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The prevalence and risk factors of PTSD symptoms among medical assistance workers during the COVID-19 pandemic



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ABSTRACT

Background: The outbreak of COVID 19 in December 2019 spread quickly and overwhelmed the local healthcare system of the epicenter. A total of 346 medical assistance teams with 42,600 reserve medics were mobilized from around the country for emergency assistance. This study aims to examine the incidence of mental health symptoms and predictors of Post-Traumatic Stress Disorders (PTSD) symptoms among the reserve medics working in Wuhan, the capital city of Hubei Province.

Methods: An anonymous survey was conducted from April 4–6, 2020 among the medics upon their returning home. A total of 225 surveys were returned with a response rate of 83%. The survey consisted of questionnaires about the medics' demographic information, social relations, mental health status (e.g. IES-R and DASS-21) and other work-related information. Mann-Whitney *U* Test, Kruskal-Wallis Test and hierarchical logistic regression models were used to examine the predictors of PTSD symptoms.

Results: During the stay in Wuhan, the medics experienced high levels of depression (46.7%), anxiety (35.6%) and stress symptoms (16.0%). Upon returning home, the overall prevalence of clinically concerned PTSD symptoms was as high as 31.6%. Further analyses revealed that PTSD symptoms and its subscales were significantly associated with age, collegial relationship and mental health status during their service.

Conclusion: The reserve medics reported a high prevalence of depression, anxiety and stress as well as clinically concerned PTSD symptoms. Comprehensive screening and intervention programs should be in place to help reserve medics cope with mental health challenges and build resilience during the COVID 19 pandemic.

1. Introduction

The outbreak of novel coronavirus disease (COVID-19) in December 2019 has spread rapidly around the world; and by August 17, 2020, it had infected 21.5 million in 216 countries, areas and territories [1]. As early as in February 2020, the Chinese central government and Wuhan municipal government built a 1000-bed hospital within 10 days and a second one with 1300 beds two days later in order to attend to the surge of COVID-19 cases. Another 13 temporary modular hospitals, converted from gymnasiums and exhibition centers, were also quickly opened for mild cases [2]. These drastic measures, along with others, intended to prevent spreading the disease to other provinces and regions, saving

their medical care systems from being overwhelmed.

However, the rapid increase in cases led to tremendous stress on the municipal medical care system in Wuhan and other cities of Hubei Province, resulting in severe shortage of medical staff. In response, the Chinese central government mobilized other provinces, municipalities and regions, to send reserve medics to the most affected cities in Hubei, especially the embattled Wuhan city. On February 24, 2020, the Chinese New Year Eve, the first reserve medical assistance team arrived in Hubei. By March 8, 2020, a total of 346 medical teams with 426,000 healthcare workers had provided emergency assistance in diagnosis, treatment and public health work in the province [3]. As the number of COVID-19 cases dwindled, medical assistance teams started to retreat

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on March 17, 2020, and on April 15, 2020 [4,5], the last one left for home.

On the front line of the COVID-19 outbreak response in Wuhan, the reserve medics worked at either the permanent hospitals, the temporary modular hospitals, or both. They were exposed to elevated hazards that put them at risk of not only infection, but also psychological distress [6]. Prior analyses have examined how the intensive, clinical-related experience of caring for infectious patients, coupled with lack of social support [7] could negatively impact the mental health of healthcare workers [8]. Studies also showed that medical workers handling emergent infectious diseases, such as Middle East Respiratory Syndrome (MERS), experienced various physical, cognitive and mental health problems including post-traumatic stress disorder (PTSD) [9,10].

As hundreds of thousands of healthcare workers are working at the frontlines of fighting COVID 19, maintaining their mental health is essential to better control the pandemic. Therefore, the purpose of this study is to examine the mental health status of healthcare workers during height of the pandemic, the prevalence of PTSD symptoms upon their returning home, and the predictors of PTSD symptoms in the same population. The study hypothesizes:

1. Demographic characteristics of the medical staff, such as age and gender, are significantly associated with the PTSD symptoms.
2. Positive social relation, especially social support from family, friends and colleagues, is a protective factor from having PTSD symptoms.
3. Mental health status is a significant predictor of PTSD symptoms among medical assistance workers.

