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Psychological problems and related factors among primary healthcare staff in major cities in China during the COVID-19 pandemic

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This study aimed to explore psychological problems and related factors among frontline primary healthcare workers who belongs to community health service centers and directly provides medical security services to community residents during the COVID-19 in Shanghai. We used a cross-sectional data analysis design to investigate the anxiety and depression levels of 929 frontline healthcare staff (primary healthcare providers, nurses, village doctors, and public health workers) during the Shanghai epidemic.The prevalence of depression among frontline primary healthcare workers was 39.7% (369 cases) and that of anxiety was 30%(279 cases). There was a significant correlation between the depression symptoms and anxiety symptoms. And factors associated with depression were being female, advanced education, expecting psychological interventions, expecting vacations as a reward, and expecting financial rewards. Factors strongly associated with anxiety were being female, expecting psychological interventions, and expecting vacations as a reward. Psychological problems among frontline primary healthcare workers merit more attention during the COVID-19 outbreak, especially those who are vulnerable (e.g., females and those with an advanced education).

Keywords Primary healthcare workers, Depression, Mental health, Risk factors, COVID-19

Background

The COVID-19 outbreak at the beginning of 2020 posed significant challenges to the global medical system due to the rapid transmission rate, diverse transmission routes, and the novel nature of the SARS-CoV-2 virus. COVID-19 infected over 200 million people globally, and the World Health Organization quickly declared a pandemic situation. In China, at least one infected case was found in all provinces, autonomous regions, and municipalities; therefore, every provincial authority launched the highest level (level 1) public health emergency response in January 2020, well before the infectious peak. During the pandemic, frontline healthcare staff worked tirelessly, facing high infection risks, excessive workloads, and shortages of human resources, which significantly affected their physical and psychological well-being[1,2]. Research from a parallel situation (SARS outbreak) in 2003 showed poor psychological health among frontline healthcare professionals, who reported heightened levels of anxiety, worry, and fear. Studies indicated that 75% of frontline healthcare professionals experienced psychological problems, including anxiety, depression, strained family relationships, somatic symptoms, and sleep disturbances[3–5].

Furthermore, the expectation of support or rewards has been shown to play a crucial role in mitigating psychological problems. During high-stress situations, such as the COVID-19 pandemic, healthcare workers who anticipated receiving psychological counseling or moral encouragement were likely to experience reduced levels of stress and anxiety. Research suggests that perceived support can buffer against the negative impacts of stress and improve overall mental health[6,7]. Recent psychological surveys conducted during the COVID-19 pandemic revealed that frontline healthcare workers continued to experience mental health deterioration, reporting significant levels of anxiety, depression, and somatic symptoms[6,7]. In China, primary healthcare workers play a crucial role in the national healthcare system. Primary healthcare services, delivered at community health centers, are the backbone of the Chinese public health infrastructure. These workers are responsible for general preventive care, health education, and basic medical services, playing a key role in both rural and urban areas.

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Since the outbreak of the COVID-19 epidemic, frontline primary healthcare staff have been the main force in the prevention and control of the epidemic, undertaking crucial tasks such as contact tracing, temperature screening, and nucleic acid testing. However, despite their critical role, their psychological well-being is often overlooked, as they are not directly involved in the diagnosis and treatment of COVID-19 cases[8,9].

At present, there are limited studies focusing on the psychological problems of frontline primary healthcare staff during the COVID-19 pandemic, especially those based on large samples. The present study aimed to investigate mental health issues among frontline primary healthcare workers in China during the COVID-19 outbreak. It is anticipated that our findings will provide a basis for psychological interventions and psychological aid strategies in the current pandemic and inform responses in future public health emergencies.

Methods

G* Power software version 3.1.9.7 was used to estimate the required sample size of this study. F-test (Linear multiple regression: Fixed model, R^2 increase) was employed. Effect size (f^2) was set at 0.15 and alpha value was set at 0.05. 189 participants would provide 95.07% power to detect a statistical significance.

