



Prevalence of posttraumatic stress symptoms in health care workers after exposure to patients with COVID-19

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ABSTRACT

Objective: To investigate the prevalence of posttraumatic stress symptoms (PTSS) of health care workers (HCWs) who were potentially or directly exposed to patients with coronavirus disease 2019 (COVID-19) in a non-core epidemic area of China.

Methods: Psychological conditions were evaluated by the multiple psychological evaluation scales in HCWs at the Affiliated Hospital of Xuzhou Medical University in Xuzhou City (a non-core epidemic area in China) during COVID-19 epidemic. According to the risk of exposure to COVID-19 patients, HCWs were divided into two groups: HCWs with high-risk (HHCW) group (who worked in wards for COVID-19 patients) and HCWs with low-risk (LHCW) group (who worked in wards for non-COVID-19 patients in the same hospital). The clinical data of psychological evaluation scales from HCWs were collected.

Results: A total of 171 HCWs were recruited in this study, with 94 (55.0%) HCWs in the HHCW group, and 77 (45.0%) HCWs in the LHCW group. Significant differences were observed in gender, work stress, job risk, and levels of fear and anxiety, and the depression between the two groups ($P < 0.05$). The incidence of PTSS was 28.7% in HHCW group, while the incidence of PTSS was 13.0% in LHCW group. The PTSS between the two groups was statistically significant ($P < 0.05$). Further logistic regression analysis displayed that the exposure to COVID-19, work stress and coping strategies were major risk factors associated with PTSS.

Conclusions: This study demonstrated that HCWs in HHCW group had a higher chance of developing PTSS when compared with those in LHCW group. The HCWs who were exposed to COVID-19 patients had more stress and chronic stress-related disorders. Stress management should be provided to the first line HCWs who combat with COVID-19.

1. Introduction

The pandemic posed a threat to human life and was a health emergency, in which a lot of illnesses and deaths occurred (Meltzer et al., 1999). Pandemic often leads to the overburden of local resources and threatens the security and normal operation of society (Quinn and

Kumar, 2014). So far, serious threats to human health include conflicts, natural disasters, and disease outbreaks (Ong et al., 2008). According to World Health Organization (WHO), the outbreak of COVID-19 has caused millions of patients and hundreds of thousands of deaths. COVID-19 has developed into a pandemic, severely hitting our communities (Hens et al., 2020). In terms of mental health, pandemic means

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psychosocial disorders that may exceed the capacity of the affected population to cope with such situations (Schneiderman et al., 2005). It could even be argued that the entire population experienced stress to some extent. It is known that the pandemic has psychological impact on healthcare workers as well as the general population (Chew et al., 2020). The widespread fear of quarantine and lockdown measures have resulted in unusual panic among the general public in many countries in the form of crazy purchases of goods (Chew et al., 2020). Therefore, the courage of HCWs during the COVID-19 outbreak did not make them immune to anxiety or stress. There is no difference between the stress level of high-risk workers and those of community workers at the time of the outbreak. Therefore, it is estimated that the incidence of psychological disorders is increasing. However, not all emerging psychological and social problems can be called diseases, and most are normal responses to unusual circumstances (Bolton and Gillett, 2019; Havelka et al., 2009). The HCWs in the first-line had to evaluate the patients who had symptoms of COVID-19, including fever and dry cough. These HCWs have a high risk of physical and psychological stress that they have never experienced. In this study we sought to understand whether different hospital working conditions could have different psychological effects. We investigated the psychological effects of COVID-19 on HHCWs and LHCWs.

2. Methods

2.1. Participant recruiting

HCWs, including doctors, nurses, administrative staff, and medical technician in the Affiliated Hospital of Xuzhou Medical University, Jiangsu, China were recruited. The participants who answered all questions in more than 30 min or less than 2 min were excluded from the study, because the usual response time of questionnaire was between 15 and 20 min (Liu et al., 2020). The study was approved by the ethics committee of the Affiliated Hospital of Xuzhou Medical University. The consent form was obtained from the participants.

