



Research paper

Psychological impact of healthcare workers in China during COVID-19 pneumonia epidemic: A multi-center cross-sectional survey investigation



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ABSTRACT

Background: Since the outbreak of 2019 new coronavirus (COVID-19) pneumonia, healthcare workers (HCW) have suffered psychological stress. The present study is to examine the prevalence of stress, anxiety and depression of HCW in China during the COVID-19 epidemic, and to determine the risk factors predicting psychological morbidities that can be used as psychological intervention targets.

Methods: A cross-sectional survey was conducted to investigate the psychological levels of HCW in multiple centers in China. The prevalence of stress, anxiety and depression were determined by using Perceived Stress Scale (PSS-14) and Hospital Anxiety / Depression scale (HAD). Psychological related factors were evaluated and correlation between job title and contact history was analyzed.

Results: We received 958 of effective responses, 73.6% of which were from Wuhan and 67.2% were female participants. 55.1% of respondents had psychological stress that is higher than that of HCW during SARS. 54.2% and 58% of participants had symptoms of anxiety and depression. Stress levels of HCW were different in job titles and years of work experience. Anxiety and depression levels were different between different gender, job titles, degrees of protective measures and levels of contact history. Gender, intermediate title, protective measures and contact history were the independent risk factors for anxiety. Protective measures and contact history were the independent risk factors for depression.

Conclusions: The COVID-19 epidemic has induced stress levels for HCW, and high percentages of HCW have anxiety and depression. The situation of HCW is worrying and intervention service is urgent.

Abbreviation

HCW	Health care works
PST	posttraumatic stress
PSTD	posttraumatic stress disorder
SARS	Severe Acute Respiratory Syndrome
MERS	Middle East respiratory syndrome

1. Introduction

Spring Festival is an important holiday for Chinese people. However, at the beginning of 2020, the outbreak and fast spread of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) disrupted all festival plans. In Wuhan City, China, 11 million people were

placed on lockdown to stop the further spread of Coronavirus Disease 2019 (COVID-19). In addition to changes in the pace of life, unfamiliarity and uncontrollability enhanced people's stress. Given that this outbreak has highlighted the fragility of psychological resilience, attention must be paid to the psychological state of healthcare workers (HCW) during epidemics (Ho et al., 2020).

Although studies have documented the mental health status and related risk factors that impacted the psychological stress and morbidities of HCW in previous disease pandemics (Chong et al., 2004), there are marked differences to the current situation. Therefore, the psychological characteristics of HCW during the COVID-19 epidemic remains unknown.

If a physician has been in a state of anxiety for a long time, this will not only adversely affect their physical health, but will also result in a

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lack of work efficiency (Bargellini et al., 2000). HCW are the main force for medical rescue, meaning an evaluation of their psychological status to improve interventions, prevent posttraumatic stress (PTS) and post-traumatic stress disorder (PTSD) and enhance their mental health is urgently needed. Thus, assessing mental health for HCW during the COVID-19 epidemic is an inevitable precondition for coping with stress and important measures for fighting disease.

In the present study, we used the perceived stress scale-14 (PSS-14) and the hospital anxiety / depression scale (HAD) to evaluate the psychological stress, anxiety and depression levels of HCW in multiple hospitals in China during COVID-19 the epidemic. Risk factors for anxiety and depression were determined and interpreted to provide further psychological interventions for this group of people.

2. Methods

2.1. Background of the survey

This study was a multi-center cross-sectional survey investigation. The questionnaires were issued on January 28, 2020, one month after the start of COVID-19 epidemic, at the peak of the epidemic period. The survey was in the form of electronic questionnaires and was distributed to medical personnel in multiple centers across the country via social media (WeChat, Tencent). The template of the electronic questionnaire was provided by the application "Questionnaire Star" that collected valid questionnaire results and summarized the information into an excel table by category for subsequent statistical analysis.

2.2. Design and measures of survey

The questionnaire consists of three parts. The first part was concerned with demographics and exposure factors, such as region, gender, education, specialty, working experience, marital status, whether participants have children, whether they live alone, their working position during the event, contact history and access to protective equipment.