We recruited 929 frontline primary healthcare workers in Shanghai through cluster sampling, and conducted a cross-sectional survey on February 26–27, 2020. The inclusion criteria were frontline healthcare professionals in Shanghai districts that worked in primary healthcare settings, voluntarily responded to the public health call, and worked for extra hours or with higher workloads to fight the COVID-19 pandemic. We investigated four professional groups: primary healthcare providers, village doctors, nurses, and public health workers. The exclusion criteria included healthcare professionals who: (1) self-reported having experienced mild mental symptoms (e.g., compulsive behaviors, anxiety, or depression) before the outbreak based on a "yes" or "no" question, or (2) had a history of mental disorders or used psychiatric medication (e.g., antidepressants, antipsychotics, or mood stabilizers) before or during the outbreak. The survey was prepared online via "Wen Juan Xing (https://www.wjx.cn)", an online research platform, has been widely applied in various studies[7]. Participants could fill out by cell phones or PC devices. Each IP address can only submit questionnaire data once. Healthcare staff participated in this study voluntarily and anonymously. All participants provided informed consent and were assured of the confidentiality of their data.

An author-designed questionnaire was used to collect demographic information including sex, marital status, age, educational level, professional title, and staff type. A series of questions was developed to gather information about factors influencing depression and anxiety and other information relating to the mental status of frontline healthcare professionals. This information included changes/increases in working hours and expected support or rewards (e.g., expecting psychological counseling, vacations, financial rewards, moral encouragement, and protective equipment for families).

We measured depression symptoms with the nine-item Patient Health Questionnaire (PHQ-9) which mentioned by the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). The PHQ-9 is a questionnaire that assesses how depressed an individual has been in the past two weeks. The questionnaire uses a four-stage scale, with "0" indicating "never" and "3" indicating "nearly every day". The total score of PHQ-9 ranges from 0 to 27, with higher scores indicating more severe depression. The PHQ-9 has been validated in the Chinese population, with studies confirming its reliability and validity in assessing depressive symptoms among various Chinese groups[10–13]. The total score ranged from 5 to 9 for mild depression, 10 to 14 for medium depression, 15 to 19 for moderate-severe depression, and 20 to 27 for high depression. According to Teymoori's study, the total score of PHQ-9 ≥ 5 indicates the presence of depressive symptoms[14]. Cronbach's alpha of the PHQ-9 was 0.815, which indicates that use the scale in the general population has good internal consistency[15].

Anxiety symptoms were measured using the Generalized Anxiety Disorder-7 (GAD-7) scale of DSM-5. This scale consists of seven items and uses Likert-scale to evaluate the frequency of anxiety over the past fortnight, with "0" being "never" and "3" being "nearly every day". Higher scores indicate greater functional impairment due to anxiety. The total score ranged from 5 to 9 for mild anxiety, 10 to 14 for medium anxiety, 15 to 21 for high anxiety. Like the PHQ-9, the GAD-7 has also been validated in the Chinese population, with studies supporting its reliability and validity for assessing anxiety symptoms among Chinese individuals[16–19]. According to Teymoori's study, the total score of GAD-7 ≥ 5 indicates the presence of anxiety symptoms[20]. Cronbach's alpha of the GAD-7 was 0.896, which indicates that use the scale in the general population has good internal consistency[21].

The survey was conducted using the "Wen Juan Xing" platform, which is widely used for online data collection in China. One of the strengths of this platform is its user-friendliness, allowing respondents to complete surveys via mobile devices or computers, and each IP address can only submit data once, reducing the risk of duplicate responses. However, a potential weakness is that the platform relies on self-reported data, which may introduce biases such as social desirability bias or inaccurate reporting.

Statistical analyses were performed with SPSS (version 26.0; IBM) and GraphPad Prism (version 9.0.0). Descriptive analyses were used to describe participants' demographic characteristics, COVID-19-related work information, and the overall prevalence of depression and generalized anxiety symptoms. We used Mann-Whitney U tests and Kruskal-Wallis one-way analyses to compare the prevalence of depression and generalized anxiety symptoms between different subgroups. We also conducted spearman's correlation analysis to explore the association between depression level and anxiety level. Hierarchical regression analysis was used to identify independent variables associated with depression and generalized anxiety symptoms. $p < 0.05$ was considered statistically significant.

Results

Participants' demographic information and depression and generalized anxiety symptoms scores

In total, 929 (98.8%) of the 940 submitted questionnaires were valid. Participants' age ranged from 21 to 66 years, with an average age of 36.22 ± 10.06 years. Other demographic data are shown in Table 1.