2.2. Evaluations of PTSS and behavioral tests in HCWs

We distributed questionnaires, containing PTSS Checklist (Civilian version, PCL-C), altruistic behavior, resilience, and job risk assessments, during the outbreak of COVID-19. PCL-C scale was designed to evaluate the post-traumatic experience of ordinary people in their ordinary lives (in contrast to war). It asks the subjects to rate themselves for the last month with problems and complaints about interruptions in five grades (1, not at all; 2, a little; 3, moderate; 4, considerable; 5, extreme). It can be divided into four categories: heightened alertness response, avoidance response, repeated recurrence response of traumatic experience, and missing social function response. The higher accumulative total score refers to the greater probability of representing PTSD () manifestation. We rated 17–37 as non-PTSS, 38–49 as mild PTSS, and 50–85 as severe PTSS. Working stress is defined as the exposure to an unfavorable combination of high job stressors and low job resources (Brunner et al., 2019), and is divided into 10 grades (0 marks no pressure at all, and 9 represents maximal pressure). Furthermore, we also assessed job exposure risk to COVID-19 (job risk) through the self-assessment questionnaire in HCWs. The responses to the questionnaire were assessed with the 10 scales (0 stands for no risk, and 9 means maximal risk). Stress resilience is defined as the dynamic ability to successfully adapt to adversity, trauma, or other significant threats (Horn and Feder, 2018). Davidson Resilience Scale (CD-RISC) was applied to examine stress resilience, because it has good reliability and validity by testing in different populations, and its predictive efficacy for mental resilience has been well recognized. CD-RISC comprises of 25 items, and each rates on a 5-point (0–4) scale (Connor and Davidson, 2003).

In addition, we further determined anxiety and major depression by adopting Generalized Anxiety Disorder 7 (GAD-7) and Patient Health

Questionnaire-9 (PHQ-9), respectively. Furthermore, insomnia is a very common disorder after stress and was evaluated by Insomnia Severity Index (ISI). In order to assess the prosocial orientation of HCWs, we evaluated altruistic behavior with an altruism scale.

2.3. The collection of clinical data

According to the risk of exposure to COVID-19 patients, HCWs were divided into two groups: HCWs with high-risk (HHCW) group (who worked in wards for COVID-19 patients) and HCWs with low-risk (LHCW) group (who worked in wards for non-COVID-19 patients in the same hospital). HHCW were those health care workers who voluntarily applied to work in COVID-19 wards. The questionnaires were self-administered and anonymous to guarantee confidentiality, because researchers were unable to interview high-risk participants.

2.4. Statistical analysis

Statistical analysis was performed with SPSS 23. Continuous variables were expressed as means \pm standard error (SEM) or the median and interquartile range, while categorical variables were analyzed as frequency and percentage. Non-parametric statistics (Mann-Whitney U tests) were utilized to assess differences between the two groups. Categorical variables were analyzed by adopting Fisher's exact test or Pearson's χ^2 test. The multi-factor logistic regression model was adopted to analyze PTSS risk factors. All statistical tests were two-sided and the P -value of <0.05 was considered significant.

3. Results

3.1. Demographic characteristics and psychological influences

In this study, 198 HCWs were invited to participate online questionnaire survey and 171 valid questionnaires were received (86.4% response rate). Among them, 94 (55.0%) HCWs at high risk (HHCW) worked in COVID-19 wards, and 77 (45.0%) HCWs at low-risk (LHCW) worked in non-COVID-19 wards. The major demographic data of the participants in Table 1 illustrated that gender, education, salary, profession, work stress, job risk, anxiety, depression, insomnia, and PTSS were statistically significant between the two groups ($P < 0.05$). Females accounted for 74.5 percent in HHCW group and 59.7 percent in LHCW group. The proportion of bachelor's degrees (59.6%) and doctor's degrees (11.7%) in HHCW were higher than those in LHCW ($P < 0.05$). Working stress and job risks in HHCW were significantly higher than those in LHCW ($P < 0.05$). PCL-C scale results revealed that the incidence of PTSS was 28.7% in HHCW group and 13.0% in LHCW group. The proportion of mild (12.8%) and severe PTSS (14.9%) in HHCW was significantly higher than that of mild (10.4%) and severe PTSS (2.9%) in LHCW group ($P < 0.05$). In HHCW group, the incidence of PTSS in doctors, nurses and others staff was 31.7%, 22% and 25%, respectively; however, in LHCW group, the incidence of PTSS in doctors, nurses and others staff was 17.2%, 23.6% and 27.8%, respectively.