The second part was the PSS-14, which was used to evaluate the stress of medical personnel following the outbreak. The scale contains 14 items, each of which has a score ranging from 0 (absolutely no) to 4 (always yes). The higher the score, the greater the HCW'S stress.

The third part was the HAD scale, which was used to evaluate anxiety and depression. There were 14 questions, seven to detect anxiety levels and seven to detect depression levels. Each question has a score of 0-3, 4-7 (asymptomatic), 8-10 (suspicious), and 11-21 (positive). A score greater than or equal to eight indicates symptoms of depression or anxiety.

2.3. Statistics

SPSS (version 22.0) and GraphPad Prism (version 7.04) were used for statistical analysis and graph plotting. Continuous variables are presented as mean or median \pm standard deviations. Classified variables are presented by percentage. A Mann-Whitney U test was used to analyze differences between two groups of nonnormally distributed data. A Kruskal-Wallis. H test was used to analyze differences among multiple groups, while a Pearson χ^2 test was used to compare categorical data.

To assess independent risk factors that result in anxiety and depression, we defined 12 risk factors as independent variables and, anxiety and depression as dependent variables. Effective factors were initially screened using a single factor logistic regression with a p -value less than 0.1, and which were then put into multiple factor logistic regression analysis. In this step, risks with p -value of less than 0.05 were considered independent risk factors that lead to anxiety and depression.

Table 1
Demographic characteristics and comparison of PSS score among characters in each group.

Region	N (%)	PSS score (Median \pm S.D)	p value ^a
Wuhan	705(73.6%)	28.00(8.49)	0.511
Other cities in Hubei	140(14.6%)	28.00(8.89)	
Other cities out of Hubei	113(11.8%)	27.00(7.22)	
Gender			
Male	314(32.8%)	27.00(8.27)	0.060
Female	644(67.2%)	28.00(8.45)	
Marital status			
Married	247(25.8%)	28.00(8.12)	0.220
Single/other	711(74.2%)	27.00(8.49)	
Obstetrical history			
No kid	301(31.4%)	28.00(8.12)	0.116
Pregnancy	27(2.8%)	32.00(6.46)	
1 kid	477(49.8%)	27.00(8.92)	
1kid and being pregnant	15(1.6%)	28.00(8.89)	
2 kids or more	138(14.4%)	28.00(7.27)	
Resident status			
Living alone	271(28.3%)	28.00(8.45)	0.869
Living with family	687(71.7%)	28.00(8.39)	
Profession			
Clinical physician	378(39.5%)	27.00(8.16)	0.246
Nurse	359(37.5%)	28.00(8.63)	
Working in CT room	32(3.3%)	29.50(7.97)	
work in clinical laboratory	87(9.1%)	28.00(8.47)	
Other position in Hospital	102(10.6%)	27.00(8.46)	
Educational background			
Junior college education	101(10.5%)	26.00(9.10)	0.505
Bachelor	525(54.8%)	28.00(8.70)	
Master	173(18.1%)	26.00(7.33)	
Doctor/Ph.D	159(16.6%)	27.00(8.08)	
Title			
Junior	418(43.6%)	28.00(8.40)	0.020*
Intermediate	372(38.8%)	28.00(8.27)	
Senior	168(17.5%)	26.00(8.50)	
Work experience, year			
less than 5 years	295(30.8%)	28.00(7.91)	0.048*
6-10 years	277(28.9%)	28.00(8.53)	
More than 11 years	386(40.3%)	27.00(8.61)	
Working Position			
Fever clinics	77(8.0%)	28.00(8.66)	0.878
Nurse	92(9.6%)	27.50(9.59)	
Working in CT room	37(3.9%)	29.00(8.01)	
work in clinical laboratory	86(9.0%)	27.00(8.49)	
Other position in Hospital	666(69.5%)	28.00(8.22)	
Protective equipment			
Adequate	47(4.9%)	38.00(8.99)	0.093
General	274(28.6%)	28.00(7.80)	
Insufficient	582(60.8%)	28.00(8.61)	
No equipment	55(5.7%)	28.00(8.21)	
Contact history			
No contact	280(29.2%)	28.00(8.92)	0.108
Contact with diagnosed	338(35.3%)	28.00(7.84)	
Contact with suspected	293(30.6%)	25.00(8.27)	
Contact with specimen of patients	47(4.9%)	28.00(8.92)	

