. reported a negative association between fatigue and mental health measures (19). But the factors associated with insomnia and fatigue of HCWs in during the COVID-19 epidemic have not been well-understood.

In this study, we identify the factors associated with insomnia and fatigue among HCWs, and evaluate organizational support's effect on insomnia and fatigue in HCWs. To this end, we conducted an online cross-sectional survey during the COVID-19 epidemic. This report may be helpful for other countries dealing with the psychological problems and fatigue that HCWs face in the fight against COVID-19.

METHODS

Study Design and Participants

We conducted an online cross-sectional survey targeting HCWs in China during the early stages of the COVID-19 epidemic (February 27, 2020 to March 12, 2020).

Participants were eligible if they: (1) were engaged in work related to healthcare, including, but not limited to, clinical doctors, nurses, medical laboratory staff, public health practitioners, health management personnel and healthcare research staff; and (2) were able to provide written informed consent. Those who were unable to complete the survey were excluded from participation.

The questionnaire was designed and piloted among HCWs before the online survey was deployed. A brief questionnaire which can be finished within 10 min was finalized to improve the acceptance of the survey. We employed a popular electronic survey tool (*Wenjuanxing*, Changsha Ranxing Information Technology Co. Ltd, China) to generate a link to the online questionnaire. Participants were recruited through peer referral. The questionnaire link was disseminated via WeChat, a popular social media platform in which users register with a unique phone number. We performed online written informed consent before the survey to ask whether participants would like to participate. It included the aims, contents, risks and benefits of participating in this study. If they answered "yes," the survey would begin. Otherwise, the survey was terminated. Once a participant submitted the questionnaire, he or she would not be able to access it again.

Ethical Approval

This study has been approved by the ethical committee at Sun Yat-sen University [(2020) No. 011].

Measures

Insomnia and Fatigue (Dependent Variables)

We used the Athens Insomnia Scale-8 (AIS-8) to assess risk of insomnia. This instrument was developed in 1985 based on the International Classification of Diseases-10 criteria, and it has been used in many evaluations of insomnia severity (20–22). The scale contains eight items which were coded on a scale from 0 to 3 (0 = none, 1 = mild, 2 = significant, 3 = severe). A cut-off point of six was used to identify participants who had insomnia. Previous studies have demonstrated this scale's reliability and validity (23). Accordingly, the instrument in this study demonstrated good internal consistency (Cronbach's $\alpha = 0.89$).

Participants were asked to evaluate their degree of fatigue during the previous week. We used a brief continuous numerical scale ranging from 0 to 10 for evaluation (0 = no fatigue, 10 = burn out).

Independent Variables

Participants' demographic information was collected, including sex, age, educational attainment, marital status, occupation(s), job title(s) and employer. Participants were also asked to describe their role in the COVID-19 response effort (1 = front line healthcare worker, 2 = non-front line healthcare worker). Front line HCWs were defined as those directly engaged in work related to the detection, testing, diagnosis and treatment of COVID-19 patients.

Data were also collected regarding work-related factors, including daily working hours, shift length and hours of sleep *per day*.

Participants were asked the extent to which they perceived support from organizations (this included government offices, state-owned enterprises, and private companies) and individuals (including friends, colleagues and their families). We designed a four-point scale to measure perceived degree of social support. Each grade was coded on a scale from 0 to 3 (0 = not at all, 1 = low, 2 = moderate, 3 = high). Participants could answer "not applicable" where appropriate.

We used the Patient Health Questionnaire-9 (PHQ-9) to assess the presence of major depressive disorder. In total, this instrument includes nine items coded on a scale from 0 to 3 (0 = not at all, 1 = several days, 2 = more than half of the days, 3 = nearly every day). Total scores ranged from 0 to 27, and a higher score suggested the presence of more severe depressive disorder. A cutoff point of five has been previously validated as an appropriate threshold for depression screening (24). Anxiety was measured using the Generalized Anxiety Disorder scale-7 (GAD-7). This instrument is a seven-item scale coded from 0 (none) to 3 (nearly every day). It is based on DSM-IV criteria. Participants were identified as having anxiety if they scored higher than four points.

Statistical Analysis

The primary outcomes of this study were insomnia (AIS-8 score > 6) and moderate to high degree of fatigue (fatigue scale score ≥ 5). Descriptive data are presented according to the distribution of the variables. Logistic modeling was used to compare participants' contributions to COVID-19 response efforts to their risk of insomnia and fatigue. In step 1, the correlation between participants' roles and the outcomes was tested, controlling for demographic variables (Model 1). In step 2, work-related factors were added, and their potential correlations with the outcomes were considered (Model 2). In step 3, other psychological factors were incorporated into the model, since there were strong correlations between the psychological factors (Model 3). In step 4 (Model 4), social support variables were added to assess how they influenced outcomes. With regard to fatigue, insomnia was also added as an associated factor, since previous studies have documented its correlation with fatigue (9). Finally, interactions between organizational support

and participants' roles, work-related factors and mental health statuses were introduced to explore the modifying effects of social support. Modifying factors with a two-tailed *p*-values <0.05 were considered significant, and are presented. Odds ratios (OR) and 95% confidence intervals (CIs) are reported for all models. All analysis was conducted with SAS 9.4 (SAS Institute Inc., Cary, NC).

RESULTS

Characteristics

For this study, a total of 3,619 individuals were recruited to participate in the online survey. After excluding those who were not healthcare workers (62/3,619, 1.7%), a total of 3,557 participants were eligible for subsequent analysis.

Of all eligible participants, 59% (2,099/3,557) worked on the front lines of containment efforts related to the COVID-19 epidemic in China. Participants were predominantly female (2,460/3,557, 69.2%), had bachelor's degrees (1,973/3,557, 55.5%), and were married (2,520/3,557, 70.8%). The majority of the participants were either clinical doctors (1,342/3,557, 37.7%) or nurses (1,333/3,557, 37.5%). Public health practitioners accounted for 8% (285/3,557) of the participants. Consistent with this finding, 85% (3,026/3,557) of participants were working in hospitals, while 230 (6.5%) were working in centers for disease control and prevention (CDCs). Most of the participants reported working over 8 h per day (73.3%). Also, most participants had received a moderate to high degree of social support from organizations and individuals; median scores were 3.0 (2.0, 3.0) and 2.7 (2.0, 3.0), respectively (**Table 1**).

Insomnia and Fatigue

The majority (2,044/3,557, 58%) of the participants suffered from insomnia, based on the AIS-8 scale. Front line HCWs were more likely than non-front line HCWs to have insomnia symptoms (1,330/2,099, 63% and 714/1,458, 49%, respectively). Similarly, 72% (1,515/2,099) of front line HCWs reported a moderate to high (score ≥ 5) degree of fatigue. This suggests that this group is more likely to report severe fatigue than non-front line HCWs (785/1,458, 53.8%). Eight point Seven percentage percent of respondents reported feeling burned out or nearly burned out (score ≥ 9: 308/3,557) (**Table 1**).

Factors Associated With Insomnia

As presented in **Table 2**, front line HCWs (OR = 1.62, 95% CI = 1.40–1.87) had higher odds of reporting insomnia symptoms than non-front line HCWs. HCWs who were married (OR = 1.60, 95% CI = 1.31–1.97) or divorced/widowed (OR = 1.84, 95% CI = 1.16–2.91) were found to be at higher risk of insomnia than unmarried HCWs. HCWs who worked in CDC facilities (OR = 2.11, 95% CI = 1.42–3.13) were found to be at higher risk of insomnia than those employed in hospital settings. Younger HCWs (OR = 0.99, 95% CI = 0.97–1.00) also had lower risks of insomnia, as did those who had obtained PhDs (OR = 0.48,

TABLE 1 | Participants' socio-demographic factors, work-related factors, social support, mental health, insomnia and fatigue (N %).

	Non-front line (N = 1,458)	Front line (N = 2,099)	Total (N = 3,557)	P
Socio-demographic				
Sex				<0.001
Male	325 (22.3)	772 (36.8)	1,097 (30.8)	
Female	1,133 (77.7)	1,327 (63.2)	2,460 (69.2)	
Age				<0.001
Mean ± SD	34.5 ± 9.8	37.1 ± 9.1	36.0 ± 9.5	
Min, Max	18.0, 68.0	17.0, 70.0	17.0, 70.0	
Median (Q1, Q3)	33.0 (27.0, 41.0)	36.0 (30.0, 44.0)	35.0 (28.0, 43.0)	
Educational attainment				<0.001
High school or below	64 (4.4)	93 (4.4)	157 (4.4)	
Junior college degree	311 (21.3)	345 (16.4)	656 (18.4)	
Bachelor's degree	733 (50.3)	1240 (59.1)	1,973 (55.5)	
Master's degree	232 (15.9)	316 (15.1)	548 (15.4)	
PhD	118 (8.1)	105 (5.0)	223 (6.3)	
Marital status				<0.001
Single	461 (31.6)	470 (22.4)	931 (26.2)	
Married	962 (66.0)	1,558 (74.2)	2,520 (70.8)	
Divorced/widowed	35 (2.4)	71 (3.4)	106 (3.0)	
Job				<0.001
Clinical doctors	515 (35.3)	827 (39.4)	1342 (37.7)	
Medical lab staff	20 (1.4)	80 (3.8)	100 (2.8)	
Nurses	663 (45.5)	670 (31.9)	1333 (37.5)	
Public health physicians	26 (1.8)	259 (12.3)	285 (8.0)	
Others	234 (16.0)	263 (12.5)	497 (14.0)	
Job title				<0.001
Unemployed	257 (17.6)	145 (6.9)	402 (11.3)	
Entry	568 (39.0)	826 (39.4)	1,394 (39.2)	
Mid-level	389 (26.7)	690 (32.9)	1,079 (30.3)	
Senior	244 (16.7)	438 (20.9)	682 (19.2)	
Employer				<0.001
Hospital	1,348 (92.5)	1,678 (79.9)	3,026 (85.1)	
CDC	7 (0.5)	223 (10.6)	230 (6.5)	
Other	103 (7.1)	198 (9.4)	301 (8.5)	
Work-related				
Daily working hours (hours)				<0.001
4∼	174 (11.9)	139 (6.6)	313 (8.8)	
6∼	269 (18.4)	368 (17.6)	637 (17.9)	
8∼	784 (53.8)	905 (43.1)	1,689 (47.5)	
10∼	176 (12.1)	351 (16.7)	527 (14.8)	
12∼	55 (3.8)	336 (16.0)	391 (11.0)	
Continuous working hours per day (hours)				<0.001
<4	357 (24.5)	219 (10.4)	576 (16.2)	
4∼	551 (37.8)	780 (37.2)	1,331 (37.4)	
6∼	221 (15.2)	460 (21.9)	681 (19.1)	
8∼	329 (22.6)	640 (30.5)	969 (27.2)	
Hours of sleep per day				<0.001
<5	33 (2.3)	91 (4.3)	124 (3.5)	
5∼	110 (7.5)	240 (11.4)	350 (9.8)	
6∼	468 (32.1)	850 (40.5)	1,318 (37.1)	

(Continued)

	Non-front line (N = 1,458)	Front line (N = 2,099)	Total (N = 3,557)	P
7~	586 (40.2)	720 (34.3)	1,306 (36.7)	
8~	261 (17.9)	198 (9.4)	459 (12.9)	
Social support				
Organizational support				0.092
Mean ± SD	2.4 ± 0.9	2.5 ± 0.7	2.4 ± 0.8	
Median (Q1, Q3)	3.0 (2.0, 3.0)	3.0 (2.0, 3.0)	3.0 (2.0, 3.0)	
Personal support				0.010
Mean ± SD	2.3 ± 0.8	2.5 ± 0.7	2.4 ± 0.7	
Median (Q1, Q3)	2.7 (2.0, 3.0)	2.7 (2.0, 3.0)	2.7 (2.0, 3.0)	
Mental health				
Depressive status				
PHQ-9 score				<0.001
Median (Q1, Q3)	4.0 (1.0, 8.0)	4.0 (1.0, 8.0)	4.0 (1.0, 8.0)	
Depression				0.003
Depressed (PHQ-9 score≤4)	812 (55.7)	1,063 (50.6)	1,875 (52.7)	
Not depressed (PHQ-9 score>4)	646 (44.3)	1,036 (49.4)	1,682 (47.3)	
Anxiety				
GAD-7 score				<0.001
Median (Q1, Q3)	2.0 (0.0, 6.0)	3.0 (0.0, 6.0)	2.0 (0.0, 6.0)	
Anxiety				0.001
No anxiety (GAD-7 score ≤4)	1,001 (68.7)	1,332 (63.5)	2,333 (65.6)	
Anxiety (GAD-7 score >4)	457 (31.3)	767 (36.5)	1,224 (34.4)	
Insomnia				
AIS-8 score				<0.001
Mean ± SD	6.6 ± 4.9	8.3 ± 5.0	7.6 ± 5.0	
Median (Q1, Q3)	6.0 (3.0, 9.0)	8.0 (5.0, 12.0)	8.0 (4.0, 11.0)	
Insomnia				<0.001
No Insomnia (AIS-8 score ≤6)	744 (51.0)	769 (36.6)	1,513 (42.5)	
Insomnia (AIS-8 score >6)	714 (49.0)	1330 (63.4)	2,044 (57.5)	
Fatigue				
Self-rated score				<0.001
Mean ± SD	4.6 ± 2.7	5.8 ± 2.5	5.3 ± 2.6	
Median (Q1, Q3)	5.0 (2.0, 6.0)	6.0 (4.0, 8.0)	6.0 (4.0, 7.0)	
Degree of fatigue				<0.001
0	171 (11.7)	89 (4.2)	260 (7.3)	
1~	203 (13.9)	177 (8.4)	380 (10.7)	
3~	299 (20.5)	318 (15.2)	617 (17.3)	
5~	432 (29.6)	626 (29.8)	1,058 (29.7)	
7~	277 (19.0)	657 (31.3)	934 (26.3)	
9~	76 (5.2)	232 (11.1)	308 (8.7)	

SD, Standard deviation; Min, Minimum; Max, Maximum; Q1, Lower quartile; Q3, Upper quartile; CDC, Centers for Disease Control and Prevention; PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder Scale-7; AIS-8, Athens Insomnia Scale-8.

95% CI = 0.30–0.76) relative to those who had only completed middle-or high-school (**Table 2**, Model 1).

Work-related factors contributed an additional 13.8% of the observed variance in insomnia symptoms. HCWs who worked 10–12 h per day (OR = 1.78, 95% CI = 1.27–2.48) and those who worked 12 h or more per day (OR = 1.47, 95% CI = 1.01–2.14) were at higher risk of insomnia than those who worked 4–6 h per day. Those who worked longer shifts were also more likely

TABLE 2 | Logistic regression of factors correlated with insomnia among healthcare workers during the COVID-19 epidemic.

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)	Model 5 OR (95% CI)
R^2 (ΔR^2)	0.057	0.195 (0.138)	0.494 (0.298)	0.494 (<0.001)	0.495 (0.001)
Chi-square	153.81	404.57	1,070.69	1.24	4.06
P value	<0.001	<0.001	<0.001	0.269	0.066
Step 1: Socio-Demographic					
Sex					
Male	Ref.	Ref.	Ref.	Ref.	Ref.
Female	0.87 (0.73, 1.03)	0.91 (0.76, 1.09)	0.77 (0.62, 0.96)	0.77 (0.62, 0.96)	0.77 (0.62, 0.96)
Age	0.99 (0.97, 1.00)	0.98 (0.96, 0.99)	0.98 (0.96, 0.99)	0.98 (0.96, 0.99)	0.98 (0.96, 0.99)
Educational attainment					
High school or below	Ref.	Ref.	Ref.	Ref.	Ref.
Junior college degree	1.04 (0.72, 1.50)	1.03 (0.69, 1.53)	1.00 (0.63, 1.59)	1.01 (0.63, 1.62)	1.01 (0.63, 1.61)
Bachelor's degree	1.00 (0.70, 1.43)	1.06 (0.72, 1.55)	0.92 (0.58, 1.44)	0.93 (0.59, 1.46)	0.93 (0.59, 1.47)
Master's degree	0.82 (0.55, 1.22)	0.90 (0.59, 1.38)	0.67 (0.40, 1.11)	0.67 (0.40, 1.12)	0.68 (0.41, 1.14)
PhD	0.48 (0.30, 0.76)	0.60 (0.37, 0.98)	0.48 (0.27, 0.87)	0.48 (0.27, 0.87)	0.49 (0.27, 0.88)
Marital status					
Single	Ref.	Ref.	Ref.	Ref.	Ref.
Married	1.60 (1.31, 1.97)	1.66 (1.33, 2.06)	1.56 (1.20, 2.02)	1.56 (1.21, 2.02)	1.56 (1.20, 2.02)
Divorced/widowed	1.84 (1.16, 2.91)	1.85 (1.13, 3.02)	1.51 (0.83, 2.74)	1.51 (0.83, 2.75)	1.53 (0.84, 2.79)
Job					
Clinical doctors	Ref.	Ref.	Ref.	Ref.	Ref.
Medical lab staff	0.76 (0.49, 1.20)	0.93 (0.57, 1.50)	0.75 (0.42, 1.34)	0.75 (0.42, 1.34)	0.75 (0.42, 1.34)
Nurses	0.97 (0.79, 1.20)	1.01 (0.81, 1.26)	1.24 (0.95, 1.61)	1.24 (0.96, 1.61)	1.24 (0.95, 1.60)
Public health physicians	0.83 (0.59, 1.18)	0.74 (0.51, 1.07)	0.74 (0.47, 1.16)	0.74 (0.47, 1.17)	0.74 (0.47, 1.16)
Other	0.75 (0.60, 0.95)	0.81 (0.63, 1.03)	0.86 (0.65, 1.16)	0.87 (0.65, 1.16)	0.86 (0.65, 1.16)
Job titles					
Entry	Ref.	Ref.	Ref.	Ref.	Ref.
Mid-level	0.98 (0.76, 1.25)	1.05 (0.81, 1.37)	1.08 (0.79, 1.48)	1.07 (0.78, 1.47)	1.07 (0.78, 1.47)
Senior	1.08 (0.89, 1.31)	1.07 (0.87, 1.31)	1.04 (0.81, 1.34)	1.04 (0.81, 1.33)	1.04 (0.81, 1.33)
None	1.05 (0.80, 1.39)	1.09 (0.81, 1.46)	1.24 (0.87, 1.76)	1.23 (0.87, 1.75)	1.23 (0.86, 1.75)
Employer					
Hospital	Ref.	Ref.	Ref.	Ref.	Ref.
CDC	2.11 (1.42, 3.13)	1.54 (1.01, 2.36)	1.42 (0.86, 2.36)	1.43 (0.86, 2.36)	1.42 (0.86, 2.36)
Other	1.13 (0.86, 1.48)	1.15 (0.86, 1.54)	1.10 (0.78, 1.56)	1.09 (0.77, 1.55)	1.11 (0.78, 1.57)
Type of healthcare workers					
Non-front line	Ref.	Ref.	Ref.	Ref.	Ref.
Front line	1.62 (1.40, 1.87)	1.33 (1.14, 1.56)	1.60 (1.33, 1.94)	1.62 (1.34, 1.96)	1.89 (0.98, 3.63)
Step 2: Work-related					
Daily working hours					
4~	..	Ref.	Ref.	Ref.	Ref.
6~	..	0.82 (0.61, 1.11)	0.89 (0.62, 1.27)	0.90 (0.63, 1.29)	0.89 (0.62, 1.28)
8~	..	0.94 (0.72, 1.24)	0.91 (0.65, 1.26)	0.91 (0.66, 1.27)	0.90 (0.65, 1.25)
10~	..	1.78 (1.27, 2.48)	1.46 (0.98, 2.17)	1.46 (0.98, 2.18)	1.44 (0.96, 2.14)
12~	..	1.47 (1.01, 2.14)	1.21 (0.78, 1.90)	1.22 (0.78, 1.91)	1.19 (0.76, 1.86)
Continuous working hours (hours)					
<4	..	Ref.	Ref.	Ref.	Ref.
4~	..	1.29 (1.03, 1.61)	1.12 (0.85, 1.46)	1.12 (0.86, 1.46)	1.13 (0.86, 1.47)
6~	..	1.43 (1.11, 1.85)	1.29 (0.95, 1.76)	1.29 (0.95, 1.76)	1.31 (0.96, 1.77)
8~	..	1.68 (1.31, 2.16)	1.44 (1.07, 1.94)	1.44 (1.07, 1.94)	1.45 (1.07, 1.95)

(Continued)

TABLE 2 | Continued

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)	Model 5 OR (95% CI)
Daily hours of sleep					
8∼	..	Ref.	Ref.	Ref.	Ref.
<5	..	13.73 (7.38, 25.52)	6.81 (3.33, 13.93)	6.76 (3.30, 13.82)	6.72 (3.29, 13.73)
5∼	..	8.54 (6.01, 12.13)	6.95 (4.59, 10.51)	6.95 (4.59, 10.51)	7.04 (4.65, 10.66)
6∼	..	3.66 (2.88, 4.67)	3.37 (2.51, 4.51)	3.36 (2.51, 4.51)	3.38 (2.52, 4.53)
7∼	..	1.82 (1.44, 2.30)	1.89 (1.42, 2.51)	1.89 (1.42, 2.51)	1.89 (1.42, 2.51)
Step 3: Mental health					
Depression					
No depression	..	..	Ref.	Ref.	Ref.
Depression	..	..	8.02 (6.51, 9.88)	7.93 (6.44, 9.78)	7.90 (6.40, 9.74)
Anxiety					
No anxiety	..	..	Ref.	Ref.	Ref.
Anxiety	..	..	3.16 (2.47, 4.03)	3.13 (2.45, 4.00)	3.13 (2.45, 3.99)
Step 4: Social support					
Organizational support	..	..	..	0.96 (0.80, 1.15)	1.20 (0.90, 1.60)
Personal support	..	..	..	0.97 (0.80, 1.17)	0.79 (0.59, 1.07)
Step 5: Modification effects					
Organizational support × Type of healthcare workers					
Organizational support × non-front line	..	..	..	..	Ref.
Organizational support × front line	..	..	..	..	0.69 (0.47, 0.99)

OR, Odds Ratio; CI, Confidence of interval; Ref, Reference; CDC, Centers for Disease Control and Prevention.
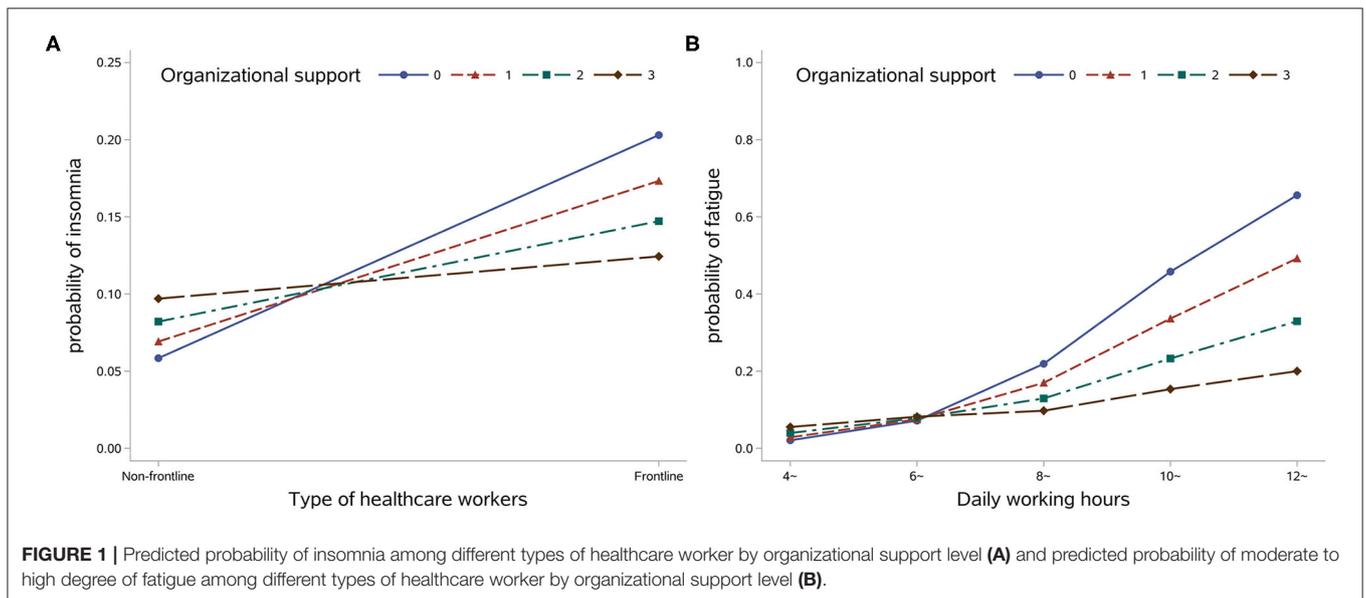
FIGURE 1 | Predicted probability of insomnia among different types of healthcare worker by organizational support level **(A)** and predicted probability of moderate to high degree of fatigue among different types of healthcare worker by organizational support level **(B)**.

to be at risk of insomnia (4∼ h vs. <4 h: OR = 1.29, 95% CI = 1.03–1.61; 6∼ h vs. <4 h: OR = 1.43, 95% CI = 1.11–1.85; 8∼ h vs. <4 h: OR = 1.68, 95% CI = 1.31–2.16). Additionally, lack of sleep was correlated with insomnia. HCWs who slept <5 h were 13.73 times more likely to report insomnia symptoms than those who slept over 8 h (OR = 13.73, 95% CI = 7.38–25.52) (**Table 2**, Model 2).

Psychological factors explained 29.8% of the variance in reported insomnia symptoms. HCWs who had depressive symptoms (OR = 8.02, 95% CI = 6.51–9.88) and those who had anxiety symptoms (OR = 3.16, 95% CI = 2.47–4.03) had higher risks of insomnia (**Table 2**, Model 3).

Social support only accounted for ∼0.1% of the variance in reported insomnia symptoms (**Table 2**, Model 4). However,

organizational support modified the correlation between a HCW's role and their risk of insomnia (OR = 0.69, 95% CI = 0.47–0.99) (**Table 2**, Model 5). With increasing organizational support, the risk of insomnia among front line HCWs declined, and the difference in insomnia risk between front line and non-front line HCWs decreased even more. Meanwhile, there was no significant influence of organizational support among non-front line HCWs (**Figure 1A**).

Factors Associated With Fatigue

The HCWs roles were also associated with fatigue in all models. Front line HCWs (OR = 1.83, 95% CI = 1.58–2.13) were at higher risk of reporting fatigue than non-front line HCWs. Additionally, HCWs who worked in CDCs were more likely to feel fatigued than those who worked in hospitals (OR = 3.59, 95% CI = 2.16–5.97) (**Table 3**, Model 1).

Work-related factors made the greatest contribution (17.3%) to reported degree of fatigue. Compared with those who worked 4–6 h per day, HCWs who worked more than 12 h per day had the highest odds of reporting fatigue (OR = 7.26, 95% CI = 4.64–11.36). Similarly, compared to those who worked <4 h per day, HCWs who worked 4 continuous hours or more per day were more likely to report a higher degree of fatigue. Compared with those who slept 8 h or more per day, HCWs who slept <8 h per day had higher odds of reporting fatigue (<5 vs. 8∼ h: OR = 7.80, 95% CI = 4.19–14.52; 5∼ vs. 8∼ h: OR = 5.32, 95% CI = 3.71–7.62; 6∼ vs. 8∼ h: OR = 3.05, 95% CI = 2.38–3.91; 7∼ vs. 8∼ h: OR = 1.88, 95% CI = 1.48–2.39) (**Table 3**, Model 2).

Psychological factors accounted for 4.3% of the variance in reported feelings of fatigue. Depressive symptoms (OR = 2.02, 95% CI = 1.65–2.46) and anxiety (OR = 1.52, 95% CI = 1.22–1.90) were considered risk factors for fatigue (**Table 3**, Model 3). Additionally, insomnia was associated with feelings of fatigue (OR = 2.45, 95% CI = 2.02–2.97), but only explained 2.5% of the total variance (**Table 3**, Model 4).

Similar to the results regarding insomnia, social support explained an additional 0.4% of the variance in reported feelings of fatigue (**Table 3**, Model 5). It also modified the correlation between daily working hours and feelings of fatigue (**Table 3**, Model 6). Organizational support mitigated the positive association between daily work hours and degree of fatigue (**Figure 1B**).

DISCUSSION

This study reported that 49 and 63.4% of non-front line and front line HCWs, respectively, experienced insomnia. Moreover, health practitioners employed in CDCs had higher risk of insomnia, and reported a higher degree of fatigue, than clinical doctors. Our results suggest that organizational support modifies the association between HCWs' role and insomnia. It also mitigates the positive correlation between working hours and reported feelings of fatigue.

The percentage of participants reporting symptoms of insomnia in our study exceeded those reported in other studies (34.0∼38.4%) (7, 25). This may partly be explained by the different scales [e.g., Insomnia Severity Index (ISI)] for assessing

insomnia severity. Several studies have suggested a higher sensitivity when diagnosing insomnia with the AIS-8 than with the ISI. Moreover, AIS-8 has shown superior diagnostic performance in detecting health outcomes associated with insomnia (26, 27). This study reports that during the COVID-19 epidemic, 53.8 and 72.2% of non-front line and front line HCWs, respectively, reported feeling moderate to high degrees of fatigue, and about 10% of participants reported being near exhaustion. These percentages were similar to those obtained in a previous study of self-reported fatigue among HCWs during the SARS outbreak (70.3%) (26). These high percentages for insomnia and feelings of fatigue should be noted as early alerts for additional psychological problems.

Health practitioners working in CDCs, who were critical to curbing the COVID-19 epidemic in China, were at an even higher risk of developing insomnia symptoms than were clinical doctors working in hospitals. During the crisis, HCWs in CDCs were tasked with administrative responsibilities and needed to undertake efforts to contain the disease. They were engaged in work related to disease surveillance, case finding, reporting, close contact tracing, investigation, laboratory testing, disinfecting high-risk public places, health education, training and policy-making (27). Heavy workload and exposure to extreme stress put them at high risk for insomnia and fatigue.