2. Methods

2.1. Study participants

The study participants consisted of 270 reserve medics dispatched to Wuhan from a Shanghai-based large hospital. These medics worked at their designated permanent hospitals, temporary modular hospitals or both in Wuhan at the height of the pandemic from January 24 to March 31, 2020. This study was approved by the Ethics Reviewed Board of Shanghai Jiao Tong University School of Public Health. A statement of implied consent was sent along with the link to the survey in a WeChat group accessible by mobile phone. Participants were notified of the purpose of the survey and that their participation was anonymous, voluntary and confidential. Participants were informed that they could drop out any time or refuse to answer any questions. Data collection lasted from April 4 to April 6, 2020, with a final sample of 225 (response rate = 83%).

2.2. Measures

2.2.1. PTSD symptoms

PTSD symptoms were measured by the Impact of Event Scale-Revised (IES-R), a 22-item self-reported measure that assesses subjective distress caused by traumatic events. IES-R has demonstrated sound validity for research in health-related trauma such as SARS and MERS [10–12]. The question items were rated on a 5-point scale ranging from 0 (“not at all”) to 4 (“extremely”), and were categorized into three subscales: *intrusion*, *avoidance* and *hyperarousal*. Data from this study showed that IES-R had excellent internal consistency (Overall Cronbach's $\alpha = 0.95$; Intrusion: Cronbach's $\alpha = 0.85$; Avoidance: Cronbach's $\alpha = 0.83$; hyperarousal: Cronbach's $\alpha = 0.86$). As in previous research, this study set 24 as the IES-R cut-off score, with scores equal or higher than 24 being of clinical concern [13]. The subscales, i.e. intrusion, avoidance, hyperarousal were dichotomized as high v. low at their respective medians.

2.2.2. Socio-demographic characteristics

Socio-demographic characteristics included sex, age, working hours and work sites (temporary modular hospitals, designated hospitals or both). Weekly working hours were calculated by the multiplication of weekly working days and average working hours per day and were then dichotomized at 40 h.

2.2.3. Relational variables

Healthy relationships contribute to good mental health, while poor relationships can be a risk factor for mental health conditions such as depression, anxiety and stress. Research showed that social support was significantly associated with mental health among vulnerable individuals, especially the trauma victims [14]. This study measures social support by asking how much emotional support they received from spouse, parents, children and best friends on their decision to join the medical assistance team. An average of social support score was calculated and then dichotomized into high and low using the median of the sample (med. = 4.4) as cutoff.

Collegial relationship and Physician-patient relationship were separately assessed by two questions: “*In Wuhan, how did you get along with colleagues?*” and “*In Wuhan, how did you get along with patients?*” with five Likert scale options from “very bad (1)” to “very well (5)”. The responses were very skewed with only 3 and 11 participants reported scores lower than 4 for collegial relationship and physician-patient relationship, respectively. Hence both variables were dichotomized into Fair (score ≤ 4) and Excellent (score = 5).

2.2.4. Mental health

The mental health status during their stay in Wuhan was assessed with the widely used Depression Anxiety Stress Scales-21 (DASS-21), a 21-item questionnaire with three 7-item subscales: Depression symptoms, Anxiety symptoms and Stress symptoms [15,16]. Based on strong negative reaction from the pilot test, three depression symptoms questions items related to hopelessness (Q10), self-depreciation (Q17) and devaluation of life (Q21), were removed from the final survey. The DASS-21 instruments demonstrated high internal consistency (Overall internal consistency for the 18 items: Cronbach's $\alpha = 0.94$; and Depression symptoms: Cronbach's $\alpha = 0.85$; Stress: Cronbach's $\alpha = 0.86$; Anxiety: Cronbach's $\alpha = 0.83$). As recommended in the literature, the subscale scores were the sum of the responses to the items multiplied by 2. The subscales were dichotomized at different cutoffs – depression symptoms: no (score = 0) and yes (score > 0); anxiety symptoms: no (score ≤ 7) and yes (score > 7); stress symptoms: no (score ≤ 14) and yes (score > 14) [17,18].

In addition, mental health counseling was assessed by asking: “*When in Wuhan, did you receive any mental health counseling?*” with options of “yes” or “no”.