a *, $p < 0.05$

3. Results

3.1. Characteristics of respondents

We collected a total of 958 anonymous and effective questionnaires across 26 provinces in China. The respondents comprised 73.6% ($n = 705$) of HCW in Wuhan, which is the capital of Hubei province and the center of COVID-19 in China, 14.6% ($n = 140$) of HCW in other cities in the Hubei province and 14.6% ($n = 113$) HCW in cities outside of Hubei. 32.8% ($n = 314$) of the participants were male, while 67.2% ($n = 644$) were female. A total of 25.8% of participants were married, 31.4% had no children and 71.7% lived with their family. Clinicians

(39.5%) and nurses (37.5%) were the main groups represented in the survey, and most (54.8%) HCW had a bachelor's degree. We also investigated job titles and work experience and found out that 43.6%, 38.8% and 17.5% of participants had junior, intermediate and senior titles respectively. 40.3% of HCW had more than 11 years of work experience, while 28.9% had 6-10 years and 30.8% had less than five years (Table 1).

Exposure factors were also listed in the survey (Table 1). 69.5% of respondents were working in the low-risk positions, while the rest were in high-risk positions such as fever clinics, respiratory and infection department, intensive care unit, CT rooms and clinical laboratories, suggesting they had a higher likelihood to contact with contagion. Protection measures and contact history with patients or specimen were also considered. A total of 60.8% of respondents reflected that that access to protection materials (mask, hat, suit, goggles and face shields) was insufficient. Only 4.9% of respondents felt satisfied with their protection measures. Most participants had had contact with diagnosed (35.3%) and suspected (30.6%) patients.

3.2. Perceived stress and related factors

The median PSS score was 28. This represents the prevalence of perceived stress levels for HCW (Supplementary Table 1), which is higher than health risk stress (HRS) criteria 25/26 of Chinese people (Tingzhong, 2002), suggesting that HCW had elevated stress levels during the COVID-19 pandemic. To measure factors related to stress, we examined the different stress levels in each group. Results showed that different job titles (junior, intermediate and senior title) ($p = 0.02$) and years of work experience (less than 5 years, 6-10 years and more than 11 years) ($p = 0.048$) affected HCW stress levels (Table 1).

3.3. Related factors for anxiety and depression

The median scores for anxiety and depression were 8 and 9 (Supplementary table 2 and 3), while 54.1% and 57.3% of HCW had symptoms of anxiety and depression respectively (Supplementary Figure 1 A and B). Regarding related factors in anxiety and depression, we found significant differences in anxiety and depression levels between males and females ($p < 0.01$ and 0.008) and between different job titles ($p = 0.002$ and 0.017). Different levels of anxiety and depression were also found between sub-groups of protective measures (sufficient, general, deficient and no protected measures) ($p = 0.001$ for anxiety and 0.007 for depression) as well as contact history (contact with diagnosed, contact with suspected, contact with specimen of patients and no contact) ($p < 0.01$) (Table 2).

3.4. Independent risk factors for anxiety

It was also found that gender, title, protective measures and contact history were independent risk factors for anxiety (Table 3). Specifically, compare to males, female HCW were more likely to have anxiety (OR = 1.594, 95% CI: 1.159–2.192). When comparing those with intermediate job titles to those with junior titles, the OR value was 1.517 (95% CI: 1.072–2.146). When comparing general protective measures with sufficient measures, the OR value was 2.184 (95% CI: 1.096–4.355). For deficient measures compared with sufficient measures, the OR value was 2.783 (95% CI: 1.430–5.416). For no measures compared to sufficient measures, the OR value was 2.993 (95% CI: 1.275–7.025). Regarding contact history, zero contact compared with contact with diagnosed patients, the OR value was 0.503 (95% CI: 0.359–0.705).

3.5. Independent risk factors for depression

Protective measures and contact history were found to be the two independent risk factors for depression. As our data showed,

Table 2
Comparison of anxiety and depression among characters in each group.