In this study, we found that psychological problems (depression and anxiety) accounted for the largest proportion (29.9%) of variance in reported insomnia symptoms, but only contributed slightly to variance in reported feelings of fatigue (4.4%). Current evidence suggests that the relationship between insomnia and depression can be bidirectional (28). Previous study reported that about 20% of patient with insomnia presented depressive symptoms (29, 30). Insomnia symptoms may have predictive value for subsequent development of depression (31). Other studies reported continued insomnia may become chronic despite successful resolution of depressive symptoms (32). Among those who firstly get insomnia and depression, 29% of patients' insomnia symptoms developed after depressive symptoms (33). Most researchers agreed that mutual effect exist between insomnia and depression (34, 35). Previous studies have reported that fatigue is the most common symptom of insomnia (9, 36). However, we found that insomnia only explained a small proportion (2.4%) of the variance in feelings of fatigue, with these feelings predominantly explained by work-related variables (17.5%). We highlight the need to identify insomnia symptoms in HCWs, and take measures to provide early intervention for psychological problems, considering that a large proportion of the variance in insomnia symptoms can be explained by depression and anxiety. Although the Chinese government has launched a series of measures related to psychological intervention, there remains a need for further studies to evaluate their effects.

A strong association was also shown between work-related factors and both insomnia and fatigue. We found that as daily working hours increased, the risk of insomnia spiked. Similar results have also been reported in other studies conducted during the COVID-19 epidemic. This evidence reveals a close

TABLE 3 | Logistic regression of factors correlated with fatigue among healthcare workers during the COVID-19 epidemic.

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)	Model 5 OR (95% CI)	Model 6 OR (95% CI)
R^2 (ΔR^2)	0.085	0.257 (0.173)	0.301 (0.043)	0.326 (0.025)	0.330 (0.004)	0.335 (0.005)
Chi-square	225.663	511.747	141.04	83.609	14.706	16.161
P-value	<0.001	<0.001	<0.001	<0.001	<0.001	0.014
Step 1: Socio-demographic						
Sex						
Male	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Female	0.77 (0.64, 0.92)	0.81 (0.67, 0.99)	0.78 (0.64, 0.96)	0.81 (0.66, 0.99)	0.81 (0.66, 1.00)	0.81 (0.66, 1.00)
Age	0.99 (0.98, 1.00)	0.99 (0.97, 1.00)	0.99 (0.97, 1.00)	0.99 (0.98, 1.01)	0.99 (0.98, 1.01)	0.99 (0.98, 1.01)
Educational attainment						
High school or below	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Junior college degree	1.22 (0.84, 1.76)	1.29 (0.86, 1.94)	1.29 (0.85, 1.96)	1.29 (0.85, 1.97)	1.32 (0.87, 2.02)	1.33 (0.87, 2.04)
Bachelor's degree	1.35 (0.94, 1.92)	1.65 (1.11, 2.45)	1.60 (1.07, 2.39)	1.63 (1.08, 2.45)	1.66 (1.10, 2.50)	1.65 (1.09, 2.49)
Master's degree	1.21 (0.81, 1.82)	1.67 (1.07, 2.62)	1.58 (1.00, 2.51)	1.69 (1.06, 2.70)	1.68 (1.05, 2.69)	1.69 (1.05, 2.70)
PhD	0.82 (0.52, 1.30)	1.40 (0.84, 2.33)	1.40 (0.83, 2.36)	1.56 (0.92, 2.65)	1.55 (0.91, 2.64)	1.52 (0.89, 2.59)
Marital status						
Single	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Married	1.23 (0.99, 1.52)	1.15 (0.92, 1.45)	1.07 (0.85, 1.35)	1.01 (0.79, 1.27)	1.01 (0.80, 1.28)	1.02 (0.80, 1.29)
Divorced/widowed	1.36 (0.84, 2.20)	1.28 (0.75, 2.17)	1.12 (0.65, 1.94)	1.08 (0.62, 1.87)	1.07 (0.61, 1.86)	1.09 (0.62, 1.90)
Job						
Clinical doctors	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Medical lab staff	0.80 (0.49, 1.31)	1.08 (0.63, 1.83)	1.02 (0.59, 1.76)	1.10 (0.63, 1.93)	1.09 (0.62, 1.91)	1.10 (0.63, 1.93)
Nurses	1.01 (0.82, 1.25)	1.19 (0.94, 1.50)	1.24 (0.98, 1.58)	1.21 (0.95, 1.54)	1.25 (0.98, 1.59)	1.24 (0.97, 1.58)
Public health practitioners	1.11 (0.76, 1.64)	1.07 (0.70, 1.63)	1.11 (0.72, 1.71)	1.16 (0.75, 1.79)	1.18 (0.76, 1.83)	1.16 (0.75, 1.80)
Other	0.90 (0.71, 1.14)	1.09 (0.84, 1.42)	1.15 (0.88, 1.50)	1.19 (0.91, 1.56)	1.20 (0.91, 1.57)	1.18 (0.90, 1.55)
Job titles						
Entry	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Mid-level	0.74 (0.58, 0.95)	0.82 (0.63, 1.08)	0.82 (0.62, 1.08)	0.79 (0.60, 1.05)	0.77 (0.58, 1.02)	0.78 (0.58, 1.04)
Senior	1.21 (0.99, 1.49)	1.27 (1.01, 1.58)	1.26 (1.01, 1.58)	1.27 (1.01, 1.60)	1.26 (1.00, 1.59)	1.25 (0.99, 1.57)
None	1.27 (0.95, 1.69)	1.46 (1.06, 1.99)	1.52 (1.10, 2.10)	1.50 (1.08, 2.09)	1.48 (1.06, 2.06)	1.47 (1.06, 2.05)
Employer						
Hospital	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
CDC	3.59 (2.16, 5.97)	2.26 (1.31, 3.90)	2.16 (1.24, 3.77)	2.09 (1.19, 3.68)	2.07 (1.18, 3.64)	2.11 (1.19, 3.73)
Other	1.00 (0.76, 1.32)	1.02 (0.74, 1.39)	0.98 (0.71, 1.36)	0.97 (0.70, 1.35)	0.94 (0.68, 1.32)	0.96 (0.69, 1.34)
Type of healthcare workers						
Non-front line	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Front line	1.83 (1.58, 2.13)	1.42 (1.20, 1.67)	1.47 (1.25, 1.74)	1.38 (1.16, 1.63)	1.43 (1.20, 1.69)	1.40 (1.18, 1.66)
Step 2: Work-related						
Daily working						
4~	..	Ref.	Ref.	Ref.	Ref.	Ref.
6~	..	1.58 (1.15, 2.15)	1.69 (1.23, 2.33)	1.74 (1.26, 2.41)	1.78 (1.29, 2.46)	1.83 (0.65, 5.14)
8~	..	2.35 (1.77, 3.12)	2.46 (1.84, 3.29)	2.56 (1.90, 3.44)	2.60 (1.93, 3.49)	6.22 (2.55, 15.17)
10~	..	5.26 (3.66, 7.55)	4.95 (3.42, 7.17)	4.89 (3.36, 7.12)	4.89 (3.36, 7.12)	5.00 (1.61, 15.55)
12~	..	7.26 (4.64, 11.36)	7.22 (4.57, 11.40)	7.36 (4.63, 11.70)	7.45 (4.68, 11.87)	14.38 (2.50, 82.57)
Continuous working hours						
<4	..	Ref.	Ref.	Ref.	Ref.	Ref.
4~	..	2.02 (1.61, 2.54)	1.94 (1.53, 2.44)	1.94 (1.53, 2.46)	1.97 (1.55, 2.49)	1.96 (1.54, 2.49)
6~	..	2.23 (1.71, 2.90)	2.16 (1.65, 2.83)	2.13 (1.62, 2.81)	2.13 (1.61, 2.80)	2.13 (1.61, 2.81)
8~	..	2.82 (2.17, 3.67)	2.64 (2.02, 3.46)	2.58 (1.96, 3.39)	2.58 (1.96, 3.39)	2.61 (1.98, 3.44)

(Continued)

TABLE 3 | Continued

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)	Model 5 OR (95% CI)	Model 6 OR (95% CI)
Hours of sleep per day						
8∼	..	Ref.	Ref.	Ref.	Ref.	Ref.
<5	..	7.80 (4.19, 14.52)	5.15 (2.72, 9.77)	4.23 (2.20, 8.12)	4.17 (2.17, 8.00)	4.17 (2.17, 8.04)
5∼	..	5.32 (3.71, 7.62)	4.04 (2.80, 5.85)	3.15 (2.16, 4.60)	3.15 (2.16, 4.60)	3.16 (2.16, 4.61)
6∼	..	3.05 (2.38, 3.91)	2.66 (2.06, 3.42)	2.25 (1.74, 2.92)	2.26 (1.74, 2.93)	2.25 (1.74, 2.92)
7∼	..	1.88 (1.48, 2.39)	1.82 (1.43, 2.32)	1.68 (1.31, 2.15)	1.69 (1.32, 2.16)	1.69 (1.32, 2.16)
Step 3: Mental health						
Depression						
No depression	..	..	Ref.	Ref.	Ref.	Ref.
Depression	..	..	2.02 (1.65, 2.46)	1.39 (1.11, 1.73)	1.35 (1.08, 1.68)	1.35 (1.08, 1.69)
Anxiety						
No Anxiety	..	..	Ref.	Ref.	Ref.	Ref.
Anxiety	..	..	1.52 (1.22, 1.90)	1.30 (1.03, 1.63)	1.27 (1.01, 1.59)	1.27 (1.01, 1.59)
Step 4: Insomnia						
Insomnia						
No Insomnia	..	..	..	Ref.	Ref.	Ref.
Insomnia	..	..	..	2.45 (2.02, 2.97)	2.44 (2.01, 2.96)	2.42 (2.00, 2.94)
Step 5: Social support						
Organizational support	..	..	..	..	0.81 (0.68, 0.96)	1.41 (0.78, 2.53)
Personal support	..	..	..	..	1.01 (0.84, 1.20)	0.69 (0.38, 1.25)
Step 6: Modification effects						
Organizational support × Daily working hours						
Organizational support × 4 h	..	..	..	..	..	Ref.
Organizational support × 6 h	..	..	..	..	..	0.74 (0.37, 1.50)
Organizational support × 8 h	..	..	..	..	..	0.52 (0.28, 0.97)
Organizational support × 10 h	..	..	..	..	..	0.43 (0.19, 0.93)
Organizational support × 12 h	..	..	..	..	..	0.36 (0.14, 0.92)

OR, Odds Ratio; CI, Confidence of interval; Ref, Reference; CDC, Centers for Disease Control and Prevention.

relationship between work overload and insomnia; overload's effect on sleep disturbance can be considerable, especially in working populations (37). Daily working hours was also found to be positively correlated with fatigue, which is consistent with a previous study (38). Moreover, in addition to daily working hours, longer continuous working hours also contributed to insomnia symptoms and feelings of fatigue. During the early stages of the COVID-19 epidemic, HCWs often worked longer each day. Under these circumstances, breaks were crucial to alleviating fatigue (39). In line with previous research, insomnia symptoms and feelings of fatigue were found to be inversely correlated with sleep duration (40). Of note, the odds of insomnia and fatigue spiked when sleeping hours decreased, especially for HCWs who reported sleeping <5 h per day.

At the outset of the COVID-19 epidemic, scarcities of both HCWs and resources made it difficult to divide work shifts between HCWs and to ensure adequate rest. During this stressful situation, organizational support attenuated the positive correlation between working hours and fatigue. This implies that political commitment from the government and

broad community participation promote anti-epidemic work (41). The Chinese government has taken several key measures to combat the COVID-19 epidemic, along with implementing additional supporting measures (42). Adequate training, as well as logistical support for HCWs, has been shown to reduce their fears of infection (2, 43). Psychological interventions may also mitigate mental health problems (44). Services provided to HCWs' families could reduce their worries about their families. With a growing number of HCWs participating in the fight against COVID-19, HCWs have gained peer support and had their workloads reduced. All of these measures could mitigate the fatigue symptoms caused by both workload and psychological problems. Organizational support could also attenuate insomnia symptoms. Of note, front line HCWs who faced more stressors were more likely to have insomnia symptoms, and they also received more organizational support. The results of this study suggest that organizational support mitigates insomnia symptoms among front line HCWs.

This study has several limitations. Firstly, participants were not selected as a representative sample of HCWs in

China. Secondly, HCWs who were under extreme stress or an extreme workload were less likely to participate in the survey, potentially leading to an underestimation of insomnia and fatigue. Thirdly, questionnaires were shortened to increase the completion rate, meaning that several potential associated factors were not included in this study.

CONCLUSION

Front line HCWs in the fight against COVID-19 have reported both insomnia symptoms and feelings of fatigue. Organizational support is negatively correlated with the risk of insomnia symptoms, and mitigates the positive correlation between working hours and degree of fatigue in front line HCWs.

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/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the ethical committee of Sun Yat-sen University [(2020) No. 011]. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LL, WC, and XZ designed the study. LL, WC, JY, SL, YY, and FZ collected the data, and SL conducted data analysis. XZ drafted the paper. LL, XZ, SL, JL, YY, and FZ contributed to paper revisions. All authors contributed to the article and approved the submitted version.

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The Psychological Status of General Population in Hubei Province During the COVID-19 Outbreak: A Cross-Sectional Survey Study

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Introduction: The current outbreak of the novel coronavirus disease 2019 (COVID-19), originating from Wuhan (Hubei, China), has rapidly spread across China and several other countries. During the outbreak of COVID-19, mental health of the general population in Hubei province may be affected. This study aimed to assess the psychological status and associated risk factors of the general population in Hubei province during the COVID-19 outbreak.

Methods: A cross-sectional online survey was used to evaluate the symptoms of posttraumatic stress disorder (PTSD), depression, and anxiety, which were assessed by the Chinese version of the Impact of Event Scale—Revised, the Patient Health Questionnaire 9, and the seven-item Generalized Anxiety Disorder Scale, respectively. Coping style was assessed by the Simplified Coping Style Questionnaire. Multivariate logistic regression analysis was carried out to detect factors associated with mental health outcomes.

Results: Among 9,225 participants, 44.5% rated symptoms of PTSD, and 17.9 and 12.7% suffered from moderate and severe symptoms of depression and anxiety, respectively. Individuals who were geographically located in Wuhan and familiar with someone who has COVID-19 had more severe symptoms of PTSD, depression, and anxiety, as well as a higher score in passive coping style ($P < 0.05$). Multivariate logistic regression analysis showed that people who were geographically located in Wuhan [odds ratio (OR) = 1.25, 95% confidence interval (CI) = 1.14–1.36, $P < 0.001$] were associated with severe symptoms of PTSD. Besides, individuals who were familiar with someone who had COVID-19 (OR = 2.33, 95% CI = 2.07–2.63, $P < 0.001$; OR = 1.90, 95% CI = 1.66–2.17, $P < 0.001$; OR = 2.06, 95% CI = 1.78–2.39, $P < 0.001$) and had a higher score in passive coping style (OR = 1.16, 95% CI = 1.14–1.17, $P < 0.001$; OR = 1.17, 95% CI = 1.15–1.19, $P < 0.001$; OR = 1.17, 95% CI = 1.15–1.19, $P < 0.001$) were associated with severe symptoms of PTSD, depression, and anxiety. Moreover, a higher score in active coping style (OR = 0.96, 95% CI = 0.95–0.97, $P < 0.001$; OR = 0.94,

95% CI = 0.93–0.94, $P < 0.001$; OR = 0.95, 95% CI = 0.94–0.96, $P < 0.001$) was associated with a lower risk of symptoms of PTSD, depression, and anxiety.

Conclusions: During the midphase of COVID-19 outbreak, quite a few people have mental health problems; nearly half of the respondents rated symptoms of PTSD, and approximately one-fifth reported moderate to severe symptoms of anxiety and depression. Our findings may lead to better comprehend the psychological status of the general public and alleviate the public mental health crisis during the COVID-19 outbreak.

Keywords: coronavirus, epidemic, psychological status, mental health, PTSD

INTRODUCTION

The current outbreak of the novel coronavirus disease 2019 (COVID-19), originating from Wuhan (Hubei, China), has rapidly spread across China and several other countries. On March 11, 2020, the World Health Organization announced the COVID-2019 outbreak as a pandemic. To date, the number of deaths associated with COVID-19 significantly exceeds those of the other two coronaviruses [severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV)], and the outbreak is still ongoing, posing a significant threat to global public health and economy (1).

Infectious outbreak naturally causes profound fear and panic in the society. As a result of rapidly increasing numbers of confirmed COVID-19 cases, patients, hospital staff, and the public have experienced psychological problems, such as anxiety, depression, and stress (2, 3). During the SARS outbreak, several scholars psychologically investigated patients, hospital staff, and noninfected community and reported significant rates of psychiatric and posttraumatic morbidities (2, 3). The MindSpot Clinic (Sydney, Australia) demonstrated a significantly increased number of cases with severe anxiety and depression symptoms during the COVID-19 pandemic (4). A US county-level census pointed out that approximately 33% of rural counties are highly susceptible to COVID-19 (5). A survey carried out in India found that since COVID-19 was declared as a pandemic and led to a nationwide blockade, the majority of Indians have experienced mental health disorders (6). In a cross-sectional study of 15,704 German residents, 44.9% reported mild symptoms of generalized anxiety; 14.3% reported symptoms of major depression, and 65.2% reported symptoms of psychological distress (7). From March 27 to April 6, there were 6,509 people in Germany with more than 50% suffering from symptoms of anxiety and depression (8). In addition, the Central People's Government of the People's Republic of China has adopted extreme measures to mitigate the negative consequences of COVID-19 outbreak. On January 23, 2020, the local government of Wuhan announced suspension of public transportation, with closure of airports, railway stations, and highways, in order to avoid disease transmission. Other cities in Hubei province declared similar traffic control measures following Wuhan immediately. On April 8, 2020, China proclaimed to lift the lockdown of Wuhan. Although the Wuhan government has succeeded in bringing the epidemic under control, its widespread has so far had inevitable

psychological consequences (9). During the outbreak, mental healthcare of the public who was affected by the 2019-nCoV epidemic in Hubei province has been under addressed, although the National Health Commission of the People's Republic of China released a notification for Emergency Psychological Crisis Intervention for COVID-19 epidemic on January 26, 2020 (10).

To the best of our knowledge, numerous scholars concentrated on the psychological responses to infectious diseases outbreaks, which were conducted on the groups in hospitals, including patients with SARS/MERS (11, 12), medical staff working to combat the illness (e.g., SARS and COVID-19) (13–15), and survivors of SARS epidemic (16). A previous study reported that 104 residents of Wuhan (under mandatory quarantine) had more severe symptoms of posttraumatic stress disorder (PTSD) than 330 residents of Shanghai (without mandatory quarantine) during the COVID-19 outbreak, although the sample size was relatively small (17). Another study investigated the prevalence of psychosocial problems among the general population under the COVID-19 epidemic and found that Hubei province (eight people) had more severe insomnia and stress symptoms than those who lived in areas outside Hubei province (18). Therefore, further data related to psychological status of noninfected general public in Hubei province are required to understand the full psychosocial dimensions of such infectious diseases. Several previous studies have focused on health condition and mortality rate of patients with COVID-19 infection or suspicion, and all have found psychological health problems (19–22). Ran et al. (23) revealed that the prevalence rates of depression, anxiety, and somatization symptoms were 47.1, 31.0, and 45.9%, respectively, among 1770 Chinese citizens during the peak prevalence of COVID-19, but confirmed or suspected cases of COVID-19 were not excluded. The psychological status of general noninfected people in Hubei province has not attracted the attention of researchers. This study is the first large-scale survey concentrated on psychological status (symptoms of PTSD, depression, and anxiety) and coping style of general noninfected population after 1 month of COVID-19 outbreak in Hubei province. We hypothesized that passive coping style and COVID-19–related exposure risks were associated with worse mental health outcomes, and quite a few people have mental health problems such as symptoms of moderate to severe PTSD, depression, and anxiety. This may be significant for government authorities and healthcare professionals to protect mental health of people who are affected by the COVID-19 outbreak worldwide.

METHODS

Setting and Participants

We used a cross-sectional survey design and anonymous online questionnaires composed of 75 single choices and short-answer questions to evaluate the psychological status of people living in Hubei province during COVID-19 outbreak, from February 28 to March 21. A total of 11,053 questionnaires from the general population of Hubei province were collected. The questionnaires included detailed demographic, COVID-19–related exposure risks, and psychometric scales. A snowball sampling strategy, concentrated on recruiting noninfected people living in Hubei province, was utilized. The online survey was first disseminated to university students, and they were encouraged to share it with others through WeChat public platform and the mainstream media. Every respondent had his/her own IP address, and at the end of the questionnaire, we would check carefully the IP address and delete the questionnaire with the same IP address. This study was approved by the ethics committee of First Affiliated Hospital of Jinan University (Guangzhou, China, approval letter: KY-2020-044) and obtained the informed written consent from all participants. The survey was anonymous, and confidentiality of information was ensured. The minimum sample size required was obtained by using PASS software (http://www.ncss.com/software/pass/procedures/). The prevalence of psychiatric morbidity was 11.7% in Taiwan based on a previous study focused on the SARS outbreak (24). The estimated acceptable margin of error was 0.1. Thus, the width of two-sided confidence interval (CI) was 0.02, and confidence level was 1 – α = 0.95. The study assumed that the effective and qualified of questionnaire were both 90%. Finally, the minimum target sample size was 4,709.

Survey Instrument

Demographic data were self-reported by participants, including age, sex, level of education, marital status, occupation, and residential location. COVID-19–related exposure risks included whether a participant knew anyone who was suspected or confirmed to have COVID-19 and whether a participant had adequate knowledge about COVID-19 (don't know, know well, very familiar). Here, the Chinese version of the Impact of Event Scale—Revised (IES-R; range, 0–88), the Patient Health Questionnaire 9 (PHQ-9; range, 0-27), the seven-item Generalized Anxiety Disorder Scale (GAD-7; range, 0-21), and the Simplified Coping Style Questionnaire (SCSQ) were used to assess symptoms of PTSD, depression, anxiety, and coping style, respectively (25). IES-R is a 22-item self-report measure intended to investigate subjective PTSD caused by traumatic life events. The standard cutoff score for screening to identify possible PTSD symptoms is 20 (26, 27). PHQ-9 is a 9-question instrument given to patients in a primary care setting to screen for the presence and severity of depression (28, 29). Item 9 of the PHQ-9 is often used to screen depressed patients for suicide risk by evaluating passive thoughts of death or self-injury within the last 2 weeks. GAD-7 is a self-assessment test, which is utilized to assess generalized anxiety disorder. It consists of seven items with high relevance and adopts a 4-point Likert scoring system from 0 to 3 points.

The standard cutoff value for moderate and severe anxiety is 10 or greater (30). Additionally, the total scores in PHQ-9 and GAD-7 were interpreted as follows: PHQ-9, normal (0–4), mild (5–9), moderate (10–14), and severe (15–27); GAD-7, normal (0–4), mild (5–9), moderate (10–14), and severe (15–21). SCSQ is a 20-item measure in Chinese culture, which was developed in 1998 based on the Ways of Coping Questionnaire. SCSQ was designed to assess attitudes and actions that individuals would take in the face of life events. Items were classified in two subscales (positive coping style and negative coping style) and rated on a 4-point Likert scale (e.g., 0 = "not take" to 3 = "usually take"). Higher scores indicated greater use of coping strategies. The Chinese version of the IES-R (31), PHQ-9 (32), GAD-7 (33), and SCSQ-20 (34) has been already used in numerous studies in China with satisfactory reliability and validity.

Statistical Analysis

Data were statistically analyzed by using SPSS 19.0 software (SPSS, Chicago, IL, USA). The significant level was at the rate of α = 0.05, and all tests were two-tailed. The original scores in the IES-R, PHQ-9, GAD-7, and SCSQ-20 were measured for normal distributions by Kolmogorov–Smirnov test ($p <$ 0.05) and were not normally distributed and were therefore presented as median with interquartile ranges (IQRs) (15, 35). The demographic characteristics of respondents, each level of symptoms of PTSD, depression, and anxiety were all presented as numbers and percentages. The nonparametric Mann–Whitney U test (15, 36) was used between two groups according to geographic location and being familiar with someone who has COVID-19. We hypothesized that respondents who were in Wuhan and familiar with someone who has COVID-19 had more severe symptoms of PTSD, depression, anxiety, and passive coping. The nonparametric Kruskal–Wallis test (15) was applied to compare the symptoms of PTSD, depression, anxiety, active coping, and passive coping between three groups according to knowledge of the epidemic. Sex, age, education level, marital status, and occupation were included as potential confounding variables. In addition, we assumed that being geographically located in Wuhan, being familiar with someone who has COVID-19, and higher level of passive coping style were risk factors for PTSD, depression, and anxiety. To identify potential risk factors for symptoms of PTSD, depression, and anxiety in noninfected respondents, multivariate logistic regression analysis was undertaken, and odds ratios (ORs) and 95% CIs were obtained from logistic regression models. After adjustment for confounding, variables were chosen based on scientifically established associations and our clinical experience, including age, sex, level of education, marital status, occupation, geographical location, knowledge of epidemic, being familiar with someone who has COVID-19, and coping style.

RESULTS

Demographic Characteristics
Patients' Demographic Characteristics

In the present study, in all 11,053 questionnaires, 396 questionnaires not filled out completely and correctly were

TABLE 1 | Demographic characteristics of respondents.

Characteristic	No. (%) (n = 9,225)
Gender	
Male	4,674 (50.7)
Female	4,551 (49.3)
Age (years)	
<18	367 (4.0)
18–25	2,071 (22.4)
26–35	3,916 (42.4)
36–45	1,772 (19.2)
46–60	867 (9.4)
>60	232 (2.5)
Marital status	
Single or divorced or widowed	3,177 (34.4)
Married	6,048 (66.6)
Education	
Senior high school or below	4,115 (44.6)
Bachelor's degree or above	5,110 (55.4)
Geographic location	
Wuhan	4,570 (49.5)
Ezhou	1,263 (13.7)
Xiangyang	997 (10.8)
Other cities in Hubei	2,395 (26.0)
Occupation	
Medical staff	297 (3.2)
Students	1,112 (12.0)
Self-employed	2,803 (30.4)
Farmers	527 (5.7)
Employed	2,400 (26.0)
Unemployed	989 (10.7)
Others	1,097 (11.9)
Knowledge of the epidemic	
Don't know much	329 (3.6)
Know well	4,571 (49.5)
Very familiar with	4,325 (46.9)
Familiar with someone to have COVID-19	
Yes	1,655 (17.9)
No	7,570 (82.1)
Relationship with infected patients	
Man and wife	30 (1.8)
Parents	31 (1.9)
Offspring	8 (0.5)
Brothers and sisters	61 (3.7)
Friends	1,234 (74.5)
Others	291 (17.6)

excluded, leading to inclusion of 10,657 valid questionnaires with no missing data. Among them, 1,432 questionnaires from individuals with confirmed or suspected COVID-19 were excluded. Finally, 9,225 noninfected cases were enrolled in the statistical analysis. Study subjects' demographic characteristics are shown in **Table 1**. Among all the participants, the majority of respondents were men (50.7%), aged 26 to 35 years (42.4%),

married (66.6%), with high level of education (55.4% with bachelor's degree or greater), geographically located in Wuhan (49.5%), self-employed (30.4%), knew well of the epidemic (49.5%), and were unfamiliar with someone who has COVID-19 (82.1%) (**Table 1**).

Psychological Status and Coping Style

Of all respondents, 4,105 (44.5%) rated symptoms of PTSD, and 1,652 (17.9%) suffered from moderate or severe symptoms of depression. According to item 9 of the PHQ-9 scale, 780 (8.5%) respondents were considered to have risks of suicide and self-injury. Besides, 1,172 (12.7%) cases suffered from moderate or severe symptoms of anxiety. In contrast to the influence of COVID-19 outbreak, all respondents' coping style assessed by using SCSQ-20 scale revealed median scores of 22.0 (IQR = 16.0–28.0) of active coping style and 10.0 (IQR = 7.0–14.0) of passive coping style. Moreover, individuals who were geographically located in Wuhan had higher scores in IES-R, PHQ-9, GAD-7, active coping, and passive coping compared with those whose geographical locations were in other cities in Hubei province. People who were familiar with someone who has COVID-19 had higher scores in IES-R, PHQ-9, GAD-7, and passive coping. Persons who were very familiar with the COVID-19 epidemic had lower scores in IES-R, PHQ-9, and GAD-7, whereas they had higher scores in active coping and passive coping (**Table 2**). Men respondents had higher scores in IES-R ($P = 0.001$, $\chi^2 = 3.421$), PHQ-9 ($P = 0.001$, $\chi^2 = 3.263$), and passive coping ($P = 0.009$, $\chi^2 = 2.626$) than female ones. Respondents had significantly different scores in IES-R ($P < 0.001$, $z = 333.062$), PHQ-9 ($P < 0.001$, $z = 102.991$), GAD-7 ($P < 0.001$, $z = 175.937$), and passive coping ($P < 0.001$, $z = 236.625$) in different occupations. Respondents who had other occupations had lower scores in IES-R, PHQ-9, GAD-7, and passive coping compared with medical staff, students, self-employed, farmers, employed, and unemployed. Respondents had significantly different scores in IES-R ($P < 0.001$, $z = 87.867$), PHQ-9 ($P < 0.001$, $z = 123.395$), GAD-7 ($P < 0.001$, $z = 104.477$), and passive coping ($P < 0.001$, $z = 74.782$). Respondents aged 46 to 60 years and older than 60 years had lower scores in IES-R, PHQ-9, GAD-7, and passive coping compared with other age ranges. Individuals who were married had higher scores in IES-R ($P < 0.001$, $z = 4.342$), active coping ($P < 0.001$, $z = 4.340$), and passive coping ($P < 0.001$, $z = 4.340$), whereas they had lower scores in PHQ-9 ($P < 0.001$, $z = -4.873$). Respondents with high level of education had higher scores in active coping ($P < 0.001$, $z = 7.825$) and passive coping ($P < 0.001$, $z = 4.079$). The aforementioned differences were statistically significant ($P < 0.05$) (**Supplementary Table 1**). In addition, respondents' demographic characteristics who were residents of Wuhan are summarized in **Supplementary Table 2**, and prevalences of symptoms of PTSD, depression, anxiety, and coping style, particularly for respondents who were residents of Wuhan, are shown in **Supplementary Table 3**. Among all the respondents who were residents of Wuhan, 4,570 (49.5%) and 2,202 (48.2%) rated symptoms of PTSD. Additionally, 880 (19.3%) rated moderate or severe symptoms of depression, and 636 (13.9%) rated moderate or severe symptoms of anxiety.