The average PHQ-9 score was 4.38 ± 4.60, and the prevalence of depression was 39.7% (369/929); 31.5% in males, 42% in females, 37.7% in unmarried participants, and 40.3% in married participants. The prevalence of depression varied by age group, and was highest for those aged 30–39 years (45.4%) followed by < 30 years (37.0%), ≥ 50 years (26.8%), and 40–49 years (22.0%). The prevalence of depression also differed by education level, being highest in university graduates (43.8%), followed by the junior college (36.1%) and secondary vocational education (22.0%) groups. No depression was reported by participants with a master's degree In China, professional title is used to evaluate expertise and career length. We found that the prevalence of depression in participants with junior-grade, medium-grade, and senior-grade titles was 39.8%, 39.6%, and 38.1%, respectively. Finally, the prevalence of depression was highest in primary healthcare doctors (41.7%), followed by nurses (39.7%), public health staff (38.7%), and village doctors (38.0%).

Participants' average GAD-7 score was 3.03 ± 4.01. The prevalence of anxiety was 30.0% (279/929); 22.5% in males, 32.1% in females, 27.4% in unmarried participants, and 30.8% in married participants. The prevalence of anxiety varied by age group, and was highest in those aged 30–39 (35.4%) and 40–49 (34.5%) years, followed by < 30 years (27.5%) and ≥ 50 years (20.3%). The prevalence of anxiety also varied by education level, being highest in university graduates (32.3%), followed by the junior college (28.1%) and secondary vocational education (20.3%) groups. No anxiety was reported in those with a master's degree. The prevalence of anxiety in participants with junior-grade, medium-grade, and senior-grade professional titles was 30.5%, 29.2%, and 28.6%, respectively. The prevalence of anxiety was highest in nurses (32.1%), followed by primary healthcare doctors (31.1%), public health staff (29.0%), and village doctors (24.1%).

Comparison of PHQ-9 scores by demographic characteristics (Table 1) showed there were significant differences by sex, age, and educational background. PHQ-9 scores were significantly higher in females than in males ($p < 0.001$), and in participants aged ≥ 50 years than those aged < 50 years ($p < 0.001$). In addition, PHQ-9 scores of participants with a secondary vocational education were significantly lower than the junior college group ($p = 0.015$) and the university graduate and master's degree groups ($p = 0.001$). Pairwise comparisons between other groups showed no significant differences.

Comparisons of GAD-7 scores by demographic data (Table 1) showed significant differences by sex, age, and educational background. GAD-7 scores were significantly higher in females than in males ($p < 0.001$), and

Characteristics	Total(n)	Percentage(%)	Z(PHQ-9)	Z(GAD-7)
Gender				
Male	200	21.5	3.588***	4.302***
Female	729	78.5		
Marital status				
Unmarried	212	22.8	-0.770	-1.214
Married	717	77.2		
Age				
21–29	338	36.4	21.016***	18.996***
30–39	240	25.8		
40–49	198	21.3		
≥ 50	153	16.5		
Educational level				
Secondary vocational	59	6.4	16.082**	11.091*
Junior college	313	33.7		
University Graduated	557	59.7		
Master-level	2	0.2		
Professional titles				
Junior-grade	590	63.5	0.821	2.552
Medium-grade	318	34.2		
Senior-grade	21	2.3		
Staff types				
Nurses	411	44.2	0.231	1.809
Primary healthcare providers	228	24.5		
Village doctors	166	17.9		
Public health workers	124	13.3		