Group Region	Anxiety N (%) P ^a	Depression N (%) P ^a		
Wuhan	382(54.2%)	0.976	409(58.0%)	0.507
Other cities in Hubei	76(54.3%)		81(57.9%)	
Other cities out of Hubei	60(53.1%)		59(52.2%)	
Gender				
Male	143(45.5%)	< 0.01**	161(51.3%)	0.008**
Female	375(58.2%)		388(60.2%)	
Marital status				
Married	135(54.7%)	0.830	143(57.9%)	0.828
Single/other	383(53.9%)		406(57.1%)	
Obstetrical history				
No kid	155(51.5%)	0.613	167(55.5%)	0.919
Pregnancy	18(66.7%)		17(63.0%)	
1 kid	262(54.9%)		275(57.7%)	
1kid and being pregnant	8(53.3%)		9(60.0%)	
2 kids or more	75(54.3%)		81(58.7%)	
Resident status				
Living alone	149(55.0%)	0.722	152(56.1%)	0.632
Living with family	369(53.7%)		397(57.8%)	
Profession				
Clinical physician	187(49.5%)	0.055	203(53.7%)	0.156
Nurse	210(58.5%)		224(62.4%)	
Working in CT room	21(65.6%)		19(59.4%)	
work in clinical laboratory	42(48.3%)		46(52.9%)	
Other position in Hospital	58(56.9%)		57(55.9%)	
Education				
Junior college education	48(47.5%)	0.066	54(53.5%)	0.098
Bachelor	284(54.1%)		306(58.3%)	
Master	107(61.8%)		109(63.0%)	
Doctor/Ph.D	79(49.7%)		80(50.3%)	
Title				
Junior	225(53.8%)	0.002**	237(56.7%)	0.017*
Intermediate	221(59.4%)		230(61.8%)	
Senior	72(42.9%)		82(48.8%)	
Work experience, year				
less than 5 years	166(56.3%)	0.082	172(58.3%)	0.293
6-10 years	160(57.8%)		167(60.3%)	
More than 11 years	192(49.7%)		210(54.4%)	
Working Position				
Fever clinics	42(54.5%)	0.329	44(57.1%)	0.954
Nurse	54(58.7%)		54(58.7%)	
Working in CT room	25(67.6%)		23(62.2%)	
work in clinical laboratory	42(48.8%)		47(54.7%)	
Other position in Hospital	355(53.3%)		381(57.2%)	
Protective equipment				
Adequate	14(29.8%)	0.001**	20(42.6%)	0.007**
General	137(50.0%)		140(51.1%)	
Insufficient	335(57.6%)		356(61.2%)	
No equipment	32(58.2%)		33(60.0%)	
Contact history				
No contact	121(43.2%)	< 0.01**	134(47.9%)	< 0.01**
Contact with diagnosed	206(60.9%)		219(64.8%)	
Contact with suspected	169(57.7%)		170(58.0%)	
Contact with specimen of patients	22(46.8%)		26(55.3%)	

a *, $p < 0.05$, **, $p < 0.01$

insufficient protective measures compared to sufficient measures, the OR value was 2.020 (95% CI: 1.088–3.749, $p = 0.026$), while for no contact compared to contact with diagnosed patients, the OR value was 0.512 (95% CI: 0.366–0.716, $p < 0.01$) (Table 4).

3.6. Relationship between job title and contact history

Notably, HCWs with different job titles had significant differences in perceived stress ($p = 0.02$) (Table 1), as shown by pairwise comparison between junior and senior titles, $p < 0.05$ (Supplementary figure 2). Given that contact history was an independent risk factor for both anxiety and depression, we determined the correlation between titles and contact history and found that the two factors were significantly correlated ($\chi^2 = 0.004$) (Table 5). Furthermore, the rates of junior titles

Table 3
Risk of Anxiety: logistic regression analysis.