In addition, the incidence of anxiety was 63.8% in HHCW group, and 45.5% in LHCW group. The proportion of moderate (6.4%) and severe anxiety (8.5%) in HHCW was higher than the proportion of moderate (3.9%) and severe anxiety (0%) in LHCW group ($P < 0.05$). The proportion of moderate and severe depression in HHCW was 10.6% and 8.5%, respectively. In comparison to HHCW group, the proportion of moderate and severe depression in LHCW was 5.2% and 1.3%, respectively. There was a statistical difference between the two groups ($P < 0.05$). The proportion of mild, moderate, and severe insomnia in HHCW was 27.7%, 6.4%, and 1.1%, respectively. In comparison, the proportion of mild, moderate and severe insomnia in LHCW was 11.7%, 2.6%, and 0%, respectively. There was a significant difference on insomnia severity index between the two groups ($P < 0.05$, Table 1).

Table 1
The demographic characteristic of all the participants.

Variables	HHCW (n = 94)	LHCW (n = 77)	Z/ χ^2	P value
Gender			4.208	0.040
Male	24 (25.5)	31 (40.3)		
Female	70 (74.5)	46 (59.7)		
Age (years)			0.564	0.754
18-30	29 (30.9)	26 (33.8)		
31-40	57 (57.4)	46 (51.9)		
41-60	8 (11.7)	5 (14.3)		
Education			9.484	0.024
Junior college	2 (2.1)	7 (9.1)		
Bachelor	56 (59.6)	36 (46.8)		
Postgraduate	25 (26.6)	30 (39.0)		
Ph.D.	11 (11.7)	4 (5.2)		
Salary (10,000)			9.380	0.009
3-8	15 (16.0)	22 (28.6)		
8-15	56 (59.6)	28 (36.4)		
> 15	23 (24.5)	27 (35.1)		
Marital			2.810	0.245
Married	76 (80.9)	54 (70.1)		
Single	17 (18.1)	21 (27.3)		
Divorced	1 (1.1)	2 (2.6)		
Coping style			0.406	0.524
Negative coping	26 (27.7)	18 (23.4)		
Positive coping	68 (72.3)	59 (76.6)		
Altruistic behaviors	32 (23, 39)	30 (21, 39)	-0.494	0.621
Psychological resilience	61.5 (50, 69)	64 (51, 71)	-1.107	0.268
Work stress	5 (3, 7)	4 (3, 6)	-2.266	0.023
Job risk	5 (3, 8)	4 (2, 6)	-2.765	0.006
PTSS			8.198	0.017
No symptoms	68 (72.3)	67 (87.0)		
Mild	12 (12.8)	8 (10.4)		
Severe	14 (14.9)	2 (2.6)		
Anxiety			13.787	0.003
No symptoms	34 (36.2)	42 (54.5)		
Mild	46 (48.9)	32 (41.6)		
Moderate	6 (6.4)	3 (3.9)		
Severe	8 (8.5)	0 (0)		
Depression			8.982	0.030
No symptoms	33 (35.1)	39 (50.6)		
Minor depression	43 (45.7)	33 (42.9)		
Moderate depression	10 (10.6)	4 (5.2)		
Severe depression	8 (8.5)	1 (1.3)		
Insomnia			9.741	0.011
No symptoms	61 (64.9)	66 (85.7)		
Mild insomnia	26 (27.7)	9 (11.7)		
Moderate insomnia	6 (6.4)	2 (2.6)		
Severe insomnia	1 (1.1)	0 (0)		

3.2. PTSS during COVID-19 epidemic were associated with the exposure to COVID-19, coping styles and work stress

In order to further identify the risk factors for various psychological effects, we classified the symptoms as asymptomatic, mild, moderate and severe based on scores, and performed chi-square tests (Table 2). The total incidence of PTSS was 21.6% in HCWs during the COVID-19 epidemic. These data indicated that there were no significant changes regarding age, gender, salary, education, marital status, and professional status ($p > 0.05$). However, there were significant differences on the exposure to COVID-19 patients, coping styles, psychological resilience, work stress, and job risk between groups ($P < 0.05$).

A multivariable logistic regression model was adopted to explore the association of PTSS with the exposure to COVID-19 patients, coping styles, psychological resilience, work stress, and job risk. Multivariate adjusted logistic regression models proved that the exposure to COVID-19 (OR 2.58, 95% CI, 1.45–5.79, $P < 0.05$), coping styles (OR 6.77, 95% CI, 2.92–15.69, $P < 0.05$), and work stress (OR 1.77, 95% CI, 1.38–2.12, $P < 0.01$) were associated with PTSS (Table 3), indicating that HCWs with the negative coping styles could induce increased risk of 6.77 times to have PTSS when compared with subjects with the positive coping

Table 2
Severity categories of PTSS measurements in subgroups.