2.3. Statistical analyses

Descriptive statistics for socio-demographic variables and mental health measurements were first presented. Given the non-normal distribution of the values, Mann-Whitney *U* Test or Kruskal-Wallis Test was performed to test whether socio-demographic characteristics were correlated with PTSD symptoms and its subscales. A hierarchical logistic regression model was used to test the unique associations of socio-demographic characteristics, social support, collegial and patient relationship and mental health with PTSD symptoms, respectively. Socio-demographic characteristics (e.g. gender, age, work site, weekly working hours) were first entered to test their relationship with PTSD symptoms in step 1, followed by relational variables in step 2, and mental health in step 3. All statistical tests were 2-sided and statistical significance was set at $p < 0.05$. Data were analyzed using SPSS version 22.0 (IBM SPSS Statistics, New York, United States).

Table 1
Descriptive characteristics of the study participants.

Characteristics	N = 225	%
Sex		
Male	63	28.0%
Female	162	72.0%
Age (year)		
21–30	72	32.0%
31–40	116	51.6%
41–60	37	16.4%
Work Site		
Designated Permanent Hospitals	181	80.4%
Temporary Modular Hospitals	22	9.8%
Both of the Above	22	9.8%
Weekly Working Hours		
≤ 40 Hrs	183	81.3%
> 40 Hrs	42	18.7%
Collegial relationship		
Fair	59	26.2%
Excellent	166	73.8%
Physician-Patient Relationship		
Fair	87	48.5%
Excellent	116	51.5%
Social Support		
Low	113	50.2%
High	112	49.8%
Mental Health Counseling		
No	181	80.4%
Yes	44	19.6%
Depression Symptoms		
No (= 0)	120	53.3%
Yes (> 0)	105	46.7%
Anxiety Symptoms		
No (≤ 7)	145	64.4%
Yes (> 7)	80	35.6%
Stress Symptoms		
No (≤ 14)	189	84.0%
Yes (> 14)	36	16.0%
PTSD Symptoms		
No (≤ 23)	154	68.4%
Yes (> 23)	71	31.6%

3. Results

3.1. Description of the study population

Table 1 shows the characteristics of the sample. A total of 225 participants completed the survey, among which 72.0% were female. The medical assistance workers were relatively young, with 83.6% being less than 40 years old, and the majority of them (80.4%) worked at designated permanent hospitals. Over 80% of them worked 40 or less hours per week: nurses worked an average of 29.5 h and physicians an average of 36.5 h per week (data available upon request). Nearly three quarters reported excellent collegial relationship and 51.5% reported excellent relationship with patients. On average, the medics enjoyed a very high level of social support (mean = 4.4, SD = 0.9). In terms of mental health status during their medical assistance period, 46.7% reported depression symptoms; 35.6% reported anxiety symptoms and 16.0% reported stress symptoms. Nonetheless, only 19.6% reported receiving mental health counseling the same period. Upon return, the overall prevalence of PTSD symptoms was 31.6% ($n = 71$), among which there were 13 (18.3%) physicians, 53 (74.6%) nurses and 5 (7.0%) others.

3.2. Univariate analyses of PTSD symptoms and its subscales

Table 2 shows the univariate analyses of PTSD symptoms and its subscales by socio-demographic and other variables. Consistently, there were significant differences in the mean of PTSD symptoms and its subscales by collegial relationship, physician-patient relationship, social support, mental health counseling, depression symptoms, anxiety

symptoms and stress symptoms. Additionally, the mean score of avoidance and intrusion differed significantly by work sites. Thirdly, avoidance was the only scale that displays significant difference across age groups – the oldest age group had the highest avoidance mean score as compared to the younger ones.

3.3. Multivariate logistic analysis

Results from the hierarchical logistic regression model analyzing the independent associations between socio-demographic characteristics, relational variables and mental health conditions with PTSD symptoms and the subscales are displayed in Table 3–1 to Table 3–4. All models were tested for multi-linearity and the variance inflation factor (IVF) were less than 5. Significant associations ($p < 0.05$) are bolded in the tables.

As shown in Table 3–1 for the IES-R total score, neither the socio-demographic characteristics nor the relational variables were statistically significant across all three models. Mental health counseling was significantly associated with PTSD symptoms (OR = 6.30, 95% CI: 2.95–13.46, $p < 0.01$) in Model 2 and Model 3 (OR = 3.50, 95% CI: 1.40–8.75, $p = 0.01$). Additionally having anxiety symptoms (OR = 4.32, 95% CI: 1.66–11.23, $p < 0.01$) and stress symptoms (OR = 5.95, 95% CI: 1.95–18.15, $p < 0.01$) were associated with PTSD symptoms in Model 3.