	β	SE	Wald value	OR (95%CI)	p^a
Gender					
Male VS Female	0.466	0.163	8.204	1.594(1.159–2.192)	0.004**
Title					
Junior			8.610		0.013
Intermediate	0.417	0.177	5.542	1,517(1.072–2.146)	0.019*
Senior	-0.018	0.261	0.005	0.982(0.589–1.638)	0.946
Protective equipment					
Adequate			10.822		0.013
General	0.781	0.352	4.924	2.184(1.096–4.355)	0.026*
Insufficient	1.024	0.340	9.083	2.783(1.430–5.416)	0.003**
None	1.096	0.435	6.343	2.993(1.275–7.025)	0.012**
Contact history					
Contact with diagnosed			17.543		0.001
Contact with suspected	-0.149	0.168	0.788	0.862(0.620–1.197)	0.375
Contact with specimen of patients	-0.471	0.343	1.889	0.624(0.319–1.222)	0.169
No contact	-0.687	0.173	15.867	0.503(0.359–0.705)	<0.01*

a *, $p < 0.05$, **, $p < 0.01$

with contact history (including diagnosed, suspected patients and specimen) were higher than those with senior and intermediate titles (Table 5, Supplementary figure 3).

4. Discussion

Epidemiological studies have documented during disease epidemics, HCW at the forefront of the fight against illness are prone to stress responses (Mata et al., 2015). Such responses lead to changes in perception and development of psychological morbidity such as anxiety, depression, PTSD, and PTSD (Kaysen et al., 2003). Studies pointed out that SARS and the Middle East respiratory syndrome Coronavirus (MERS-CoV) caused high rates of psychological morbidity for HCW in hospitals. Even one to three years after SARS, fear, chronic stress and depression remained for HCW (Nickell et al., 2004). However, the prevalence of the psychological impacts of COVID-19 on HCW has not been reported. In the current study, we evaluated stress levels and analyzed independent risk factors for anxiety and depression for HCW during the COVID-19 outbreak.

4.1. Prevalence of stress, anxiety and depression

We aim to evaluate the levels of stress and psychological morbidities such as anxiety and depression for HCWs during the COVID-19 outbreak. Firstly, we assessed stress levels using the PSS-14 scale that has been widely used in studies about stress events, physical and psychological health and stress control (Cohen et al., 1983; Mimura and

Table 4
Risk of Depression: logistic regression analysis.

Risk	β	SE	Wald	OR (95%CI)	p^a
Protective equipment					
Adequate			9.104		0.028
General	0.355	0.328	1.176	1.427(0.750–2.713)	0.278
Insufficient	0.703	0.315	4.967	2.020(1.088–3.749)	0.026*
None	0.740	0.416	3.165	2.095(0.927–4.734)	0.075
Contact history					
Contact with diagnosed			15.300		0.002
Contact with suspected	-0.312	0.168	3.444	0.732(0.527–1.018)	0.063
Contact with specimen of patients	-0.302	0.342	0.781	0.739(0.379–1.444)	0.377
No contact	-0.669	0.171	15.294	0.512(0.366–0.716)	<0.01**

a *, $p < 0.05$, **, $p < 0.01$

Griffiths, 2004). In one study PSS was used to examine the stress of Chinese people under typical conditions. It was found that a score of 25 for females and 26 for males was the cut-off values for health risk stress (Tingzhong, 2002). We found a PSS core of 28 for HCW in our study, suggesting that the COVID-19 epidemic has induced elevated stress levels for HCW when compared with the general population under typical conditions.

Additionally, scholars investigating the psychological impact of HCW during SARS found that 39.3% of HCW had elevated stress levels (Lu et al., 2010), whereas we found that 55.1% of HCW had elevated stress levels during the COVID-19 epidemic. Thus, it appears that the COVID-19 epidemic induced the prevalence of stress for HCW and that this was more serious than during SARS. Additionally, stress levels of HCW were higher than the general public in China during the COVID-19 epidemic, where 8.1% reported moderate to severe stress levels (Wang et al., 2020).