	No symptoms	Mild or Moderate	Severe	Z/ χ^2	P value
Gender (%)				0.561	0.766
Male	45 (81.8)	5 (9.1)	5 (9.1)		
Female	90 (77.6)	15 (12.9)	11 (9.5)		
Age (%)				3.134	0.075
18-30	45 (81.8)	7 (15.6)	3 (6.7)		
31-40	71 (75.5)	11 (11.7)	12 (12.8)		
41-60	19 (86.4)	2 (9.1)	1 (4.5)		
Education (%)				6.323	0.436
Junior college	9 (100)	0	0		
Bachelor	69 (75.0)	12 (13.0)	11 (12.0)		
Postgraduate	47 (85.5)	5 (9.1)	3 (5.5)		
Ph.D.	10 (66.7)	3 (20.0)	2 (13.3)		
Salary (X10,000, %)				4.041	0.425
3-8	30 (81.1)	4 (10.8)	3 (8.1)		
8-15	62 (73.8)	11 (13.1)	11 (13.1)		
>15	43 (86.0)	5 (10.0)	2 (4.0)		
Marital (%)				5.221	0.136
Married	101 (77.7)	17 (13.1)	12 (9.2)		
Single	33 (86.8)	2 (5.3)	3 (7.9)		
Divorced	1 (33.3)	1 (33.3)	1 (33.3)		
Groups (%)and profession (%)				5.921	0.205
HHCWs	69 (73.4)	12 (12.8)	13 (13.8)		
Nurse	39 (78.0)	5 (10.0)	6 (12.0)		
Doctor	27 (68.3)	7 (17.1)	6 (14.6)		
Other stuff	3 (75.0)	0	1 (25.0)		
LHCWs	60 (87.0)	15 (10.4)	2 (2.6)	15.508	0.004
Nurse	16 (72.7)	6 (27.3)	0		
Doctor	32 (80.0)	7 (17.5)	1 (2.5)		
Other stuff	12 (80.0)	2 (13.3)	1 (6.7)		
Coping style (%)				19.759	0.000
Negative coping	24 (54.5)	10 (22.7)	10 (22.7)		
Positive coping	111 (87.4)	10 (7.9)	6 (4.7)		
Altruistic behaviors (%)	135 (78.9)	20 (11.7)	16 (9.4)	4.182	0.496
Psychological resilience (%)	135 (78.9)	20 (11.7)	16 (9.4)	5.161	0.003
Job risk (%)	135 (78.9)	20 (11.7)	16 (9.4)	11.336	0.001
Work stress (%)	135 (78.9)	20 (11.7)	16 (9.4)	28.984	0.001

styles. Exposure to COVID-19 also increased PTSS risk by 2.58 times compared with the non-exposure, and working stress increased the PTSS risk by 1.77 times in HCWs, as demonstrated in Table 3.

4. Discussion

In this study, the findings revealed that gender, education level, salary, work stress, job risk, depression, anxiety, insomnia, and PTSS during the epidemic period were statistically significant between high-risk HCWs and low-risk HCWs. Moreover, HCWs who exposed to patients with confirmed or suspected COVID-19 pneumonia, were at higher risks of mental health problems, which was similar to the HCWs during SARS epidemic in 2003. Among frontline HCWs in 2003, 68% of participants reported high level of stress and 57% was found experiencing psychological distress (Tam et al., 2004). During the outbreak of SARS, HCWs were reported to have higher stress, higher depression/anxiety, and higher PTSS (Lee et al., 2007). After the outbreak of SARS

Table 3
Logistic regression analysis for the risk factors associated with PTSS.

Variable	Unadjusted		Adjusted	
	OR (95%CI)	P value	OR (95% CI)	P value
Exposure				
LHCW	1(Reference)	NA	1(Reference)	NA
HHCW	2.12 (0.82–5.46)	0.12	2.58 (1.45–5.79)	0.02
Coping style				
Positive coping	1(Reference)	NA	1(Reference)	NA
Negative coping	3.16 (1.19–9.37)	0.02	6.77 (2.92–15.69)	0.00
Psychological resilience	0.99 (0.96–1.02)	0.44	0.97 (0.95–0.99)	0.00
Job risk	0.91 (0.71–1.17)	0.47	1.28 (1.09–1.51)	0.00
Work stress	1.66 (1.24–2.23)	0.00	1.77 (1.38–2.12)	0.00