TABLE 2 | Prevalence of PTSD symptoms, depressive symptoms, anxiety symptoms, and coping style according to respondents.

Characteristic	No. (%) (n = 9,225)	Total score, median (IQR)
Prevalence		
IES-R, PTSD symptoms		16.0 (4.0–32.0)
<20	5,120 (55.5)	
≥20	4,105 (44.5)	
PHQ-9, depressive symptoms		3.0 (0.0–8.0)
<10	7,573 (82.1)	
≥10	1,652 (17.9)	
PHQ-9, depressive symptoms		
0–4 (Normal)	5,300 (57.5)	
5–9 (Mild)	2,273 (24.6)	
10–14 (Moderate)	1,078 (11.7)	
15–27 (Severe)	574 (6.2)	
GAD-7, anxiety symptoms		3.0 (0.0–7.0)
<10	8,053 (87.3)	
≥10	1,172 (12.7)	
GAD-7, anxiety symptoms		
0–4 (Normal)	5,723 (62.0)	
5–9 (Mild)	2,330 (25.3)	
10–14 (Moderate)	951 (10.3)	
15–21 (Severe)	221 (2.4)	
SCSQ-20, coping styles		
Active coping		22.0 (16.0–28.0)
Passive coping		10.0 (7.0–14.0)

Geographic location	Median (IQR)	p value	Z value
IES-R		<0.001	7.150
Wuhan (n = 4,570)	18.0 (5.0–34.0)		
Other cities in Hubei (n = 4,655)	14.0 (4.0–30.0)		
PHQ-9		<0.001	4.231
Wuhan	4.0 (0.0–8.0)		
Other cities in Hubei	3.0 (0.0–8.0)		
GAD-7		<0.001	4.670
Wuhan	3.0 (0.0–7.0)		
Other cities in Hubei	3.0 (0.0–7.0)		
Active coping		<0.001	3.337
Wuhan	22.0 (16.0–28.0)		
Other cities in Hubei	21.0 (15.0–28.0)		
Passive coping		<0.001	4.775
Wuhan	11.0 (7.0–14.0)		
Other cities in Hubei	10.0 (6.0–14.0)		

Familiar with someone to have COVID-19	Median (IQR)	p value	Z value
IES-R		<0.001	20.071
Yes (n = 1,655)	27.0 (12.0–40.0)		
No (n = 7,570)	14.0 (4.0–29.0)		
PHQ-9		<0.001	16.688
Yes	6.0 (2.0–10.0)		

(Continued)

TABLE 2 | Continued

No	3.0 (0.0–7.0)		
GAD-7		<0.001	18.911
Yes	5.0 (2.0–9.0)		
No	2.0 (0.0–6.0)		
Passive coping		<0.001	8.540
Yes	11.0 (8.0–15.0)		
No	10.0 (7.0–14.0)		

Knowledge of the epidemic	Median (IQR)	p value	χ² value
IES-R		0.011	9.068
Don't know much (n = 329)	16.0 (4.0–32.0)		
Know well (n = 4,571)	17.0 (5.0–32.0)		
Very familiar with (n = 4,325)	15.0 (4.0–32.0)		
PHQ-9		<0.001	68.600
Don't know much	4.0 (0.0–8.0)		
Know well	4.0 (0.0–8.0)		
Very familiar with	3.0 (0.0–7.0)		
GAD-7		<0.001	42.832
Don't know much	2.0 (0.0–7.0)		
Know well	3.0 (0.0–7.0)		
Very familiar with	2.0 (0.0–6.0)		
Active coping		<0.001	358.361
Don't know much	17.0 (11.0–21.0)		
Know well	21.0 (15.0–26.0)		
Very familiar with	24.0 (17.0–30.0)		
Passive coping		<0.001	81.125
Don't know much	9.0 (6.0–13.0)		
Know well	10.0 (7.0–13.0)		
Very familiar with	11.0 (7.0–15.0)		

Risk Factors for Symptoms of PTSD, Depression, and Anxiety

According to the results of multivariate logistic regression analysis, after adjusting for other confounding including sex, age, education level, marital status, and occupation, individuals who were geographically located in Wuhan (OR = 1.25, 95% CI = 1.14–1.36, $P < 0.001$) were found to be associated with severe symptoms of PTSD. Individuals who were familiar with someone who has COVID-19 were associated with severe symptoms of PTSD, depression, and anxiety (OR = 2.33, 95% CI = 2.07–2.63, $P < 0.001$; OR = 1.90, 95% CI = 1.66–2.17, $P < 0.001$; OR = 2.06, 95% CI = 1.78–2.39, $P < 0.001$). Compared with not knowing much of the COVID-19 epidemic, those who were very familiar with the COVID-19 outbreak were associated with a lower risk of PTSD symptoms (OR = 0.76, 95% CI = 0.59–0.97, $P = 0.030$). As for coping style, a higher level of active coping style (OR = 0.96, 95% CI = 0.95–0.97, $P < 0.001$; OR = 0.94, 95% CI = 0.93–0.94, $P < 0.001$; OR = 0.95, 95% CI = 0.94–0.96, $P < 0.001$) was associated with a lower risk of symptoms of PTSD, depression, and anxiety. On the contrary, higher level of passive coping style

(OR = 1.16, 95% CI = 1.14–1.17, $P < 0.001$; OR = 1.17, 95% CI = 1.15–1.19, $P < 0.001$; OR = 1.17, 95% CI = 1.15–1.19, $P < 0.001$) was associated with severe symptoms of PTSD, depression, and anxiety. Compared with those younger than 18 years, ages 18–25, 26–35, and 36–45 years were significantly associated with severe symptoms of PTSD (OR = 1.60, 95% CI = 1.20–2.14, $P = 0.001$; OR = 1.39, 95% CI = 1.02–1.90, $P = 0.040$; OR = 1.59, 95% CI = 1.15–2.20, $P = 0.005$), and ages older than 60 years were linked with a lower risk of symptoms of depression and anxiety (OR = 0.41, 95% CI = 0.21–0.82, $P = 0.011$; OR = 0.38, 95% CI = 0.18–0.82, $P = 0.013$). Compared with those with bachelor's degree or greater, cases who were at senior high school level or below were associated with severe symptoms of PTSD, depression, and anxiety (OR = 1.25, 95% CI = 1.13–1.38, $P < 0.001$; OR = 1.28, 95% CI = 1.13–1.45, $P < 0.001$; OR = 1.33, 95% CI = 1.15–1.53, $P < 0.001$). Compared with unemployed individuals, students were associated with a lower risk of symptoms of PTSD and anxiety (OR = 0.69, 95% CI = 0.55–0.88, $P = 0.003$; OR = 0.62, 95% CI = 0.44–0.87, $P = 0.005$). Additionally, having other professions was associated with a lower risk of symptoms of PTSD, depressive, and anxiety (OR = 0.58, 95% CI = 0.47–0.71, $P < 0.001$; OR = 0.60, 95% CI = 0.45–0.80, $P < 0.001$; OR = 0.51, 95% CI = 0.37–0.71, $P < 0.001$) (**Table 3**).

DISCUSSION

The findings of the present survey suggest initial psychological responses of noninfected individuals living in Hubei province from February 28 to March 21. About 6 weeks after the COVID-19 outbreak, the Wuhan government imposed an unprecedented extensive blockade for 5 weeks and indefinite traffic restrictions. The results unveiled that 44.5% of respondents rated the PTSD symptoms, 17.9% of respondents reported moderate to severe depressive symptoms, and 12.7% of respondents reported moderate to severe anxiety symptoms. People who were geographically located in Wuhan and those who were familiar with someone who has COVID-19 reported more severe symptoms of PTSD, depression, and anxiety. Moreover, passive coping style and being familiar with someone who has COVID-19 were found to be associated with worse mental health outcomes. To our knowledge, this is the first large sample survey concentrated on individuals' psychological status living in Hubei province since the outbreak of COVID-19.

Our results showed that a substantial proportion of residents of Hubei province, especially residents of Wuhan, had PTSD, as evidenced by the proportion of symptoms of PTSD, depression, and anxiety. Similarly, more than half of the participants felt helpless because of the COVID-19 pandemic, and a mild stressful impact was found on local Chinese residents in Liaoning province (37). The prevalence of symptoms of anxiety and depression was in agreement with that reported in the outbreak of SARS and MERS and during the initial stage of the COVID-19 epidemic among the general population in China (26, 30, 38). However, the prevalence of PTSD symptoms in the current study was greater than that reported during the outbreak of SARS and MERS (26, 30, 39). The following reasons might account for this phenomenon: (1) official confirmation of human-to-human transmission of COVID-19; (2) the local government of Wuhan imposed unprecedented widespread lockdown and traffic restrictions, and similar measures were adopted in other cities in Hubei province; (3) lack of medical protection resources in the early stage of the COVID-19 epidemic; and (4) Wuhan is the center of the outbreak, with the greatest number of people infected, the most exposed information, and the stronger impact on people's emotions. Furthermore, the present study was carried out at 6 weeks after the COVID-19 outbreak and 5 weeks after the blockade and traffic restrictions, which were different from the initial stage of the epidemic (38, 40). Over the past month and a half, people have gone through an adaption process that better reflects the profound impact of the epidemic on their psychological responses. Moreover, individuals who knew their family and friends to have COVID-19 had more severe symptoms of PTSD, depression, and anxiety. Such people were likely at a high risk of infection because of their close and frequent contact with COVID-19 patients and may warrant early and focused support services. Although persons underwent symptoms suggestive of depression, anxiety, and PTSD, the scales that were used to evaluate these symptoms were noted insufficient to confirm these diagnoses. Hence, further structured diagnostic interviews are required to confirm a diagnosis of depression, anxiety, and PTSD.

Coping style can be divided into active coping and passive coping. Active coping refers to taking a direct and rational way to solve a problem, whereas passive coping is linked to dealing with problems by avoidance, withdrawal, and denial (41). Fu et al. found 70.2% of Wuhan residents adopted active coping style, such as taking part in activities, talking to others, and maintaining an optimistic attitude, but 29.8% relied on passive coping style during the outbreaks (42). In the current study, a higher level of passive coping style was associated with severe symptoms of PTSD, depression, and anxiety, whereas a higher level of active coping style was associated with a lower risk of psychological symptoms. These findings indicated that more passive coping and less active coping style were risk factors for worse mental health outcomes. Previous studies demonstrated that passive coping could be an important risk factor for PTSD, affective disorders, and suicide (43–45). A number of scholars pointed out that active coping–based strategies were conducive to positive psychosocial outcomes (46, 47). In addition, studies emphasized that coping style–based methods could mediate the relationship between social support and individuals' adjustment outcomes, including psychological distress and depression (48). Taken together, the aforementioned results highlighted the importance of integrating coping style–based methods into psychological interventions during the COVID-19 epidemic.

As the COVID-19 epidemic continues to spread, our findings may provide vital guidance for the improvement of public mental health strategies: (1) health authorities need to pay further attention to high-risk groups based on social demographic information such as geographic location in Wuhan, being familiar with someone who has COVID-19, being at senior high school level or below, and unemployed individuals for early psychological interventions; (2) health authorities need to

TABLE 3 | Results of multivariate logistic regression analyses.

Variable	No. of severe cases/no. of total cases (%)	B	Standard error	Wald	*P* value	OR (95% CI)
IES-R, PTSD symptoms						
Constant	NA	−1.58	0.23	48.08	<0.001***	NA
Geographic location						
Wuhan	2,202/4,570 (48.2)	0.22	0.05	22.91	<0.001***	1.25 (1.14–1.36)
Other cities in Hubei	1,903/4,655 (40.9)	NA	NA	NA	NA	1 [Reference]
Familiar with someone to have COVID-19						
Yes	1,052/1,655 (63.6)	0.85	0.06	193.19	<0.001***	2.33 (2.07–2.63)
No	3,053/7,570 (40.3)	NA	NA	NA	NA	1 [Reference]
Active coping	NA	−0.04	0.01	124.74	<0.001***	0.96 (0.95–0.97)
Passive coping	NA	0.15	0.01	738.88	<0.001***	1.16 (1.14–1.17)
Age (years)						
<18	107/367 (29.2)	NA	NA	NA	NA	1 [Reference]
18–25	954/2,071 (46.1)	0.47	0.15	10.305	0.001**	1.60 (1.20–2.14)
26–35	1,812/3,916 (46.3)	0.33	0.16	4.23	0.040*	1.39 (1.02–1.90)
36–45	847/1,772 (47.8)	0.47	0.17	7.87	0.005**	1.59 (1.15–2.20)
46–60	315/867 (36.3)	0.15	0.18	0.76	0.382	1.17 (0.83–1.64)
>60	70/232 (30.2)	−0.15	0.23	0.43	0.514	0.86 (0.55–1.35)
Education						
Senior high school or below	1,879/4,115 (45.7)	0.23	0.05	19.54	<0.001***	1.25 (1.13–1.38)
Bachelor's degree or above	2,226/5,110 (43.6)	NA	NA	NA	NA	1 [Reference]
Occupation						
Medical staff	132/297 (44.4)	−0.02	0.15	0.01	0.911	0.98 (0.73–1.32)
Students	382/1,112 (34.4)	−0.37	0.12	9.05	0.003**	0.69 (0.55–0.88)
Self-employed	1,439/2,803 (51.3)	0.15	0.09	2.84	0.092	1.17 (0.98–1.39)
Farmers	283/527 (53.7)	0.19	0.12	2.41	0.120	1.21 (0.95–1.54)
Employed	1,173/2,400 (48.9)	0.16	0.09	2.94	0.086	1.17 (0.98–1.40)
Unemployed	394/989 (39.8)	NA	NA	NA	NA	1 [Reference]
Others	302/1,097 (27.5)	−0.55	0.11	26.85	<0.001***	0.58 (0.47–0.71)
Knowledge of the epidemic						
Don't know much	150/329 (45.6)	NA	NA	NA	NA	1 [Reference]
Know well	2,108/4,571 (46.1)	0.08	0.13	0.36	0.549	1.08 (0.84–1.38)
Very familiar with	1,847/4,325 (42.7)	−0.28	0.13	4.68	0.030*	0.76 (0.59–0.97)
PHQ-9, depressive symptoms						
Constant	NA	−2.40	0.29	70.77	<0.001***	NA
Familiar with someone to have COVID-19						
Yes	464/1,655 (28.0)	0.64	0.07	88.89	<0.001***	1.90 (1.66–2.17)
No	1,188/7,570 (15.7)	NA	NA	NA	NA	1 [Reference]
Active coping	NA	−0.07	0.01	204.57	<0.001***	0.94 (0.93–0.94)
Passive coping	NA	0.16	0.01	494.50	<0.001***	1.17 (1.15–1.19)
Age						
<18	53/367 (14.4)	NA	NA	NA	NA	1 [Reference]
18–25	440/2,071 (21.2)	0.34	0.19	3.39	0.065	1.41 (0.98–2.02)
26–35	732/3,916 (18.7)	0.21	0.20	1.06	0.304	1.23 (0.83–1.82)
36–45	316/1,772 (17.8)	0.22	0.21	1.10	0.295	1.24 (0.83–1.86)
46–60	96/867 (11.1)	−0.19	0.23	0.68	0.410	0.83 (0.53–1.29)
>60	15/232 (6.5)	−0.88	0.35	6.53	0.011*	0.41 (0.21–0.82)
Education						
Senior high school or below	788/4,115 (19.1)	0.25	0.06	15.12	<0.001***	1.28 (1.13–1.45)
Bachelor's degree or above	864/5,110 (16.9)	NA	NA	'NA	NA	1 [Reference]
Occupation						
Medical staff	47/297 (15.8)	−0.19	0.20	0.95	0.331	0.82 (0.56–1.22)

(Continued)

TABLE 3 | Continued

Variable	No. of severe cases/no. of total cases (%)	B	Standard error	Wald	P value	OR (95% CI)
Students	183/1,112 (16.5)	−0.23	0.15	2.28	0.131	0.79 (0.59–1.22)
Self-employed	611/2,803 (21.8)	0.07	0.12	0.38	0.540	1.07 (0.86–1.35)
Farmers	123/527 (23.3)	0.09	0.15	0.38	0.540	1.10 (0.82–1.47)
Employed	437/2,400 (18.2)	−0.04	0.12	0.11	0.742	0.96 (0.76–1.21)
Unemployed	146/989 (14.8)	NA	NA	NA	NA	1 [Reference]
Others	105/1,097 (9.6)	−0.52	0.15	12.44	<0.001***	0.60 (0.45–0.80)
GAD-7, anxiety symptoms						
Constant	NA	−2.85	0.32	77.61	<0.001***	NA
Familiar with someone to have COVID-19						
Yes	353/1,655 (21.3)	0.72	0.08	91.72	<0.001***	2.06 (1.78–2.39)
No	819/7,570 (10.8)	NA	NA	NA	NA	1 [Reference]
Active coping	NA	−0.05	0.01	79.19	<0.001***	0.95 (0.94–0.96)
Passive coping	NA	0.16	0.01	395.13	<0.001***	1.17 (1.15–1.19)
Age						
<18	38/367 (10.4)	NA	NA	NA	NA	1 [Reference]
18–25	314/2,071 (15.2)	0.28	0.21	1.68	0.196	1.32 (0.87–2.00)
26–35	515/3,916 (13.2)	0.10	0.23	0.20	0.659	1.11 (0.71–1.73)
36–45	225/1,772 (12.7)	0.12	0.24	0.26	0.607	1.13 (0.71–1.80)
46–60	68/867 (7.8)	−0.35	0.26	1.82	0.177	0.70 (0.42–1.17)
>60	12/232 (5.2)	−0.96	0.39	6.12	0.013*	0.38 (0.18–0.82)
Education						
Senior high school or below	571/4,115 (13.9)	0.28	0.07	15.70	<0.001***	1.33 (1.15–1.53)
Bachelor's degree or above	601/5,110 (11.8)	NA	NA	NA	NA	1 [Reference]
Occupation						
Medical staff	35/297 (11.8)	−0.35	0.22	2.50	0.114	0.70 (0.46–1.09)
Students	125/1,112 (11.2)	−0.48	0.17	7.73	0.005**	0.62 (0.44–0.87)
Self-employed	422/2,803 (15.1)	−0.18	0.13	2.03	0.154	0.83 (0.65–1.07)
Farmers	90/527 (17.1)	−0.10	0.17	0.33	0.563	0.91 (0.66–1.26)
Employed	308/2,400 (12.8)	−0.25	0.13	3.53	0.060	0.78 (0.61–1.01)
Unemployed	119/989 (12.0)	NA	NA	NA	NA	1 [Reference]
Others	73/1,097 (6.7)	−0.67	0.17	16.14	<0.001***	0.51 (0.37–0.71)

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

identify immediate psychological needs of general population who develops worse mental health outcomes during the epidemic; (3) the government and health authorities should urgently provide accurate data during the epidemic to reduce the impact of rumors; (4) promotion of positive coping style–based strategies is highly encouraged to support the needs of general population during the epidemic; (5) secure services should be set up to provide psychological counseling using electronic devices and applications (e.g., smartphones and tablets) for affected patients, as well as their families and members of the public; and (6) integrated crisis prevention and intervention systems, including epidemiological surveillance, screening, referral, and targeted interventions, should be provided to reduce symptoms of PTSD and prevent further mental health problems.

This timely survey on the psychological status and coping styles of general populations during the COVID-19 epidemic included 9,225 respondents in Hubei province, a sample size larger than that of most related studies. Although Hubei province

is the origin of the epidemic, the general populations in other provinces may have similar psychological conditions as a result of COVID-19. In addition, a comparative study on the psychological status of the general population in Hubei before and after the blockade can be compared in the future. However, this study has several limitations. First, we adopted snowball sampling strategy. The snowball sampling strategy is not based on random selection of samples and does not truly reflect the actual pattern of the general population. Second, a self-selection effect might have occurred for those individuals who experienced the greatest or least levels of PTSD. Third, lack of household income information in the questionnaire made it infeasible to assess the impact of income on mental health. Fourth, this was a cross-sectional study that examined respondents' psychological status, and it could not determine whether respondents' psychological status was affected by the COVID-19 epidemic. Fifth, although we found that having other occupations was markedly associated with a lower risk of symptoms of PTSD, depression, and anxiety

compared with unemployed individuals, the questionnaire did not provide details on other occupations. Finally, respondents had to use a computer or smartphone to respond, suggesting that they may be more educated and socioeconomically stable than the population as a whole.

CONCLUSIONS

During the midphase of the COVID-19 outbreak in Hubei province, nearly half of the respondents rated PTSD symptoms, and approximately one-fifth reported moderate and severe symptoms of anxiety and depression. Moreover, passive coping style and COVID-19–related exposure risks were considered to be associated with worse mental health outcomes. Therefore, it is highly essential to establish early practical public mental health programs for population in places where the epidemic originated, so as to improve the mental health and quality of life of affected population.

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/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of First Affiliated Hospital of Jinan University (Guangzhou, China, Approval Letter: KY-2020-044). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

YW and LH: design the study. GC, JG, ZQ, SZ, TS, and JW: contribute to data acquisition. GC and YW: contribute to data analysis. GC, JG, and ZQ: write the manuscript. YW and LH: revise the manuscript. All authors contribute to and have approved the final manuscript.

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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.2021.622762/full#supplementary-material

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Comparisons of Characteristics Between Psychological Support Hotline Callers With and Without COVID-19 Related Psychological Problems in China

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Background: To compare the characteristics between hotline callers with and without the Coronavirus Disease 2019 (COVID-19) related psychological problems.

Methods: From January 25 to March 31, 2020, 581 callers with COVID-19 related psychological problems (COVID-19 callers) and 695 callers without COVID-19 related psychological problems (non-COVID-19 callers) to the Beijing Psychological Support Hotline were recruited. The demographic characteristics, primary concerns, suicidal ideation, depression and other psychological problems were compared between the two groups of callers.

Results: Both groups of the callers were predominantly female and highly educated. The primary concerns reported by the COVID-19 callers were depression (38.4%) and family relationship problems (26.0%). As compared to the non-COVID-19 callers, COVID-19 callers reported more financial (7.4%) and work related problems (4.1%), but revealed lower prevalence of suicidal ideation (47.9% v 71.3%), lower degrees of psychological distress (74.3 v 79.1), intensity of suicidal ideation (0 v 50), severity of depression (57.9 v 65.1), and higher degree of hopefulness (41.1 v 33.6) (all *p* values < 0.01). Additionally, a lower proportion of COVID-19 callers met the criteria of depressed mood (51.6% v 61.4%) and other 4 symptoms than the non-COVID-19 callers (*p* values < 0.01).

Conclusions: Based on the content of the primary concerns and the relatively low level of depression of the COVID-19 callers, the psychological intervention for them during the pandemic should focus on "psychological supports." Coping strategies for daily life stressors and promotion of scientific knowledge about the pandemic should also be included in the hotline-related interventions.

Keywords: COVID-19, psychological problem, hotline, psychological intervention, suicide

INTRODUCTION

The outbreak of the Coronavirus Disease 2019 (COVID-19) has had a substantial impact on the mental health of the general population (1–4). During the pandemic, confirmed cases, people in quarantine, front-line healthcare workers and the general public have experienced varying degrees of anxiety, distress, and fear (2). To mitigate the psychological disturbance and possible psychological damage to the public, various forms of professional psychological crisis intervention services have been delivered in China (5). Our psychological support hotline, an online mental health service, provides real-time interactive psychological support, guidance, and crisis intervention remotely to different groups of people (6, 7). During the pandemic, the Beijing Psychological Support Hotline (BPSH) provides 24/7 COVID-19 related psychological counseling services to Mandarin-speaking Chinese globally.

The psychological support hotline is considered to play a key role in responding to public emergencies (8, 9). Most of the previous studies about hotline callers have focused on the general characteristics of callers and effectiveness of interventions for suicide (10–13). During the 2003 outbreak of the Severe Acute Respiratory Syndrome (SARS), a preliminary study on the characteristics of the callers to the epidemic psychological support hotline in China concluded that callers with epidemic related problems were predominantly female, middle-aged and young adults, with main concerns about mood and SARS-related questions (14, 15).

Although a large number of studies have reported the impact of COVID-19 on the mental health of the public (3, 4, 16, 17), many individuals had mental health problems prior to the pandemic or their concerns were unrelated with the COVID-19. Thus, it is improper to indiscriminately deliver psychological crisis intervention services to hotline callers, disregarding whether their main concerns were COVID-19 related or not. In order to understand the impact of the pandemic on public mental health, we compare characteristics of psychological disturbances between the callers whose concerns were and were not COVID-19-related. These findings will be useful for the further development of more specific hotline-based psychological crisis intervention model during public health emergency.

During the COVID-19 pandemic, the BPSH received a large number of calls with psychological problems related to the disease. The present study aims to analyze the probable differences between the hotline callers who reported psychological problems associated with COVID-19 (COVID-19 calls) and those with psychological problems unrelated with the pandemic (referred to as "non-COVID-19 calls"). Based on BPSH data, we focus on the probable differences in the demographic characteristics, primary concerns, suicidal ideation, depression and other psychological problems between the two groups of callers during the most severe period of COVID-19 in China.

MATERIALS AND METHODS

Sampling

Shortly after the announcement of the human to human contagion of the COVID-19 on January 20th, 2020, the BPSH labeled each call as COVID-19 or a non-COVID-19 call. If caller complained that his/her psychological disturbances were related to the COVID-19, or mentioned COVID-19 more than once during the hotline conversation, the call was labeled as a COVID-19 call. Whereas, if the caller did not mention the epidemic at all during the entire call, it was determined as a non-COVID-19 call.

All calls to the BPSH during January 25th to 31st March 2020—the most serious stage of the epidemic in China—were considered for the present study. Exclusion criteria were: (1) "null" calls, (i.e., silence only or hoax callers; (2) the caller's main purpose was not seeking for psychological support, (3) repeat calls (i.e., multiple calls from the same person, reported by callers or indicated by phone number). For repeat calls, only one call was selected for analysis. Generally, the call with the fewest missing interested data was selected; in the case that the number of variables with missed data was equal for repeated calls, the first call was selected. Among the calls which met the above criteria, all COVID-19 calls were included. Given many more non-COVID-19 calls were expected during the study period, we randomly selected (using SPSS 18.0) 20% of the eligible calls in the final data analysis.

Measures

At the BPSH, operators are required to follow a specific work-flow and ask callers for demographic information, including gender, age, education in years, marital status, and work status. In addition, operators ask callers about their suicidal ideation and the intensity of the ideation (0–100 points), their degree of psychological distress (on a scale of 0–100, with 0 meaning no psychological distress and 100 meaning the most severe psychological distress), as well as their hopefulness score (on a scale of 0–100, with 0 meaning completely hopeless and 100 meaning completely hopeful). Similarly, a score of 0 is regarded as without suicidal ideation and 100 means that one definitely wants to take one's life. The above assessment is performed twice per call, i.e., at the beginning and at the end of the index call.

The primary concerns reported by callers are categorized into nine groups: (1) family relationship problems, referring to conflicts with family members; (2) non-family relationship problems, referring to interpersonal conflicts peoples other than family members, including romantic relationship breakup; (3) financial problems, referring to debts, failed investments, etc.; (4) work-related problems; (5) school or study-related problems; (6) other negative life events; (7) psychiatric problems, defined as a history of any mental disorder other than depression; (8) depression, referring to severe depression as detected by the structured Chinese Depression Screening Scale (18); and (9) other problems, i.e., areas that could not be specifically categorized into the above eight problems. At the end of the call, the operator selects no more than the top three categories from

which to record the primary concerns that best reflect the caller's psychological situation.

Suicidal Ideation and Plan

Suicidal ideation and plan are assessed by the operator asking the caller, "In the last 2 weeks, have you repeatedly thought about death, felt that death is better than living, or thought about hurting yourself?" If the caller responds "yes," the caller will then be asked if there is an actual suicide plan. Based on the caller's response, the operator classifies the caller as one of the following three statuses: no suicidal ideation, suicidal ideation without a specific plan, or suicidal ideation with a specific plan.

Depression

The presence of 9 depressive symptoms of the Diagnostic and Statistical Manual of Mental Disorders, and the duration of the symptoms (if present) are assessed by the operator using the structured Chinese Depression Screening Scale (18). The score for depressive symptoms is the product of severity and days, summed for the 9 depressive symptoms. Then the score is converted into 0–100. The eight depressive symptoms other than suicidal ideation (classified as either present or absent) are classified into three levels: symptomatic (i.e., symptoms were present for at least 14 days); subthreshold symptoms (i.e., symptoms were present but for <14 days); or asymptomatic (i.e., symptoms were not present).

Other Social and Psychological Variables

Other psychological problems were defined as the following: (1) history of prior suicide attempt; (2) substance misuse; (3) chronic life events, i.e., long-term and current adverse psychological effects of past or current life events, such as those with ongoing family conflicts or work stress; (4) acute life events; (5) history of physical/sexual abuse; (6) fear of being attacked in the past month; (7) severe physical illness, i.e., presence of physical illness or disabilities that have a serious impact on their lives; and (8) history of suicidal acts of family members or friends.

These psychological problems were assessed by the operator asking the caller one by one, following preset instructions. For example, presence of acute life events is assessed by asking the caller, "In the last week, have any life events happened that seriously affected you psychologically?" If the caller answers "yes," he/she would be further asked to evaluate the severity of the impact (on a scale of 1–5, with no effect counted as one and a maximum effect counted as five). A score of 3 (moderate effect) or higher was considered as experiencing an acute life event.