Stress is a processed response to the pressure source and can lead to psychological illnesses such as anxiety and depression (Gong et al., 2014). We found that more than half (54.2%) of the respondents developed anxiety, which is a much higher number than physicians in China (25.6–35.3%) (Ahmed et al., 2009; Gong et al., 2014; Zhou et al., 2016) and other countries (2.2–24%) under typical conditions (Ahmed et al., 2009). The anxiety levels of respondents were also higher than those of medical residents (20%–30%) (Buddeberg-Fischer et al., 2009) and physicians in oncology department (19%) (Paiva et al., 2018) who were assumed to be under greater pressure than physicians in other departments. Additionally, 58% of HCW in our study had symptoms of depression, which is higher than those of oncologists (12%) (Paiva et al., 2018).

These data suggests an urgent need for psychological intervention for HCW, as mental health is crucial not only for their own well-being, but also for their work efficacy, which contributes to the quality of medical services and patient safety, and may, in turn, affect psychological health of HCW (Ruotsalainen et al., 2014).

4.2. Related factors of psychological impacts

We also aimed to determine the related factors which endanger the psychological health of HCW as these may be potential targets for intervention. Protective measures were one such factor, as there were differences in levels of anxiety and depression for the various degrees of protection. More importantly, protective measures were the independent risk factor for the development of anxiety and depression, which is in line with one study about SARS, in which it was found the sufficient protection was a positive factor for mental health of HCW (Kaysen et al., 2003). However, the sudden occurrence of the COVID-19 outbreak, which was both fast and widespread, the particular timing (coinciding with the Spring Festival) and traffic control-led to a shortage of masks, goggles, face shields and protective clothing. Under such conditions, some HCW used masks repeatedly and did not drink water or go to the bathroom to prolong the life of their protective

Table 5
Number and percentage of HCW with different contact history.

Title	Contact with diagnosed (%)	Contact with suspected (%)	Contact with specimen (%)	No contact (%)	χ^2 ^a
Junior	135(32.3%)	150(35.9%)	23(5.5%)	110(26.3%)	
Intermediate	141(37.9%)	101(27.2%)	22(5.9%)	108(29.0%)	^a 0.004**
Senior	62(36.9%)	42(25.0%)	2(1.2%)	62(36.9%)	

a **, $p < 0.01$

equipment, which might reduce its effectiveness and increase the risk of infection. We suggest that these physical and psychological responses induced symptoms of anxiety and depression.

Contact history was another important independent risk factor for both anxiety and depression. However, the conclusion that contact history affects psychological health is controversial. Authors of one study about SARS announced that contact with an infected patient was not an adverse factor for psychological health (Maunder et al., 2006). In contrast, authors of another study indicated that HCW who had more possible exposure to SARS were 2-3 times more likely to have high PTS levels than those without exposure (Kaysen et al., 2003; Wu et al., 2009). In our study, when compared to those who had had no contact, HCW who had contact with diagnosed patients were approximately twice as likely to develop anxiety and depression. This is because contact with infected and suspected patients will induce fear and uncertainty for the virus, as there is no effective medication for treating COVID-19 pneumonia, and the prognosis is inclusive. Additionally, the incubation time of COVID-19 pneumonia is longer than SARS, meaning the sustained and cumulative stress over time turns into anxiety.

It is also notable that professional title was related to psychological impact (Table 1-3), which is consistent with previous studies where it was found that title was correlated with work experience, training and income, and that it affects physicians' distress (Angerer et al., 2008; Wang and Wang, 2019). In addition to these previous findings, we firstly unveil that job titles affect stress as a result of contact history (Table 5 and supplementary figure 3). The senior and junior titles were found to have significant differences in stress (Supplementary Figure 2), which could be explained by the observation that juniors have more contact with infected patients and specimens than senior HCW (Supplementary Figure 3). Interestingly, HCW with all three types of title have endured stress (median PSS = 28, 28, 26 respectively), but only intermediate titles were an independent risk factor for anxiety (Table 3). This is because, firstly, there was more chance for the intermediate HCW to have contact with diagnosed patients (Supplementary Figure 3). Moreover, HCW with intermediate titles are more likely to work in high-risk units but may have less ability to deal with emotion (Angerer et al., 2008). Finally, intermediate HCW may have more pressure than senior titled HCW in terms of income, family burden and promotions (Wang et al., 2010). Therefore, intermediate titled HCW were the most susceptible to anxiety in the COVID-19 epidemic.