Table 1. Participants' demographic information and depression and generalized anxiety symptoms scores. $^*p < 0.05, ^{**}p < 0.01, ^{***}p < 0.001$.
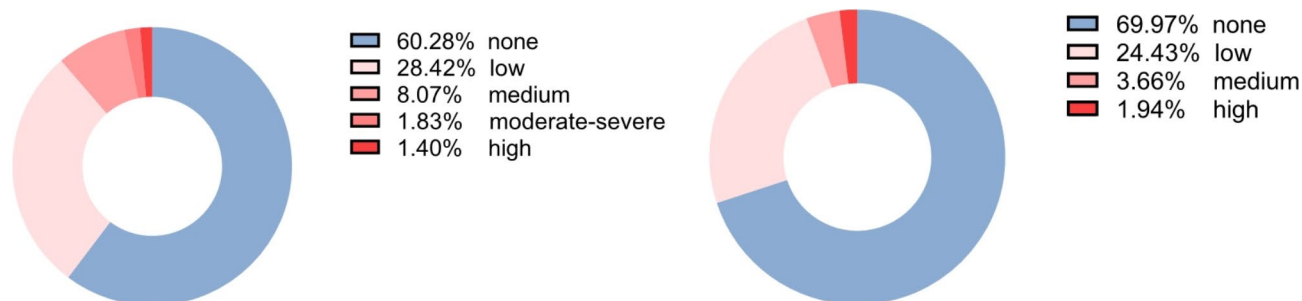
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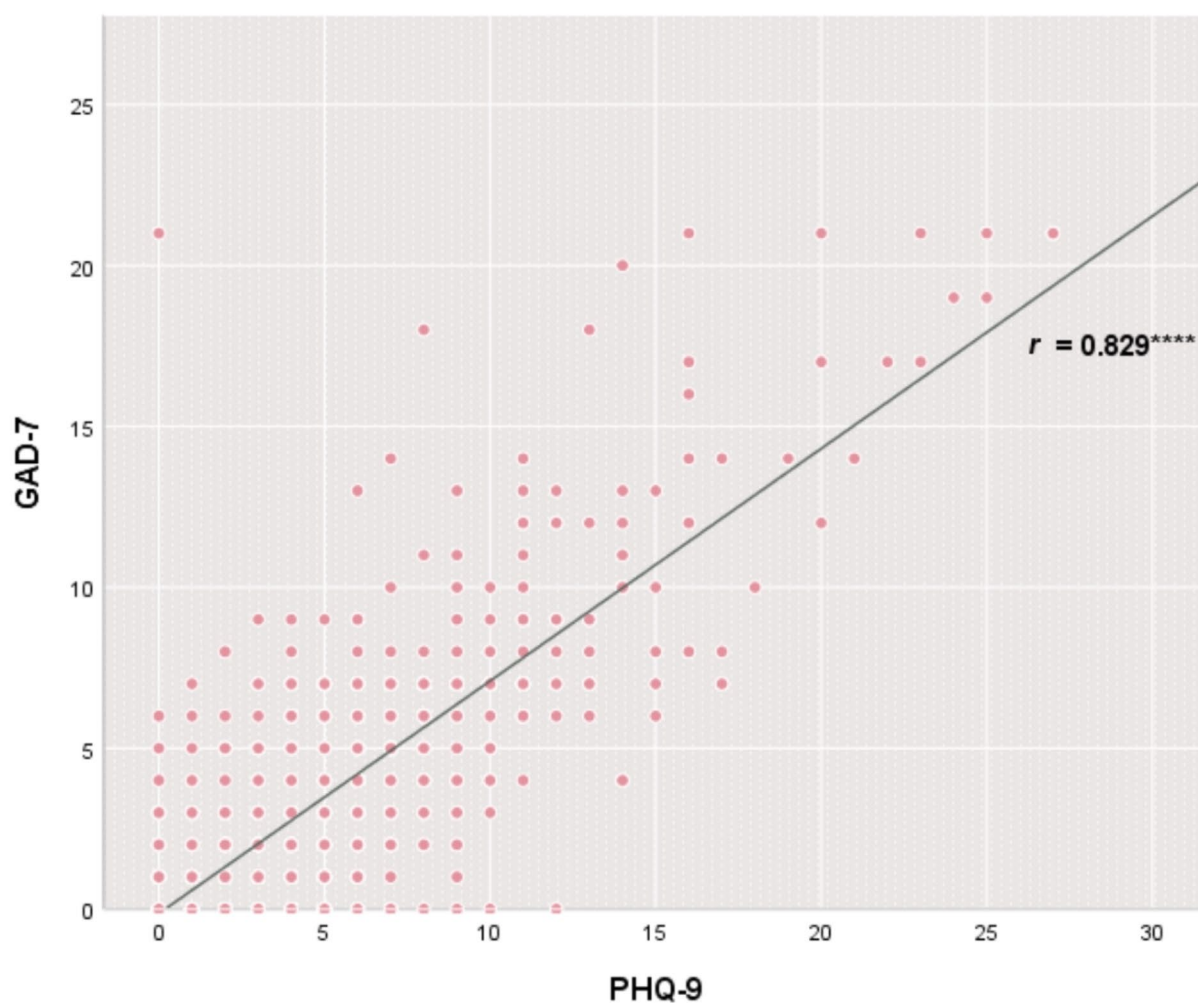**Fig. 1**. Distribution of PHQ-9 and GAD-7 scores among frontline primary healthcare staff.

Fig. 2. Correlations between PHQ-9 and GAD-7 scores ****$p < 0.0001$.

in those aged ≥ 50 years than in those aged 30–39 years ($p = 0.004$) and 40–49 years ($p = 0.001$). Although the multiple sample comparison showed a significant difference between the four education level groups ($p < 0.05$), pairwise comparisons found no significant differences.

Figure 1 shows the distribution of PHQ-9 and GAD-7 scores among 929 frontline primary healthcare staff in Shanghai. The PHQ-9 scores had a strong positive correlation with the GAD-7 scores ($r = 0.829$, $p < 0.0001$) (Fig. 2).

