Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Journal of Psychiatric Research 129 (2020) 198–205

Contents lists available at ScienceDirect

Journal of Psychiatric Research

journal homepage: www.elsevier.com/locate/jpsychires

Psychological impact of coronavirus disease (2019) (COVID-19) epidemic on medical staff in different posts in China: A multicenter study

Li-Qiong Wang [a], Meng Zhang [a], Guang-Mei Liu [a], Shi-Ying Nan [b], Tao Li [b], Li Xu [b], Yan Xue [b], Min Zhang [b], Lei Wang [b], Yun-Dong Qu [b,**], Feng Liu [b,*]

[a] Department of Infection, Jinan Infectious Disease Hospital, Cheeloo College of Medicine, Shandong University, China
[b] Department of Infectious Disease and Hepatology, The Second Hospital, Cheeloo College of Medicine, Shandong University, China

ARTICLE INFO

Keywords:
COVID-19
Stress
Psychological
Depression
Anxiety
Resilience
Psychology
Medical staff
Hospital

ABSTRACT

Objective: An outbreak of coronavirus disease 2019 (COVID-19) is a public health emergency of international concern and poses a big challenge to medical staff and general public. The aim is to investigate psychological impact of COVID-19 epidemic on medical staff in different working posts in China, and to explore the correlation between psychological disorder and the exposure to COVID-19.

Methods: A multicenter WeChat-based online survey was conducted among medical staff in China between 26 February and 3 March 2020. Medical staff deployed to Hubei province from other provinces and medical staffs in different posts outside Hubei were selected to represent diverse exposure intensities to the threat of COVID-19. Anxiety, depression, sleep quality, stress and resilience were evaluated using scales including GAD-7, PHQ-9, PSQI, PSS-14, and CD-RISC-10. Latent class analysis was performed to identify potential staff requiring psychological support.

Results: A total of 274 respondents were included, who serving at 4 posts as follows, staff backing Hubei province, isolation wards outside Hubei, fever clinic and infectious disease department, and other departments outside Hubei. The total scores of anxiety, depression, sleep quality and stress were statistically different among groups, meanwhile an increasing tendency of anxiety, depression and sleep quality scores with increasing risk of exposure to COVID-19 was found ($p < 0.05$). Subsequent post-hoc analysis indicated that the staff backing Hubei had higher scores of anxiety, depression, sleep quality and perceived stress (adjusted $p < 0.05$). The combined prevalence of anxiety, depression and insomnia of staff backing Hubei reached as high as 38%. Four-class latent class analysis showed 3 categories of population (69.4%) may need psychological support.

Conclusions: High prevalence of anxiety, depression and insomnia exist in medical staff related to COVID-19. The higher the probability and intensity of exposure to COVID-19 patients, the greater the risk that medical staff will suffer from mental disorders, suggesting continuous and proper psychiatric intervention are needed.

1. Introduction

An outbreak of 2019 novel coronavirus disease (COVID-19) spread quickly across the country, with the first pneumonia cases were identified in Wuhan city, Hubei province, China(Huang et al., 2020). By March 5, 80, 565 people were infected in China and Hubei province accounted for 67, 466 cases, meanwhile 14,759 cases were found outside of China (WHO, 2020a). The World Health Organization (WHO) declared the COVID-19 a public health emergency of international concern on January 30, 2020 (WHO, 2020b).

More than forty thousands of medical staff from other provinces has been deployed to Hubei province to rescue the dangerous situation since January 25, 2020. Meanwhile, more health care workers of internal medicine and fever clinics across the country are fighting against this highly infectious disease. Since it's a new emerging disease that we've never seen before, there is no effective medicine or vaccine available so far. The medical staff is also at risk of SARS-CoV-2 virus infection or even death. Thus, it is a really brave feat full of danger, requiring great courage and responsibility. As of February 11, 2020, it was reported that a total of 3019 Chinese medical staff were infected and 5 died (Novel

* Corresponding author.
** Corresponding author.
E-mail addresses: yundongqu@sina.com (Y.-D. Qu), f.liu@126.com (F. Liu).

https://doi.org/10.1016/j.jpsychires.2020.07.008
Received 26 April 2020; Received in revised form 23 June 2020; Accepted 10 July 2020
Available online 14 July 2020

Coronavirus Pneumonia Emergency Response Epidemiology Team, 2020; Zhao, 2020). The number of medical staff infected and died from SARS-CoV-2 virus infection is still rising.

It was noticed that nearly all medical staff had presented their petition to join the brave action against the epidemic before they were deployed to Hubei province or local isolation wards. However, little was known about the psychological disorders they would confront with the growing epidemic given the extensive media coverage highlight the potential threat and the uncertainty regarding the shortage of medical material, especially personal protective equipment (PPE), although they had all necessary PPE when departing (see details in supplementary file).

In the present study, a multicenter survey was performed to investigate the psychological disorders related to medical staff serving in different posts. A brief questionnaire was designed and distributed to medical staff of several hospitals through WeChat group, including the medical staff deployed to Hubei province from other provinces and their colleagues in isolation wards outside Hubei who also need to face the COVID-19 patients in local hospitals, and also including medical staff in fever clinics, infectious disease department and other departments.