As mentioned in previous studies (Bialek and Sadowski, 2019), females are more likely to experience stress and develop anxiety. From our survey, it appears that females are more willing to take part in the research, since 67.2% of our sample is female (Table 1), suggesting there are more female nurses and doctors, and that females are more likely to recognize that they need help.

5. Limitation

A limitation of the present study is that we did not measure psychological impacts before the epidemic. Therefore, we cannot exclude effects brought about by nonepidemic causes. Additionally, is this a cross-sectional survey; thus, sustained psychological impact is not analyzed. Thirdly, we did not compare stress levels of medical and non-medical healthcare workers. Authors of a recent study conducted in

Singapore found a higher prevalence of anxiety among non-medical healthcare workers compared to medical personnel (Ho et al., 2020). As such, further information is required from China healthcare workers.

6. Conclusions

In summary, we found a high prevalence of stress, anxiety and depression for HCW during the COVID-19 epidemic in China. Independent risk factors for anxiety and depression were gender, professional title, protective support and contact history. This indicates that, during the COVID-19 pandemic, it is helpful for HCW to have access to protective equipment support and that intermediate and female HCW should be given primary concern and psychological support. Various strategies can be adopted in that regard. Firstly, intermediate and female HCW can be teamed up with experienced medical personnel to increase their practical abilities. Secondly, psychological education is needed to help HCW reduce pressure, so as to improve their psychological endurance. Thirdly, the activities of Balint Groups should be promoted to improve their ability to deal with challenging emotions and ensure the quality of medical treatment. Finally, promotions and financial incentives may be used to encourage HCW during disease epidemics.

Author's statement

I certify that all authors have seen and approved the final version of the manuscript being submitted. They warrant that the article is the authors' original work, hasn't received prior publication and isn't under consideration for publication elsewhere. The following declarations are also included in this statement:

Ethic

The study was approved by the Ethics Committee of Zhongnan Hospital of Wuhan University.

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Author contributions

Xiao Xiao has done the figure plotting and most part of writing. Xiaobin Zhu is responsible for writing the method part and design of the questionnaires. Shuai Fu and Yugang Hu did statistics throughout the manuscript. Xiaoning Li and Jinsong Xiao take responsibilities for scales selection, the integrity of data and analyzing results.

Declarations of Competing Interest

None.