Table 3–2 shows the regression results for the subscale of avoidance. Neither the socio-demographic characteristics nor the relationship variables were significantly associated with avoidance. However, mental health counseling was a significant factor in both Model 2 (OR = 4.88, 95% CI: 1.88–12.71, $p < 0.01$) and Model 3 (OR = 4.88, 95% CI: 1.88–12.71, $p < 0.01$). In addition, having anxiety symptoms (OR = 12.67, 95% CI: 4.72–33.98, $p < 0.01$) was significantly associated with avoidance.

For intrusion (Table 3–3), the older age group (41y–60y) is consistently more likely to have intrusion as compared with the younger group (21y–30y) in all of the three models. Medics working at temporary modular hospital were less likely to report intrusion in Model 1 (OR = 0.29, 95% CI: 0.1–0.88, $p = 0.03$) and Model 2 (OR = 0.20, 95% CI: 0.06–0.68, $p = 0.01$), but not in Model 3. In addition, mental health counseling was a significant factor in both Model 2 (OR = 5.4, 95% CI: 2.44–11.93, $p < 0.01$) and Model 3 (OR = 3.36, 95% CI: 1.32–8.52, $p = 0.01$). And lastly, those with anxiety symptoms (OR = 4.09, 95% CI: 1.69–9.89, $p < 0.001$) were significantly associated with reporting intrusion.

For hyperarousal (Table 3–4), both gender and age were not significant across all the models. The location of work (e.g. working in designated hospitals and modular hospitals) was significant in Model 1 (OR = 0.21, 95% CI: 0.06–0.75, $p = 0.02$) and Model 2 (OR = 0.19, CI: 0.05–0.72, $p = 0.02$), but not in Model 3. As for relational variables, collegial relationship was significant across Model 2 (OR = 0.30, 95% CI: 0.12–0.74, $p = 0.01$) and Model 3 (OR = 0.34, 95% CI: 0.12–0.97, $p < 0.05$), but social support (OR = 0.47, 95% CI: 0.25–0.91, $p = 0.03$) and mental health counseling (OR = 3.3, 95% CI: 1.53–7.13, $p < 0.01$) were significant only in Model 2. Both depression (OR = 3.4, 95% CI: 1.43–8.1, $p = 0.01$) and stress symptoms (OR = 3.48, 95% CI: 1.45–8.35, $p = 0.01$) were significantly associated with hyperarousal in Model 3.

4. Discussion

To the best of our knowledge, this is one of the first empirical studies to examine mental health and PTSD symptoms among medical assistance workers responding to the COVID-19 pandemic in China. Our study reveals a high prevalence of mental health issues among the reserve medics during their stay in Wuhan and high rate of PTSD symptoms upon returning home.

The prevalence of anxiety, depression and stress symptoms in our

Table 2
Distribution of IES-R and its subscales among study participants.