COVID-19-related work information and depression and generalized anxiety symptoms scores

Our results demonstrated that daily working hours were associated with depression and anxiety. Participants were divided into two groups according to whether their daily working hours had increased by over 2 h. We found that 638 participants (68.7%) reported their daily working hours had increased by ≤2 h, and 291 participants (31.3%) reported their daily hours had increased by >2 h. An increase in daily working hours by >2 h was associated with significantly higher PHQ-9 and GAD-7 scores than an increase of ≤2 h ($p < 0.0001$) (Fig. 3).

Participants were asked about the kinds of support they were expecting. Expecting psychological interventions ($p < 0.001$), vacations ($p < 0.001$), financial rewards ($p < 0.001$), and protective equipment for families ($p = 0.002$) were significantly associated with higher PHQ-9 scores compared with no related demands. According to the results of GAD-7 scores, expecting psychological interventions ($p < 0.001$), vacations ($p < 0.001$), and financial rewards ($p < 0.001$) were significantly associated with higher GAD-7 scores compared with no related demands (Table 2).

Factors influencing depression and anxiety in frontline healthcare staff

Logistic regression analyses were conducted with depression and anxiety as the dependent variables and factors influencing depression and anxiety as the independent variables (Tables 3 and 4). The results showed that being female was a risk factor for both depression and anxiety. Compared with males, females were 1.68 (odds ratio [OR] = 1.676, $p = 0.004$) and 1.66 (OR = 1.660, $p = 0.01$) times more likely to have symptoms of depression and anxiety, respectively. In terms of psychological demands, the risk for both depression and anxiety in those that expected psychological interventions (depression: OR = 2.375, $p < 0.001$; anxiety: OR = 3.162, $p < 0.001$) and vacations (depression: OR = 2.182, $p < 0.001$; anxiety: OR = 3.169, $p < 0.001$) was significantly higher than in those with no related expectations. Moreover, a higher educational background was associated with a higher the possibility of depression symptoms (OR = 1.438, $p = 0.003$). Participants with an expectation of financial reward also had a significantly higher risk for depression than those without this expectation (OR = 1.600, $p = 0.005$).

Discussion

Healthcare professions are stressful and challenging. In addition to long working hours, high intensity work, frequently facing complicated situations, and high risk for exposure to pathogens, healthcare professionals are obligated to respond to public health events such as pandemics. This means that healthcare professionals are vulnerable to mental disturbance and may require specific mental health services[22]. In early 2020, thousands of healthcare workers across China made the difficult decision to join the frontline fight against the emerging COVID-19 pandemic. The outbreak coincided with the Spring Festival, which is traditionally a time spent with family and loved ones. High-intensity work with patients diagnosed with definite/potential COVID-19, the strict need to follow regulations for protection, inadequate protective equipment, and apprehension about
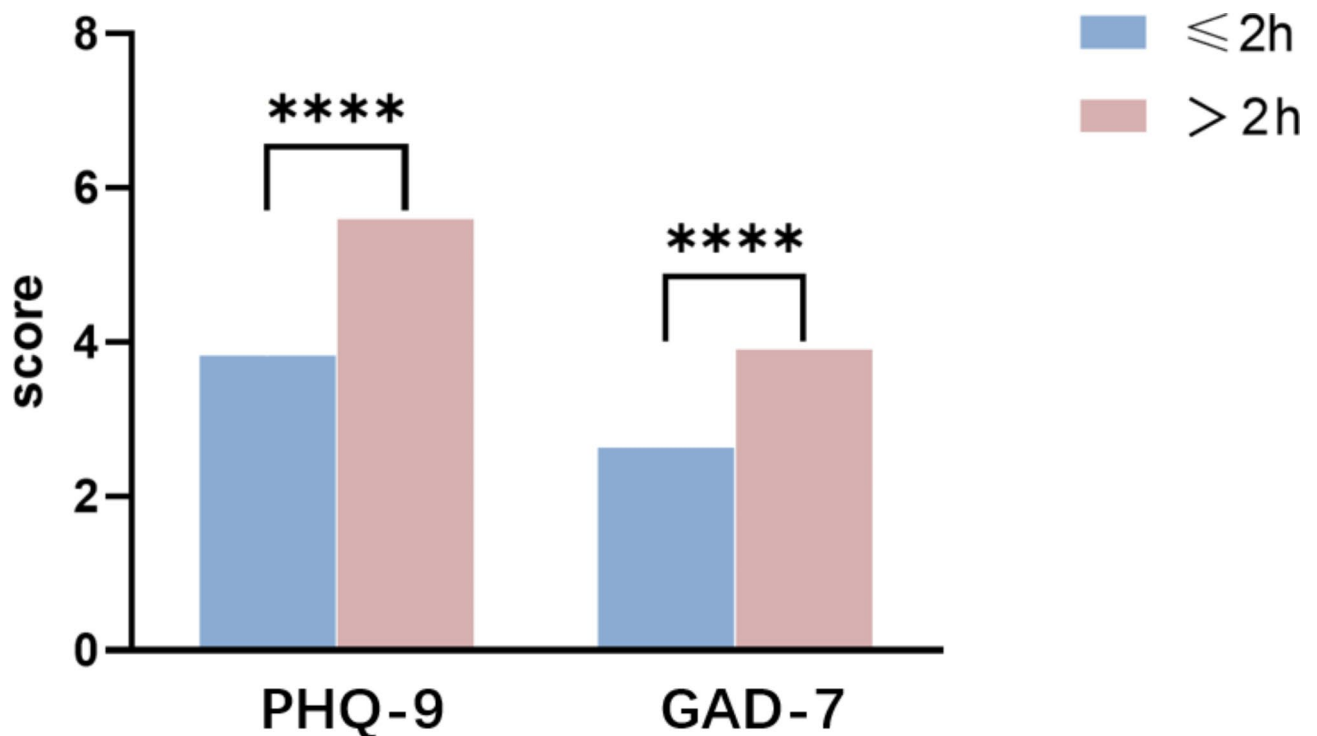

