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.

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Research paper

COVID-19 negatively impacts on psychological and somatic status in frontline nurses

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ABSTRACT

Background: COVID-19 has become a public health emergency based on its clinical characteristics. Previous studies demonstrated that the onset of a sudden and immediately life-threatening illness could lead to extraordinary amounts of psychological pressure on nurses who play an important role in the illness. Whether COVID-19 pandemic has greater impacts on the psychological status and somatic symptoms from nurses who stand in the frontline of this crisis remain unclear.

Methods: We evaluated post-traumatic stress disorder (PTSD), anxiety and somatic symptoms in the frontline nurses (n = 438) who served in Wuhan, China, during COVID-19 crisis. Nurses who did not worked in the frontline of COVID-19 served as controls (n = 452). The investigation was processed by online questionnaires including: impact of event scale-revised (IES-R) , self-rating anxiety scale (SAS), and somatic symptoms.

Results: Prevalence of moderate and severe PTSD was significantly increased in the frontline nurses compared to non-frontline nurses. Prevalence of mild anxiety was significantly increased in frontline nurses compared to non-frontline nurses. There were more frontline nurses suffering from severe insomnia and losing weight compared to non-frontline nurses. Severity of PTSD (IES-R score), but not severity of anxiety (SAS score) was similarly positively correlated to incidence of insomnia and weight loss in both frontline and non-frontline nurses to a similar extent.

Limitations: The results only represented psychological statues and somatic symptom on one time point thus the development of psychological stress and somatic symptom during pandemic of COVID-19 in the frontline nurses were missing.

Conclusions: COVID-19 negatively impacted on psychological and somatic status in frontline nurses. PTSD may be the most reliability and validity criteria for evaluating psychological and somatic status for frontline nurses of COVID-19.

1. Instruction

Coronavirus disease 2019 (COVID-19) was first identified in December 2019 in Wuhan city, Hubei province, China (Centers for Disease Control and Prevention, 2019 Novel coronavirus. Wuhan China: Information for Healthcare Professionals). From the end of December 2019, COVID-19 began to find throughout Hubei province and other areas in China and other countries in the world (World Health Organization, 2019; World Health Organisation (WHO) Coronavirus disease, 2019 (COVID-19) Situation Report, 2020).

Previous studies have shown that health care workers can lead to anxiety, depression, stress and post-traumatic stress disorder (PTSD) in response to acute infectious diseases (Hawryluck et al., 2004; Wu et al., 2005; Wu et al., 2005). Be in the daily routine or disasters, nurses are on the frontline and are responsible for providing holistic care for the patients. It was shown that the onset of a sudden and immediately life-threatening illness, such as SARS and Ebola, could lead to extraordinary amounts of pressure on nurses (Liu et al., 2012). Many factors may have dramatic effects on their somatic and mental status, such as physical exhaustion, increased workload, inadequate personal equipment, nosocomial transmission, and the need to make ethically difficult decisions on the rationing of care. In addition, their resilience can be

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further influenced by the lack of social support and distancing, risk of transfection as well as unsettling changes of working environments. Therefore, nurses are especially vulnerable to mental health problem, such as anxiety, depression, fear and insomnia in response to acute infectious diseases (Pappa et al., 2020; Wu et al., 2009).

Most of the current COVID-19 research focused on physical (somatic) healthy, but research data on mental health are lacking. A recent study found that, in public, more than 50% of people reported moderate or severe psychological impact (Wang et al., 2020a,b). Whether COVID-19 impact on psychological status in frontline nurses more than that in nurses who did not work in the frontline of COVID-19 remains unclear.

In the present study, we investigated the current psychological status among frontline nurses who completed the support during COVID-19 pandemic in Wuhan by answering the psychological status-related questionnaires. Nurses who did not go to Wuhan and did not worked in the frontline of COVID-19 (non-frontline) served as controls. We provided strong evidence that more frontline nurses suffered from insomnia, weight loss, moderate/severe PTSD and anxiety compared to non-frontline nurses. Moreover, increased insomnia and weight loss in the frontline nurses was positively correlated to severity of PTSD and anxiety evaluated by scores of IES-R and SAS.