Characteristics	IES-R total		IES-R avoidance		IES-R intrusion		IES-R hyperarousal	
	Mean (SD)	<i>p</i>	Mean (SD)	<i>p</i>	Mean (SD)	<i>p</i>	Mean (SD)	<i>p</i>
Sex*		0.74		0.10		0.16		0.18
Male	15.41 (15.79)		5.32 (6.19)		7.14 (6.50)		2.95 (4.09)	
Female	17.18 (14.40)		5.13 (5.27)		8.68 (6.72)		3.37 (3.79)	
Age (year)**		0.18		0.04		0.67		0.12
21–30	14.71 (15.41)		4.64 (5.60)		6.81 (6.41)		3.26 (4.27)	
31–40	17.18 (14.78)		5.19 (5.45)		8.67 (6.69)		3.32 (3.91)	
41–60	18.97 (13.45)		6.22 (5.66)		9.73 (6.83)		3.03 (2.90)	
Work Site**		0.16		0.07		0.02		0.10
Designated Permanent Hospitals	5.49 (5.68)		8.71 (6.77)		3.61 (4.05)		17.81 (15.20)	
Temporary Modular Hospitals	4.50 (4.86)		5.64 (5.12)		2.18 (2.67)		12.32 (11.66)	
Both of the Above	3.32 (4.60)		7.05 (6.83)		1.41 (2.48)		11.77 (12.73)	
Weekly Working Hours*		0.94		0.67		0.86		0.86
≤ 40 Hrs	16.61 (14.62)		5.09 (5.42)		8.30 (6.61)		3.22 (3.90)	
> 40 Hrs	17.00 (15.69)		5.57 (6.04)		8.02 (7.07)		3.40 (3.78)	
Collegial Relationship *		< 0.01		0.01		< 0.01		< 0.01
Fair	23.29 (17.10)		7.73 (6.37)		10.20 (7.18)		5.36 (4.62)	
Excellent	14.34 (13.16)		4.28 (4.91)		7.55 (6.37)		2.51 (3.27)	
Physician-Patient Relationship *		< 0.01		< 0.01		0.05		0.01
Fair	20.12 (16.32)		6.70 (6.16)		9.19 (6.96)		4.24 (4.45)	
Excellent	14.08 (12.99)		4.03 (4.71)		7.54 (6.40)		2.51 (3.19)	
Social Support*		< 0.01		< 0.01		0.01		< 0.01
Low	19.76 (15.82)		6.26 (5.97)		9.26 (6.67)		4.25 (4.45)	
High	13.58 (13.02)		4.10 (4.84)		7.23 (6.57)		2.25 (2.88)	
Mental Health Counseling*		< 0.01		< 0.01		< 0.01		< 0.01
No	14.03 (13.14)		4.21 (5.02)		7.20 (6.02)		2.62 (3.26)	
Yes	9.18 (5.80)		12.55 (7.56)		5.86 (5.01)		27.59 (16.29)	
Depression Symptoms*		< 0.01		< 0.01		< 0.01		< 0.01
No (= 0)	9.29 (10.16)		2.61 (3.77)		5.33 (5.37)		1.36 (2.12)	
Yes (> 0)	25.13 (14.77)		8.12 (5.77)		11.59 (6.47)		5.42 (4.28)	
Anxiety Symptoms*		< 0.01		< 0.01		< 0.01		< 0.01
No (≤ 7)	10.33 (10.75)		2.92 (3.93)		5.81 (5.62)		1.59 (2.28)	
Yes (> 7)	28.20 (14.19)		9.28 (5.68)		12.66 (6.20)		6.26 (4.34)	
Stress Symptoms*		< 0.01		< 0.01		< 0.01		< 0.01
No (≤ 14)	13.18 (11.77)		3.92 (4.43)		6.92 (5.80)		2.34 (2.82)	
Yes (> 14)	35.08 (15.54)		11.83 (6.03)		15.22 (6.75)		8.03 (5.03)	

Note: * Mann-Whitney U Test; ** Kruskal-Wallis Test. Bold means statistical significance.

Table 3-1
Results of the hierarchical multiple logistic regression analysis on PTSD symptoms (IES-R).

Variables	Model 1			Model 2			Model 3		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Sex (Ref. = male)	1.05	0.53–2.09	0.88	1.25	0.58–2.68	0.57	0.83	0.32–2.19	0.71
Age (Ref. = 21–30)									
31–40	1.34	0.70–2.60	0.38	1.66	0.80–3.47	0.18	1.48	0.63–3.50	0.37
41–60	1.53	0.63–3.75	0.35	2.18	0.80–5.92	0.13	3.01	0.94–9.65	0.06
Work Sites (Ref. = Designated Permanent Hospitals)									
Temporary Modular Hospitals	0.53	0.18–1.57	0.25	0.36	0.10–1.27	0.11	0.71	0.17–2.90	0.63
Both of the Above	0.70	0.25–1.92	0.49	0.70	0.23–2.13	0.54	2.16	0.63–7.43	0.22
Weekly Working Hours (Ref. ≤ 40 Hrs)	1.18	0.55–2.50	0.67	1.16	0.51–2.66	0.73	1.02	0.39–2.67	0.97
Collegial Relationship (Ref. = Fair)				0.40	0.16–1.01	0.05	0.44	0.14–1.40	0.16
Physician-Patient Relationship (Ref. = Fair)				0.84	0.35–2.04	0.71	1.07	0.36–3.18	0.91
Social Support (Ref. = Low)				0.93	0.47–1.83	0.83	1.47	0.64–3.36	0.36
Mental Health Counseling (Ref. = No)				6.30	2.95–13.46	< 0.01	3.50	1.40–8.75	0.01
Depression Symptoms (Ref. = No)							2.02	0.77–5.27	0.15
Anxiety Symptoms (Ref. = No)							4.32	1.66–11.23	< 0.01
Stress Symptoms (Ref. = No)							5.95	1.95–18.15	< 0.01