Fig. 3. Comparison of the scores of PHQ-9 and GAD-7 among participants at different increased daily hours ****$p < 0.0001$.

What support do you expect to receive at present?	Total(*n*)	Percentage(%)	Z(PHQ-9)	Z(GAD-7)
Expecting psychological counseling				
Yes	162	17.4	-6.137***	-6.924***
No	767	82.6		
Expecting vacations				
Yes	562	60.5	-8.802***	-8.102***
No	367	39.5		
Expecting financial rewards				
Yes	565	60.8	-6.264***	-5.702***
No	364	39.2		
Expecting moral encouragement				
Yes	477	51.3	-1.027	-1.852
No	452	48.7		
Requiring protective equipment for families				
Yes	661	71.2	-3.156**	-1.725
No	268	28.8		

Table 2. Participants' expected support and depression and generalized anxiety symptoms scores. *p < 0.05,**p < 0.01,***p < 0.001.

	B	β	OR	95%CI	*P* value
Gender	0.517	0.179	1.676	1.180–2.381	0.004**
Educational background	0.363	0.121	1.438	1.135–1.821	0.003**
Expecting psychological intervention	0.865	0.186	2.375	1.648–3.422	< 0.001***
Expecting financial reward	0.470	0.166	1.600	1.155–2.216	0.005**
Expecting vacation	0.780	0.166	2.182	1.575–3.023	< 0.001***

Table 3. Logistic regression analysis with depression (PHQ-9) as a dependent variable (*n* = 929). NOTE: B = unstandardized beta; β = standardized regression weight; OR = odd ratio; CI = confidence interval; * *P* < 0.05; ** *P* < 0.01; *** *P* < 0.001.

	B	β	OR	95%CI	*P* value
Gender	0.507	0.197	1.660	1.129–2.440	0.010*
Expecting psychological intervention	1.151	0.185	3.162	2.201–4.542	< 0.001***
Expecting vacation	1.153	0.171	3.169	2.267–4.430	< 0.001***

Table 4. Logistic regression analysis with anxiety (GAD-7) as a dependent variable (*n* = 929). NOTE: B = unstandardized beta; β = standardized regression weight; OR = odd ratio; CI = confidence interval; * *P* < 0.05; ** *P* < 0.01; *** *P* < 0.001.

being infected with an uncharted pathogen may cause psychological problems such as symptoms of anxiety and depression.

Huang et al. reported the incidence of stress disorders was 27.39% among frontline healthcare professionals who were "the first group" to fight the COVID-19 outbreak. That survey investigated 41 frontline nurses and found 35 nurses experienced psychological problems of various degrees in the first 2 weeks working during the COVID-19 outbreak[23]. At the time of the present study, frontline healthcare staff had been working in the context of the pandemic for more than 2 months, meaning their mental health warranted attention. The present study was conducted to explore the relationship between psychological demands and negative emotions among frontline primary healthcare staff, based on self-report of depression/anxiety symptoms and demographic factors.