Statistical Analysis

In this study, age and education in years were converted into tertiles; marital status was classified as unmarried, married, and others; and employment was classified as student, employed, unemployed, and other. The changes in the caller's psychological distress, hopefulness, and intensity of suicidal ideation before and after the call were the difference between the beginning and the ending of the call. Chi-square tests, independent samples t-tests, and Mann-Whitney U tests were used to compare the differences between COVID-19 callers and non-COVID-19 callers.

RESULTS

The process of sampling is shown in the **Figure 1**. Briefly, the BPSH received 6,001 calls from January 25th to 31st March 2020. Eighteen percent of calls were from Beijing, 3.6% of calls from Hubei Province, calls from other provinces varied between 0.1–7.0%, and the other 0.3% of calls from overseas including Taiwan, Hongkong, and Macao. A total of 803 calls identified as null (e.g., silence only, hoax calls) and 1,021 calls not seeking psychological support were excluded. The final sample was 4,177 calls seeking psychological support. Among these, 827 calls were randomly selected. One hundred and fifteen of the 827 calls were COVID-19 calls, thus remained 712 calls were non-COVID-19 callers. Repeat calls were excluded, resulting in 695 non-repeat non-COVID-19 calls. Meanwhile drawing from the original full sample, 581 non-repeat COVID-19 calls were also identified and included.

The 1,276 recruited calls averaged 44.2 min in length of the call, with 45.9 min for COVID-19 calls and 42.9 min for non-COVID-19 calls. As seen in **Table 1**, 66.2% of the callers were female, and the gender difference between the COVID-19 callers and non-COVID-19 callers was not statistically significant. There were however, statistically significant differences in demographic variables such as age, education years, marital status, and employment status between the two groups. More than twice as many of COVID-19 callers were over 30 years old as that in the non-COVID-19 callers. COVID-19 callers were more highly educated, more likely to be married, and were employed than non-COVID-19 callers.

As seen in **Table 2**, the differences between the COVID-19 and non-COVID-19 groups were statistically significant for several groups of the primary concerns encountered by the callers. For COVID-19 callers, the top three primary concerns were depression, family relationship problems, and other psychiatric problems, while for non-COVID-19 callers, the top three major problems were family relationship problems, non-family relationship problems, and depression. The proportion of COVID-19 callers with family and non-family relationship problems was lower than that of non-COVID-19 callers, while the prevalence of depression, encountering financial and work-related problems among COVID-19 callers were higher than that of non-COVID-19 callers. While we subdivided the mentioned groups of primary concerns into specific stressors, results indicated that, COVID-19 callers were less likely to report conflicts with parents (16.0 vs. 24.7%, $\chi^2 = 14.70$, $P < 0.001$) and romantic relationship breakup (7.4 vs. 17.0%, $\chi^2 = 26.33$, $P < 0.001$) than non-COVID-19 callers, however, COVID-19 callers were more likely to experience high work-related competition (2.6 vs. 0.7%, $\chi^2 = 7.11$, $P = 0.008$) and income decrease (1.5 vs. 0.4%, $\chi^2 = 4.24$, $P = 0.039$) than non-COVID-19 callers.

Table 3 shows that the prevalence of suicidal ideation in COVID-19 callers in the 2 weeks prior to the index call was lower than those in the non-COVID-19 callers and reached statistical significance. As regards the proportion of callers with other social and psychological characteristics, the COVID-19 callers were less likely to report chronic life events, history of suicidal behavior, and fear of being assaulted than the non-COVID-19 callers. With

FIGURE 1 | Flow chart for recruitment of the call.
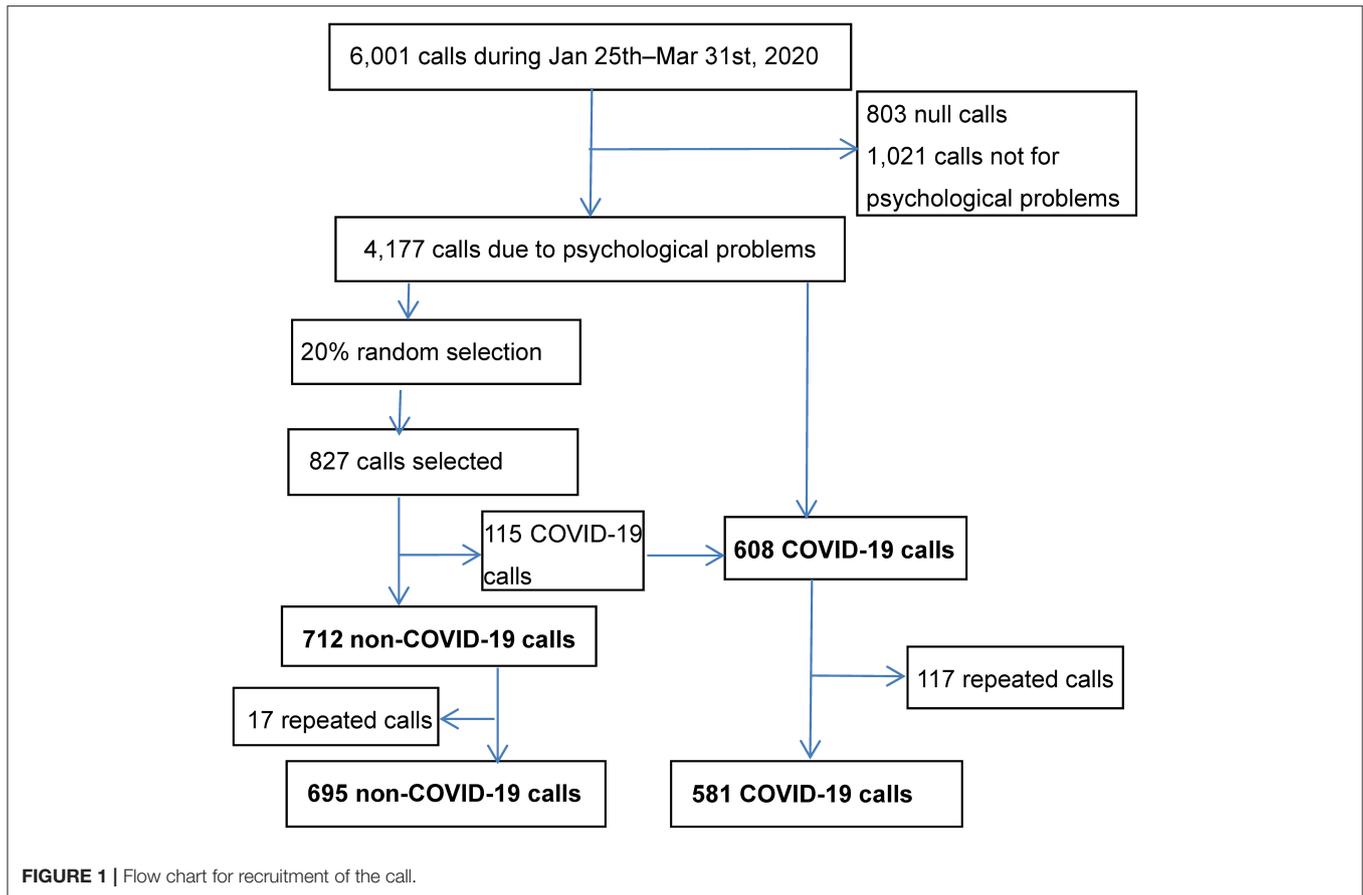
respect to scores assessed at the beginning of the index call, COVID-19 callers reported lower scores of psychological distress, intensity of suicidal ideation, and severity of depression, but higher score of hopefulness than non-COVID-19 callers.

The changes in psychological distress, hopefulness, and intensity of suicidal ideation were defined as the scores of the three variables reported by callers at the end of the index call minus the reported scores at the beginning of the call. A comparison of the changes in the three psychological variables indicated that, after the hotline psychological intervention, both groups' psychological distress and intensity of suicidal ideation were reduced whereas hopefulness increased. There was no statistically significant difference between the two groups in terms of the changes in the psychological distress and hopefulness (see **Table 4**). However, the decrease of intensity of suicidal ideation in COVID-19 callers was less than that in non-COVID-19 callers ($p < 0.001$).

Of the 1,276 callers, 868 callers, including 417 COVID-19 callers and 451 non-COVID-19 callers, completed interviews to assess depressive symptoms. Differences between the two groups on five of the nine depressive symptoms were statistically significant, i.e., depressed mood, suicidal ideation or behavior, sleep problems, loss of energy, and worthlessness. The non-COVID-19 callers were more likely to report depressive symptoms than COVID-19 callers (see **Table 5**).

DISCUSSION

According to guidance for emergency psychological crisis intervention and the psychological support hotline issued by the National Health Commission at the early stage of the COVID-19 outbreak in China (5, 6), the hotline intervention served to disseminate public health information related to the prevention and control of COVID-19 and teach coping strategies for managing stressful events and gaining emotional relief. Although many have experienced stress due to the COVID-19 pandemic (3, 4, 9, 16, 17), it is not reasonable to assume that all callers to the psychological support hotline were distressed by the pandemic and seeking help for psychological problems as a result of COVID-19. Based on our best knowledge, this is the first study to describe the social and psychological characteristics of hotline callers with or without COVID-19-related psychological disturbance.

Results of the present study indicate that, hotline callers reporting COVID-19 related psychological disturbance are different from callers who endorse psychological problems unrelated to COVID-19. COVID-19 callers were older, highly educated, employed, and more likely to be married compared with non-COVID-19 callers. Although a higher proportion of COVID-19 callers reported depression (38.4%) than the non-COVID-19 callers, depression and psychological distress severity

TABLE 1 | Comparison of characteristics of COVID-19 callers and non-COVID-19 callers [n (%)].

Characteristics	All callers (n = 1,276)	COVID-19 callers (n = 581)	Non-COVID-19 callers (n = 695)	χ^2	p
Gender				0.02	0.896
Female	844 (66.2)	386 (66.4)	458 (66.1)		
Male	430 (33.8)	195 (33.6)	235 (33.9)		
Age				110.80	<0.001
<20 years	436 (35.7)	132 (23.3)	304 (46.3)		
20–29 years	480 (39.2)	221 (39.0)	259 (39.4)		
30+ years	307 (25.1)	213 (37.6)	94 (14.3)		
Education years				45.39	<0.001
0–9	371 (30.9)	125 (22.6)	246 (37.9)		
10–12	250 (20.8)	105 (19.0)	145 (22.3)		
≥13	580 (48.3)	322 (58.3)	258 (39.8)		
Marital status				73.99	<0.001
Unmarried	963 (78.1)	380 (67.1)	583 (87.4)		
Married	219 (17.8)	153 (27.0)	66 (9.9)		
Other	51 (4.1)	33 (5.8)	18 (2.7)		
Employment status				90.43	<0.001
Student	526 (43.0)	174 (30.6)	352 (53.8)		
Employed	459 (37.6)	278 (48.9)	181 (27.7)		
Unemployed	200 (16.4)	87 (15.3)	113 (17.3)		
Other	37 (3.0)	29 (5.1)	8 (1.2)		

Each variable contains missing values, so the sum of the callers of each variable is less than the total number of callers.

TABLE 2 | Comparison of the primary concerns reported by COVID-19 callers and non-COVID-19 callers [n (%)].

Primary concerns	All callers (n = 1,276)	COVID-19 callers (n = 581)	Non-COVID-19 callers (n = 695)	χ^2	p
Family relationship problems	370 (29.0)	151 (26.0)	219 (31.5)	4.69	0.030
Non-family relationship problems	255 (20.0)	74 (12.7)	181 (26.0)	35.04	<0.001
Financial problems	75 (5.9)	43 (7.4)	32 (4.6)	4.47	0.034
Work-related problems	66 (5.2)	41 (7.1)	25 (3.6)	7.72	0.005
Study-related problems	82 (6.4)	34 (5.9)	48 (6.9)	0.59	0.444
Other negative events	54 (4.2)	28 (4.8)	26 (3.7)	0.91	0.341
Depression (assessed)	386 (30.3)	223 (38.4)	163 (23.5)	33.43	<0.001
Other psychiatric problems	242 (19.0)	111 (19.1)	131 (18.8)	0.01	0.907
Other problems	13 (1.0)	5 (0.9)	8 (1.2)	0.27	0.607

and the prevalence and intensity of suicidal ideation were lower among COVID-19 callers than that among non-COVID-19 callers. COVID-19 callers were less likely to be involved in interpersonal conflicts, but more likely to report work-related and financial problems, compared to non-COVID-19 callers. To some extent, different psychological concerns between the two groups of callers were associated with different social roles among different age groups. During the pandemic, difficulties of financial problems (reduced work opportunities and income) were common, and persons aged 30 year or older (often responsible for earning money and supporting a family) were more sensitive to this situation and attributed it to the COVID-19 than the younger. Although family relationship problem is one of

the most involved concerns in present and previous studies (10), relative less callers linked it with the pandemic, especially among people younger than 20 years old.

Previous studies have reported that more than half of the BPSH callers report suicidal ideation and/or suicide attempts (10). During the current COVID-19 outbreak, the prevalence of suicidal ideation among non-COVID-19 callers was comparable to previous studies, whereas that of COVID-19 callers was significantly lower than non-COVID-19 callers. Furthermore, the mental health problems of COVID-19 callers were less severe than that of non-COVID-19 callers. A survey on the mental health status of mainland Chinese general population in February, 2020, has shown that all were under widespread stress,

TABLE 3 | Comparison of suicidal ideation, other psychological problems, and mood assessment between COVID-19 callers and non-COVID-19 callers [n (%)].

Assessment	All callers (n = 1,154)	COVID-19 callers (n = 541)	Non-COVID-19 callers (n = 613)	χ^2	p
Suicidal ideation				65.91	<0.001
No suicidal ideation	458 (39.7)	282 (52.1)	176 (28.7)		
Ideation without plan	552 (47.8)	207 (38.3)	345 (56.3)		
Ideation with plan	144 (12.5)	52 (9.6)	92 (15.0)		
History of suicidal behavior	239 (27.8)	100 (24.0)	139 (31.3)	5.65	0.017
Substance misuse	73 (8.9)	32 (8.0)	41 (9.7)	0.75	0.390
Severe physical illness	84 (10.2)	41 (10.3)	43 (10.2)	0.003	0.958
Chronic life events	528 (64.5)	234 (58.8)	294 (69.8)	10.89	0.001
Physical/sexual abuse	130 (16.0)	54 (13.6)	76 (18.2)	3.19	0.074
Fear of assault	148 (18.2)	52 (13.1)	96 (23.0)	13.46	<0.001
Acute life events	459 (56.2)	221 (55.7)	238 (56.7)	0.08	0.774
History of suicidal behavior of family members or friends	360 (44.4)	172 (43.5)	188 (45.2)	0.22	0.637
	($\bar{x} \pm s$)	($\bar{x} \pm s$)	($\bar{x} \pm s$)	t	p
Psychological distress	76.89 ± 21.42	74.33 ± 22.60	79.10 ± 20.11	−3.56	<0.001
Hopefulness	37.05 ± 30.67	41.09 ± 31.36	33.56 ± 29.65	3.84	<0.001
Severity of depression	61.58 ± 22.31	57.85 ± 23.54	65.09 ± 20.51	−4.72	<0.001
	Median (IQR)	Median (IQR)	Median (IQR)	z	p
Intensity of suicidal ideation[a]	40 (0,75)	0 (0,60)	50 (0,80)	−8.07	<0.001

[a]Given the skewed distribution of the intensity of suicidal ideation, we used the Mann-Whitney U test.

TABLE 4 | Comparison of changes in psychological variables before and after intervention between COVID-19 callers and non-COVID-19 callers [($\bar{x} \pm s$)].

Variables	All callers (n = 1,154)	COVID-19 callers (n = 541)	Non-COVID-19 callers (n = 613)	t/z	p
Psychological distress	−26.56 ± 24.49	−26.87 ± 24.77	−26.28 ± 24.26	0.35	0.730
Hopefulness	9.69 ± 18.58	10.45 ± 18.74	9.01 ± 18.43	1.09	0.276
Intensity of suicidal ideation[a]	0 (−50, 0)	0 (−30, 0)	−15 (−50, 0)	−5.08	<0.001

[a]Given the skewed distribution of the intensity of suicidal ideation, Median (IQR) and results of the Mann-Whitney U test were reported.

with depression and anxiety in the early stages of the COVID-19 pandemic (17). Our results suggest that the mental health problems among COVID-19 callers might reflect a psychological reaction induced by the pandemic rather than clinical mental disorders. They may inform the effective allocation of mental health support during times of public health crises.

These findings highlight the value of psychological support i.e., early public education on mental health, especially on how to cope with psychological stress induced by the pandemic in response to emergent public health crises. Specifically, hotline-based interventions should focus on delivering brief psycho-education about the common physical and mental reactions to stress, and encourage the teaching of healthy coping strategies, in the context of rapport and emotional support to reduce the stressful impact of the COVID-19. Given only 15% calls of the BPSH (608/4177, see the **Figure 1**) complained COVID-19 related problems, the findings also indicate that we should pay attention to non-COVID-19 callers and continue to provide

high quality psychological interventions during times of public health crises.

Previous studies on hotline callers during the 2003 SARS epidemic have shown that callers' main concerns were seeking emotional support and information about the epidemic (14, 15). Consistent with these studies, in our study, the most common concern of COVID-19 callers was depression. In addition, the contagiousness of COVID-19, large number of people affected, long duration of the pandemic, and limited ability to work or go to work due to lockdown or quarantine, together contributed to a high proportion of COVID-19 callers reporting financial and work-related problems. The wide range of needs reported by callers left hotline operators ill-equipped. In addition to basic counseling skills, operators need to be trained in scientific knowledge and public health information about COVID-19, in order to effectively help callers.

There was no significant gender difference between COVID-19 and non-COVID-19 callers to the BPSH. Most callers

TABLE 5 | Comparison of assessed depressive symptoms between COVID-19 callers and non-COVID-19 callers [n (%)].

Features	All callers (n = 868)	COVID-19 callers (n = 417)	Non-COVID-19 callers (n = 451)	χ^2	p
Depressed mood				10.23	0.006
Symptomatic	492 (56.7)	215 (51.6)	277 (61.4)		
Subthreshold	28 (32.3)	145 (34.8)	135 (29.9)		
Asymptomatic	96 (11.1)	57 (13.7)	39 (8.6)		
Diminished interest				4.96	0.084
Symptomatic	420 (48.5)	186 (44.6)	234 (52.1)		
Subthreshold	221 (25.5)	113 (27.1)	108 (24.1)		
Asymptomatic	225 (26.0)	118 (28.3)	107 (23.8)		
Suicidal ideation				37.91	<0.001
Symptomatic	631 (72.9)	264 (63.3)	367 (81.9)		
Asymptomatic	234 (27.1)	153 (36.7)	81 (18.1)		
Weight change				3.56	0.169
Symptomatic	383 (45.0)	173 (41.9)	210 (47.8)		
Subthreshold	246 (28.9)	122 (29.5)	124 (28.2)		
Asymptomatic	223 (26.2)	118 (28.6)	105 (23.9)		
Sleep problem				13.90	0.001
Symptomatic	427 (50.6)	180 (44.0)	247 (56.8)		
Subthreshold	257 (30.5)	143 (35.0)	114 (26.2)		
Asymptomatic	160 (19.0)	86 (21.0)	74 (17.0)		
Agitation or retardation				5.01	0.082
Symptomatic	289 (34.3)	125 (30.6)	164 (37.8)		
Subthreshold	199 (23.6)	100 (24.4)	99 (22.8)		
Asymptomatic	355 (42.1)	184 (45.0)	171 (39.4)		
Loss of energy				21.75	<0.001
Symptomatic	455 (54.3)	188 (46.4)	267 (61.7)		
Subthreshold	198 (23.6)	105 (25.9)	93 (21.5)		
Asymptomatic	185 (22.1)	112 (27.7)	73 (16.9)		
Worthlessness				21.62	<0.001
Symptomatic	515 (61.5)	221 (54.8)	294 (67.6)		
Subthreshold	167 (19.9)	82 (20.3)	85 (19.5)		
Asymptomatic	156 (18.6)	100 (24.8)	56 (12.9)		
Diminished thinking ability				3.81	0.149
Symptomatic	453 (54.6)	208 (52.0)	245 (57.0)		
Subthreshold	174 (21.0)	95 (23.8)	79 (18.4)		
Asymptomatic	203 (24.5)	97 (24.3)	106 (24.7)		

Each variable contains missing values, so the sum of the callers of each symptom is less than the total number of callers.

self-identified as women during the COVID-19 pandemic, as during normal times (10, 12, 13) and after catastrophic events (15, 19, 20). That is, irrespective of major public health emergencies, women still appear more likely to call the hotline in seek for psychological counseling to help themselves, and major public health events did not increase the proportion of men making calls to psychological support hotline. Crisis intervention workers should not only *passively* wait for people to come to seek help, but should also *proactively* reach out to those in need. For example, a mass media campaign can be used to disseminate information about the disease, preventive measures, some knowledge of possible physical and psychological reactions to the pandemic, and internet-based self-help coping strategies.

COVID-19 callers were better educated and more likely to be married and employed compared to non-COVID-19 callers. This may highlight discrepancy in the utilization of free and supportive resources based on socioeconomic status (SES). Our results suggest an urgent need to further publicize and promote the hotline as an immediate and convenient psychological service for those of relatively low SES. Such services seek to promote wellness and resilience, while preventing the onset of clinical disorders and, during public health emergencies, serve as a useful source of scientific knowledge for physical health. Public health campaigns might target this group to ensure equitable access and utilization.

The findings in the present study extend our knowledge of the impacts of the COVID-19 pandemic on mental health. Previous studies reported that a large number of people were psychologically disturbed during the pandemic (1–4, 16, 17), however, results in our study indicated that the severity of psychological problem (depression, suicidal ideation etc.) due to the pandemic was slight than what we have imagined, and the COVID-19 callers reported more financial or work related problems than non-COVID-19 callers. The findings implied that, to some extent, the psychological disturbance among COVID-19 callers might be a psychological reaction to the stressors induced by the pandemic, rather than clinical mental disorders. Psychological supports, coping strategies, and public education on the COVID-19 might be important psychological intervention methods during the pandemic.

There are several limitations to the present study. First, the present study recruited hotline callers in China only, which limits the generalization of our findings to other populations. Given that our results are limited in timeframe, and other countries may have experienced a more prolonged impact of the pandemic, it is not clear whether these findings would apply in countries outside of China. Second, previous studies have reported that the COVID-19 causes increased levels of depression and anxiety in the general public (2–4, 17). Given that BPSH has historically focused on suicide prevention, our data protocols are mainly designed for depression and suicide risk and as such, neglect asking about anxiety. The present study did not collect data on anxiety, which appears especially relevant for a fear-inducing global pandemic. Third, the present study did not identify whether callers were confirmed cases, front-line healthcare workers, or other important sub-groups. This limits our exploration of the associations between characteristics and differences of the caller's personal identification and the psychological problems. Fourth, non-COVID-19 callers in this study likely experienced COVID-19 related stress, and we cannot completely disregard the potential impact of the COVID-19 on their presenting concerns. Finally, we relied on callers' self-reports, which may limit the accuracy of collected data; nevertheless, the anonymous nature of hotline may lead to increased honesty during such calls, in turn, it is difficult to describe the associations of caller's personal information and his/her primary concerns more clearly.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Review Committee of Beijing Huilongguan Hospital. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

LZ and YT designed the study and conducted data analysis, LZ, ZL, YT, MW, and NL drafted the manuscript, LZ, YW, and CW contributed to collect data. All authors contributed to the interpretation and revision of the manuscript, read and approved the final manuscript.

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Social Media Exposure, Psychological Distress, Emotion Regulation, and Depression During the COVID-19 Outbreak in Community Samples in China

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The outbreak of coronavirus disease 2019 (COVID-19) has been a global emergency, affecting millions of individuals both physically and psychologically. The present research investigated the associations between social media exposure and depression during the COVID-19 outbreak by examining the mediating role of psychological distress and the moderating role of emotion regulation among members of the general public in China. Participants ($N = 485$) completed a set of questionnaires online, including demographic information, self-rated physical health, and social media exposure to topics related to COVID-19. The Impact of Event Scale-Revised (IES-R), the Beck Depression Inventory-II (BDI-II), and the Emotion Regulation Questionnaire (ERQ) were utilized to measure psychological distress about COVID-19, depression, and emotion regulation strategies, respectively. Results found that older age and greater levels of social media exposure were associated with more psychological distress about the virus ($r = 0.14$, $p = 0.003$; $r = 0.22$, $p < 0.001$). Results of the moderated mediation model suggest that psychological distress mediated the relationship between social media exposure and depression ($\beta = 0.10$; $Boot\ 95\%\ CI = 0.07, 0.15$). Furthermore, expressive suppression moderated the relationship between psychological distress and depression ($\beta = 0.10$, $p = 0.017$). The findings are discussed in terms of the need for mental health assistance for individuals at high risk of depression, including the elderly and individuals who reported greater psychological distress and those who showed preference usage of suppression, during the COVID-19 crisis.

Keywords: COVID-19, social media exposure, depression, psychological distress, emotion regulation

INTRODUCTION

The outbreak of coronavirus disease 2019 (COVID-19), a severe acute respiratory syndrome (SARS), was reported on December 31, 2019, in Wuhan, China. Within several weeks, the disease had rapidly spread throughout the world, and on March 9, 2020, the World Health Organization (WHO) declared that COVID-19 had turned into a worldwide pandemic (1). By May 11, 2020, more than 4 million individuals worldwide had been diagnosed with COVID-19 (2), and the number of cases is still on the rise.

Previous research has demonstrated noticeable psychological problems in individuals diagnosed with COVID-19 (3, 4) as well as the general public (5–7). In a study conducted in hospitalized patients diagnosed with COVID-19, it was estimated that approximately one third of patients with COVID-19 experience symptoms of anxiety and depression, with symptom severity being associated with lower social support (4). In another study, more than half of health care workers reported symptoms of depression, with greater severity among frontline health care workers who worked directly with patients (8). Moreover, due to the highly contagious nature of the disease, strict lockdown was imposed all over China. The COVID-19 crisis has also had a significant impact on the mental health of members of the general public, people who have not become ill because of the virus may nevertheless experience psychological distress related to the illness. In a nationwide survey of 52,730 non-patients in China at the end of January 2020, about 35% of individuals reported experiencing moderate to severe psychological stress related to COVID-19 (9). More specifically, the prevalence rates of depression were 20.1% in Huang and Zhao (10) and 53.5% in Liu et al. (11), estimated with the Center for Epidemiology Scale for Depression [CES-D; (12)] and the Patient Health Questionnaire-9 [PHQ-9; (13)], respectively. Approximately 4.6% of participants suffered from posttraumatic stress symptoms 1 month after the COVID-19 outbreak (14).

Beyond establishing prevalence, it is important to identify factors associated with higher and lower risk of depression among the general population during the COVID-19 pandemic. Massive social media use was found to be associated with poor sleep quality, elevated depressive symptoms, and behavior issues in adolescents, such as cyberbullying (15–17). Previous research demonstrated that greater exposure to trauma-related media information was associated with an increased risk of developing mental health problems over time. In the study of Holman et al. (18), they compared the impact of media-based indirect exposure and direct exposure on acute stress response after 2013 Boston Marathon bombing, and it was found that bombing-related media exposure was more strongly related to acute stress than direct exposure to the bombings (18), and these associations may accumulate over time, generating a vicious cycle of media use and distress (19).

According to the emotional contagion theory (20), emotional state could be transferred from one person to another through automatic mimicry, such as facial expression and postures. For example, happiness can be spread from person to person through social interactions (21). Moreover, emotional contagion could also occur online, in the absence of typical in-person interaction clues (22, 23), especially for negative emotions. Negative posts were followed by more negative responses than positive posts on Twitter, which then increased the amount of negative posts the following week and thus provided greater opportunity for the emotional contagion (24). Media effect theory has been developed to explain how media use brings a change to people's cognition, emotion, and behavior (25).

A great deal of information outrushed on the Internet after the outbreak of COVID-19. Internet posts concerning COVID-19 showed a sharp increase after human-to-human transmission was confirmed on January 20, 2020, and the number of posts was associated with the number of diagnosed patients (26), indicating great concern about the spread of COVID-19. Though health information could help relieve the stress (27), misinformation was also disseminated, and it may cause fear and stress among the public (28). According to the emotional contagion theory and media effect theory, those who did not get infected of the virus may also suffer from emotional distress and depression after browsing social media posts related to COVID-19. Consistently, several studies have demonstrated that massive social media exposure to information related to COVID-19 was positively associated with more severe mental health problems, such as anxiety and depression (29, 30). Nevertheless, only a few studies have examined the underlying mechanism that might mediate or moderate this association. Liu and Liu (31) found that exposure to social media was related to higher levels of anxiety, and the association was mediated by vicarious traumatization. Given the close relationship between social media exposure and perceived distress (18, 19, 31), the present study assumed that psychological distress may play a mediation role between social media exposure and depression.

People use multiple emotion regulation strategies to regulate their emotional response to crisis. Cognitive reappraisal involves the cognitive reevaluation of emotion-inducing situations. The use of cognitive reappraisal can reduce negative affect and its physiological correlates, thus it is considered to be an adaptive emotion regulation strategy (32). In addition, the use of cognitive reappraisal was associated with higher levels of positive affect and greater satisfaction with life (33–35) and better psychological consequences such as decreased anxiety and depression [e.g., (36)]. Expressive suppression is a response-focused form of emotion regulation when a person tries to inhibit his or her emotion expressive behavior after the emotional response has already been generated (32). Expressive suppression is considered a maladaptive emotional regulation strategy, which has been shown to increase negative emotional feelings and result in poor social consequences (37). Generally, expressive suppression was associated with higher and cognitive reappraisal with lower posttraumatic symptoms in response to crisis (38, 39), while another study reported a non-significant correlation between cognitive reappraisal and severity of posttraumatic symptoms in a clinical sample of trauma-exposed women (40).