Note: Bold mean statistical significance.

study was much higher than those in the general population. During the COVID-19 outbreak, one study, using DASS-21 in 190 Chinese cities, found that 28.8%, 16.5%, and 8.1% of participants have anxiety, depression and stress symptoms, respectively, in the general population [19]. In contrast, our findings revealed much higher prevalence of anxiety (35.6%), depression (46.7%), and stress symptoms (16.0%) among medical assistance workers. Understandably, medical workers had higher risks of being infected, faced dying COVID-19 patients daily,

and experienced exhaustion from long time stressful work, which could lead to heightened mental health issues as compared to the general public [9,20].

Upon returning home, the reserve medics reported a much higher prevalence of PTSD symptoms than both the general public and their peers elsewhere. Compared with 31.6% of PTSD prevalence in this study, other research showed that lifetime prevalence of PTSD in the general population ranges from 2% to 9% [21]. And amid the outbreak

Table 3–2
Results of the hierarchical multiple logistic regression analysis on IES-R subscale: avoidance.

Variables	Model 1			Model 2			Model 3		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Sex (Ref. = male)	1.27	0.67–2.44	0.47	1.64	0.78–3.43	0.19	0.89	0.36–2.21	0.80
Age (Ref. = 21–30)									
31–40	1.22	0.66–2.26	0.53	1.57	0.77–3.18	0.21	1.60	0.68–3.76	0.28
41–60	1.39	0.59–3.26	0.45	1.96	0.76–5.08	0.17	2.99	0.98–9.13	0.05
Work Sites (Ref. = Designated Permanent Hospitals)									
Temporary Modular Hospitals	0.89	0.34–2.31	0.81	0.72	0.24–2.19	0.57	1.21	0.35–4.19	0.76
Both of the Above	0.50	0.18–1.38	0.18	0.48	0.16–1.44	0.19	1.25	0.36–4.36	0.72
Weekly Working Hours (Ref. ≤ 40 Hrs)	1.32	0.65–2.7	0.45	1.39	0.62–3.10	0.43	1.38	0.55–3.48	0.50
Collegial Relationship (Ref. = Fair)				0.40	0.16–1.00	0.05	0.37	0.12–1.15	0.09
Physician-Patient Relationship (Ref. = Fair)				0.73	0.31–1.68	0.45	0.83	0.3–2.3	0.72
Social Support (Ref. = Low)				0.82	0.43–1.57	0.55	1.40	0.63–3.11	0.41
Mental Health Counseling (Ref. = No)				6.87	3.08–15.31	< 0.01	4.88	1.88–12.71	< 0.01
Depression Symptoms (Ref. = No)							0.95	0.38–2.4	0.92
Anxiety Symptoms (Ref. = No)							12.67	4.72–33.98	< 0.01
Stress Symptoms (Ref. = No)							2.91	0.88–9.62	0.08

Note: Bold mean statistical significance.

of COVID 19, prevalence of PTSD symptoms among Wuhan residents was 7% [22]. Another recent study among medical workers caring for COVID 19 patients at a tertiary infectious disease hospital in China's Anhui province reported a 27.39% of PTSD symptoms prevalence roughly the same period of time [23]. During SARS outbreak in 2003, only about 10% of medics in a Beijing hospital [12] and 11% of nurses in Taiwan reported PTSD symptoms [24]. One explanation of the high PTSD symptoms prevalence among the reserve medics might be the team's proximity to the epicenter of the COVID-19 outbreak [25] and the lack of knowledge of the new virus. Further studies should examine how PTSD symptoms among the healthcare workers change over time.

The study found little evidence for the hypothesis that demographic characteristics were associated with PTSD symptoms. Except for age (> 41 y) being a significant factor for intrusion, few demographic variables were significantly associated with the PTSD symptoms and its subscales. As for the second hypothesis about social relationship, this study did not find significant association between emotional support from family/friends and PTSD symptoms; however, excellent collegial relationship was significantly associated with lower probability of hyperarousal among the medic reserves. This might be because medical assistance workers have experienced dramatic changes in the social network [20]: social interactions with family and friends were mostly replaced by collegial relationship, which not only moderated against the impact of high stress on well-being and related health outcomes

[26], but also acted as strong buffers on PTSD symptoms and turnover [27]. Hence, enhancement of collegial relationships through group activities and conflict resolution training, especially for those who have difficulties in collegial relationship [28], might improve mental health well-being.