2. Methods

2.1. Cross-sectional online survey

A WeChat-based online survey was carried out among medical staff between 26 February and 3 March 2020. Medical staff deployed to Hubei province from Shandong Province and medical staffs at different posts outside Hubei were selected to represent diverse exposure intensities to the threat of COVID-19. During the survey period, the cumulative number of confirmed COVID-19 cases grew very slowly and seemed to have entered the plateau phase (see Fig. 1).

The survey was conducted with the WeChat-based survey program **Questionnaire Star (China)** (https://www.wjx.cn/jq/59945908.aspx). WeChat is the most popular social application on smartphones in China, and all the medical staff had their own WeChat account. The Quick Response (QR) code directing to the online survey was distributed in medical staff's working groups of several hospitals (see supplementary Figure 1). Filling questionnaires at home or hotels outside working hours was recommended. All included hospitals had fever clinic and department of infectious disease. Any group member who scanned the QR code and filled in the online survey was included in the present study. The informed consent was declared at the beginning of the online survey, and their final submissions were regarded as their confirmation of informed consent. The protocol was also approved by the ethics committee of the Second Hospital of Shandong University.

2.2. Psychometric instruments

Demographic information included age, gender (coded: 1-male or 2-female), education (code: 1-college or below, 2-Bachelor's degree, 3-Graduate), age and marital status (code: 1-unmarried, 2-married). Depressive symptoms were evaluated through the Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001; Spitzer et al., 1999). Nine items assess depressive symptoms, and participants reported the frequency of symptoms experienced over the past two weeks. Each symptom was rated on a 4-point scale ranging from 0-Not at all to 3-Nearly every day. Moderate or severe level of anxiety was identified when the total score was 10 or above.

Anxiety was evaluated using the 7-item Generalized Anxiety Disorder Scale (GAD-7), a brief self-reported scale with good reliability and validity in the general population (Spitzer et al., 2006). Participants were asked to report how frequently they had been bothered by various symptoms over the past two weeks. The scale accordingly produced a summary of GAD scores ranging from 0 to 21. Respondents scoring 10 or above were identified as moderate or severe anxiety (Ruiz et al., 2011).

Sleep quality were evaluated by Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989). PSQI questionnaire contains 19 self-rating questions and subsequently yield seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency and sleep disturbance, use of sleeping medication and daytime dysfunction. Its overall score ranges from 0 to 21. Participants who scored higher than 5 were considered as poor sleepers.

Psychological stress was accessed through 14-item Perceived Stress Scale (PSS-14) (Cohen et al., 1983). The scale comprises 14 items with two (negative and positive) subscales. Participants rate each item on a 5-point Likert scale, ranging from 0-Never to 4-Very often. Its scores range from 0 to 56, with higher scores indicating greater perceived stress.

The resilience was evaluated through 10-item Connor-Davidson Resilience Scale (CD-RISC-10) (Campbell-Sills and Stein, 2007). This scale is comprised of ten of the original 25 items. Each item is rated from 0-Not true at all to 4-True nearly all the time, and total points range from 0 to 40.

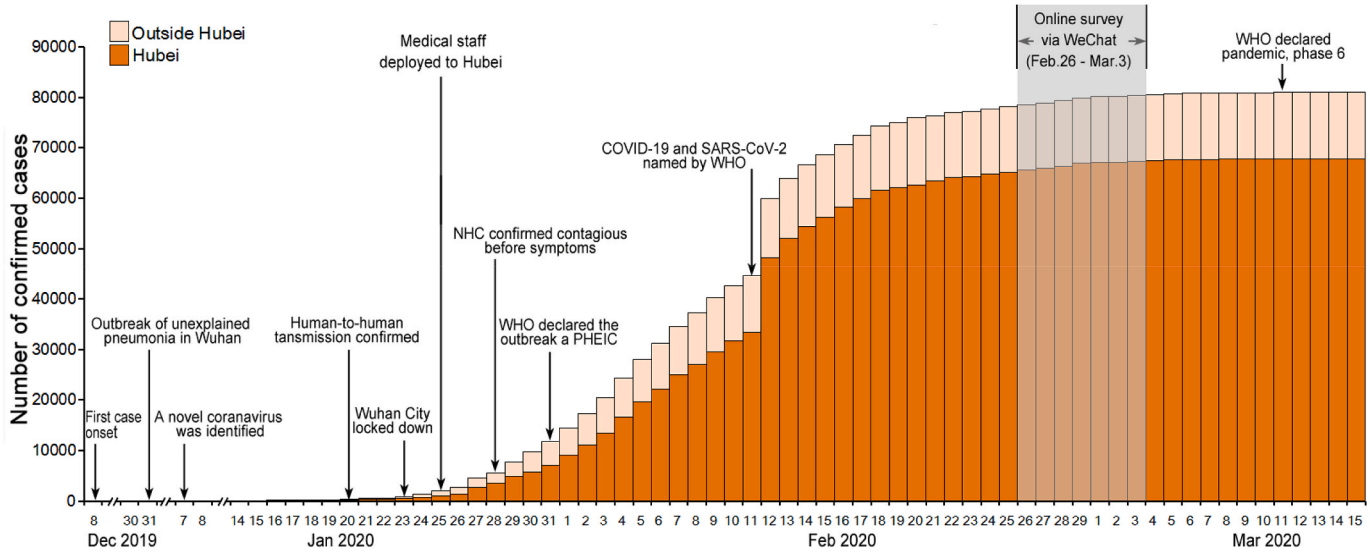

Fig. 1. Timeline of COVID-19 and survey date. Medical staffs were deployed to Hubei since Jan. 25, 2020, and the online survey was conducted 1 month after that. The cumulative number seemed to be in plateau phase.