There are only a few studies that examine the interaction between stress and emotion regulation on psychological well-being, and mixed results have been reported. Roos et al. (41) found that suppression, rather than reappraisal, moderated the relationship between stressful life events and physiological responses to acute stressors, while another study suggested a moderating role of cognitive reappraisal between stress and depression (42). Nevertheless, in a recent study using daily diary method, it was found that both cognitive reappraisal and expressive suppression moderated the associations between stress and suicidal thoughts, and the associations were weaker among individuals who reported habitual use of either strategy (43).

While previous studies have investigated psychological distress and depression severity related to COVID-19 separately, to the best of our knowledge, no study has examined the extent

to which emotion regulation strategies may predict or moderate relations between psychological distress and depression during the COVID-19 outbreak. Given the high prevalence rate of depression on the public under COVID-19 (11), assessing the moderating role of emotion regulation between psychological distress and depression may uncover the mechanism of generating and developing mental illness during the pandemic and provide evidence for the effectiveness of applying certain emotion regulation strategies on reducing mental health burden among the general population.

The present study was conducted in mid-February 2020, at which time the number of COVID-19 cases in China had reached 66,576 (44), and the number was still rising. The sample was made up of members of the general population who were not patients with COVID-19. The goals of the study were to estimate the prevalence of depression and to explore the relationships among social media exposure, psychological distress about COVID-19, emotion regulation strategies, and symptoms of depression. Social isolation is helpful in preventing virus spread but also could be a public health concern for the elderly (45) and was a risk factor for depression and anxiety (46). Therefore, it was hypothesized that (1) the elderly would report more severe mental health problems and (2) social media exposure may exacerbate psychological distress and depression during the COVID-19 outbreak. Considering that adaptive and non-adaptive emotion regulation strategies could be utilized in responding to stress elicited by COVID-19 and were closely related to severity of depressive symptoms, moderation analyses were conducted to examine whether the use of emotion regulation moderated the predictive relationship between psychological distress and depressive symptom. As there is still much controversy regarding the moderating effect of specific emotion regulation strategies on the relations between psychological distress and depression (38, 41, 42), no specific hypothesis was made regarding the moderating role of suppression and reappraisal. The moderating role of suppression and reappraisal would be examined, respectively.

METHODS

Participants

Potential participants among Chinese citizens were invited to complete questionnaires *via* the Internet, using links sent *via* Social Networking Services (SNSs; such as WeChat) from February 16 to February 19, 2020, using a snowball sampling technique. Of the 576 participants who filled out the questionnaires, 87 were excluded from the final data analysis because the completion time was <180 s or the same answer was given to more than 80% of the items. Four participants were diagnosed patients or frontline medical workers and were also excluded from analysis. There were 485 participants in the final sample (193 males, 39.8%; 292 females, 60.2%). Participants' ages ranged from 12 to 75, with most (76.1%) aged between 18 and 50. Nearly half of the participants (45.8%) were currently enrolled students. About half lived in urban areas (212; 43.7%) and about half in rural areas (273; 56.3%). About half were married, divorced, or widowed (226; 46.6%) and about half were

single (259; 53.4%). Among the participants, 55 (11.3%) were from Hubei province. This study was approved by the local ethics committee. All participants provided informed consent to having their anonymous data used for research. In addition, informed consent was obtained from teachers of middle school students before data collection.

Measures

Demographic Information

Demographic variables included age, gender (male, female), marital status (single, married, divorced, widowed), education level (middle school, high school, college or higher), and region (urban, rural). In addition, participants were asked to provide a self-rating of physical health on a 5-point Likert scale from 1 ("very bad") to 5 ("very good").

Coronavirus Disease 2019-Related Information

Social media exposure was measured by one item, which was consistent with a previous study (29). Participants rated how much they focused on information related to COVID-19 on social media (e.g., Weibo, WeChat) each day using a 5-point Likert scale from 1 ("almost never") to 5 ("almost always").

Psychological Distress

The Impact of Event Scale-Revised [IES-R; (47); Chinese version by (48)] is a frequently used self-report scale to measure psychological distress following a traumatic event (49). The IES-R contains 22 items, and participants are asked to rate each item on a 5-point Likert scale ranging from 0 ("not at all") to 4 ("extremely"), resulting in a total possible score ranging from 0 to 88. The items were adapted to refer in particular to distress elicited by COVID-19. For example, the original item "Any reminder brought back feelings about it" was changed to "Any reminder brought back feelings about COVID-19." The Cronbach α coefficient in the present study was 0.92.

Depression Severity

The Beck Depression Inventory-II [BDI-II; (50)] was used to measure depressive symptoms. The BDI-II contains 21 items. On each item, participants are asked to choose one of four statements that best describes their feelings, with scores ranging from 0 to 3 for each item. For example, one item provides the following four options: "I do not feel sad" (0), "I feel sad" (1), "I am sad all the time and I can't snap out of it" (2), and "I am so sad and unhappy that I can't stand it" (3). The total possible score ranges from 0 to 63, and participants can be categorized as being at one of four levels of depression severity according to their total score: no or minimal depression (0–13), mild depression (14–19), moderate depression (20–28), and severe depression (≥29). The Chinese version of BDI-II was reliable on assessing depressive symptom (51). The Cronbach α coefficient in the present study was 0.92.

Emotion Regulation

Participants' use of various emotion regulation strategies was measured using the Emotion Regulation Questionnaire [ERQ; (32)]. The ERQ includes 10 items, and participants are asked to rate each item on a 7-point Likert scale ranging from 1 ("strongly disagree") to 7 ("strongly agree"). The ERQ has two subscales:

cognitive reappraisal (six items) and expressive suppression (four items). A higher subscale score indicates more frequent use of that emotion regulation strategy. The Chinese version of ERQ was proven to be good in reliability and validity (52). In the present study, the Cronbach α coefficients were 0.88 and 0.76 for the cognitive reappraisal subscale and expressive suppression subscale, respectively.

Data Analysis

Data analyses were conducted using SPSS 25.0, and the p-value threshold for statistical significance was set at 0.05 (two-tailed). First, to establish the validity of the data, common method bias was assessed using Harman's single-factor test. Principal component analysis extracted 10 factors whose eigenvalues were larger than 1, and the first factor explained 23.36% of the total variance. Result did not reveal severe common method bias in the present study. Then, descriptive analyses were conducted, including correlations among all variables. Independent-samples t-tests and one-way analyses of variance (ANOVAs) were conducted to determine if scores for depression and for psychological distress about COVID-19 varied depending on demographic variables, physical health, and social media exposure. The prevalence of depression was also estimated. Secondly, a moderated mediation model was conducted using Model 14 of PROCESS macro (53) to further explore the relationship of social media exposure, psychological distress, emotion regulation strategies, and depression (**Figure 1**). The first step of direct regression of independent variable to dependent variable was not necessary for mediation analysis (54); thus, the full model was conducted straightforward. Additionally, conditional direct and indirect effects were calculated with nonparametric bootstrapping method with 5,000 resamples. Finally, simple slope analysis was conducted to explore the patterns of significant moderation effect.

RESULTS

Descriptive Information

The ANOVA results showed that individuals at an older age and those with a higher education level experienced more severe psychological distress than individuals at a younger age or with a lower level of education (see **Table 1** for descriptive and test statistics). Additionally, there was a significant positive correlation between age and psychological distress, $r = 0.14$, $p = 0.003$. Self-rated health was associated with depression and psychological distress; individuals with worse physical health status suffered more severe depression and psychological distress about the virus.

Descriptive statistics and correlations among social media exposure, psychological distress, emotion regulation, and depression are presented in **Table 2**. Social media exposure was positively related to psychological distress and depression, $r = 0.22$, $p < 0.001$; $r = 0.09$, $p = 0.042$. Psychological distress was positively correlated with depression, $r = 0.45$, $p < 0.001$. Significant correlations were also found between the use of the expressive suppression emotion regulation strategy and psychological distress, $r = 0.22$, $p < 0.001$, and depression

severity, $r = 0.16$, $p < 0.001$. The correlations between cognitive reappraisal and depression or psychological distress were not significant, $ps > 0.05$.

Prevalence of Depression

The prevalence of depression was estimated based on the BDI-II categorical system (50). In the current sample, 413 participants (85.1%) were classified as showing no to minimal depression (BDI-II scores from 0 to 13); 39 participants (8.0%) showed mild depression (BDI-II scores 14–19); 24 participants (5.0%) showed moderate depression (BDI-II scores 20–28), and nine participants (1.9%) showed severe depression (BDI-II scores 29 and above). Thus, 15.9% of the sample showed at least mild depression according to the BDI-II system of classifying respondents according to the severity of depression.

The Moderated Mediation Model

To examine the relationship between social media exposure, psychological distress, emotion regulation, and depression, a moderated mediation model was conducted. Results showed that social media exposure positively predicted psychological distress ($β = 0.24$, $p < 0.001$), and psychological distress positively predicted depression severity ($β = 0.043$, $p < 0.001$; **Table 3**). The conditional indirect effect was significant ($β = 0.10$; *Boot 95% CI = 0.07, 0.15*), while the conditional direct effect was non-significant ($β = −0.04$; *Boot 95% CI = −0.12, 0.05*). Thus, these results indicated that psychological distress fully mediated the relationship between social media exposure and depression. In addition, the interaction of psychological distress and expressive suppression in predicting depressive symptoms was significant ($β = 0.10$, $p = 0.017$). Simple slope analysis showed that among individuals who reported higher frequencies in using expressive suppression, psychological distress was significantly associated with more severe depression symptoms ($β = 0.52$, $p < 0.001$; **Figure 2**). Among individuals who reported a lower level of expressive suppression, significant correlation was also found between psychological distress and depression ($β = 0.33$, $p < 0.001$). Thus, psychological distress related to COVID-19 was associated with more severe symptoms of depression among participants both with high and low habitual usage of expressive suppression strategy, but with a greater predictive value among those who reported higher levels of suppression. Nevertheless, the interaction effect of cognitive reappraisal and psychological distress on depression was not significant ($β = −0.02$, $p = 0.696$); thus, the associations between psychological distress and depression severity were not influenced by cognitive reappraisal.

DISCUSSION

In this study, we investigated the mediating role of psychological distress and the moderating role of emotion regulation on the relationship between social media exposure and symptoms of depression of the general public during the COVID-19 pandemic in China. The prevalence of depression was 15.9%, and depression severity was correlated with worse physical health. Older age and more frequent exposure to social media posts about COVID-19 were associated with a higher

FIGURE 1 | The hypothesis moderated mediation model of social media exposure, psychological distress, emotion regulation, and depression.
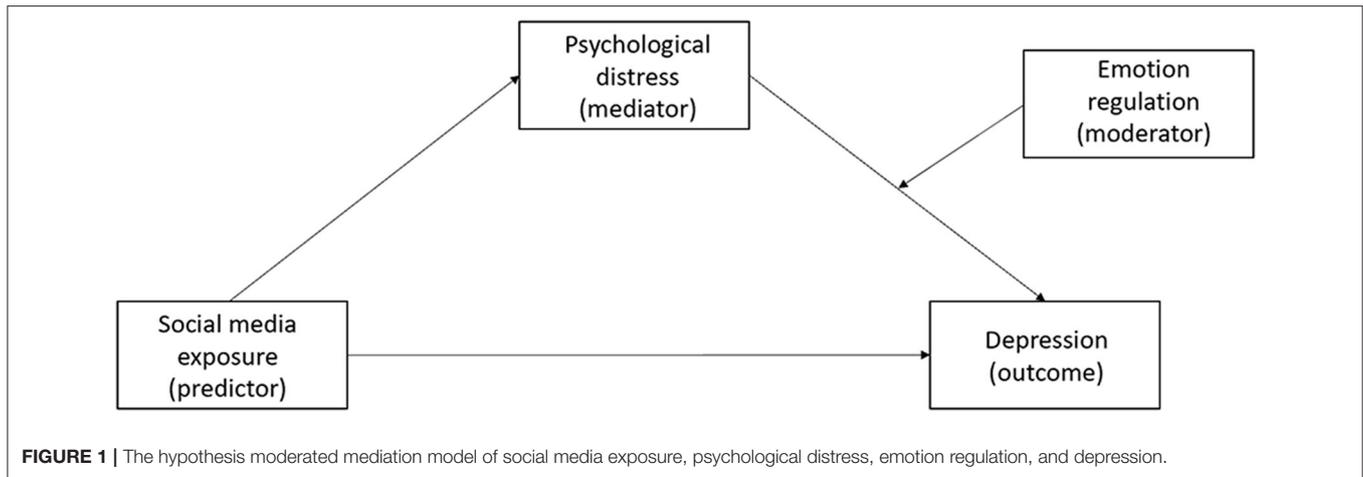
TABLE 1 | Comparison of sample characteristics on psychological distress and depression.

Characteristic		n (%)	IES-R	BDI-II
			$M \pm SD$	$M \pm SD$
Full sample		485 (100)	21.63 ± 13.55	6.24 ± 8.00
Gender	Male	193 (39.8)	21.46 ± 13.69	6.19 ± 8.99
	Female	292 (60.2)	21.74 ± 13.48	6.28 ± 7.30
	t		0.22	0.12
Region	Urban	212 (43.7)	22.65 ± 13.97	5.66 ± 6.91
	Rural	273 (56.3)	20.84 ± 13.18	6.69 ± 8.75
	t		1.46	1.45
Locality	Hubei province	55 (11.3)	23.62 ± 13.71	7.20 ± 5.85
	Others	430 (88.7)	21.38 ± 13.52	6.12 ± 8.24
	t		1.156	0.943
Age (years)	① >20	133 (27.4)	18.46 ± 13.53	7.09 ± 8.90
	② 21–30	142 (29.3)	22.46 ± 13.11	6.34 ± 7.42
	③ 31–40	93 (19.2)	22.60 ± 12.92	6.14 ± 8.64
	④ 41–50	96 (19.8)	23.24 ± 14.52	5.41 ± 7.39
	⑤ 50>	21 (4.3)	24.48 ± 12.39	4.48 ± 5.06
	F		2.68*	0.90
	Bonferroni		① < ④[a]	
Education	① Middle school	147 (30.3)	17.42 ± 12.71	6.44 ± 8.41
	② High school	95 (19.6)	22.15 ± 13.45	6.66 ± 8.12
	③ College or higher	243 (50.1)	23.98 ± 13.53	5.95 ± 7.73
	F		11.30**	0.33
	Bonferroni		① < ②, ① < ③	
Marital Status	① Married[b]	226 (46.6)	22.92 ± 13.60	5.48 ± 7.31
	② Unmarried	259 (53.4)	20.51 ± 13.43	6.90 ± 8.52
	T		1.96	1.96
Self-rated health	① Bad or average	60 (12.4)	22.87 ± 14.38	9.88 ± 10.33
	② Good	144 (29.7)	25.24 ± 13.65	6.85 ± 7.20
	③ Very good	281 (57.9)	19.52 ± 12.92	5.15 ± 7.59
	F		9.05**	9.58**
	Bonferroni		② > ③	① > ②, ① > ③

IES-R, The Impact of Event Scale-Revised; BDI-II, Beck Depression Inventory-II.
[a]p = 0.08.
[b]Including married, divorced, and widowed.
*p < 0.05, **p < 0.01.

TABLE 2 | Descriptive statistics and correlations among psychological distress, emotion regulation, and depression.
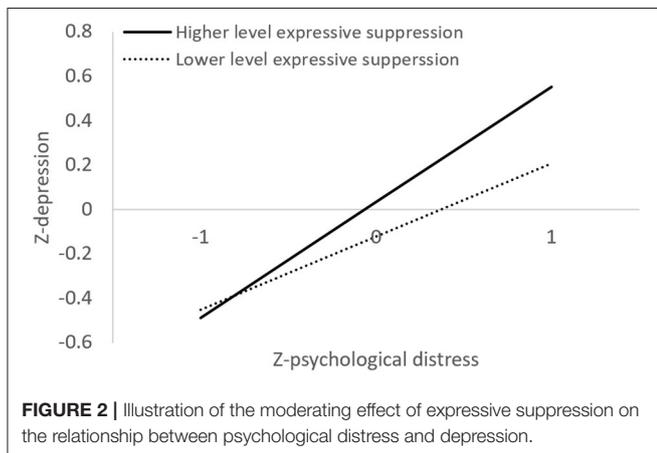
	1	2	3	4	5	M	SD
1.Social media exposure	–	0.22**	0.09*	0.02	−0.01	3.93	0.90
2. IES-R		–	0.45**	0.07	0.22**	21.63	13.55
3. BDI-II			–	−0.03	0.16**	6.24	8.00
4. ERQ: cognitive reappraisal				–	0.54**	27.87	7.36
5. ERQ: expressive suppression					–	15.20	4.77

N = 485. IES-R, The Impact of Event Scale-Revised; BDI-II, Beck Depression Inventory-II; ERQ, Emotion Regulation Questionnaire.
*p < 0.05, **p < 0.01.

TABLE 3 | Testing the moderated mediation effect of social media exposure, psychological distress, and expressive suppression on depression.

	Psychological distress			Depression		
	β	SE	t	β	SE	t
Social media exposure	0.24	0.04	5.43**	−0.04	0.04	−0.87
Psychological distress (PD)				0.43	0.04	10.12**
Expressive suppression (ES)				0.08	0.04	1.87
PD × ES				0.10	0.04	2.41*
R^2	0.06			0.22		
F	29.47**			33.82**		

N = 485. The beta values are standardized coefficients.
*p < 0.05, **p < 0.01.

FIGURE 2 | Illustration of the moderating effect of expressive suppression on the relationship between psychological distress and depression.

level of psychological distress. Moreover, psychological distress played a mediating role in the relationship between social media exposure and depression, and the associations between psychological distress and depressive symptom severity were moderated by expressive suppression. The results demonstrate the psychological impact of COVID-19 outbreak on non-patients and suggest targets for possible intervention programs for the general population.

In the current study, nearly one in six members of the general public reported at least mild depression. The prevalence rate in our sample was relatively lower than in previous studies, in which 20.1–53.5% of participants reported depressive and anxiety symptoms, respectively (10, 11), which was conducted from January 30 to February 13, during which the new confirmed cases of COVID-19 reached a peak, whereas the present study was conducted from February 16 to 19, during which time the number of recovered COVID-19 patients has exceeded that of new cases for the first time (55). Moreover, this discrepancy might be related to the different measures of depressive symptoms used in the three studies. The present study applied the BDI-II, which was constructed based on the cognitive–behavioral model and emphasizes the cognitive symptoms of depression (56). Huang and Zhao (10) applied the CES-D, which emphasizes negative emotions (12), and Liu et al. (11) applied the PHQ-9, which incorporates the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) diagnostic criteria for major depressive disorder (13). Lambert et al. (57) found that the PHQ-9 cutoff is easier to reach than the CES-D cutoff, and the CES-D cutoff score is easier to reach than the BDI-II cutoff. The present study was administered during the COVID-19 outbreak; it could be more convincing to measure the dependent variable by comparing the severity of depressive symptoms from before and during the pandemic. A nationwide epidemiological study, however, demonstrates a lifetime prevalence rate of 6.8% for depression disorders in China (58); thus, the prevalence of depressive symptoms is more than two-fold higher during the COVID-19 pandemic compared with before the COVID-19 pandemic.

In the present study, individuals with worse self-reported physical health also reported more elevated levels of depression and psychological distress about COVID-19. Although our participants were not infected by COVID-19, the rapid spread

and high infectiousness of the virus (59) can cause changes in the lifestyles of non-patients, such as isolation to avoid exposure. Moreover, the practice of social distancing may result in more loneliness, which might contribute to elevated depressive symptoms (60). These lifestyle changes have been shown to have negative psychological effects, including generalized anxiety disorder, symptoms of depression, disrupted sleep (10), and symptoms of acute posttraumatic stress disorder (PTSD) (14).

People at an older age reported higher levels of psychological distress, which was consistent with Qiu et al. (9). The elderly and people with underlying health conditions have been shown to be more vulnerable to COVID-19 (61, 62). Perceived ageism and social isolation also contributed significantly to the relationship between age and psychological distress (63). Therefore, psychological interventions and physical health care services for the elderly are in urgent need to accommodate for potential emotional distresses in response to the COVID-19 crisis (64).

Informed by the emotional contagion theory and media effect theory, the study examined the association between social media exposure and psychological distress, and we found exposure to social media content concerning COVID-19 was associated with greater psychological distress. Indirect exposure to traumatic event *via* electronic media could lead to increased levels of PTSD and vicarious trauma (65, 66), especially exposure to the widely disseminated misleading information related to the COVID-19 outbreak on social media platforms (67). Additionally, the significant associations between social media exposure and depression severity were consistent with findings from a recent study, in which time spent on COVID-19 news *via* social media was utilized as measures of social media exposure, and they found that the time spent on social media was related to elevated depressive symptoms (68). Besides, the mediation effect suggested that social media exposure contributed to the elevated depressive symptom through psychological distress. Media exposure to COVID-19 has been found to be positively related to acute stress (69). There is considerable evidence that greater social media exposure is a risk factor contributing to depression and psychological distress in adolescents (70); further investigations are needed to clarify the potential moderators between the relationship of social media exposure and depressive severity related to COVID-19 in people of different ages.

Greater psychological distress related to COVID-19 was positively correlated with more severe depression symptoms. Psychological distress has been shown to be a common response to traumatic events such as traffic accidents and natural disasters (71, 72). Psychological distress has also been shown to be present nearly 4 years after receiving a diagnosis of SARS, an infectious disease that affects the respiratory system similar to the COVID-19 (73), suggesting a persistent impact of this kind of infectious disease on mental health. The results in the current study suggest that psychological distress related to the COVID-19 pandemic may predict the development of more severe chronic psychiatric illnesses, such as depression.

Results showed that the interaction between expressive suppression and psychological distress positively predicted depression severity, suggesting that habitual use of suppression strategy together with higher levels of psychological distress in response to COVID-19 outbreak contributes to the development of depression symptoms. The result was consistent with that of a recent study (41), which found that individuals who reported a higher level of expressive suppression exhibited enhanced physiological response in reaction to stressful life events. A large amount of research has shown that expressive suppression was closely related to the development and maintenance of depression episodes (32, 74–77). Specifically, the usage of expressive suppression was associated with increased negative affect and decreased positive affect in daily life (78) and to be inconducive to the maintenance of good interpersonal relationships, thus aggravated depressive symptoms (79).

On the other hand, the associations between depression and cognitive reappraisal, an adaptive emotion regulation strategy, did not reach significance level. The result was consistent with those of previous research (80, 81), in which insignificant correlations between cognitive reappraisal and depression were reported. Contrary to expressive suppression, a response-focused emotion regulation, cognitive reappraisal was an antecedent-focused strategy, which requires individuals to make adjustments before behavior and psychological well-being are affected (32). The COVID-19 was a public health emergency of international concern; thus, it was difficult for individuals to pre-evaluate the psychological impact and to regulate their emotions ahead of its sudden outbreak. In addition, it has been shown that expressive suppression was associated with higher stress-related symptoms in trauma-exposed community samples, while cognitive reappraisal was not (40). The meta-analysis indicated a medium effect size on the associations between suppression and posttraumatic stress symptoms, but no significant effect was found for reappraisal and post-trauma symptoms (82). These findings indicated that for stress-related symptoms, expressive suppression may play a more important role than cognitive reappraisal. However, further studies are needed to test the potential mediating role of other emotion regulation strategies (such as distraction and social sharing) as well as consider other relevant outcome variables, such as anxiety.

The current study has several limitations. Firstly, the sample size was not large enough to be representative of non-patients affected by COVID-19 in China. Secondly, due to lockdown measures, data were collected *via* SNSs with self-reported questionnaires; thus, the results might be susceptible to memory bias and response tendencies such as social desirability. Recruitment *via* SNSs might bias samples and result in underrepresentation of older individuals (83). There were only a few participants over the age of 60 in the present study; the geriatric age-group, however, has a higher risk of contracting the disease and greater prevalence of psychological distress related to COVID-19 (46). Thirdly, this was a cross-sectional survey research that only revealed correlational effect. Causal relationships among social media exposure and depression cannot be determined. Longitudinal research is warranted to explore the dynamic change in mental health during different stages of the COVID-19 pandemic and uncover the underlying mechanism on the development and maintenance of mental disorders.

CONCLUSIONS

The present study contributes to the better understanding of the role of social media exposure to COVID-19 in amplifying psychological distress and mental health consequences. Older age, poor self-reported physical health, and higher exposure to social media content about the pandemic were risk factors for mental health problems. Psychological distress fully mediated the relationship between social media exposure and depression. Additionally, habitual use of expressive suppression interacting with levels of psychological distress about COVID-19 contributed to a higher level of depression. The results highlight the necessity of providing psychological assistance for the elderly, and individuals reported greater psychological distress and habitual use of suppression during the COVID-19 pandemic. The current study helps to inform evidence-based guidelines for minimizing psychological distress and promoting mental well-being during the global pandemic emergency.

DATA AVAILABILITY STATEMENT

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

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ETHICS STATEMENT

This study was reviewed and approved by Central China Normal University. All participants provided informed consent to having their anonymous data used for research. In addition, informed consent was obtained from teachers of middle school students before data collection.

AUTHOR CONTRIBUTIONS

Y-tZ and R-tL collected and analyzed the data and wrote the first draft of the paper. X-jS and MP commented significantly to the draft of the paper. XL generated the idea, designed and supervised the study, and wrote the first draft of the paper. All authors have contributed to and have approved the final text.

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Mental Health Status of Late-Middle-Aged Adults in China During the Coronavirus Disease 2019 Pandemic

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Background: The novel coronavirus 2019 (COVID-19) pandemic and related compulsory measures have triggered a wide range of psychological issues. However, the effect of COVID-19 on mental health in late-middle-aged adults remains unclear.

Methods: This cross-sectional, web-based survey recruited 3,730 participants ($\geq$ 50 years old) between February 28 and March 11 of 2020. The Patient Health Questionnaire-9, Generalized Anxiety Disorder-7, Insomnia Severity Index, and Acute Stress Disorder Scale were used to evaluate depression, anxiety, insomnia, and acute stress symptoms. Multivariate logistic regression analysis was fitted to explore risk factors that were associated with the selected outcomes.

Results: The mean age of the participants was 54.44 ± 5.99 years, and 2,026 (54.3%) of the participants were female. The prevalence of depression, anxiety, insomnia, and acute stress symptoms among late-middle-aged adults in China during the COVID-19 pandemic was 20.4, 27.1, 27.5, and 21.2%, respectively. Multivariable logistic regression analyses showed that participants who were quarantined had increased odds ratios for the four mental health symptoms, and those with a good understanding of the COVID-19 pandemic displayed a decreased risk for all mental health symptoms among late-middle-aged adults. In addition, participants with a low income and with a risk of COVID-19 exposure at work had a remarkably high risk of depression, anxiety, and acute stress symptoms.

Conclusions: Mental health symptoms in late-middle-aged adults in China during the COVID-19 pandemic are prevalent. Population-specific mental health interventions should be developed to improve mental health outcomes in late-middle-aged adults during this public health emergency.

Keywords: COVID-19, late-middle-aged adults, mental health, prevalence, risk factors

INTRODUCTION

The novel coronavirus 2019 (COVID-19) outbreak began in December of 2019 and became an international public health emergency. COVID-19 is highly contagious and spreads quickly (1). More than 73 million people were infected with COVID-19, and 1,663,474 patients died worldwide as of December 19, 2020 (2). To control the escalation of the pandemic, governments have implemented several restrictive measures, including screening programs, control and containment measures, and quarantine strategies (3–5). The devastating consequences of the COVID-19 pandemic and compulsory measures that place people in isolation may trigger a wide range of psychological issues (6, 7). The identification of people who are at risk for developing mental health symptoms during the COVID-19 pandemic is important for policy making and medical resource allocation.

Based on published data, COVID-19 affects late-middle-aged adults more frequently than children and young adults (8). The geriatric population is generally more susceptible to severe illness and has a high mortality rate, ranging from 15 to 20%, because of more prolonged recovery and a faster progression of comorbidity caused by COVID-19 (9–11). Due to their relatively lower utilization of online social media, late-middle-aged adults may be sensitive to isolation and loneliness that are consequences of restrictive measures such as traffic restrictions and quarantine (12–15). Thus, they may suffer from more psychological stress during the COVID-19 pandemic; however, restrictive measures limit their access to mental health assistance (16). Moreover, previous studies found a high prevalence of mood and anxiety disorders and a heavy mental disorder burden in late-middle-aged adults, making them a vulnerable population for mental illness during COVID-19 (17, 18). The World Health Organization has warned that the risks of COVID-19 may generate greater mental health symptoms in these individuals during the pandemic and should receive more attention (19).

During other epidemics involving respiratory pathogens, such as severe acute respiratory syndrome, psychological symptoms among the geriatric population raised great concerns, and several personal and epidemic-related factors were associated with mental illness in late-middle-aged adults (20, 21). A recent study analyzed the psychological effects of COVID-19 on people over 60 years of age in China and found that 37.1% experienced depression and anxiety, with gender differences in emotional responses to the pandemic (22). Moreover, in late-middle-aged adults, an inverse relationship was found between age and mental health symptoms (23). However, a comprehensive profile of the mental health status of late-middle-aged individuals during the COVID-19 pandemic does not exist. The present study evaluated mental health outcomes among late-middle-aged adults during the COVID-19 pandemic by quantifying the magnitude of depression, anxiety, insomnia, and acute stress symptoms and analyzing potential risk factors that are associated with these mental health symptoms.

METHODS

Participants

The study was approved by the ethics committee of Peking University Sixth Hospital (Institute of Mental Health). Written informed consent was received online before the respondents began the questionnaire. This study follows the American Association for Public Opinion Research (AAPOR) reporting guidelines and the Strengthening the Reporting of Observational Studies in Epidemiology (STORBE) guidelines.