The third hypothesis, i.e. mental health status is a significant predictor of PTSD symptoms, was well supported by the data. Consistent with a growing body of literature that reports the coexistence and comorbidity of anxiety, stress, depression and PTSD [10,29], the study revealed that mental health related variables, including mental health service use, are significant predictors of PTSD symptoms. Recent neuroscience research showed that synaptic density reductions and network-level alterations may contribute to comorbid disorders of depression and PTSD [30], and high anxiety sensitivity tends to form gist representations, which in turn may increase PTSD severity [31]. In addition, people with higher levels of stress could find it difficult to relax, easy to feel upset or agitated, and are impatient [18], resulting in negative impacts on PTSD symptoms [32]. Hence, in addition to disease knowledge, we suggest that pre-job training about mental health issues and mental health screening are essential for the wellbeing of healthcare workers in the frontline of fighting COVID 19. In addition, healthcare administrators should improve the work environment (e.g. reducing work hours, provision of leisure activities and rest space [33]) and provide sufficient resources such as mental health counseling

Table 3–3
Results of the hierarchical multiple logistic regression analysis on IES-R subscale: intrusion.

Variables	Model 1			Model 2			Model 3		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Sex (Ref. = male)	1.07	0.55–2.08	0.83	1.23	0.6–2.51	0.58	0.69	0.29–1.6	0.38
Age (Ref. = 21–30)									
31–40	1.68	0.9–3.14	0.11	2.09	1.05–4.18	0.04	2.11	0.95–4.69	0.07
41–60	3.06	1.26–7.38	0.01	4.14	1.6–10.70	< 0.01	5.86	2.03–16.95	< 0.01
Work Sites (Ref. = Designated Permanent Hospitals)									
Temporary Modular Hospitals	0.29	0.1–0.88	0.03	0.20	0.06–0.68	0.01	0.27	0.07–1.03	0.06
Both of the Above	0.37	0.13–1.02	0.06	0.33	0.11–1.01	0.05	0.70	0.21–2.34	0.56
Weekly Working Hours (Ref. ≤ 40 Hrs)	0.85	0.40–1.79	0.67	0.81	0.36–1.8	0.60	0.67	0.27–1.65	0.38
Collegial Relationship (Ref. = Fair)				0.88	0.47–1.66	0.16	1.26	0.6–2.66	0.52
Physician-Patient Relationship (Ref. = Fair)				0.53	0.22–1.3	0.63	0.71	0.25–2.02	1.00
Social Support (Ref. = Low)				0.82	0.36–1.85	0.69	1.00	0.39–2.6	0.54
Mental Health Counseling (Ref. = No)				5.40	2.44–11.93	< 0.01	3.36	1.32–8.52	0.01
Depression Symptoms (Ref. = No)							2.58	1.1–6.09	0.03
Anxiety Symptoms (Ref. = No)							4.09	1.69–9.89	< 0.01
Stress Symptoms (Ref. = No)							2.64	0.82–8.49	0.10

Note: Bold mean statistical significance.

Table 3–4
Results of the hierarchical multiple logistic regression analysis on IES-R subscale: hyperarousal.