2.3. Data analysis plan

Continuous variables were expressed as the means and standard deviations or medians and range when appropriate. Categorical variables were summarized as the counts and percentages in each category. Kurtosis, skewness, and Shapiro-Wilk test were calculated to assess variables' distribution.

Wilcoxon rank-sum tests were applied to continuous variables, chi-square tests and Fisher's exact tests were used for categorical variables as appropriate. The Jonckheere-Terpstra test was used to determine if there is a statistically significant trend between total scores of the scales and the decreasing exposure risks to COVID-19 patients.

Multivariate analysis was performed using logistic regression to examine the association between psychological status and a priori chosen demographic variables, including age, gender, marital status, working year, education, current post, job type and original post.

Latent Class Analysis (LCA) was performed to identify subtypes of depressives and anxiety symptoms as previously described (Norcini Pala et al., 2016). In brief, LCA approach posits participants could be divided into mutually exclusive latent classes (Collins and Lanza, 2013). These classes are inferred from a set of indicators, which usually are unobservable. Individuals are assigned to one latent class based on the pattern of anxiety and depressive symptoms. The 7 anxiety and 9 depressive symptoms assessed with the GAD-7 and PHQ-9 were treated as ordinal variables (0-"Not at all" to 3-"Nearly every day"). The option 3-"Nearly every day" was collapsed into a single category with option 2-"More than half the days" due to the infrequent selection. When ordinal indicators are analyzed, the software produces item conditional probabilities, a parameter that helps to further characterize and distinguish the latent classes. The LCA analysis was performed using R language and R package poLCA (Linzer and Lewis., 2011; R Core Team, 2018).

3. Results

3.1. Demographic data

Demographic statistics of 274 participants are listed in Table 1. All participants were divided to 4 groups according to current working posts, i.e. medical staff backing Hubei province (group A, n = 50), isolation wards outside Hubei (group B, n = 75), fever clinic and infectious disease department outside Hubei (group C, n = 81), and other departments outside Hubei (group D, n = 68). The above four groups were assumed to have declining possibilities exposed to COVID-19 patients or SARS-CoV-2 virus.

The gender, education and working years were similar among the four groups. Medical staff from isolation wards (group B) had lower married rates, but further pairwise comparisons did not reach statistical significance (adjusted P > 0.05). The median age was statistically different among groups, and further pairwise comparisons revealed that medical staff in other departments were older than staff backing Hubei and staff in local isolation wards (both adjusted P = 0.036). The overall median fill-in time was less than 8 min, which is consistent with the expected time when we designed the study. Medical staff backing Hubei spent fewest seconds on filing among groups, which may due to the greatest pressure they faced at that time (see following correlation analysis results).

3.2. Descriptive statistics of scales and correlation analysis

The total scores of GAD-7, PHQ-9, PSS-14, CD-RISC-10 and PSQI scales are listed in Table 2. The total scores of GAD-7, PHQ-9, PSS-14 and PSQI were significantly different among groups, except for CD-RISC-10. The post-hoc analysis indicated that the staff backing Hubei was a special group, for this group was statistically different with other 2–3 groups. Regarding depressive scale PHQ-9 and sleep quality scale PSQI, the score of staff backing Hubei was higher than any other group. For anxiety scale GAD-7, they have higher scores than staff in infectious disease department and other departments. Meanwhile they have higher perceived stress PSS-14 scores than staff in fever clinic and other departments.

The prevalence of anxiety, depression and insomnia are shown in Fig. 2. The overall prevalence of anxiety, depression and insomnia were 13.9% (9.8%–18%), 16.1% (11.7%–20.4%) and 19.7% (15.0%–24.4%), respectively. As expected, medical staff backing Hubei had the highest prevalence, whichever of anxiety (20%), depression (22%) and insomnia (26%). On the contrary, medical staff working in other departments outside Hubei had the lowest prevalence of anxiety (7.4%), depression (4.4%) and insomnia (10.3%).

Correlation analysis results were listed in Table 3. Current post (staff backing Hubei) correlated with anxiety, depression, perceived stress and poor sleep quality. Marital status (married) was related with anxiety and poor sleep quality, while elder age and longer working year correlated with lower stress and better resilience.

Logistic regression for anxiety, depression and insomnia are reported in Table 4. The current post was only predictor of anxiety. For depression, marriage, current post and original post (infectious department) were revealed as predictors. Female, marital status (married) and current posts were predictors of insomnia. When age and occupation entered the final regression equation to eliminate potential bias, the results were very similar to Table 4 (see supplementary Table 3).

3.3. Latent class analysis of anxiety and depression

As the prevalence of anxiety and depression were high and some individuals had both of them. Latent class analysis was performed to explore the potential classifications for both anxiety and depression. Finally the four-class model was selected as it had smallest Bayesian Information Criterion (BIC) with acceptable sample-adjusted BIC (BICn) entropy (see Supplementary Table 1).

Table 1
Demographic characteristics.