We found the prevalence of depression was 39.7% and that of anxiety was 30.0%, suggesting negative emotions were significant issues in this population. It is important to note that female participants were more likely to report depression and anxiety than their male counterparts. This could indicate a potential selection bias, where females, who may be more willing to express mental health concerns, are overrepresented in the sample. This could have led to an overestimation of the prevalence of depression and anxiety in this study. This was consistent with a previous study that suggested general mental health and sense of achievement were worse among female nurses than male nurses[24]. This may be because women are more expressive and prefer to interact verbally or non-verbally with others, but the protective regulations that restricted normal interpersonal

communication during COVID-19 deprived women of their usual outlet for negative emotions. In addition to their professional roles, women in China also shoulder the burden of traditional roles such as caring for families and raising children. During the COVID-19 outbreak, increased working hours in restricted areas, long-term separation from family/children, and the long-term absence from family roles might also have resulted in negative emotions.

The present study found that participants with higher education levels were more likely to have depression symptoms, which was consistent with a previous study[25] This finding could be attributed to the effect of stress from individual and social stereotypes associated with high education, which consider people with a higher education background as "strong," and mean highly educated people desire success and suffer for failures. Therefore, when highly educated healthcare professionals found that they were as powerless as those with a lower education level when facing COVID-19, they might have been more likely to feel frustrated.

This study also explored the psychological demands of frontline primary healthcare professionals from the perspective of social support in the pandemic situation. We found a significant positive relationship between the expectation of receiving psychological aid or vacations and the prevalence of anxiety and depression. This may be explained by the pervasive impact of the sudden COVID-19 outbreak; although this made everyone passive participants, the impact was more severe for healthcare professionals as an acute degree stress event. In addition, the prolonged stress and high demands placed on these professionals may have contributed to burnout, which has been associated with severe emotional exhaustion, reduced performance, and depersonalization. Burnout could further exacerbate the mental health issues observed in this population, potentially leading to long-term negative consequences such as professional dissatisfaction, absenteeism, and high turnover rates. Research has revealed that healthcare staff is more likely to experience psychological problems after mass incidents than the general public[26], and may experience a long-term and sustained influence of stress if they continuously work in an environment with a high risk for infection[27]. Therefore, an explanation from an emotional regulation perspective is that our participants experienced COVID-19 as an intense and continuous stress event. Although they can adapt to the effect of pressure through their own emotional regulation mechanisms in the short-term, long-term accumulated negative emotions need to be relieved via timely outside help and extra rest, which requires psychological intervention or a vacation.

This study also revealed a significant positive relationship between expecting financial reward and depression. From the perspective of the needs-hierarchy theory, financial reward plays a role of an incentive; it satisfies individuals' psychological needs for recognition and respect. A previous study suggested that the intense doctor-patient relationship and long-term occupational stress could reduce healthcare professionals' satisfaction with their career, and noted a correlation between salary and emotional expression requirements of healthcare staff[28–30]. Both of these findings were supported by the present study. During the pandemic, medical professionals are at higher risk for infection than non-professionals, and have to work extra hours with increased workloads, and suffer a higher uncertain risk in care and rescue than usual. This means they may seek equity from external resources to maintain their inner balance.

Research has showed that working environment and benefits were important factors related to healthcare professionals' employment decisions (e.g., whether to stay or quit)[31]. Therefore, an appropriate reward at the right time plays an important role in satisfying a healthcare professional's sense of fairness and helping to regulate their emotions, which are essential for staff retention and improving healthcare services. These factors merit careful consideration when making decisions or policies relating to healthcare staff. Furthermore, psychological distress experienced by healthcare workers during crises such as the COVID-19 pandemic has been referred to as "secondary disasters," a term used to describe the mental health consequences resulting from the extended exposure to traumatic and high-stress situations in a pandemic environment. In addition to focusing on the mental health of confirmed/suspected COVID-19 cases, policy making related to pandemic control should pay more attention to the mental well-being of frontline healthcare staff.

In addition to improving its emergency response, the healthcare system needs to pay more attention to the mental health of female and highly educated healthcare staff, and establish corresponding measures such as psychological interventions, financial rewards, and additional vacations. These efforts will encourage and empower primary healthcare staff, and increase their satisfaction and well-being.