Variables	Model 1			Model 2			Model 3		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Sex (Ref. = male)	1.27	0.65–2.49	0.49	1.69	0.79–3.61	0.18	1.06	0.43–2.64	0.90
Age (Ref. = 21–30)									
31–40	1.18	0.63–2.21	0.60	1.59	0.78–3.23	0.20	1.47	0.66–3.3	0.35
41–60	1.04	0.43–2.52	0.93	1.54	0.58–4.11	0.39	1.84	0.61–5.54	0.28
Work Sites (Ref. = Designated Permanent Hospitals)									
Temporary Modular Hospitals	0.44	0.15–1.26	0.13	0.43	0.14–1.36	0.15	0.67	0.19–2.43	0.55
Both of the Above	0.21	0.06–0.75	0.02	0.19	0.05–0.72	0.02	0.41	0.09–1.83	0.24
Weekly Working Hours (Ref. ≤ 40 Hrs)	1.86	0.89–3.91	0.10	2.15	0.94–4.89	0.07	2.22	0.88–5.63	0.09
Collegial Relationship (Ref. = Fair)				0.30	0.12–0.74	0.01	0.34	0.12–0.97	0.04
Physician-Patient Relationship (Ref. = Fair)				0.95	0.41–2.23	0.90	1.34	0.5–3.61	0.56
Social Support (Ref. = Low)				0.47	0.25–0.91	0.03	0.55	0.26–1.17	0.12
Mental Health Counseling (Ref. = No)				3.30	1.53–7.13	< 0.01	1.84	0.72–4.73	0.21
Depression Symptoms (Ref. = No)							3.40	1.43–8.10	0.01
Anxiety Symptoms (Ref. = No)							3.48	1.45–8.35	0.01
Stress Symptoms (Ref. = No)							1.50	0.52–4.35	0.45

Note: Bold mean statistical significance.

service, and personal protective equipment [34,35] during the pandemic such as to effectively alleviate anxiety, stress and depression.

4.1. Limitation

The findings of this study should be understood with several limitations in mind. First, recall bias may influence participants' reported mental health condition while in Wuhan. Also, it is unclear how long PTSD symptoms may persist or develop in the future. Longitudinal study is needed to examine the protective factors and long-term impacts of serving as reserve medical workers during the COVID-19 pandemic. Second, the study participants were not randomly selected, and findings were not generalizable to the larger population of reserve medics during the pandemic. Third, although we surveyed the types of facilities where the healthcare workers were stationed, we did not measure level of exposure, a factor for developing PTSD symptoms. Nevertheless, this study provides timely and important information to understand the psychological impacts of the COVID-19 pandemic on reserve medical workers. Future research should continue to understand the

psychological well-being of healthcare workers who deal with infectious disease outbreaks and the effectiveness of intervention programs.

5. Conclusions

The study surveyed reserve medics who worked at the front line of the COVID-19 pandemic in Wuhan, China. The results showed that although none of the reserve medics were infected with the virus, a considerable proportion of the medics suffered from mental health problems during their service and experienced PTSD symptoms upon their return to their hometown. Preemptive measures should be taken to avoid or alleviate the mental health burden among medics in the future.

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Appendix A. Appendix

Impact of event scale- revised (IES-R)	
Intrusion subscale	
1.	Any reminder brought back feelings about it
2.	I had trouble staying asleep
3.	Other things kept making me think about it
6.	I thought about it when I didn't mean to
9.	Pictures about it popped into my mind
14.	I found myself acting or feeling like I was back at that time
16.	I had waves of strong feelings about it
20.	I had dreams about it
Avoidance subscale	
5.	I avoided letting myself get upset when I thought about it or was reminded of it
7.	I felt as if it hadn't happened or wasn't real
8.	I stayed away from reminders of it
11.	I tried not to think about it
12.	I was aware that I still had a lot of feelings about it, but I didn't deal with them
13.	My feelings about it were kind of numb
17.	I tried to remove it from my memory
22.	I tried not to talk about it
Hyperarousal subscale	
4.	I felt irritable and angry
10.	I was jumpy and easily startled
15.	I had trouble falling asleep
18.	I had trouble concentrating
19.	Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart
21.	I felt watchful and on-guard

Depression anxiety stress scale-21 (DASS-21)

Depression	
3.	I couldn't seem to experience any positive feeling at all.
5	I found it difficult to work up the initiative to do things.
13.	I felt down-hearted and blue.
16.	I was unable to become enthusiastic about anything.
Anxiety	
2.	I was aware of dryness of my mouth.
4.	I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion).
7.	I experienced trembling (e.g. in the hands).
9.	I was worried about situations in which I might panic and make a fool of myself.
15.	I felt I was close to panic.
19.	I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat).
20.	I felt scared without any good reason.
Stress	
1.	I found it hard to wind down.
6.	I tended to over-react to situations.
8.	I felt that I was using a lot of nervous energy.
11.	I found myself getting agitated.
12.	I found it difficult to relax.
14.	I was intolerant of anything that kept me from getting on with what I was doing.
18.	I felt that I was rather touchy.
Leftout	
10.	I felt that I had nothing to look forward to.
17.	I felt I wasn't worth much as a person.
21.	I felt that life was meaningless.

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