	Overall n = 274	Group A: Staff Backing Hubei n = 50	Group B: Isolation wards n = 75	Group C: Fever Clinic/ID department n = 81	Group D: Other departments n = 68	P value
Age (years)	37 (22–64)	35 (24–52)	33 (22–55)	37 (23–58)	40 (22–64)	0.027
Gender (female, %)	212(77.4%)	38(76%)	60(80%)	63(77.8%)	51(75%)	0.902
Marital Status (married, %)	224(81.8%)	41(82%)	53(70.7%)	70(86.4%)	60(88.2%)	0.026
Working Years (year)	12.5 (1–48)	10.5 (1–30)	11 (5–34)	11 (1–36)	17.5 (1–48)	0.096
Education(college/Bachelor's/ graduate,%)	14.2/50.7/35.1	6.0/62.0/32.0	17.3/54.7/28.0	14.8/45.7/39.5	16.2/44.1/39.7	0.266
Occupation (doctor/nurse,%)	40.8/59.2	26.0/74.0	30.7/69.3	55.6/44.4	45.9/54.1	0.001
Fill-in time (second)	467 (173–6081)	395 (203–993)	481 (182–3820)	503 (273–6081)	490 (230–1961)	0.012

Abbreviations: ID, infectious disease.

Table 2
Sores of Psychological scales.

Scale	Overall n = 274	Group A n = 50	Group B n = 75	Group C n = 81	Group D n = 68	P value	Post-hoc P value
GAD-7	4.5(0–21)	7(0–20)	5(0–17)	5(0–21)	3(0–14)	<0.001	A vs B: 0.011 A vs C: 0.005 A vs D: 0.003
PHQ-9	5(0–21)	7(0–20)	6(0–19)	5(0–21)	2.5(0–15)	<0.001	A vs B: <0.001 A vs C: 0.001 A vs D: <0.001
PSS-14	22(0–47)	24(3–47)	22(3–39)	24(4–47)	18(0–41)	0.036	A vs B: 0.006 A vs D: 0.018
CD-RISC-10	28(0–40)	28.5(0–40)	29(0–40)	25(4–40)	28(0–40)	0.752	NS*
PSQI	8(2–18)	8(2–18)	9(3–17)	8(3–17)	7(2–14)	0.003	A vs B: 0.002 A vs C; 0.005 A vs D: 0.026

Abbreviations: NS, no significance.

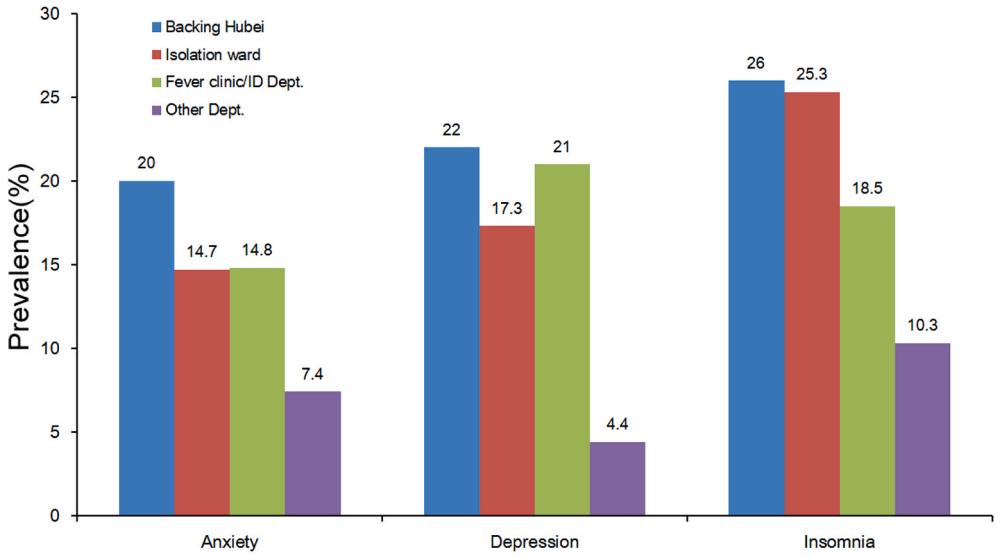

Fig. 2. Prevalence of anxiety, depression and insomnia of medical staffs in different posts. Staffs backing Hubei had the highest pervalnce of anxiety, depression and insomnia.

Table 3
Correlation analysis between psychological scales and variables.

	Age	Working year	Gender	Marriage	Education	Occupation	Current post	Original post	Fill-in time
GAD-7	0.04	0.052	0.126*	0.146*	0.011	0.048	−0.211**	0.149*	0.080
PHQ-9	−0.059	−0.039	0.05	0.101	−0.041	0.068	−0.259**	0.'132*	−0.026
PSS-14	−0.221**	−0.186**	0.051	0.016	−0.092	0.087	−0.129*	0.096	−0.192**
PSQI	0.005	0.016	0.1	0.125*	−0.062	0.042	−0.173**	0.065	0.074
CD-RISC-10	0.145*	0.128*	−0.08	−0.093	0.054	−0.069	0.017	−0.075	0.064

*p < 0.05, **p < 0.01.