This cross-sectional, web-based study was conducted between February 28 and March 11 of 2020, during which the COVID-19 pandemic in China had stabilized and the cumulative number of confirmed cases reached a peak. A self-designed survey was released through the Joybuy web portal (http://www.jd.com/), a large commerce and information service platform with 0.44 billion active users in China by 2020. Among the 56,932 participants who provided informed consent and completed the questionnaire, 3,740 who were ≥ 50 years old completed all the survey questions. Ten participants who were infected with COVID-19 were excluded. Finally, a total of 3,730 late-middle-aged adults were included in the analyses.

Covariates and Outcomes

The survey lasted ~15 min and consisted of four parts that gathered information about demographic variables, asked epidemic-related questions, evaluated isolation conditions and social attitudes, and used standardized mental health-related scales. All questions in the questionnaire were introduced elsewhere (24).

The covariates used in this paper could be briefly categorized into the following five parts: (1) demographic characteristics, e.g., gender, living area, level of education, marital status, and monthly family income; (2) medical conditions, e.g., history of chronic diseases, history of psychiatric disorders, and family history of psychiatric disorders; (3) epidemic-related factors, e.g., participation in frontline work, family members or friends who were infected, family members or friends participating in frontline work, residence in Hubei Province, status of work or school resumption, and risk of exposure to patients due to occupational reasons; (4) experience with public health interventions, e.g., community control, traffic restrictions, and quarantine; and (5) concern and understanding of the COVID-19 pandemic. The levels of concern about and understanding of the COVID-19 pandemic were assessed using visual analog scales that ranged from 0 to 10, in which 0 indicated no concern or understanding and 10 indicated high concern about or understanding of the COVID-19 pandemic. The levels of concern about the COVID-19 pandemic were divided into two categories: scores > 5 were defined as highly concerned about the COVID-19 pandemic, and scores ≤ 5 were defined as not highly concerned about the COVID-19 pandemic.

The main mental health outcomes were depression, anxiety, insomnia, and acute stress symptoms, which were assessed in the fourth part of the survey using Chinese versions of the 9-item Patient Health Questionnaire (PHQ-9) (25), the 7-

item Generalized Anxiety Disorder Scale (GAD-7) (26), the Insomnia Severity Index (ISI) (27), and the Acute Stress Disorder Scale (ASDS) (28). Participants were classified as endorsing the corresponding symptoms according to the following cut-offs: PHQ-9 (normal [0–4], mild [5–9], moderate [10–14], and severe [15–21] depression), GAD-7 (normal [0–4], mild [5–9], moderate [10–14], and severe [15–21] anxiety), ISI (normal [0–7], subthreshold [8–14], moderate [15–21], and severe [22–28] insomnia), and ASDS (acute stress symptoms [dissociative cluster score ≥ 9 and cumulative re-experiencing, avoidance, and arousal cluster scores ≥ 28]). All measures were validated for use in Chinese populations (26, 29, 30). Based on values established in the literature (24, 31), cut-off scores of 5 for the PHQ-9, 5 for the GAD-7, and 8 for the ISI were adopted to detect depression, anxiety, and insomnia symptoms, respectively.

Statistical Analysis

Descriptive statistics were used to analyze demographic characteristics and pandemic-related information. The prevalence of mild and moderate-to-severe depression, anxiety, insomnia, and acute stress symptoms are reported as percentages of cases in different populations among all and quarantined late-middle aged adults. χ^2 tests were used to compare the prevalence of different mental health symptoms in stratified populations.

Respondents with missing values were removed from the multivariate logistic regression analysis. Multivariate logistic regression analysis was performed to calculate the adjusted odds ratios (AORs) and 95% confidence intervals (CIs) of the risk of mental health symptoms among all and quarantined late-middle-aged adults after adjusting for potential confounders, including demographic characteristics, medical conditions, epidemic-related factors, experience with public health interventions, and concern about and understanding of the COVID-19 pandemic. Analyses were conducted using SPSS 22 software. Statistical significance was set at $p < 0.05$, and all tests were two-tailed.

RESULTS

Demographic Characteristics

Table 1 shows the demographic characteristics of the 3,730 participants. The mean age of the sample was 54.44 ± 5.99 years. Of all participants, the majority were female (54.3%), married (91.9%), lived in urban areas (97.1%), and had a university degree or higher (67.1%). The proportions of late-middle-aged adults with a history of chronic disease, a history of psychiatric disorders, and a family history of psychiatric disorders were 24.0, 0.3, and 0.6%, respectively. Of all participants, 515 (13.8%) were frontline healthcare workers, 1,165 (31.2%) had family members or friends who were frontline workers, and 28 (0.8%) had family members or friends who were infected with COVID-19. Moreover, 3,508 (94.0%) participants were highly concerned about the COVID-19 pandemic, and 3,312 (88.8%) had a good understanding of the COVID-19 pandemic. Regarding isolation conditions, 3,435 (92.1%) participants experienced community control, 2,489 (66.7%) experienced traffic restrictions, and 737 (19.8%) had been quarantined.

TABLE 1 | Demographic characteristics and pandemic-related information among late-middle-aged participants.

Factor	Participants, no. (%)
Overall	3,730 (100.0)
Gender	
Male	1,704 (45.7)
Female	2,026 (54.3)
Living area	
Urban	3,623 (97.1)
Rural	107 (2.9)
Level of education	
Less than college	1,229 (32.9)
College degree or higher	2,501 (67.1)
Marital status	
Married	3,428 (91.9)
Unmarried	302 (8.1)
Monthly family income, ¥[a]	
0–4,999	888 (23.8)
5,000–11,999	1,742 (46.7)
≥ 12,000	1,100 (29.5)
Region	
Eastern	1,494 (40.1)
Northern	918 (24.6)
Northwest	114 (3.1)
Northeast	377 (10.1)
Central	273 (7.3)
Southern	337 (9.0)
Southwest	216 (5.8)
Missing	1 (0.0)
History of chronic disease	
Yes	896 (24.0)
No	2,712 (72.7)
Unknown	122 (3.3)
History of psychiatric disorders	
Yes	11 (0.3)
No	3,690 (98.9)
Unknown	29 (0.8)
Family history of psychiatric disorders	
Yes	23 (0.6)
No	3,672 (98.4)
Unknown	35 (0.9)
Are you a frontline worker?	
Yes	515 (13.8)
No	3,215 (86.2)
Have any of your family members or friends been infected with COVID-19?	
Yes	28 (0.8)
No	3,702 (99.2)
Are any of your family members or friends frontline workers?	
Yes	1,165 (31.2)
No	2,565 (68.8)
Are you in Hubei Province now?	
Yes	147 (3.9)
No	3,583 (96.1)

(Continued)

TABLE 1 | Continued

Factor	Participants, no. (%)
Are you highly concerned about the COVID-19 pandemic?	
Yes	3,508 (94.0)
No	222 (6.0)
Do you have a good understanding of the COVID-19 pandemic?	
Yes	3,312 (88.8)
No	418 (11.2)
Are you back to work now?	
Absent from work	1,035 (27.7)
Always at work	676 (18.1)
Not back to work	781 (20.9)
Back to work	1,238 (33.2)
Are you likely to be exposed to other people at work?	
Exposed to patients who are infected with COVID-19	121 (3.2)
Exposed to patients with other diseases	79 (2.1)
Exposed to general people	973 (26.1)
Not at work, work at home, or without exposure to people at work	2,334 (62.6)
Missing values	223 (6.0)
Do you live in a community that restricts people's access?	
Yes	3,435 (92.1)
No	295 (7.9)
Were there any traffic restrictions in your area during the pandemic?	
Yes	2,489 (66.7)
No	1,241 (33.3)
Have you ever experienced quarantine?	
Yes	737 (19.8)
No	2,993 (80.2)

COVID-19, coronavirus disease 2019. [a]1 ¥ = USD$0.14.

Prevalence of Mental Health Symptoms in Late-Middle-Aged Adults

A total of 761 (20.4%) respondents reported depression symptoms, including 473 (12.7%) with mild depressive symptoms and 288 (7.7%) with moderate-to-severe depressive symptoms. A total of 1,011 (27.1%) respondents had anxiety symptoms, including 688 (18.4%) with mild anxiety and 323 (8.7%) with moderate-to-severe anxiety. A total of 1,027 (27.5%) respondents had insomnia symptoms, including 820 (22.0%) with mild insomnia symptoms and 207 (5.8%) with moderate-to-severe insomnia symptoms. A total of 791 (21.2%) respondents reported acute stress symptoms.

The prevalence of depression, anxiety, insomnia, and acute stress symptoms was high among the following groups of participants: (1) participants with a history of psychiatric disorders (depression, 72.7%; anxiety, 72.7%; insomnia, 54.5%; acute stress, 54.5%); (2) participants who experienced traffic restrictions (depression, 22.3%; anxiety, 29.0%; insomnia, 29.1%; acute stress, 22.5%); and (3) participants who had been quarantined (depression, 26.1%; anxiety, 33.2%;

insomnia, 32.4%; acute stress, 25.9%). Individuals with a good understanding of the COVID-19 epidemic had a low prevalence of depression (19.1%), anxiety (26.1%), insomnia (26.6%), and acute stress (20.1%) symptoms. The following groups of late-middle-aged adults had a high prevalence of depression, anxiety, and acute stress symptoms: (1) those with a low income (0–4,999 yuan/month: depression [22.6%], anxiety [30.7%], acute stress [23.8%]; 5,000–11,999 yuan/month: depression [21.6%], anxiety [28.1%], acute stress [22.5%]); (2) residents of Hubei Province (depression, 29.9%; anxiety, 42.2%; acute stress, 29.9%); and (3) those who were likely to be exposed to patients who were infected with COVID-19 at work (depression, 38.0%; anxiety, 45.5%; acute stress, 35.5%). Additional details regarding the prevalence of mental health symptoms in the different populations are presented in **Table 2**. Additionally, the prevalence of mental health symptoms in the quarantined populations is presented in **Supplementary Table 1**.

Factors Associated With Mental Health Symptoms in Late-Middle-Aged Adults

A total of 223 participants (6.0%) were excluded from the regression analysis because of missing data. Several personal factors were associated with mental health symptoms. Male participants (AOR = 0.83, 95% CI = 0.70−0.97, p = 0.020) and married individuals (AOR = 0.76, 95% CI = 0.58–1.00, p = 0.046) had a lower risk of insomnia symptoms. Compared with participants who had a family income ≥ 12,000 yuan/month, late-middle-aged adults with low income were more susceptible to the following mental health symptoms: (1) depression (0–4,999 yuan/month: AOR = 1.35, 95% CI = 1.04–1.76, p = 0.026; 5,000–11,999 yuan/month: AOR = 1.37, 95% CI = 1.11–1.69, p = 0.004); (2) anxiety (0–4,999 yuan/month: AOR = 1.48, 95% CI = 1.17–1.87, p = 0.001; 5,000–11,999 yuan/month: AOR = 1.35, 95% CI = 1.12–1.63, p = 0.002); and (3) acute stress (0–4,999 yuan/month: AOR = 1.44; 95% CI = 1.11–1.87, p = 0.006; 5,000–11,999 yuan/month: AOR = 1.40, 95% CI = 1.14–1.72, p = 0.001). Additionally, associations were found between the following factors: (1) a history of chronic disease and insomnia (AOR = 1.51, 95% CI = 1.27–1.80, p < 0.001); (2) a history of psychiatric disorders and depression (AOR = 6.56, 95% CI = 1.62–26.56, p = 0.008); (3) a history of psychiatric disorders and anxiety (AOR = 5.01, 95% CI = 1.25–20.12, p = 0.023); and (4) a family history of mental disorders and anxiety (AOR = 2.96, 95% CI = 1.22–7.21, p = 0.017).

Participants who were likely to be exposed to patients who were infected with COVID-19 at work had a higher mental health risk than participants without a risk of exposure to patients who were infected with COVID-19. The AORs were as follows: (1) 2.57 (95% CI = 1.67–3.97, p < 0.001) for depression; (2) 2.39 (95% CI = 1.58–3.61, p < 0.001) for anxiety; and (3) 2.05 (95% CI = 1.32–3.16, p = 0.001) for acute stress. Additionally, participants with family members or friends who were infected with COVID-19 had a higher risk of acute stress (AOR = 2.28, 95% CI = 1.00–5.20; p < 0.050), and Hubei residents had a higher risk of anxiety symptoms (AOR = 1.63, 95% CI = 1.11–2.40, p = 0.012).

TABLE 2 | Categories of severity of anxiety, depression, insomnia, and acute stress in late-middle-aged adults stratified by pandemic-related factors.

	Depression[a]				Anxiety[b]				Insomnia[c]				Acute stress[d]		
	Participants, no. (%)				Participants, no. (%)				Participants, no. (%)				Participants, no. (%)		
Variables	Normal	Mild	Moderate to severe	p[e]	Normal	Mild	Moderate to severe	p[e]	Normal	Mild	Moderate to severe	p[e]	Normal	Stressed	p[e]
Overall	2,969 (79.6)	473 (12.7)	288 (7.7)		2,719 (72.9)	688 (18.4)	323 (8.7)		2,703 (72.5)	820 (22.0)	207 (5.5)		29,39 (78.8)	791 (21.2)	
Gender				0.912				0.422				0.119			0.283
Male	1,355 (79.5)	223 (13.1)	126 (7.4)		1,253 (73.5)	305 (17.9)	146 (8.6)		1,256 (73.7)	364 (21.4)	84 (4.9)		1,356 (79.6)	348 (20.4)	
Female	1,614 (79.9)	250 (12.3)	162 (8.0)		1,466 (72.4)	383 (18.9)	177 (8.7)		1,447 (71.4)	456 (22.5)	123 (6.1)		1,583 (78.1)	443 (21.9)	
Living area				0.081				0.123				0.224			0.427
Urban	2,891 (79.8)	456 (12.6)	276 (7.6)		2,648 (73.1)	663 (18.3)	312 (8.6)		2,631 (72.6)	796 (22.0)	196 (5.4)		2,858 (78.9)	765 (21.1)	
Rural	78 (72.9)	17 (15.9)	12 (11.2)		71 (66.4)	25 (23.4)	11 (10.3)		72 (67.3)	24 (22.4)	11 (10.3)		81 (75.7)	26 (24.3)	
Level of education				0.136				0.086				0.839			0.587
Less than college	961 (78.2)	160 (13.0)	108 (8.8)		874 (71.1)	235 (19.1)	120 (9.8)		888 (72.3)	269 (21.9)	72 (5.9)		962 (78.3)	267 (21.7)	
College degree or higher	2,008 (80.3)	313 (12.5)	180 (7.2)		1,845 (73.8)	453 (18.1)	203 (8.1)		1,815 (72.6)	551 (22.0)	135 (5.4)		1,977 (79.0)	524 (21.0)	
Marital status				0.122				0.407				0.011			0.878
Married	2,739 (79.9)	428 (12.5)	261 (7.6)		2,505 (73.1)	632 (18.4)	291 (8.5)		2,503 (73.0)	739 (21.6)	186 (5.4)		2,700 (78.8)	728 (21.2)	
Unmarried	230 (76.2)	45 (14.9)	27 (8.9)		214 (70.9)	56 (18.5)	32 (10.6)		200 (66.2)	81 (26.8)	21 (7.0)		239 (79.1)	63 (20.9)	
Monthly family income, ¥[f]				0.001				< 0.001				0.278			< 0.001
0–4,999	687 (77.4)	123 (13.9)	78 (8.8)		615 (69.3)	181 (20.4)	92 (10.4)		638 (71.8)	200 (22.5)	50 (5.6)		677 (76.2)	211 (23.8)	
5,000–11,999	1,366 (78.4)	226 (13.0)	150 (8.6)		1,253 (71.9)	329 (18.9)	160 (9.2)		1,248 (71.6)	396 (22.7)	98 (5.6)		1,350 (77.5)	392 (22.5)	
≥ 12,000	916 (83.3)	124 (11.3)	60 (5.5)		851 (77.4)	178 (16.2)	71 (6.5)		817 (74.3)	224 (20.4)	59 (5.4)		912 (82.9)	188 (17.1)	
History of chronic disease				0.178				0.021				< 0.001			0.132
Yes	696 (77.7)	124 (13.8)	76 (8.5)		648 (72.3)	166 (18.5)	82 (9.2)		598 (66.7)	232 (25.9)	66 (7.4)		692 (77.2)	204 (22.8)	
No	2,179 (80.3)	331 (12.2)	202 (7.4)		1,995 (73.6)	489 (18.0)	228 (8.4)		2,028 (74.8)	558 (20.6)	126 (4.6)		2,157 (79.5)	555 (20.5)	
Unknown	94 (77.0)	18 (14.8)	10 (8.2)		76 (62.3)	33 (27.0)	13 (10.7)		77 (63.1)	30 (24.6)	15 (12.3)		90 (73.8)	32 (26.2)	
History of psychiatric disorders				< 0.001				< 0.001				< 0.001			0.002
Yes	3 (27.3)	4 (36.4)	4 (36.4)		3 (27.3)	4 (36.4)	4 (36.4)		5 (45.5)	2 (18.2)	4 (36.4)		5 (45.5)	6 (54.5)	
No	2,946 (79.8)	466 (12.6)	278 (7.5)		2,700 (73.2)	679 (18.4)	311 (8.4)		2,685 (72.8)	808 (21.9)	197 (5.3)		2,916 (79.0)	774 (21.0)	
Unknown	20 (69.0)	3 (10.3)	6 (20.7)		16 (55.2)	5 (17.2)	8 (27.6)		13 (44.8)	10 (34.5)	6 (20.7)		18 (62.1)	11 (37.9)	
Family history of psychiatric disorders				0.059				0.022				0.240			0.511
Yes	16 (69.6)	4 (17.4)	3 (13.0)		13 (56.5)	9 (39.1)	1 (4.3)		16 (69.6)	4 (17.4)	3 (13.0)		19 (82.6)	4 (17.4)	
No	2,930 (79.8)	466 (12.7)	276 (7.5)		2,686 (73.1)	672 (18.3)	314 (8.6)		2,666 (72.6)	807 (22.0)	199 (5.4)		2,895 (78.8)	777 (21.2)	
Unknown	23 (65.7)	3 (8.6)	9 (25.7)		20 (57.1)	7 (20.0)	8 (22.9)		21 (60.0)	9 (25.7)	5 (14.3)		25 (71.4)	10 (28.6)	
Are you a frontline worker?				0.014				0.009				0.041			0.086
Yes	389 (75.5)	70 (13.6)	56 (10.9)		351 (68.2)	105 (20.4)	59 (11.5)		354 (68.7)	129 (25.0)	32 (6.2)		391 (75.9)	124 (24.1)	
No	2,580 (80.2)	403 (12.5)	232 (7.2)		2,368 (73.7)	583 (18.1)	264 (8.2)		2,349 (73.1)	691 (21.5)	175 (5.4)		2,548 (79.3)	667 (20.7)	

(Continued)

TABLE 2 | Continued

Variables	Depression[a]				Anxiety[b]				Insomnia[c]				Acute stress[d]		
	Participants, no. (%)				Participants, no. (%)				Participants, no. (%)				Participants, no. (%)		
	Normal	Mild	Moderate to severe	p^e	Normal	Mild	Moderate to severe	p^e	Normal	Mild	Moderate to severe	p^e	Normal	Stressed	p^e
Have any of your family members or friends been infected with COVID-19?				0.122				0.304				0.162			0.019
Yes	19 (67.9)	3 (10.7)	6 (21.4)		18 (64.3)	5 (17.9)	5 (17.9)		17 (60.7)	8 (28.6)	3 (10.7)		17 (60.7)	11 (39.3)	
No	2,950 (79.7)	470 (12.7)	282 (7.6)		2,701 (73.0)	683 (18.4)	318 (8.6)		2,686 (72.6)	812 (21.9)	204 (5.5)		2,922 (78.9)	780 (21.1)	
Are any of your family members or friends frontline workers?				0.641				0.077				0.017			0.439
Yes	922 (79.1)	147 (12.6)	96 (8.2)		827 (71.0)	226 (19.4)	112 (9.6)		814 (69.9)	288 (24.7)	63 (5.4)		909 (78.0)	256 (22.0)	
No	2,047 (79.8)	326 (12.7)	192 (7.5)		1,892 (73.8)	462 (18.0)	211 (8.2)		1,889 (73.6)	532 (20.7)	144 (5.6)		2,030 (79.1)	535 (20.9)	
Are you in Hubei Province now?				0.003				< 0.001				0.108			0.008
Yes	103 (70.1)	24 (16.3)	20 (13.6)		85 (57.8)	39 (26.5)	23 (15.6)		98 (66.7)	40 (27.2)	9 (6.1)		103 (70.1)	44 (29.9)	
No	2,866 (80.0)	449 (12.5)	268 (7.5)		2,634 (73.5)	649 (18.1)	300 (8.4)		2,605 (72.7)	780 (21.8)	198 (5.5)		2,836 (79.2)	747 (20.8)	
Are you back to work now?				0.187				0.353				0.343			0.342
Absent from work	828 (80.0)	117 (11.3)	90 (8.7)		764 (73.8)	176 (17.0)	95 (9.2)		745 (72.0)	222 (21.4)	68 (6.6)		803 (77.6)	232 (22.4)	
Always at work	527 (78.0)	96 (14.2)	53 (7.8)		486 (71.9)	128 (18.9)	62 (9.2)		476 (70.4)	160 (23.7)	40 (5.9)		536 (79.3)	140 (20.7)	
Not back to work	608 (77.8)	110 (14.1)	63 (8.1)		553 (70.8)	155 (19.8)	73 (9.3)		564 (72.2)	178 (22.8)	39 (5.0)		606 (77.6)	175 (22.4)	
Back to work	1,006 (81.3)	150 (12.1)	82 (6.6)		916 (74.0)	229 (18.5)	93 (7.5)		918 (74.2)	260 (21.0)	60 (4.8)		994 (80.3)	244 (19.7)	
Are you likely to be exposed to other people at work?				< 0.001				< 0.001				0.504			< 0.001
Exposed to patients infected with COVID-19	75 (62.0)	26 (21.5)	20 (16.5)		66 (54.5)	34 (28.1)	21 (17.4)		80 (66.1)	31 (25.6)	10 (8.3)		78 (64.5)	43 (35.5)	
Exposed to patients with other diseases	63 (79.7)	9 (11.4)	7 (8.9)		60 (75.9)	14 (17.7)	5 (6.3)		57 (72.2)	20 (25.3)	2 (2.5)		63 (79.7)	16 (20.3)	
Exposed to general people	796 (81.8)	115 (11.8)	62 (6.4)		723 (74.3)	178 (18.3)	72 (7.4)		714 (73.4)	217 (22.3)	42 (4.3)		799 (82.1)	174 (17.9)	
Not at work, work at home, or without exposure to people at work	1,884 (80.7)	296 (12.7)	154 (6.6)		1,731 (74.2)	423 (18.1)	180 (7.7)		1,706 (73.1)	493 (21.1)	135 (5.8)		1,853 (79.4)	481 (20.6)	
Do you live in a community that restricts people's access?				0.435				0.277				0.327			0.704
Yes	2,729 (79.4)	445 (13.0)	261 (7.6)		2,496 (72.7)	640 (18.6)	299 (8.7)		2,482 (72.3)	759 (22.1)	194 (5.6)		2,704 (78.7)	731 (21.3)	
No	240 (81.4)	28 (9.5)	27 (9.2)		223 (75.6)	48 (16.3)	24 (8.1)		221 (74.9)	61 (20.7)	13 (4.4)		235 (79.7)	60 (20.3)	
Were there any traffic restrictions in your area during the pandemic?				< 0.001				< 0.001				0.003			0.006
Yes	1,935 (77.7)	351 (14.1)	203 (8.2)		1,767 (71.0)	482 (19.4)	240 (9.6)		1,765 (70.9)	580 (23.3)	144 (5.8)		1,929 (77.5)	560 (22.5)	
No	1,034 (83.3)	122 (9.8)	85 (6.8)		952 (76.7)	206 (16.6)	83 (6.7)		938 (75.6)	240 (19.3)	63 (5.1)		1,010 (81.4)	231 (18.6)	

(Continued)

TABLE 2 | Continued

Variables	Depression[a]				Anxiety[b]				Insomnia[c]				Acute stress[d]		
	Participants, no. (%)				Participants, no. (%)				Participants, no. (%)				Participants, no. (%)		
	Normal	Mild	Moderate to severe	p[e]	Normal	Mild	Moderate to severe	p[e]	Normal	Mild	Moderate to severe	p[e]	Normal	Stressed	p[e]
Have you ever experienced quarantine?				< 0.001				< 0.001				0.001			< 0.001
Yes	545 (73.9)	108 (14.7)	84 (11.4)		492 (66.8)	148 (20.1)	97 (13.2)		498 (67.6)	181 (24.6)	58 (7.9)		546 (74.1)	191 (25.9)	
No	2,424 (81.0)	365 (12.2)	204 (6.8)		2,227 (74.4)	540 (18.0)	226 (7.6)		2,205 (73.7)	639 (21.3)	149 (5.0)		2,393 (80.0)	600 (20.0)	
Are you highly concerned about the COVID-19 pandemic?				0.004				0.364				0.363			0.004
Yes	2,809 (80.1)	437 (12.5)	262 (7.5)		2,563 (73.1)	645 (18.4)	300 (8.6)		2,548 (72.6)	768 (21.9)	192 (5.5)		2,781 (79.3)	727 (20.7)	
No	160 (72.1)	36 (16.2)	26 (11.7)		156 (70.3)	43 (19.4)	23 (10.4)		155 (69.8)	52 (23.4)	15 (6.8)		158 (71.2)	64 (28.8)	
Do you have a good understanding of the COVID-19 pandemic?				< 0.001				< 0.001				< 0.001			< 0.001
Yes	2,681 (80.9)	398 (12.0)	233 (7.0)		2,449 (73.9)	593 (17.9)	270 (8.2)		2,431 (73.4)	705 (21.3)	176 (5.3)		2,645 (79.9)	667 (20.1)	
No	288 (68.9)	75 (17.9)	55 (13.2)		270 (64.6)	95 (22.7)	53 (12.7)		272 (65.1)	115 (27.5)	31 (7.4)		294 (70.3)	124 (29.7)	

COVID-19, coronavirus disease 2019. [a]Scores of 5–9 on the Patient Health Questionnaire−9 were defined as mild depression, and scores of ≥ 10 were defined as moderate-to-severe depression. [b]Scores of 5–9 on the Generalized Anxiety Disorder−7 were defined as mild anxiety, and scores of ≥ 10 were defined as moderate-to-severe anxiety. [c] cores of 8–14 on the Insomnia Severity Index were defined as subthreshold insomnia, and scores of ≥ 15 were defined as moderate-to-severe insomnia. [d]Acute stress symptoms were defined as having an Acute Stress Disorder Scale dissociative cluster score of ≥ 9 and cumulative re-experiencing, avoidance, and arousal cluster scores of ≥ 28. [e] χ^2 tests were used to compare the prevalence of mild-to-severe mental health symptoms in different populations. [f] 1 ¥ = USD$0.14.

Participants who were quarantined exhibited a higher risk for all mental health symptoms after adjustment (depression: AOR = 1.35, 95% CI = 1.10–1.67, p = 0.005; anxiety: AOR = 1.28, 95% CI = 1.06–1.55, p = 0.012; insomnia: AOR = 1.30, 95% CI = 1.07–1.57, p = 0.007; acute stress: AOR = 1.36, 95% CI = 1.11–1.67, p = 0.003). Participants who experienced traffic restrictions reported depressive symptoms (AOR = 1.28, 95% CI = 1.04–1.57, p = 0.018) when compared with participants without traffic restrictions. In quarantined late-middle-aged adults, lower family income was associated with a higher risk for developing the following mental health symptoms: (1) depression (0–4,999 yuan/month: AOR = 2.77, 95% CI = 1.55–4.95, p = 0.001; 5,000–11,999 yuan/month: AOR = 1.92, 95% CI = 1.19–3.08, p = 0.008); (2) anxiety (0–4,999 yuan/month: AOR = 2.27, 95% CI = 1.35–3.84, p = 0.002; 5,000–11,999 yuan/month: AOR = 1.68, 95% CI = 1.10–2.56, p = 0.017); and (3) acute stress (0–4,999 yuan/month: AOR = 1.95, 95% CI = 1.10–3.44, p = 0.022; 5,000–11,999 yuan/month: AOR = 1.74, 95% CI = 1.10–2.75, p = 0.017). However, a lower education level resulted in a lower risk for depression (AOR = 0.53, 95% CI = 0.41–0.83, p = 0.005) and acute stress (AOR = 0.64, 95% CI = 0.41–0.98, p = 0.040). The detailed results of the multivariate analysis of the risk factors associated with mental health symptoms in quarantined late-middle-aged adults are shown in **Supplementary Table 2**.

Moreover, participants who had a good understanding of the COVID-19 pandemic were less vulnerable to depression (AOR = 0.55, 95% CI = 0.42–0.73, p < 0.001), anxiety (AOR = 0.65, 95% CI = 0.50–0.85, p = 0.002), insomnia (AOR = 0.67, 95% CI = 0.52–0.87, p = 0.003), and acute stress (AOR = 0.66, 95% CI = 0.50–0.88, p = 0.004). The detailed results of the multivariate analysis of the risk factors associated with depression, anxiety, insomnia, and acute stress symptoms in late-middle-aged adults during the COVID-19 pandemic are shown in **Table 3**.

DISCUSSION

This cross-sectional survey enrolled 3,730 respondents and determined the prevalence of mental health symptoms among late-middle-aged adults in China during the COVID-19 pandemic. Overall, 20.4, 27.1, 27.5, and 21.2% of late-middle-aged adults reported depression, anxiety, insomnia, and acute stress symptoms, respectively. After controlling for confounding factors, including demographic characteristics and pandemic-related factors, quarantine experience and the level of understanding of the COVID-19 pandemic were associated with all four mental health outcomes. Participants with a low income and who had COVID-19 exposure risk at work had a remarkably high risk of depression, anxiety, and acute stress symptoms. These findings may help understanding about the impact of the COVID-19 pandemic on mental health in late-middle-aged adults and provide information for stratified psychological prevention and intervention strategies.