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Supplementary materials

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References

- Ahmed, I., Banu, H., Al-Fageer, R., Al-Suwaidi, R., 2009. Cognitive emotions: depression and anxiety in medical students and staff. *J. Crit. Care* 24, e1–e7.
- Angerer, P., Petru, R., Nowak, D., Weigl, M., 2008. [Working conditions and depression in physicians]. *Dtsch. Med. Wochenschr.* 133, 26–29.
- Bargellini, A., Barbieri, A., Rovesti, S., Vivoli, R., Roncaglia, R., Borella, P., 2000. Relation between immune variables and burnout in a sample of physicians. *Occup. Environ. Med.* 57, 453–457.
- Bialek, K., Sadowski, M., 2019. Level of stress and strategies used to cope with stress by physicians working in intensive care units. *Anaesthesiol. Intensive Ther.* 51, 361–369.
- Buddeberg-Fischer, B., Stamm, M., Buddeberg, C., Klaghofer, R., 2009. [Anxiety and depression in residents - results of a Swiss longitudinal study]. *Z. Psychosom. Med. Psychother.* 55, 37–50.
- Chong, M.Y., Wang, W.C., Hsieh, W.C., Lee, C.Y., Chiu, N.M., Yeh, W.C., Huang, O.L., Wen, J.K., Chen, C.L., 2004. Psychological impact of severe acute respiratory syndrome on health workers in a tertiary hospital. *Br. J. Psychiatry* 185, 127–133.
- Cohen, S., Kamarck, T., Mermelstein, R., 1983. A global measure of perceived stress. *J. Health Soc. Behav.* 24, 385–396.
- Gong, Y., Han, T., Chen, W., Dib, H.H., Yang, G., Zhuang, R., Chen, Y., Tong, X., Yin, X., Lu, Z., 2014. Prevalence of anxiety and depressive symptoms and related risk factors among physicians in China: a cross-sectional study. *PLoS One* 9, e103242.
- Ho, C.S., Chee, C.Y., Ho, R.C., 2020. Mental Health Strategies to Combat the Psychological Impact of COVID-19 Beyond Paranoia and Panic. *Ann. Acad. Med. Singapore* 49, 155–160.
- Kaysen, D., Resick, P.A., Wise, D., 2003. Living in danger: the impact of chronic traumatization and the traumatic context on posttraumatic stress disorder. *Trauma Violence Abuse* 4, 247–264.
- Lu, S.H., Tian, B.C., Yang, T.Z., Chen, D.W., Chi, Y.H., 2010. [Perceived stress in general public during prevalence of severe acute respiratory syndrome and its impact on health behavior]. *Zhonghua Yu Fang Yi Xue Za Zhi* 44, 128–133.
- Mata, D.A., Ramos, M.A., Bansal, N., Khan, R., Guille, C., Di Angelantonio, E., Sen, S., 2015. Prevalence of depression and depressive symptoms among resident physicians: a systematic review and meta-analysis. *JAMA* 314, 2373–2383.
- Maunder, R.G., Lancee, W.J., Balderson, K.E., Bennett, J.P., Borgundvaag, B., Evans, S., Fernandes, C.M., Goldbloom, D.S., Gupta, M., Hunter, J.J., McGillis Hall, L., Nagle, L.M., Pain, C., Peczenik, S.S., Raymond, G., Read, N., Rourke, S.B., Steinberg, R.J., Stewart, T.E., VanDeVelde-Coke, S., Veldhorst, G.G., Wasylenki, D.A., 2006. Long-term psychological and occupational effects of providing hospital healthcare during SARS outbreak. *Emerg. Infect. Dis.* 12, 1924–1932.
- Mimura, C., Griffiths, P., 2004. A Japanese version of the perceived stress scale: translation and preliminary test. *Int. J. Nurs. Stud.* 41, 379–385.
- Nickell, L.A., Crighton, E.J., Tracy, C.S., Al-Enazy, H., Bolaji, Y., Hanjrah, S., Hussain, A., Makhlof, S., Upshur, R.E., 2004. Psychosocial effects of SARS on hospital staff: survey of a large tertiary care institution. *CMAJ* 170, 793–798.
- Paiva, C.E., Martins, B.P., Paiva, B.S.R., 2018. Doctor, are you healthy? A cross-sectional investigation of oncologist burnout, depression, and anxiety and an investigation of their associated factors. *BMC Cancer* 18, 1044.
- Ruotsalainen, J.H., Verbeek, J.H., Marine, A., Serra, C., 2014. Preventing occupational stress in healthcare workers. *Cochrane Database Syst Rev.* , CD002892.
- Tingzhong, Y., 2002. A study on the psychological stress of urban population in social transformation. *Chin. J. Epidemiol.* 06, 3.
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C.S., Ho, R.C., 2020. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus Disease (COVID-19) epidemic among the general population in China. *Int. J. Environ. Res. Public Health* 17.
- Wang, J.N., Sun, W., Chi, T.S., Wu, H., Wang, L., 2010. Prevalence and associated factors of depressive symptoms among Chinese doctors: a cross-sectional survey. *Int. Arch. Occup. Environ. Health* 83, 905–911.
- Wang, Y., Wang, P., 2019. Perceived stress and psychological distress among Chinese physicians: The mediating role of coping style. *Medicine (Baltimore)*. 98, e15950.
- Wu, P., Fang, Y., Guan, Z., Fan, B., Kong, J., Yao, Z., Liu, X., Fuller, C.J., Susser, E., Lu, J., Hoven, C.W., 2009. The psychological impact of the SARS epidemic on hospital employees in China: exposure, risk perception, and altruistic acceptance of risk. *Can. J. Psychiatry* 54, 302–311.
- Zhou, J., Yang, Y., Qiu, X., Yang, X., Pan, H., Ban, B., Qiao, Z., Wang, L., Wang, W., 2016. Relationship between Anxiety and Burnout among Chinese Physicians: A Moderated Mediation Model. *PLoS One* 11, e0157013.