The conditional probabilities of responses to 16 items in each category are shown in Fig. 3. Each category had its unique characteristics and represents a different response pattern. Category 1, or severe anxiety and depressive symptom subtype, represent the most sever type of both anxiety and depression. Responses to nearly all items were moderate or severe, and this subtype accounted for 10.3% of all participants. Category 2, or moderate anxiety and depression subtype, had nearly all moderate response to nearly all 16 item. This subtype accounted for 22.5% of the total population. Category 3, or mild/moderate anxiety with no/mild depression, usually had moderate anxiety with mild or no depressive symptoms. This subtype accounted for 36.7% of the total population. Category 4, or Low/no anxiety and depressive symptoms, had neither anxiety nor depressive symptoms, which accounted for 30.6% of the total population.

The distribution of each category in different posts is shown in Fig. 4. Category 1 and Category 2 represent the population with severe or moderate anxiety and depression. The combined proportions of these 2 categories were 50.0%, 41.4%, 27.2% and 17.7%, respectively, which also showed a gradually decreasing tendency.

4. Discussion

From the end of 2019, nearly all Chinese health care workers were plunged into the serious trouble as the sudden outbreak of COVID-19 in Hubei. Medical teams have been deployed to Hubei from other provinces since January 25. Our results indicated that there was significant higher psychological distress in medical staff deployed to Hubei province. The psychological characteristics of medical team backing Hubei

Table 4
Logistic regression results.

Dependent	Variable	B	S.E	P value	OR	95%CI
GAD-7	Gender	1.012	0.560	0.071	2.751	0.919–8.240
	Marriage	1.202	0.632	0.057	3.328	0.964–11.492
	Current Post	−0.465	0.183	0.011	0.628	0.439–0.900
PHQ-9	Age	−0.836	0.440	0.057	0.434	0.183–1.026
	Marriage	1.106	0.527	0.036	3.023	1.077–8.486
	Education	−0.347	0.239	0.145	0.707	0.443–1.128
	Original Post	0.792	0.357	0.027	2.208	1.097–4.445
	Current Post	−0.440	0.188	0.019	0.644	0.446–0.930
PSQI	Age	−0.695	0.370	0.060	0.499	0.242–1.030
	Gender	0.984	0.472	0.037	2.676	1.062–6.747
	Marriage	0.938	0.462	0.042	2.555	1.033–6.321
	Current Post	−0.362	1.289	0.020	0.696	0.513–0.945

were markedly different from other medical personnel. These results are accordance with some reports (Kang et al., 2020).

To our knowledge, this is the first multicenter survey to evaluate the mental disorders of medical workers in different situations when they encounter the nationwide epidemic. The initial hypothesis was the higher possibility and intensity medical staff contact COVID-19 patients, the more severe psychological problems they have. Considering their heavy work load and limited rest time, the questionnaire was designed to be very brief and the expected completion time was 10 min. Thanks to the easy use of smartphones and WeChat application, the actual completion time was less than 8 min.

In our research, the doctors and nurses, who were deployed to Hubei province or worked in local isolation wards, have to face confirmed COVID-19 patients and had relatively longer service length. The doctors and nurses deployed to Hubei had to worked in a new unfamiliar environment, and the patients they faced every day were more critical, many of them needed rescue (Chen et al., 2020; Guan et al., 2020). In contrast, the doctors and nurses in local isolation wards faced mostly mild patients, with very few cases of serious illness and death. For doctors and nurses working in the local fever clinic and infection department wards, they had adequate protective equipment, and had relatively low risk of encountering confirmed or suspected COVID-19 cases.

The present study showed that medical staff deployed to Hubei had the highest prevalence of anxiety, depression and poor sleep, if adding them up, the combined prevalence of at least one mental disorder reached as high as 38%. It was reported that deployment-related stressors was positively correlated with mental health problems at pre-deployment and during deployment (Sipos et al., 2018). The present convey was conducted during their deployment, about 1 month after they were deployed to Hubei province or to local isolation wards outside Hubei. The possible reasons for such a high prevalence are as follows: First, their departure for Hubei was too hastily to complete all necessary trainings, although they were still given some psychological counseling. Second, the original specialties of most medical staff were respiratory medicine, intensive medicine, other internal medicine specialties, and anesthesia, thus they lack expertise and protection skills against infectious diseases. Last but not least, after arriving in Hubei, they were in daily contact with critically ill patients, working for long hours, resting in designated hotels which led to lack communication with family and friends and social support.

A study by Lee, etc. assessed the psychological impact of the 2015 MERS outbreak on hospital workers (Lee et al., 2018). The results revealed medical staff performing MERS-related tasks showed the highest risk for post-traumatic stress disorder symptoms even after home quarantine. In the present study, there were high prevalence of mental health problems in medical staff related to COVID-19, what's more, the prevalence differed among different working environments. The medical staff deployed to Hubei had the highest possibility and intensity of exposure to COVID-19 patients, followed by those in local isolation wards, fever clinic/infectious department wards, and other department wards. As the possibility and intensity of exposure to COVID-19 decreases, the prevalence of anxiety tends to decrease, this trend had statistical significance using Jonckheere–Terpstra test. Similar trends were found for depression and sleep quality. This trend simply revealed the potential impact of different working environments on occurrence of mental health problems.