Previous studies have mainly focused on young and middle-aged adults (32–34). The mental health status of late-middle-aged adults has been relatively understudied. The present study found that approximately one-fifth (20.4%) to one-quarter (27.5%)

of late-middle-aged adults experienced mild-to-severe mental health symptoms, including anxiety, depression, insomnia, and acute stress, during the COVID-19 pandemic in China. The prevalence of anxiety and acute stress in the present study was comparable to another study in late-middle-aged Australian adults, but the prevalence of depressive symptoms in Australia was higher than in the present study, which may be attributable to cultural differences and different measures (35). A previous study of 1,556 adults aged ≥ 60 years reported that 37.1% had anxiety or depression symptoms during the COVID-19 crisis (22). We found that 30.1% of late-middle-aged adults had depression or anxiety symptoms (17.4% of the participants had both depression and anxiety, 3.0% participants had depression only, and 9.7% participants had anxiety only), which was similar to but slightly lower than previous findings. These differences may have resulted from the distinct study design, different demographic characteristics of the population, and the time of data collection during the COVID-19 pandemic. Compared with young individuals from the same sample, the prevalence of mental health symptoms was lower in late-middle-aged adults (24). Older adults had a high prevalence of a history of chronic disease and low monthly family income, whereas more young individuals had family members or friends who were infected with COVID-19, had been quarantined, and were more likely to be exposed to patients who were infected with COVID-19, which increased the risk of mental health symptoms during the pandemic (24). We speculate that resilience is important when late-middle-aged adults confront the COVID-19 pandemic (36, 37). Further studies are needed to investigate the prevalence of mental health symptoms in late-middle-aged adults and to compare mental health outcomes in different populations during this public health emergency.

The present study identified several factors that were strongly associated with mental health symptoms in late-middle-aged adults during the COVID-19 pandemic. Notably, individuals with quarantine experience had a higher risk of all reported mental health symptoms. Moreover, low family income was associated with several mental health symptoms in quarantined participants. Quarantine has emerged as an effective public health measure to restrain the spread of COVID-19 infection, but it can hamper access to basic supplies, disrupt information flow, and increase both fear and anxiety (38, 39). Additionally, quarantine experience also leads to social isolation and a sense of loneliness, especially for geriatric populations who may be less comfortable using online tools (12, 13, 15, 40). Increases in proinflammatory immune responses and decreases in antiviral immune responses may be involved in the mechanism that underlies the impact of quarantine experience on mental health outcomes (13, 41). Several strategies could be developed to cope with the negative affect caused by quarantine. First, the quarantine period should be as short as possible because longer quarantine periods are associated with poorer psychological outcomes (38). Second, adequate supplies need to be provided to late-middle-aged adults, especially those who are impoverished. Third, social connections need to be enhanced, such as regular phone calls and suitable online applications (12, 42). Fourth, regular physical activity

TABLE 3 | Multivariable regression analysis of the risk factors associated with depression, anxiety, insomnia, and acute stress symptoms in late-middle-aged adults during the COVID-19 pandemic.

Variable	Depression		Anxiety		Insomnia		Acute stress	
	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	P
Gender								
Male	0.96 (0.80–1.15)	0.642	0.86 (0.73–1.01)	0.075	0.83 (0.70–0.97)	0.020	0.86 (0.72–1.03)	0.107
Female	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Living area								
Urban	0.90 (0.55–1.47)	0.682	0.89 (0.56–1.39)	0.598	0.88 (0.56–1.39)	0.595	1.13 (0.68–1.89)	0.642
Rural	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Level of education								
Less than college	0.94 (0.77–1.16)	0.560	0.99 (0.82–1.19)	0.879	0.96 (0.80–1.15)	0.672	0.86 (0.70–1.06)	0.153
College degree or higher	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Marital status								
Married	0.89 (0.65–1.20)	0.434	1.02 (0.77–1.35)	0.887	0.76 (0.58–1.00)	0.046	1.15 (0.84–1.58)	0.375
Unmarried	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Monthly family income, ¥[a]								
0–4,999	1.35 (1.04–1.76)	0.026	1.48 (1.17–1.87)	0.001	1.03 (0.82–1.30)	0.800	1.44 (1.11–1.87)	0.006
5,000–11,999	1.37 (1.11–1.69)	0.004	1.35 (1.12–1.63)	0.002	1.11 (0.93–1.33)	0.253	1.40 (1.14–1.72)	0.001
≥ 12,000	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
History of chronic disease								
Yes	1.18 (0.97–1.44)	0.103	1.06 (0.88–1.27)	0.566	1.51 (1.27–1.80)	< 0.001	1.15 (0.95–1.40)	0.161
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Unknown	1.19 (0.74–1.91)	0.484	1.55 (1.03–2.35)	0.036	1.64 (1.09–2.47)	0.019	1.37 (0.87–2.16)	0.168
History of psychiatric disorders								
Yes	6.56 (1.62–26.56)	0.008	5.01 (1.25–20.12)	0.023	3.16 (0.85–11.68)	0.085	3.21 (0.88–11.68)	0.077
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Unknown	0.46 (0.11–1.97)	0.298	1.04 (0.33–3.33)	0.942	2.84 (0.91–8.90)	0.073	1.71 (0.49–5.93)	0.396
Family history of psychiatric disorders								
Yes	2.09 (0.81–5.40)	0.130	2.96 (1.22–7.21)	0.017	0.97 (0.37–2.58)	0.956	0.99 (0.32–3.04)	0.990
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Unknown	1.70 (0.57–5.08)	0.346	1.45 (0.53–3.92)	0.468	0.61 (0.20–1.81)	0.369	0.62 (0.19–2.07)	0.438
Are you a frontline worker?								
Yes	1.21 (0.91–1.60)	0.184	1.19 (0.93–1.53)	0.174	1.15 (0.89–1.48)	0.278	1.26 (0.96–1.66)	0.102
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Have any of your family members or friends been infected with COVID-19?								
Yes	1.62 (0.69–3.83)	0.272	1.20 (0.52–2.78)	0.664	1.62 (0.72–3.65)	0.241	2.28 (1.00–5.20)	< 0.050
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Are any of your family members or friends frontline workers?								
Yes	0.93 (0.76–1.13)	0.481	1.04 (0.87–1.24)	0.685	1.13 (0.95–1.34)	0.181	0.98 (0.81–1.19)	0.813
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Are you in Hubei Province now?								
Yes	1.37 (0.90–2.08)	0.141	1.63 (1.11–2.40)	0.012	1.02 (0.68–1.53)	0.918	1.28 (0.84–1.95)	0.248
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Are you back to work now?								
Absent from work	0.92 (0.68–1.23)	0.560	0.87 (0.67–1.13)	0.299	0.98 (0.75–1.26)	0.848	0.95 (0.72–1.26)	0.738
Always at work	1.11 (0.87–1.43)	0.402	1.00 (0.80–1.26)	0.968	1.15 (0.92–1.44)	0.216	0.94 (0.73–1.21)	0.641
Not back to work	1.12 (0.83–1.50)	0.453	1.07 (0.82–1.39)	0.636	0.99 (0.76–1.29)	0.928	0.92 (0.69–1.23)	0.577
Back to work	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Are you likely to be exposed to other people at work?								
Exposed to patients infected with COVID-19	2.57 (1.67–3.97)	< 0.001	2.39 (1.58–3.61)	< 0.001	1.39 (0.91–2.14)	0.130	2.05 (1.32–3.16)	0.001

(Continued)

TABLE 3 | Continued

Variable	Depression		Anxiety		Insomnia		Acute stress	
	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	P
Exposed to patients with other diseases	1.06 (0.58–1.94)	0.853	0.93 (0.53–1.64)	0.802	1.02 (0.59–1.74)	0.954	0.96 (0.53–1.75)	0.889
Exposed to general people	0.99 (0.76–1.29)	0.925	1.05 (0.83–1.33)	0.696	1.02 (0.81–1.29)	0.869	0.86 (0.66–1.12)	0.275
Not at work, work at home, or without exposure to people at work	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Do you live in a community that restricts people's access?								
Yes	1.12 (0.78–1.61)	0.533	1.16 (0.84–1.60)	0.363	1.05 (0.77–1.44)	0.739	1.06 (0.75–1.50)	0.735
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Were there any traffic restrictions in your area during the pandemic?								
Yes	1.28 (1.04–1.57)	0.018	1.16 (0.97–1.38)	0.116	1.18 (0.99–1.41)	0.066	1.17 (0.96–1.43)	0.114
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Have you ever experienced quarantine?								
Yes	1.35 (1.10–1.67)	0.005	1.28 (1.06–1.55)	0.012	1.30 (1.07–1.57)	0.007	1.36 (1.11–1.67)	0.003
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Are you highly concerned about the COVID-19 pandemic?								
Yes	1.04 (0.70–1.54)	0.858	1.27 (0.87–1.85)	0.220	1.12 (0.78–1.62)	0.540	0.86 (0.59–1.26)	0.437
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Do you have a good understanding of the COVID-19 pandemic?								
Yes	0.55 (0.42–0.73)	< 0.001	0.65 (0.50–0.85)	0.002	0.67 (0.52–0.87)	0.003	0.66 (0.50–0.88)	0.004
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	

AOR, adjusted odds ratio; COVID-19, coronavirus disease 2019. [a] 1 ¥ = USD$0.14.

and mindfulness practices should be implemented during the pandemic (40, 43).

Understanding COVID-19-related information and being cognizant of exposure risk at work were two other important risk factors for mental health symptoms in late-middle-aged adults. Similar to previous findings, most of the participants had a good understanding and knowledge of the pandemic (44). Our findings showed that a good understanding of the COVID-19 pandemic could help relieve mental health symptoms, including depression, anxiety, insomnia, and acute stress. This indicates the need to disseminate pandemic-related information to the late-middle-aged population during the pandemic (45, 46). Additionally, compared with participants who did not have a risk of exposure to COVID-19 patients at work, late-middle-aged adults who were potentially exposed to COVID-19 patients at work had a higher risk of developing depression, anxiety, and acute stress. This finding is consistent with previous studies of the general population, healthcare workers, and technical staff (24, 47, 48), thus demonstrating that providing more personal protective equipment for people with jobs that have a high exposure risk can improve well-being during the COVID-19 pandemic.

Some demographic characteristics, especially income level, were associated with mental health symptoms. Low income was associated with a higher risk of depression, anxiety, and acute stress symptoms. Poverty leads to an increase in the prevalence of mental health symptoms (49, 50). Past experience suggests that the consequences of economic downturns can be devastating for the elderly (51). During the pandemic,

income losses can destroy work plans, increase life burdens, and render people more susceptible to mental illness (51, 52). Therefore, late-middle-aged adults with a low family income should receive more access to social support. In the present study, a history of chronic disease was not a significant risk factor for depression, anxiety, or acute stress symptoms. Late-middle-aged adults with chronic disease only exhibited insomnia symptoms, which contradicts a survey in the Spanish population aged ≥ 60 years that reported a higher prevalence of depressive and anxiety symptoms in individuals with chronic disease (53). These disparate findings can be partially explained by differences in age and living area. Most of the participants in the present study were relatively young and lived in urban areas. Therefore, they may have fewer comorbidities and can receive medical assistance more easily. This indicates that sufficient medical care, including mental health services, is necessary for this population.

The present study has limitations. First, selection bias may be unavoidable because of the use of an online social media application to recruit participants. The survey was conducted among internet users who were highly educated and more concerned about the pandemic; thus, the representativeness of the sample might be limited. Second, all the variables were only self-reported and not confirmed with validated tools, which may inflate the relationship between those factors and mental health symptoms. Third, this was a cross-sectional study that lacked a longitudinal follow-up. Dynamic changes in mental health symptoms among late-middle-aged adults during different phases of the COVID-19 pandemic are unknown.

Long-term psychological implications in this population should be investigated further.

CONCLUSIONS

In conclusion, late-middle-aged adults had a relatively high prevalence of depression, anxiety, insomnia, and acute stress symptoms during the COVID-19 pandemic in this survey. Factors such as quarantine experience, the level of understanding of the COVID-19 pandemic, risk of exposure to patients with COVID-19 at work, and economic status were associated with mental health symptoms in late-middle-aged adults. These findings indicate that mental health symptoms are common among late-middle-aged adults during the COVID-19 pandemic. Stratified interventions to promote well-being in late-middle-aged adults should be implemented during the pandemic. Future studies are needed to explore the long-term effects of COVID-19 on mental health in late-middle-aged adults.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by ethics committee of Peking University Sixth Hospital. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

Y-BZ, LS, Z-AL, J-YQ, X-LH, Y-PB, JS, and LLu conceived and designed the framework of this study. LS, Z-AL, J-YQ, and X-LH collected data. Y-BZ, LS, Z-AL, LLiu, Y-HW, Q-DL, and ZW executed the statistical analyses. Y-BZ and LS drafted the manuscript. KY, WY, YH, X-YS, Y-PB, JS, and LLu revised the manuscript. All authors read and approved the final manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.643988/full#supplementary-material

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Post-traumatic Growth Level and Its Influencing Factors Among Frontline Nurses During the COVID-19 Pandemic

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Objective: To assess post-traumatic growth (PTG) level and explore its influence factors among frontline nurses during the COVID-19 pandemic.

Methods: From April 11th to 12th, 2020, a cross sectional study was conducted on 116 frontline nurses who had participated in fight against the COVID-19 in Wuhan city, China. General information and psychological discomfort were collected. Chinese version post-traumatic growth inventory with 20 items was applied to assess PTG level. Univariable analyses and multiple linear regression were performed to explore potential influencing factors of PTGI score.

Results: The average score of PTGI in frontline nurses was 65.65 ± 11.50. In univariable analyses, gender, age, education level, marital status, living with parents, professional title, working years and professional psychological support was not statistically associated with the PTGI score. In both univariable and multivariable analyses, having support from family members and friends, being psychological comfort and having children and increased the PTGI score significantly. The three factors only explained 3.8% variance.

Conclusion: Moderate PGT was observed in the frontline nurses who had battled against COVID-19. Social support and professional psychological intervention should be applied to further improve PTG level. Further studies with large sample size are required to explore more potential influencing factors.

Keywords: COVID-19, frontline health worker, nurses, post-traumatic growth, influencing factors

BACKGROUND

In recent decades, the emergence of coronavirus has posed a huge threat on global health for causing significant mortality worldwide, such as severe acute respiratory syndrome (SARS-CoV) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV) [1]. In December 2019, the first case of coronavirus disease 2019 (COVID-19) emerged in Wuhan city, Hubei province, China [2].

The COVID-19 requires timely diagnosis and effective treatment to prevent progression to severe or critical infection and lower risk of death [3]. Healthcare workers (HCWs) was the first-line fighters treating patients with COVID-19. Many HCWs in Wuhan city had been fighting against

the COVID-19 pandemic for about 3 months. Increasing number of infected cases and uncertainty in the virus made HCWs under considerable workload and psychological pressure (4). A systematic review concluded high prevalence of post-traumatic stress symptoms (PTSS) related to the COVID-19 pandemic among HCWs and summarized potential predictors, such as young age, female and lack of social support (5).

Although a traumatic event can cause post-traumatic negative symptoms, the negative experience can be a "catalyst" for positive change, a growing number of studies showed positive post-traumatic growth (PTG) resulting from coping with trauma and an adaptive response to the adverse trauma (6, 7). PTG had been extensively studies in some natural disasters, such as earthquakes (8) and tsunami (9). HCWs may have great potential to develop PTG because of their professional characteristics. Nurses reported higher PTG score compared with social workers when working with war victims (10). During the COVID-19 pandemic, Kristine Olson and Martin Huecker emphasized the great significance to study PTG and its facilitators among HCWs (11, 12). A study conducted in February 2020 showed that 167 frontline nurses in Henan and Hubei, China, had demonstrated a moderate and above level of PTG during the early stages of the pandemic, meanwhile, the PTG level was associated with working years, self-confidence in frontline work, awareness of risk, psychological intervention, or training and deliberate rumination (13). Another large-scale survey conducted in April 2020 discussed relationship among burnout and PTG, influencing factors of PTG were not explored (14). However, little studies focused on the PTG level of nurses who had been locked in Wuhan city and had been working at frontline to against the pandemic from the beginning of the pandemic.

In this study, a selected tertiary Grade A hospital of Wuhan city was the first hospital to treat patients infected with COVID-19 from the beginning of the outbreak. More than 5,200 COVID-19 patients and 30,000 fever patients were admitted. This survey was conducted after the Wuhan city was unlocked at April 8th. It is of great significance to investigate post-traumatic growth level and its influencing factors among this population. Results from this study may help nursing managers identify nurses at risk of low PTG and develop systematic and effective intervention program.

METHODS

Respondents

At January 23, 2020, the Wuhan city was blocked and the COVID-19 outbreak started. These nurses from a designated tertiary grade A hospital in Wuhan city were recruited to treat patients infected with COVID-19. At April 8th, 2020, the Wuhan city was unblocked. Until then, these nurses had been working in the isolation ward and had been living alone in a designated hotel to decrease transmission. We conducted this survey in the designated hospital from April 11th, 2020 to April 12, 2020. Inclusion criteria: (1) Had been participating in the frontline from beginning of the pandemic (2) working years ≥1 year, (3) agreed to participate in this survey.

This study was reviewed and approved by the Ethics Committee of the Union Hospital of Tongji Medical College,

Huazhong University of Science and Technology [2020] Lunshenzi (0025); Special approval was obtained from the new coronavirus pneumonia emergency in 2020, project number 2020kfyXGYJ001.

Measuring Instruments and Data Collection

A self-administered online questionnaire was developed and distributed by a QR code linked to questionnaire. Each question was required to be answered before submission, and the time consumed for each recorded was further inspected. The questionnaire consisted of three parts: (1) Informed consent and instruction, (2) basic characteristics, and (3) a Chinese version of Post-Traumatic Growth Inventory (PTGI).

The basic characteristics included age(years), gender (male/female), marital status (married/unmarried/divorced/widowed), education level (high school or below/college/undergraduate/postgraduate/doctor), professional title (general nurse/ nurse practitioner/supervisor nurse /chief nurse), working experience (years), whether you had children (yes/no), whether you lived with parents (yes/no), and whether you got support from family and friends during the epidemic (yes/no), and any physical discomfort during the epidemic (yes/no). If participants reported they had physical discomfort, they were required to check specific discomforts (yes/no for each item), including insomnia, gray hair/hair loss, weight loss, loss of appetite, irregular menstruation, Lumbar muscle strain/muscle soreness, coughing/sputum, and skin eczema.

Post-Traumatic Growth Inventory (PTGI) was developed by Tedeschi and Calhoun to assess PTG level (15). The original version included 21 items in 5 dimensions. In this study, a Chinese version with 20 items was adopted (16). Its Cronbach's α was 0.874. The item 18 "I am more firm in my religious belief" was deleted based on low correlation with total score and Chinese local culture. This scales consisted of 5 dimension, namely, Insights on life (6 items), personal strength (3 items), new possibilities (4 items), relationships with others (3 items), and self-transformation (4 items). The Likert scale was used, each score ranged from 0 to 5 for a total of 100 points. Higher score suggested higher level of PTG. A total score >60 or average item score >3 indicated moderate and higher levels of PTG (17, 18).

Statistical Analysis

Age was classified into three categories, 20~30, 31~40, and 41~50 years. Work experience was divided into three types, <3, 3~8, and >8 years. With the limitation of small sample size, one category with few number in basic variable was combined based on medical knowledge. For PTGI score, descriptions were conducted for total score, 5 domains, and 20 items.

Categorical variables were described as frequency and percentage. Continuous variables were expressed as mean ± standard deviation or median (interquartile range) based on normality test. We performed group comparisons on total PTGI score for all basic characteristics. Both normality and homogeneity of variance were tested, Student' t-test or Wilcoxon rank-sum test was applied for two groups, analysis of variance or Kruskal-Wallis H-test were conducted for

TABLE 1 | Total score of Post-traumatic growth inventory and its 5 dimension and their average score of items.

Post-traumatic growth	Score Mean ± SD/Median (Q1, Q3)	Average score of items Mean ± SD/Median (Q1, Q3)
Post-traumatic growth total score, 20 items	65.65 ± 11.50	3.28 ± 0.57
5 domains		
Insights on life, 6 items	22.00 (20.00, 25.00)	3.67 (3.33, 4.17)
Personal strength, 3 items	10.00 (9.00, 11.00)	3.33 (3.00, 3.67)
New possibilities, 4 items	12.00 (10.00, 13.00)	3.00 (2.50, 3.25)
Relationship with others, 3 items	9.00 (8.00, 10.00)	3.00 (2.67, 3.33)
Self-transformation, 4 items	12.00 (11.00, 14.00)	3.00 (2.75, 3.50)

SD, standard deviation; Q1, the first quartile; Q3, the third quartile.

more than two groups. In multivariable regression, all basic characteristics were included, stepwise linear regression analysis was used to select potential effects of basic characteristics on PTGI. In the regression, binary variable (yes/no) of any physical discomfort was included instead of each specific discomfort.

All statistical analyses were conducted using SPSS version 19.0 (SPSS Inc., Chicago, IL). $P < 0.05$ (2-sided) was considered statistically significant.

RESULT

A total of 116 participants completed the questionnaires. After checking the filling time and missing values, no record was excluded, finally, 116 participants were included for final analysis. The average age was 34.07 years, 40% were younger than 30 years and the majority of participants was female (106, 91.40%). The average of total PTG score was 65.65 ± 11.50 and the average score of 20 items were 3.28 ± 0.57. Insights on life had the highest average score (median, 3.67), followed by personal strength, relationship with others, self-transformation and new possibilities, see **Table 1**. For each item, the top 3 items were item 13 (I can cherish each day better), item 15 (I have more sympathy for others) and item 2 (I have a better understanding of my life value). The last 3 items were item 14 (This event brought me a new opportunity), item 16 (I spent more energy on inter personal relationships), and item 3 (I developed a new interest).

In group comparison for basic characteristics, participants having child/children reported significantly higher PTG score than those without child/children, 67.27 ± 12.13 vs. 61.89 ± 8.94, $P < 0.001$. Compared with participants without any physical discomfort during the epidemic, participants who reported physical discomfort had higher PTG score (66.72 ± 11.52 vs. 61.05 ± 10.45, $P = 0.036$). Meanwhile, significantly higher PTG was observed in participants who got support from family and friends during the epidemic, 65(58, 74) vs. 59 (55, 63), $P = 0.043$. However, no significant difference existed in PTG score as related to gender, age group, marital status, education level, professional title, working experience group, and living with parents before the epidemic (**Table 2**).

In stepwise linear regression, all basic characteristics were included, but only having children, any physical discomfort and getting support from family and friends during the epidemic were kept in morel and independently and significantly increased the PTG score, 5.34 (95%CI, 0.87–9.90), 5.68 (95%CI, 0.36–10.99), and 9.82 (95%CI, 0.41, 19.24), respectively (**Table 3**). However, the three included characteristics only explained the 3.8% variation of PTG score (adjusted $R^2 = 0.038$), which indicated that other key factors were not included.

At last, the description of specific physic discomforts among 94 participants was reported in **Table 4**. The main symptom is insomnia (59.5%). About one in five nurses experienced gray hair/hair loss, weight loss, and loss of appetite. Meanwhile, about 10% nurses suffered from irregular menstruation.

DISCUSSION

Sudden emergency of the COVID-19 epidemic can be understood as a traumatic event which may trigger a PTSD-like responses and mental problems. In our study, these frontline nurses had been working in the epidemic center since the COVID-19 outbreak in Wuhan city. After Wuhan city was unlocked, the average score of PTG, as positive effect of the COVID-19 epidemic, was 65.65. It was similar to 70.53 in Pan's study (13). It suggested frontline nurses experienced a moderate and high growth after the epidemic.

Although the Wuhan city has many medical resources, including four tertiary A hospitals, a large number of patients have flowed into the hospital after the outbreak and it resulted in an apparent deficiency of medical resources. Many local nurses had been fighting against the COVID-19 for about 3 months since then. High-intensity and high-risk work required them to maintain resilience. During wok, these frontline nurses had to face many critically ill patients and deaths. After work, they were isolated in a single room, unable to meet with family and friends, and maintained a social distance with others. However, higher scores in "Treasure every day," "I have more sympathy for others," and "Better understanding of my life value" suggested that the experience make them realized the value of life. These nurses experienced the epidemic from the block to unblock, which could greatly affirm their efforts.

In this study, having children increased PTG level. "Mother being strong" is a public opinion on mothers. The duties and

TABLE 2 | Univariable analysis of basic characteristics on post-traumatic growth.

Variable	Number	PTG Score	F/t/z	P
Gender			0.27	0.785
Female	106	65.56 ± 11.60		
Male	10	66.60 ± 10.84		
Age (years)			0.64	0.532
20–30	46	64.17 ± 10.35		
31–40	50	66.76 ± 12.40		
41–50	20	66.25 ± 11.88		
Marital status			1.75	0.083
Married	91	66.62 ± 11.89		
Unmarried and others	25	62.12 ± 9.33		
Education			0.40	0.693
College and below	14	66.50 ± 7.92		
Undergraduate and above	102	65.53 ± 11.93		
Professional title			0.27	0.765
Nurse	18	63.83 ± 11.77		
Nurse practitioner	63	65.87 ± 11.24		
Supervisor nurse and higher	35	66.17 ± 12.50		
Working experience (years)			0.76	0.470
<3	42	64.64 ±10.78		
3–8	49	67.18 ± 12.34		
≥9	25	64.32 ± 11.05		
Whether you have children			2.66	0.009
Yes	81	67.27 ± 12.13		
No	35	61.89 ± 8.94		
Whether you live with parents before the epidemic			0.66	0.512
Yes	52	64.87 ± 11.78		
No	64	66.28 ± 11.32		
Any physical discomfort during the epidemic			2.11	0.036
Yes	94	66.72 ± 11.52		
No	22	61.05 ± 10.45		
Getting support from family and friends during the epidemic[a]			2.02	0.043
Yes	100	65(58, 74)[b]		
No	16	59 (55, 63)[b]		

[a]Wilcoxon rank-sum test; [b]median (the first quartile, the third quartile).
PTG, Post-traumatic growth.

role of mothers make them more brave and strong when facing difficulties and challenges. A psychological research on frontline nurses showed that the identity of "mother" shows a higher level of post-traumatic growth after trauma [19]. Appearance of physical discomfort during the epidemic also elevated the PTG level. The main symptoms of COVID-19 were similar to other common diseases, any physical discomfort during the fighting might be considered as additional negative event, which caused the nurses to suspect being infected. They might feel lucky if these discomforts relieved, which promoted the positive changes eventually. Moreover, an improved physical condition could help nurses cope with stress and reduce the psychological burden. Higher PTG was observed in nurses who got support from family and friends. Social support can turn trauma into growth by activating the cognitive process that promotes PTG [20]. A study on victims of the Sewol Ferry disaster showed that social support was positively associated with PTG level [21]. During the epidemic, two studies on Chinese healthcare workers found that social support relieved psychological pressure and promote mental health [22, 23]. However, it should be noted that the three factors only explained a small part of variation of PTG score. The Wuhan city where the participants located had just been unlocked, participants were still working at frontline and had not enough time to reflect deeply, and the potential characteristics affected the PTG level slightly.

Overall, the frontline nurses reported moderate PTG level. Post-traumatic depreciation, inverse of PTG, can coexist with PTG in the aftermath of Trauma [24]. Nursing administrators should make effective strategies to further improve PTG among frontline nurses. Promotors for PTG had been summarized by another systematic review by Charlotte Henson, such as sharing negative emotions and positive reappraisal [25]. A

TABLE 3 | Multiple stepwise regression of post-traumatic growth and related factors.

Variable	Coefficient (95% CI)	t	P
Whether you have children			
Yes	5.34 (0.87, 9.90)	2.36	0.02
No	Reference	–	–
Any physical discomfort during the epidemic			
Yes	5.68 (0.36, 10.99)	2.12	0.04
No	Reference	–	–
Getting support from family and friends during the epidemic			
Yes	9.82 (0.41, 19.24)	2.07	0.04
No	Reference	–	–

TABLE 4 | The prevalence of physical discomfort among 116 participants.

Symptoms of discomfort	Frequency	Percentage
Insomnia	69	59.48%
Gray hair/hair loss	31	26.7%
Weight loss	28	24.1%
Loss of appetite	25	21.6%
Irregular menstruation	11	10.4%
Lumbar muscle strain/muscle soreness	2	1.72%
Coughing/Sputum	2	1.72%
Skin eczema	1	0.9%

novel intervention program had been developed to improve nurses' PTG significantly (26). Based on results in this study, three strategies can be recommended. Firstly, increasing social support. The importance role of social support from family and friends during MERS-CoV epidemic and COVID-19 epidemic has been emphasized (27, 28). We should encourage family members, friends, and colleagues to maintain communication and communication with frontline nurses as much as possible. Item 14 "This event brought me a new opportunity" got the lowest score, it was significant to increase the rewards and give preferential policy for title evaluation and recruitment for these frontline nurses. Meanwhile, the media should cooperate with the hospital to guide the public correctly, such as reducing the panic caused by the fear of being infected by healthcare work. Secondly, regular screening for nurse with low PTG level and organizing professional psychological intervention. It can help frontline nurses eliminate fear, reduce psychological burden, and relieve work pressure. Setting up an anti-epidemic narrative nursing team can be an appealing method to conduct online psychological assistance and offline psychological assistance. Thirdly, no one is sure when the next outbreak will be. When facing stress, the different coping styles adopted by healthcare workers may have an important effect on mental health (29). Nurses with positive coping, appropriate social experience and psychological maturity should be recruited to the frontline. In addition, mindfulness decompression therapy is an effective strategy for relieving high-intensity stress and strengthening ability to regulate emotions (30).

The survey was a cross-sectional study with small sample size. New psychological problems may be revealed over time, meanwhile, this study only investigated a tertiary Grade A general hospital in Wuhan, representativeness of the sample was limited. Only three influencing factors were found with low explanation, future research should continue to elucidate potential factors that are predictive of PTG level. Meanwhile, a large longitudinal study in different regions was suggested to further explore PTG level and its change profile, and more potential influencing factors, which can formulate effective measures to promote nurses' PTG.