CI, confidence interval; OR, odds ratio.

in 2003, 10%–18% of HCWs had various symptoms, such as anxiety, PTSD, and depression (Wu et al., 2005). Also, long traumatic exposures to SARS patients were more highly related to PTSD in HCWs than short-time exposures (Kaysen et al., 2003). Similarly, two studies revealed that HCWs in the core-area of COVID-19 epidemic from Wuhan City and New York City had significant PTSS (Liu et al., 2020; Shechter et al., 2020). Therefore, our finding and previous reports indicated that the epidemic of COVID-19 and SARS both caused psychological problems in HCWs during the combating with infective viruses.

During the acute phase of SARS in 2003, Su et al. reported that the incidence of depression and insomnia was higher in those HCWs who were exposed to infected patients, but the incidence of PTSS remained non-significant (Su et al., 2007). In contrast, we observed that the incidence of PTSS in HHCW was significantly higher than that in LHCW group ($P < 0.05$); HWCs exposed to COVID-19 had 2.58 times more PTSS symptoms than those not exposed. This suggested that the HCWs exposed to COVID-19 patients might have higher chances of developing PTSS than the HCWs exposed to SARS patients. A recent study reported about 994 HCWs from Wuhan City in China that COVID-19 exposure level was a risk factor for mental health problems including PTSS (Kang et al., 2020), which supported our findings. Lin et al. indicated that emergency department workers had higher incidence of PTSD (21.7%) than non-emergency department workers (13%) during the SARS epidemic (Lin et al., 2007). Therefore, the occurrence of PTSD in HCWs should be further examined in different time points after COVID-19 epidemic.

In our study, we also identified the risk factors that are associated with PTSS in HCWs. We found that the coping styles, working stress, and the exposure to patients were found to be highly associated with PTSS. Importantly, HCWs with negative coping styles increased 6.77 times risk to have PTSS compared with HCWs with positive coping styles. Consistent with our conclusion, coping styles and working stress were also found to be critical mediators for the development of mental problems during SARS epidemic (Koh et al., 2005; Maunder, 2003; Maunder et al., 2006; Sim et al., 2004; Styra et al., 2008). During COVID-19 epidemic, HCWs faced more significant risks that were different from the usual clinical practice (Chen et al., 2020). Therefore, to reduce the psychological problems in HCWs who exposed to COVID-19 patients, adequate training for positive coping styles and workplace supports should be provided for the first-line HCWs during and after COVID-19 epidemic. Also, HCWs may require professional assistance for the psychopathological issues.

5. Conclusion

The study contributes to our understanding that front-line HCWs

have high risk of developing psychological problems. Therefore, our study suggests that all front-line HCWs should acquire psychological counseling to reduce their working stress caused by disease outbreaks, so they can provide excellent treatment for patients. Considerable researches should be carried out to determine the long-term psychological effects of HHCW after the COVID-19 epidemic.

CRedit authorship contribution statement

Hao Chen: Writing - original draft, Formal analysis, Data curation, collected data, analyzed the data, drafted the manuscript. All the authors read and approved the publication of the final manuscript. **Yanbo Cheng:** Data curation, Writing - original draft, collected data. All the authors read and approved the publication of the final manuscript. **Bilal Muhammad:** Writing - original draft, Formal analysis, Data curation, analyzed the data. All the authors read and approved the publication of the final manuscript. **Shengli Li:** Data curation, Writing - original draft, collected data. All the authors read and approved the publication of the final manuscript. **Zhigang Miao:** Writing - original draft, Formal analysis, Data curation, analyzed the data. All the authors read and approved the publication of the final manuscript. **Bo Wan:** Writing - original draft, Formal analysis, Data curation, analyzed the data, drafted the manuscript. All the authors read and approved the publication of the final manuscript. **Mannan Abdul:** Writing - original draft, Formal analysis, Data curation, analyzed the data. All the authors read and approved the publication of the final manuscript. **Zhong Zhao:** Writing - original draft, conceived and designed experiments, drafted the manuscript. All the authors read and approved the publication of the final manuscript. **Deqin Geng:** Writing - original draft, conceived and designed experiments. All the authors read and approved the publication of the final manuscript. **Kingshun Xu:** Writing - original draft, conceived and designed experiments, drafted the manuscript. All the authors read and approved the publication of the final manuscript.

Declaration of competing interest

The authors declared no conflict of interest.

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