The results showed that 20% of the total population had either anxiety or depression, for medical staff deployed to Hubei, the prevalence raised to 28%. A probability model comprising 4 classes were found through latent class analysis. Category 1 represented severe anxiety with depression, and Category 2 represented moderate anxiety with depression. These 2 categories accounted for 32.8% of total population, and need prompt psychological intervention clinically. Category 3 represented medical staff with mild/moderate anxiety with no/mild depression (36.7% of total population), which also need proper psychological counseling to keep their mental health. Category 4 represented medical staff with no anxiety and depression, they accounted for 30.6% of total population. In other words, only 30.6% of total populations did not need psychological support. For medical staff deployed to Hubei, only 22% (11/50) of the total population had no anxiety or depression, and about 80% of them need psychological intervention or counseling. Therefore, the new categories helps to identify more medical workers who need psychological support, and the corresponding psychological intervention could be more targeted.

Regarding the related factors with mental disorders in medical staff, both correlation analysis and logistic regression indicated that current post correlated with anxiety, depression and insomnia. Other variables, such as gender (female), marital status (married), younger age, shorter working years were related with anxiety, insomnia or perceived stress. These predictors were mostly consistent with previous research. For example, Sareen reported that women were much more vulnerable to stress and more likely to develop post-traumatic stress disorder (Sareen et al., 2013). National Mental Health Survey of Doctors and Medical Students conducted in Australia revealed that young doctors and female had the rates of stress and burnout, and work stress and burnout were important risk factor for depression and suicide. The senior medical staff with longer working time tended to possess more professional skills and social experience to deal with the complex situation, which could explain their lower perceived stress and better resilience (BeyondBlue, 2013).

As the COVID-19 epidemic continues to spread, the present study may provide strong evidence for psychological support strategy not only in China but also other places affected by COVID-19 epidemic. The emergency response is associated with all levels of stress which may affect emergency responders through all stages of deployment. Therefore psychological support is to prevent and manage stress and it impacts on physical and mental health throughout the deployment. National Health Commission of China published the guideline of psychological crisis intervention for 2019-nCoV pneumonia on Jan 27, 2020 (National Health Commission of the People's Republic of China, 2020). Psychological intervention teams, who were mainly psychiatrists, had been set up by the local Mental Health Center of Wuhan city and had participated in clinical psychological intervention for health care workers and patients (Kang et al., 2020). As showed by the present study, the prevalence of mental disorders of medical staff was still high in 1 month after deployment. Thus the psychological intervention for medical staff should be given before deployment and during deployment. This study may provide a policy impetus to include such psychological interventions and enough preventive measures before and during the similar emergency deployment.