CONCLUSION

In this study, we observed moderated PGT level among these frontline nurses who had battled against COVID-19 in Wuhan city for more than 3 months. Having children, physical discomfort and getting support from family and friends during the epidemic were three influencing factors. Social support and professional psychological intervention should be applied to further improve PTG level. Moreover, further multicenter longitudinal studies with large sample size are required.

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/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Medical Ethics Committee. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

XP initiated and conceived this research article with her nursing team, collected data and supported with the first-line nurses' interviews, supervised, gave suggestions, and has involved in the original article writing. HZ has involved in contributing article with English version and translated the article. YY has involved in original article writing with Chinese version and supported the interview missions. ZR has involved in original article writing with Chinese version and supported the interview missions. DH has supervised our interviews and gave some professional advices to our article. QH has gave some professional advices to our article. All authors contributed to the article and approved the submitted version.

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Latent Profiles and Influencing Factors of Posttraumatic Stress Symptoms Among Adults During the COVID-19 Pandemic

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The COVID-19 pandemic severely affected public health and the prevalence of posttraumatic stress symptoms among adults in Hubei Province, China. In this study, a total of 2,930 (662 males and 2,268 females) adults answered a questionnaire obtaining information on their demographics, posttraumatic stress symptoms (i.e., intrusion and avoidance), social media exposure, social media involvement, and self-efficacy. Results of the latent profile analysis identified four latent profiles of posttraumatic stress symptoms, which are, no symptoms, high intrusion–low avoidance, moderate symptoms, and high symptoms. The multinomial logistic regression analyses revealed the contributors to the posttraumatic stress symptoms subgroups. Adults with high social media involvement were classified into the high intrusion–low avoidance group, whereas adults with low self-efficacy were included in the moderate symptoms group. Meanwhile, adults with high social media involvement and low self-efficacy were included in the high symptoms group. Interventions may focus on decreasing social media involvement for the adults in the high Intrusion–low avoidance group, improving self-efficacy for the adults in the moderate symptoms group, and reducing social media involvement and improving self-efficacy for the adults in the high symptoms group.

Keywords: social media, self-efficacy, COVID-19, latent profile, posttraumatic stress symptoms

INTRODUCTION

COVID-19 is an infectious disease caused by the most recently discovered coronavirus (1). As global public health threats (2), major infectious diseases can seriously affect public physical health, and cause mental health problems, such as posttraumatic stress symptoms. Posttraumatic stress symptoms refer to a set of mental symptoms triggered by traumatic events (e.g., war, accidents, violence, and disasters) and the experiences of people involved in such events (3), including intrusion, avoidance, hyperarousal, and negative alterations in cognition and mood (4). Major infectious diseases were bio-disasters and traumatic events, which may lead to posttraumatic stress symptoms among wider populations (2). For example, a recent study assessed the prevalence of posttraumatic stress symptoms during coronavirus outbreaks (e.g., SARS, MERS, and COVID-19) through a systematic review and the meta-analysis method and found that posttraumatic stress symptoms are common during coronavirus outbreaks, and approximately one in every

10 individuals from the general population experiences posttraumatic stress symptoms (5). Other empirical studies observed the existence of posttraumatic stress symptoms in the general population during the COVID-19 pandemic. For example, Crosta et al. reported that among 1,253 adults in Italy, approximately 35.59% belong to the high posttraumatic stress symptoms group (6). Liu et al. revealed that 31.8% of young adults in the United States experience high levels of posttraumatic stress symptoms (7). The above studies revealed the prevalence of posttraumatic stress symptoms among adults during the COVID-19 pandemic.

Furthermore, people generally experience different posttraumatic stress symptoms from traumatic events. Specifically, people may exhibit one or more posttraumatic stress symptoms (8), and the severity of each symptom varies (9). This variation indicates the existence of potential posttraumatic stress symptoms profiles among people. Latent profile analysis (LPA) is essential for capturing individual differences. LPA is a person-centered approach that can identify homogeneous subgroups (10), which can be used to develop population-based clinical treatments and interventions. Researchers explored latent posttraumatic stress symptoms profiles in adults with traumatic experiences. For example, Zhou et al. identified three posttraumatic stress symptoms profiles among 191 cancer patients, namely, the non-symptoms group, hyperarousal symptoms group, and severe symptoms group (11). Maguen et al. proposed a four-class posttraumatic stress symptoms profiles for 227 Iraq and Afghanistan veterans, namely, high symptoms, intermediate symptoms, intermediate symptoms with low emotional numbing, and low symptoms (12). However, studies on latent posttraumatic stress symptoms profiles in adults who experienced an infectious disease are limited. In addition, as a novel infectious disease, COVID-19 differs from other infectious diseases in terms of its long incubation period, rapid transmission, and widespread coverage area (13). Thus, using LPA to identify posttraumatic stress symptoms subgroups in adults during the COVID-19 pandemic is necessary to promote the research development of COVID-19.

To reduce the spread of COVID-19, the Chinese government implemented strict "physical distancing and quarantine" measures in the country, especially in Hubei Province. Physical distancing involves reducing close physical contact, and quarantine means restricting public activities or segregating individuals who are well but may have been exposed to COVID-19 (14). Although physical distancing and quarantine entail physical separation, social connections persist through social media platforms (15). Previous studies revealed the "double-edged sword" role of social media. On the one hand, social media can help ease anxiety and increase positive emotions during the COVID-19 pandemic (16). On the other hand, using social media to obtain information on COVID-19 may amplify the threats of the disease and cause mental health problems (17). In the use of social media, social media exposure and involvement play a significant role in the prevalence of posttraumatic stress symptoms. Social media exposure refers to people's active or passive collection of information about COVID-19 from social media (18), whereas social media involvement refers to people's

attention to and participation in social media (19), such as sharing and posting information about COVID-19. A recent study reported that in 4,827 Chinese adults, over 80% report frequent exposure to news and information about COVID-19 on social media (20). In terms of the impact of posttraumatic stress symptoms, previous studies examined the contribution of social media use to posttraumatic stress symptoms. For example, a study on 967 adults showed that compared with direct exposure to Hurricane Sandy, using social media to learn about Hurricane Sandy can cause posttraumatic stress symptoms (21). Monfort and Afzali investigated the posttraumatic stress symptoms experienced by 451 young adults after the 2015 terrorist attack in Paris and found that social media use is a predictor of posttraumatic stress symptoms (22). However, the impact of social media exposure and involvement on posttraumatic stress symptoms should be proven.

During physical distancing and quarantine periods, people's self-efficacy is closely related to posttraumatic stress symptoms. Self-efficacy is a positive personality characteristic that refers to an individuals' belief in his/her ability to execute or accomplish a task (23). Individuals with a high level of self-efficacy typically have positive mental health and a low likelihood of experiencing posttraumatic stress symptoms. For example, Nygaard et al. surveyed 617 adults who experienced the 2004 Southeast Asian tsunami and revealed a negative relationship between self-efficacy and posttraumatic stress symptoms (24). Meanwhile, LeBlanc found that people who perceive a low level of self-efficacy exhibit posttraumatic stress symptoms (25). Thus, self-efficacy may be a predictor of posttraumatic stress symptoms among individuals during the COVID-19 pandemic.

Based on existing research results, speculating that adults in Hubei Province may have different posttraumatic stress symptoms profiles during the COVID-19 pandemic is reasonable. Moreover, social media exposure, social media involvement, and self-efficacy may predict latent posttraumatic stress symptoms profiles. Considering intrusion and avoidance as core and basic posttraumatic stress symptoms, the present study focuses on the latent profiles of intrusion and avoidance (26). In summary, this study aims to (a) identify latent profiles of intrusion and avoidance among adults in Hubei Province and (b) explore whether social media exposure, social media involvement, and self-efficacy are contributors to different profiles of intrusion and avoidance.

METHOD

Participants and Procedure

The sample in this study was a subset in the Social Cognition and Behavior Investigation of COVID-19 survey. This survey was conducted from January 31 to February 8, 2020, which was the peak of the COVID-19 outbreak in Mainland China. The survey aimed to understand how people in Wuhan; other cities in Hubei, excluding Wuhan; and other cities outside Hubei perceived and responded to COVID-19. The characteristics of COVID-19 (13) make most individuals without protection susceptible to infection. Participants were recruited via convenience sampling through social media. Convenience

sampling through social media is a typical and common method used in public health emergency studies (27, 28). A total of 7,058 individuals (2,157 males and 4,901 females; mean age = 26.06 years, SD = 12.91, range = 8–72 years) participated voluntarily in the investigation. Ethics approval was obtained from the Human Subjects Ethics Sub-Committee of [anonymous for peer review]. The participants clicked on the agree button to indicate their agreement and informed consent before completing the questionnaire.

The participants of the current study (a) were residents of Hubei Province, (b) were over 18 years old, (c) could complete the online survey through social media, (d) could understand Chinese, and e) considered COVID-19 as a major stressful event in the past 2 weeks. Specifically, a criterion for the participants who considered COVID-19 as a major stressful event was that they perceived threat and stress from COVID-19 in the past 2 weeks, including the items "*My family/friends/neighbors and I may be infected with COVID-19*" (perceived threat) and "*I feel stressed about COVID-19*" (perceived stress). Participants who claimed to be positive, suspected to be positive, or survived the disease were excluded. Ultimately, 2,930 adults participated in the current study, including 662 males (mean age = 39.98 years, SD = 7.18) and 2,268 females (mean age = 37.12 years, SD = 6.42).

Table 1 presents the demographic information of the participants. Among the participants, 66.28% (N = 1,942) attained a high school education or above. The subjective socioeconomic status of the participants was measured using the MacArthur Scale of Subjective Socioeconomic Status Ladder (29), with 10 rungs ranging from 1 (lowest) to −10 (highest). In addition, 34.03% of the participants (N = 997) indicated having a middle socioeconomic status. For the self-reported general health, the participants were required to rate their general health as "very poor," "poor," "normal," "good," or "very good," and approximately 74.95% of the participants (N = 2,196) reported having "good" or "very good" health.

Measures
Posttraumatic Stress Symptoms
Posttraumatic stress symptoms were measured by an eight-item version of the Impact of Event Scale, which is a short version of the original 15-item scale (30). The eight-item version of the Impact of Event Scale contained two subscales, namely, intrusion and avoidance (31), which comprised four items each. The keywords for the items were modified to suit the current situation (e.g., "*Try to remove it from my memory*" was changed to "*Try to remove COVID-19 from my memory*") (32). The participants were required to answer the questions using a four-point Likert scale (0 = not at all, 1 = rarely, 3 = sometimes, 5 = often). The total score of each subscale represented the score of each dimension. The scale demonstrated good internal consistency coefficients (Cronbach's alpha = 0.78) in the previous study (31). In the current study, the Cronbach's alpha vales of the entire scale, intrusion subscale, and avoidance subscale were above 0.82.

Social Media Exposure and Involvement
Two items were developed to assess social media exposure and involvement based on a previous study on MERS (33). One item

TABLE 1 | Descriptive statistics of main variables and sample characteristics (N = 2,930).

Variables	N	Percentage
	Mean ± SD	**Range**
Total posttraumatic stress symptoms	16.96 ± 7.88	0–40
Intrusion	10.46 ± 5.04	0–20
Avoidance	6.51 ± 4.52	0–20
Social media exposure	5.00 ± 1.19	1–6
Social media involvement	3.51 ± 1.71	1–6
Self-efficacy	3.79 ± 0.71	1–5
Gender		
Male	662	22.59%
Female	2,268	77.41%
Educational level		
Primary school and below	172	5.87%
Junior school	816	27.85%
High school	889	30.34%
Bachelor and above	1,053	35.94%
Subjective socioeconomic status		
1 (lowest)	217	7.41%
2	105	3.58%
3	232	7.92%
4	257	8.77%
5	997	34.03%
6	634	21.64%
7	280	9.56%
8	164	5.60%
9	21	0.72%
10 (highest)	23	0.78%
Self-reported general health		
Very poor	4	0.14%
Poor	44	1.50%
Normal	686	23.41%
Good	1,366	46.62%
Very good	830	28.33%

(i.e., frequency of seeing or hearing information about COVID-19 on social media) was used to assess social media exposure, and the participants were required to answer the question on a six-point scale (ranging from 1 = rarely to 6 = always). The higher the score, the more the social media exposure. Social media involvement was measured by the other item (i.e., frequency of posting or sharing information about COVID-19 on social media), and participants were instructed to answer the question on a six-point scale (ranging from 1 = rarely to 6 = always). The higher the score, the more the social media involvement.

Self-efficacy
Self-efficacy in terms of COVID-19 was assessed with a four-item scale adopted from previous studies (33, 34). The respondents were asked to indicate the extent to which they agreed or disagreed with the statements about their self-efficacy on a five-point Likert scale ranging from 1 (strongly disagree) to

5 (strongly agree). The keywords were modified based on the current pandemic. High mean scores indicate high levels of self-efficacy in terms of COVID-19. The scale was reliable, with a Cronbach's alpha score of 0.78 in the previous study (33). In the present study, the Cronbach's alpha of the scale was 0.71.

Data Analysis

First, the descriptive and correlation statistics of the main variables (i.e., total posttraumatic stress symptoms, intrusion, avoidance, social media exposure, social media involvement, and self-efficacy) were obtained. Second, LPA was conducted to determine the latent profiles of intrusion and avoidance based on the scores of the eight items. LPA is a person-oriented approach that exhibits advantages over variable-oriented approaches. Variable-oriented approaches are used to identify variables of interest and describe their relations with individuals (35), whereas LPA focuses on identifying common attributes at the individual level and distinguishing homogeneous subgroups (10). The following indices were employed to determine the fitness of the results: the low Akaike information criteria (AIC), Bayesian information criterion (BIC), adjusted BIC values (ABIC), high entropy, and a significant value ($p < 0.001$) of Lo–Mendell–Rubin and likelihood ratio test (LMR-LRT), which indicates a superior fit (36). Third, multivariate ANOVA was conducted to test the group differences in the main variables. Finally, multinomial logistic regression analyses were performed to examine the association between the latent profiles of intrusion and avoidance and contributors (i.e., social media exposure, social media involvement, and self-efficacy). The data were analyzed using SPSS 24.0 and Mplus 7.4.

RESULTS

Descriptive and Correlation Statistics

The descriptive statistics (*mean $\pm$ SD*) of the main variables are presented in **Table 1**. For the correlations among the variables, total posttraumatic stress symptoms was positively related to social media exposure ($r = 0.06$, $p < 0.01$) and social media involvement ($r = 0.14$, $p < 0.01$), but negatively related to self-efficacy ($r = -0.04$, $p < 0.05$). Intrusion was positively correlated with avoidance ($r = 0.36$, $p < 0.01$), social media exposure ($r = 0.12$, $p < 0.01$), and involvement ($r = 0.17$, $p < 0.01$), whereas avoidance was negative related to self-efficacy ($r = -0.06$, $p < 0.01$).

Latent Profile Analysis

Table 2 displays the relevant indices of the LPA results. Based on the LMR-LRT, the two-to five- profile solutions were acceptable. The five-profile solution was rejected because it included a subgroup comprising <10% of the total sample. Given that the BIC was the most sensitive LPA index (36), the four-profile solution was the fittest.

Profile 1 included 13.52% of the total sample ($N = 396$) and representative participants without posttraumatic stress symptoms (no symptoms group). Profile 2 comprised 14.71% of the total sample ($N = 431$) and representative participants with high levels of intrusion and low levels of avoidance (high

intrusion–low avoidance group). Profile 3 included 32.56% of the total sample ($N = 954$, and representative participants with moderate levels of intrusion and avoidance (moderate symptoms group). Profile 4 consisted of 39.21% of the total sample ($N = 1,149$) and representative participants with high levels of intrusion and avoidance (high symptoms group). The standardized means of the four profiles are presented in **Figure 1**.

Multivariate ANOVA Analysis

The ANOVA indicated that the four groups (i.e., no symptoms group, high intrusion–low avoidance group, moderate symptoms group, high symptoms group) exhibited significant differences in terms of the total posttraumatic stress symptoms ($F = 3212.09$, $p < 0.001$), intrusion ($F = 1812.57$, $p < 0.001$), and avoidance ($F = 2448.35$, $p < 0.001$). The results also showed significant differences in the four groups in social media exposure ($F = 6.13$, $p < 0.001$), social media involvement ($F = 18.88$, $p < 0.001$), and self-efficacy ($F = 8.08$, $p < 0.001$). Specifically, the participants in the no symptoms group demonstrated high levels of self-efficacy (mean = 3.89, SD = 0.68) and low levels of social media exposure (mean = 4.97, SD = 1.26) and social media involvement (mean = 3.25, SD = 1.74). The participants in the high intrusion–low avoidance group obtained high scores on social media exposure (mean = 5.20, SD = 1.12), social media involvement (mean = 3.86, SD = 1.65), and self-efficacy (mean = 3.90, SD = 0.77). The participants in the moderate symptoms group scored low on social media exposure (mean = 4.91, SD = 1.20), social media involvement (mean = 3.27, SD = 1.71), and self-efficacy (mean = 3.75, SD = 0.68). Finally, the participants in the high symptoms group showed high levels of social media exposure (mean = 5.02, SD = 1.18) and social media involvement (mean = 3.66, SD = 1.69) and low levels of self-efficacy (mean = 3.75, SD = 0.70).
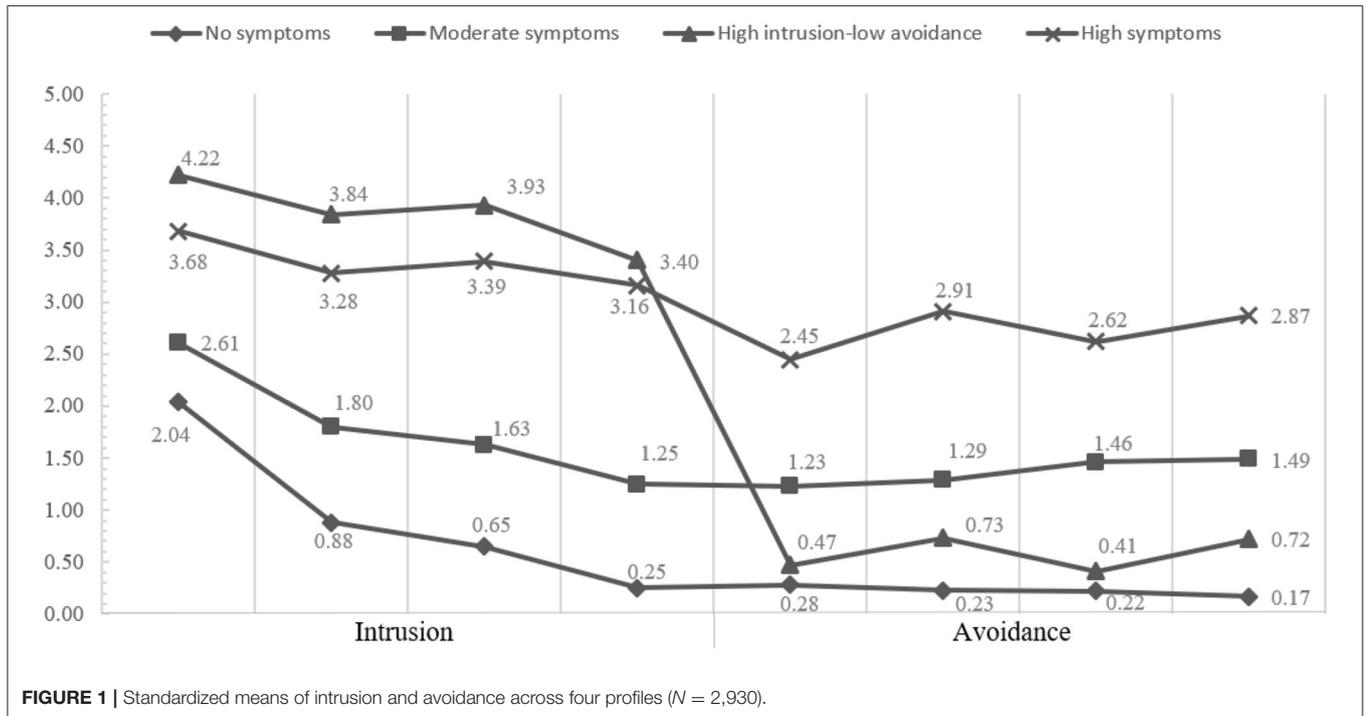
Multinomial Logistic Regression Analyses

The high intrusion–low avoidance, moderate symptoms, and high symptoms groups were compared with the no symptoms group as the reference group. **Table 3** shows that compared with the no symptoms group, (a) the adults with high social media involvement (OR = 1.21, 95%CI = 1.11–1.32) were classified into the High Intrusion-Low Avoidance group, (b) the adults with low self-efficacy (OR = 0.76, 95% CI = 0.64–0.90) had a high probability of being classified into the moderate symptoms group, and (c) the adults who reported high social media involvement (OR = 1.18, 95%CI = 1.09–1.26) and low self-efficacy (OR = 0.73, 95%CI = 0.62–0.87) were placed in the high symptoms group. However, social media exposure had no influence on the three symptoms groups.

Furthermore, the no symptoms, moderate symptoms, and high symptoms groups were compared with the high intrusion–low avoidance group as the reference group. The results revealed that (a) the adults with low social media involvement (OR = 0.84, 95% CI = 0.76–0.90) were classified into the no symptoms group; (b) the adults with low social media exposure (OR = 0.89, 95% CI = 0.80–0.99), social media involvement (OR = 0.85, 95% CI = 0.79–0.91), and self-efficacy (OR = 0.78, 95% CI = 0.66–0.92) had a high probability of being included in the moderate symptoms group; and (c) the adults who reported low

Model	AIC	BIC	ABIC	Entropy	LMR P-value	LRT P-value	Minimum Class Size N (%)
Two-profile	54108.81	54258.37	54178.94	0.84	<0.0001	<0.0001	1,124 (38.36%)
Three-profile	51978.99	52182.41	52074.38	0.86	<0.0001	<0.0001	412 (14.06%)
Four-profile	**50587.92**	**50845.18**	**50708.56**	**0.85**	**<0.0001**	**<0.0001**	**396 (13.52%)**
Five-profile	49972.34	50283.44	50118.22	0.86	<0.0001	<0.0001	233 (7.95%)
Six-profile	49795.77	50160.72	49966.89	0.86	0.3012	0.2958	90 (3.07%)

AIC, Akaike's information criterion; BIC, Bayesian Information Criterion; ABIC, Sample-size adjusted BIC; LMR, Lo-Mendell-Rubin adjusted likelihood ratio test; LRT, Bootstrapped likelihood ratio test. Bold represents best fit for each respective statistic.

FIGURE 1 | Standardized means of intrusion and avoidance across four profiles (N = 2,930).

self-efficacy (OR = 0.76, 95% CI = 0.64–0.89) were designated to the high symptoms group.

DISCUSSION

The current study explored the latent profiles of posttraumatic stress symptoms (i.e., intrusion and avoidance) among adults in Hubei Province during the COVID-19 pandemic. The results identified a four-profile solution that included a no symptoms group, high intrusion–low avoidance group, moderate symptoms group, and high symptoms group. The results of the multinomial logistic regression analyses validated the contribution of social media involvement and self-efficacy to the subgroups. Specifically, high social media involvement contributed to high intrusion and low avoidance levels, low self-efficacy contributed to moderate symptoms, and high social media involvement and low self-efficacy were associated with high symptoms. Ultimately, social media exposure showed no influence on the latent profiles of intrusion and avoidance.

The no symptoms, moderate symptoms, and high symptoms groups identified in the current study were similar to the subgroups among adults who experienced other traumatic events. For example, a study explored latent posttraumatic stress symptoms classes in 810 adults during a hurricane and identified a four-class pattern comprising severe, moderate, mild, and negligible groups (37). However, the high intrusion–low avoidance group that emerged in this study differed from existing posttraumatic stress symptoms groups. Thus, discussing the differences between the high intrusion–low avoidance group and high symptoms group is essential and meaningful. On the one hand, the participants in the high intrusion–low avoidance group demonstrated intrusion, whereas the participants in the high symptoms group exhibited intrusion and avoidance. On the other hand, the results of the ANOVA revealed that the adults in the high intrusion–low avoidance group had high levels of social media involvement and self-efficacy, whereas the adults in the high symptoms group had high levels of social media involvement and low levels of self-efficacy. The above findings indicated that self-efficacy may be a predictor of low avoidance.

TABLE 3 | Multinomial logistic regression modeling results of four profiles (N = 2,930).

	B	SE	p	Odds Ratio	95% CI for Odds Ratio
High intrusion–low avoidance vs. No symptoms					
Social media exposure	0.07	0.07	0.27	1.08	[0.95, 1.22]
Social media involvement	0.19	0.04	**0.00**	1.21	[1.11, 1.32]
Self-efficacy	−0.03	0.10	0.75	0.97	[0.79, 1.18]
Moderate symptoms vs. No symptoms					
Social media exposure	−0.04	0.05	0.44	0.96	[0.87, 1.06]
Social media involvement	0.03	0.04	0.50	1.03	[0.95, 1.10]
Self-efficacy	−0.28	0.09	**0.001**	0.76	[0.64, 0.90]
High symptoms vs. No symptoms					
Social media exposure	−0.03	0.05	0.55	0.97	[0.88, 1.07]
Social media involvement	0.16	0.04	**0.00**	1.18	[1.09, 1.26]
Self-efficacy	−0.31	0.09	**0.00**	0.73	[0.62, 0.87]

CI, confidence interval. The influences for statistical significant are in bold.

The results of the correlation analysis also provided evidence for the negative relationship between avoidance and self-efficacy. Thus, self-efficacy improvement can be used in interventions to reduce avoidance.

The present study focused on social media exposure to and involvement in COVID-19 information and determined the predictable role of social media involvement in posttraumatic stress symptoms. However, social media exposure exerted no influence on posttraumatic stress symptoms, which was inconsistent with our primary hypothesis. Social media exposure and involvement had different meanings in the current study. Social media exposure refers to people actively or passively obtaining information (i.e., seeing or hearing information) about COVID-19 from social media (18). Meanwhile, social media involvement refers to the behavior of actively obtaining information (i.e., posting, sharing, and commenting on information) about COVID-19 from social media, which entails increased attention to and engagement in information about COVID-19 (19). Moreover, social media exposure and social media involvement refer to the varying degrees that people indulge in social media (38). Social media exposure emphasizes receiving information about COVID-19, whereas social media involvement involves receiving and sharing information about COVID-19. Thus, social media involvement entails more active behaviors and higher indulgence than social media exposure. Furthermore, social media exposure and involvement exert different influences on posttraumatic stress symptoms. With the popularity of social media and diversification of its functions, social media exposure to COVID-19 information is common (20). All social media users can receive information about COVID-19, which may be why social media exposure had an insignificant impact on posttraumatic stress symptoms. In addition, as mentioned above, social media involvement indicates deeper indulgence in social media than social media exposure. Studies pointed out that high social media involvement may amplify adults' perceived risks of COVID-19 (17), which may harm public mental health. Therefore, in

our study social media involvement showing a significant influence on posttraumatic stress symptoms is understandable. Overall, the results highlighted the significant role of social media involvement and self-efficacy and provided evidence for population-based clinical treatments and interventions. For the high intrusion–low avoidance group, interventions should aim to reduce social media involvement (e.g., decrease time spent on social media). For the moderate symptoms group, interventions based on self-efficacy may be effective to reduce posttraumatic stress symptoms in adults (e.g., improve belief in ability to overcome COVID-19). For the high symptoms group, social media involvement and self-efficacy may be essential for interventions.

However, several limitations and directions for future research should be noted. First, the sample was unevenly distributed, which may influence the results. To determine whether the findings can be applied to a demographically representative sample, a subsample (N = 1,063) was created by randomly reducing the data to match the census records in terms of gender (male vs. female) and age (ranging from 35 years to 54 years). The census data of Hubei Province were obtained from reports by the National Bureau of Statistics (39). Similar results were observed in the demographically representative sample (see the **Supplementary Documents**). Fundamentally, researchers should consider using highly efficient methods in the future to address the issue of representativeness. Second, the current scale assessed limited posttraumatic stress symptoms (i.e., intrusion and avoidance). Thus, other symptoms (e.g., hyperarousal and negative alterations in cognition and mood) should be examined, and the latest multidimensional tools should be employed in future studies. The third issue concerns the cross-cultural applicability of the eight-item version of the Impact of Event Scale. Actually, the original 15-item version of the Impact of Event Scale was previously validated in the Western contexts (40) and the Chinese contexts (41), which showed satisfactory psychometric characteristics among adults. Therefore, we believe that the short version of the Impact of Event Scale used in the current study may also have cross-cultural applicability. Finally, data were collected using a cross-sectional design, but a longitudinal study should be conducted to further examine the characteristics of posttraumatic stress symptoms in adults.

In conclusion, this study targeted adults in Hubei Province, China, to investigate the heterogeneity of posttraumatic stress symptoms (i.e., intrusion and avoidance) and examine the factors contributing to posttraumatic stress symptoms subgroups during the COVID-19 pandemic. The results showed that social media involvement and self-efficacy may be predictors of posttraumatic stress symptoms among adults in Hubei Province. The findings provided evidence for public health management during the COVID-19 pandemic. On the one hand, social media plays a significant role in disseminating risk information on COVID-19. However, social media involvement may amplify adults' perceived risks of COVID-19 (17) and threaten their mental health. Thus, scientific media broadcasts and moderate social media involvement should be promoted in public health management. On the other hand, interventions promoting self-efficacy should be implemented widely by social workers and psychologists to help improve public health.

DATA AVAILABILITY STATEMENT

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

AUTHOR CONTRIBUTIONS

WD: conceptualization, methodology, visualization, writing—review and editing, supervision, and project administration. QG: conceptualization, methodology, formal analysis, and writing—original draft. QJ: conceptualization, methodology, visualization, and writing—review and editing. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.620521/full#supplementary-material

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