However, it is important to acknowledge the limitations of this study. First, as a cross-sectional study, it is not possible to define causality in the relationships observed, such as the association between psychological demands and negative emotions, which raises the issue of reverse causality. While we identified associations between these factors, we cannot determine whether psychological demands lead to negative emotions or vice versa. Future longitudinal or experimental studies would be better suited to exploring these causal relationships. Second, this study did not address potential selection and misclassification biases. Selection bias may have arisen due to voluntary participation, where healthcare workers experiencing higher levels of stress or mental health issues may have been more likely to participate, potentially inflating the prevalence rates of depression and anxiety. Misclassification bias may also have occurred due to reliance on self-reported data, where participants might not have accurately reported their psychological status. Future research should consider using more rigorous sampling techniques and objective psychological assessments to reduce these biases. Third, the data collection was conducted over a very short period (February 26–27, 2020), during the first wave of the pandemic. This limited data collection window may not fully capture the evolving psychological impact on healthcare workers over time. Future studies should aim for a longer data collection period to better assess changes in mental health across different phases of the pandemic. Finally, although we recruited a relatively large sample of 929 valid respondents, the study's sample size may still limit the generalizability of the findings. Future studies should aim to recruit larger and more diverse samples across different regions to enhance the external validity of the results. Expanding the discussion of these limitations is crucial for a more comprehensive understanding of the study's findings and their implications. Additionally, this study relies on self-reported data, which may

introduce biases such as social desirability bias and selective reporting, potentially affecting the accuracy of the results. Participants might be inclined to provide answers that align with social expectations or underreport or overreport their psychological status, leading to data inaccuracies. Future research should incorporate multiple data collection methods, such as structured interviews or third-party evaluations, to verify the accuracy of self-reported data and reduce the potential impact of these biases on study findings.

Future research should explore longitudinal data collection to better understand the dynamic changes in mental health among healthcare workers during different phases of the pandemic. Although the abundance of studies that have already confirmed the applicability of PHQ-9 and GAD-7 in China, it remains crucial to undertake additional validation and optimization efforts tailored specifically to diverse populations and geographical regions. Additionally, further studies could investigate the long-term psychological consequences of working under pandemic conditions and explore potential interventions to mitigate mental health problems in this population. Research into the neural mechanisms underlying stress and emotional regulation in healthcare workers may also offer deeper insights into how to support their mental well-being in high-stress environments.

Conclusions
The current research shows significant levels of anxiety and depression symptoms among frontline primary healthcare workers during the COVID-19 pandemic. The main risk factors of depression were female, higher education, counseling, vacation and bonus demand. Women and psychological demands of counseling, vacation demands are the main risk factors for anxiety. This study can provide evidence-based information for governments and policymakers to design effective mental health intervention strategies for primary healthcare workers. Continuous attention to the mental health of this group is crucial, and the value of this study lies in addressing the empirical research gap specifically for frontline healthcare workers in Shanghai, China. Although similar risk factors may have been discussed globally, this study uniquely contributes specific evidence based on actual data analysis and validation in a major city in China. The specificity of our sample of primary healthcare personnel further enriches our understanding of these risk factors.This empirical research supports governments and policymakers in designing region-specific mental health intervention strategies during public health crises and highlights the need for long-term mental health monitoring of healthcare workers. We believe that such localized studies offer valuable references for policy adjustments and resource allocation.

Given the limitations of the study sample, this research focuses exclusively on the mental health status of healthcare workers in Shanghai. However, since Shanghai is one of China's major cities with a significant floating population, the findings may be generalizable to healthcare workers in other large cities with similar demographic characteristics. Nonetheless, these results may not be applicable to healthcare workers in cities with smaller or less transient populations. In addition, based on the findings, we recommend the systematic use of PHQ-9 and GAD-7 among primary healthcare workers to regularly monitor their mental health. This could help identify early symptoms of anxiety and depression, allowing timely intervention to improve both their well-being and productivity.

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

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Author contributions

Yi Cui , Ling Li and Xiaofei Mao designed the study, analysed the data and drafted the manuscript. Jingzhou Xu performed the statistical analysis and prepared the tables and figures. Jingzhou Xu, Shuyu Xu and Hao Wang collected the data. Tong Su interpreted the results and supervised the entire study. All authors have read and approved the final manuscript.

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Declarations

Competing interests

The authors declare no competing interests.

Ethics statement

All participants signed written informed consent form in ethics approval and consent to participate. The study was approved by the ethic committee of Naval Medical University in accordance with the ethical standards established in the 1964 Declaration of Helsinki and its later amendments.

Additional information

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