The present study also has some limitations. The data was gathered

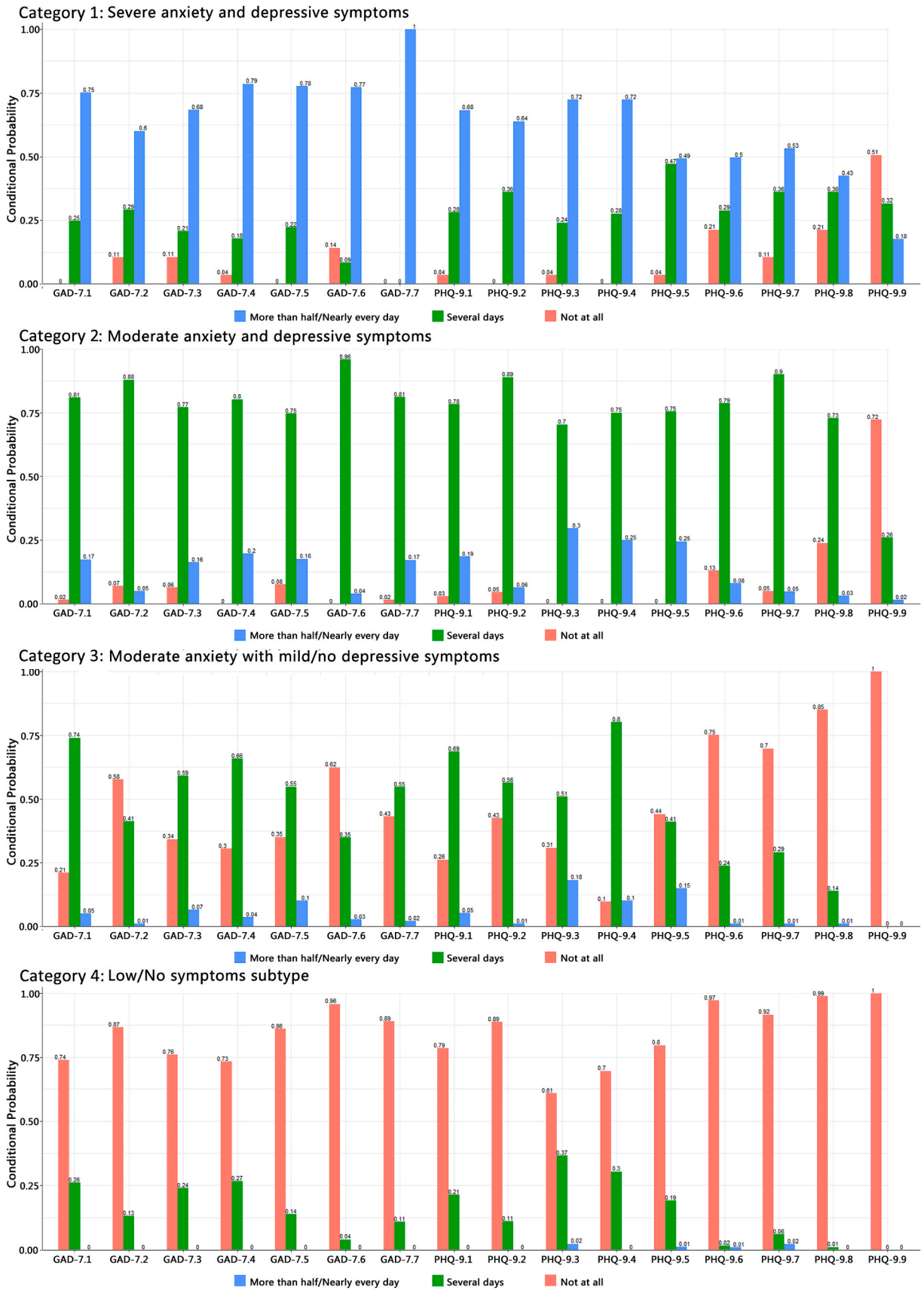

Fig. 3. Latent class analysis of anxiety and depression. Four categories with different response patterns were found. The bars in different colors indicate conditional probabilities of each item. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

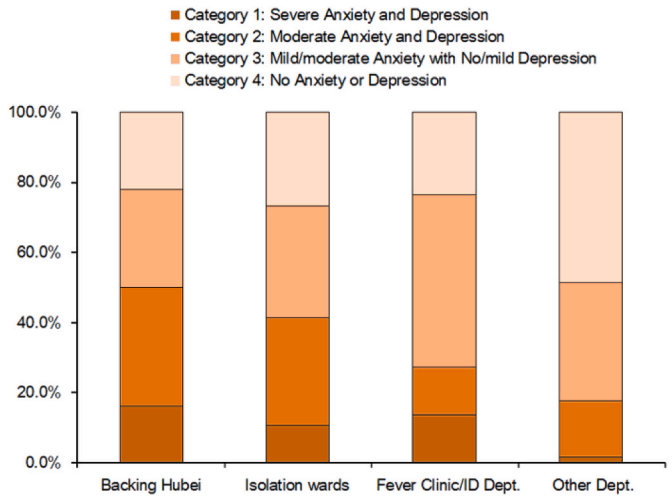

Fig. 4. Distribution of latent classes in different groups. Category 1 and Category 2 represent severe or moderate anxiety and depression, the combined proportion of these 2 categories reached 50% in staffs backing Hubei.

through WeChat group. Although the QR code was easy-accessible in medical staff's working group, it may be easily neglected due to too many more important messages and too busy work. The exact response rate could not be accurately calculated since it was difficult to count the people who scanned the QR code but failed to complete all questionnaires. Another limitation is that post-traumatic stress symptom scale (PSS) may be more suitable to measure the stress, while 14-item perceived stress scale was selected in order to shorten fill-in time. Eight-item SPRINT (Short Post-Traumatic Stress Disorder Rating Interview) scale may be better in similar situation in future survey(Connor and Davidson, 2001). Finally, due to the smaller sample size of each subgroup, the calculated prevalence in subgroups could not be so accurate.

In conclusion, high prevalence of anxiety, depression and insomnia exist in medical staff related to COVID-19. The higher the probability and intensity of exposure to COVID-19 patients, the greater the risk that medical staff will suffer from mental disorders, suggesting continuous and proper psychiatric intervention is needed.

CRediT authorship contribution statement

Li-Qiong Wang: Software, Investigation, Data curation, Writing - original draft, Writing - review & editing. **Meng Zhang:** Investigation, Data curation, Formal analysis, Writing - original draft. **Guang-Mei Liu:** Investigation, Resources, Validation. **Shi-Ying Nan:** Investigation, Resources, Validation. **Tao Li:** Visualization, Writing - review & editing. **Li Xu:** Investigation, Resources. **Yan Xue:** Investigation, Resources. **Min Zhang:** Investigation, Resources. **Lei Wang:** Methodology, Investigation, Resources. **Yun-Dong Qu:** Conceptualization, Methodology, Writing - original draft, Supervision. **Feng Liu:** Conceptualization, Methodology, Writing - original draft, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This work was supported by the National Science and Technology Major Project of China (No. 2018ZX10723203) and the National Key Research and Development Program of China (No.2017YFC0908104).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2020.07.008.

References

BeyondBlue, 2013. National Mental Health Survey of Doctors and Medical Students. BeyondBlue, the National Depression Initiative, Melbourne, Australia.
Buysse, D.J., Reynolds 3rd, C.F., Monk, T.H., Berman, S.R., Kupfer, D.J., 1989. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatr. Res. 28 (2), 193–213.
Campbell-Sills, L., Stein, M.B., 2007. Psychometric analysis and refinement of the connor-davidson resilience scale (CD-RISC): validation of a 10-item measure of resilience. J. Trauma Stress 20 (6), 1019–1028.
Chen, N., Zhou, M., Dong, X., Qu, J., Gong, F., Han, Y., Qiu, Y., Wang, J., Liu, Y., Wei, Y., Xia, J., Yu, T., Zhang, X., Zhang, L., 2020. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 395 (10223), 507–513.
Cohen, S., Kamarck, T., Mermelstein, R., 1983. A global measure of perceived stress. J. Health Soc. Behav. 24 (4), 385–396.
Collins, L.M., Lanza, S.T., 2013. Latent Class and Latent Transition Analysis: with Applications in the Social, Behavioral, and Health Sciences, first ed. John Wiley & Sons.
Connor, K.M., Davidson, J.R., 2001. SPRINT: a brief global assessment of post-traumatic stress disorder. Int. Clin. Psychopharmacol. 16 (5), 279–284.
R Core Team, 2018. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna.
Guan, W.J., Ni, Z.Y., Hu, Y., Liang, W.H., Ou, C.Q., He, J.X., Liu, L., Shan, H., Lei, C.L., Hui, D.S.C., Du, B., Li, L.J., Zeng, G., Yuen, K.Y., Chen, R.C., Tang, C.L., Wang, T., Chen, P.Y., Xiang, J., Li, S.Y., Wang, J.L., Liang, Z.J., Peng, Y.X., Wei, L., Liu, Y., Hu, Y.H., Peng, P., Wang, J.M., Liu, J.Y., Chen, Z., Li, G., Zheng, Z.J., Qiu, S.Q., Luo, J., Ye, C.J., Zhu, S.Y., Zhong, N.S., China Medical Treatment Expert Group for 2019-nCoV, 2020. Clinical characteristics of coronavirus disease 2019 in China. N. Engl. J. Med. 382 (18), 1708–1720.
Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., Gu, X., Cheng, Z., Yu, T., Xia, J., Wei, Y., Wu, W., Xie, X., Yin, W., Li, H., Liu, M., Xiao, Y., Gao, H., Guo, L., Xie, J., Wang, G., Jiang, R., Gao, Z., Jin, Q., Wang, J., Cao, B., 2020. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 395 (10223), 497–506.
Kang, L., Li, Y., Hu, S., Chen, M., Yang, C., Yang, B.X., Wang, Y., Hu, J., Lai, J., Ma, X., Chen, J., Guan, L., Wang, G., Ma, H., Liu, Z., 2020. The mental health of medical workers in Wuhan, China dealing with the 2019 novel coronavirus. Lancet Psychiatry 7 (3), e14.
Kroenke, K., Spitzer, R.L., Williams, J.B., 2001. The PHQ-9: validity of a brief depression severity measure. J. Gen. Intern. Med. 16 (9), 606–613.
Lee, S.M., Kang, W.S., Cho, A.R., Kim, T., Park, J.K., 2018. Psychological impact of the 2015 MERS outbreak on hospital workers and quarantined hemodialysis patients. Compr. Psychiatr. 87, 123–127.
Linzer, D.A., Lewis, J., 2011. poLCA: polytomous variable latent class Analysis. J. Stat. Software 42 (10), 1–29.
National Health Commission of the People's Republic of China, 2020. The guideline of psychologicalcrisis intervention for 2019-nCoV pneumonia. Jan 27, 2020. http://www.nhc.gov.cn/xcs/zhengcwj/202001/6adc08b966594253b2b791be5c3b9467.shtml. (Accessed 6 March 2020).
Norcini Pala, A., Steca, P., Bagrodia, R., Helpman, L., Colangeli, V., Viale, P., Wainberg, M.L., 2016. Subtypes of depressive symptoms and inflammatory biomarkers: an exploratory study on a sample of HIV-positive patients. Brain Behav. Immun. 56, 105–113.
Novel Coronavirus Pneumonia Emergency Response Epidemiology Team, 2020. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. Zhonghua Liuxingbingxue Zazhi 41 (2), 145–151.
Ruiz, M.A., Zamorano, E., Garcia-Campayo, J., Pardo, A., Freire, O., Rejas, J., 2011. Validity of the GAD-7 scale as an outcome measure of disability in patients with generalized anxiety disorders in primary care. J. Affect. Disord. 128 (3), 277–286.
Sareen, J., Erickson, J., Medved, M.I., Asmundson, G.J., Enns, M.W., Stein, M., Leslie, W., Doupe, M., Logsetty, S., 2013. Risk factors for post-injury mental health problems. Depress. Anxiety 30 (4), 321–327.
Sipos, M.L., Kim, P.Y., Thomas, S.J., Adler, A.B., 2018. U.S. Service member deployment in response to the ebola crisis: the psychological perspective. Mil. Med. 183 (3–4), e171–e178.
Spitzer, R.L., Kroenke, K., Williams, J.B., 1999. Validation and utility of a self-report version of PRIME-MD: the PHQ primary care study. Primary care evaluation of mental disorders. Patient health questionnaire. J. Am. Med. Assoc. 282 (18), 1737–1744.
Spitzer, R.L., Kroenke, K., Williams, J.B., Lowe, B., 2006. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch. Intern. Med. 166 (10), 1092–1097.

WHO, 2020a. Coronavirus disease (COVID-2019) situation reports -45. March 5, 2020a. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200305-sitrep-45-covid-19.pdf. (Accessed 6 March 2020).
WHO, 2020b. Coronavirus disease (COVID-2019) situation reports -11. January 31, 2020b. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200131-sitrep-11-ncov.pdf. (Accessed 6 March 2020).
Zhao, L., 2020. 3,000 medical workers infected with novel coronavirus: Researchers. Feburary 17, 2020. http://www.chinadaily.com.cn/a/202002/17/WS5e4a9af2a3101282172782b3.html. (Accessed 6 March 2020).