2. Methods

2.1. Participants

All participants (nurses) were from hospitals in Liaoning province. Using hospital nurse roster, a stratified random sample of two groups was invited/selected online survey by text invitation via WeChat individually. Group 1 included nurses who had worked in the frontline caring COVID-19 patients, then left Wuhan and quarantined in Liaoning province (frontline nurse, $n = 438$); Group 2 included nurses who had never worked for COVID-19 patients and never been in Wuhan (non-frontline nurses, $n = 452$). All participants were full-time nurse at age of 18 years or above and were capable and willing to participate in the survey. Exclusion criteria included nurses who were unwilling to participate in the survey; lack of internet access; inability to complete an online survey; presence of chronic medical disorders; suspected or confirmed infection of COVID-19.

2.2. Screening questionnaire

Qualitative exploratory method was used to conduct this research via online questionnaires. The survey was conducted in the frontline nurses within 2 weeks after returning from Wuhan (frontline nurses, quarantined at the same place). Nurses who did not work for COVID-19 patients (non-frontline) served as controls.

The structured questionnaire covered several areas including: (1). demographic and occupational data; (2) impact of event scale-revised (IES-R) which includes 22-item self-report measure assessing subjective distress caused by traumatic events; and (3) Self-rating anxiety scale (SAS), and (4) somatic symptoms in the past 14 days, such as insomnia, headache, weight loss and poor appetite;

2.2.1. Impact of event scale-revised

The psychological impact of the COVID-19 pandemic was measured by Impact of Event Scale-Revised (IES-R) which is a self-administered questionnaire that has been well-validated and extensively used for determining the extent of psychological impact in response to COVID-19 pandemic (Christianson and Marren, 2012; Hao et al., 2020; Wang et al., 2020a,b). The IES-R questionnaire included 22 items (Supplementary Table 1). Response to each item was divided into 5 levels (0–4 points): 0 = never; 1 = rarely; 2 = sometimes; 3 = often; 4 =always. Participants should indicate how often each statement applies to him/her within 2 weeks after coming back home from Wuhan (frontline nurses) or 2 weeks before taking this survey (non-frontline nurses). Whereas, non-frontline nurses should indicate how often each statement applies to him/her within 2 weeks before the survey. The total IES-R score was 88 which indicated the severity of post-traumatic stress disorder (PTSD) in response to COVID-19 pandemic. The total IES-R score was divided into 4 groups for defining the severity of PTSD: 0–8 =sub-clinical PTSD; 9–25 = mild PTSD; 26–43=moderate PTSD and 44–88=severe PTSD (Christianson and Marren, 2012).

2.2.2. Self-rating anxiety scale

The Self-Rating Anxiety Scale (SAS) was used to assess anxiety which included 20-item self-report assessment (Supplementary Table 2) as described previously (Zung, 1971). The questionnaires were related to cognitive, autonomic, motor, and central nervous system symptoms. Participants should indicate how much each statement applies to him/her within 2 weeks after coming back home from Wuhan (frontline nurses) or within a period of one or two weeks prior to taking the test (non-frontline nurses). Questions from 1–15 were scored from 1–4, score 1 = never; 2 = sometimes; 3 = often; 4 = continuously, while questions from 16–20 were scored from 4-1 as they evaluated positive impacts. Score 1 = continuously; 2 = often; 3 = sometimes; 4 = never. Therefore, the total raw scores range will be 20–80. According to the previous study that score of ≥ 50 can be considered as anxiety (Cheng et al., 2020). The total SAS scores were divided into 4 groups for defining the level of anxiety as described previously: 25–49 = normal; 50–59 =mild; 60–69 =moderate; ≥ 70 =severe (Cheng et al., 2020).

2.2.3. Evaluation of somatic symptoms

Somatic symptoms including insomnia, weight loss, headache and poor appetite was also evaluated with questionnaires.

Insomnia

Insomnia in frontline and non-frontline was evaluated with a questionnaire including 4 levels: no insomnia=never had insomnia; mild insomnia= insomnia 1 and 2 times per week; moderate insomnia-=insomnia 3 and 5 times per week; severe insomnia=insomnia every day.

Weight loss

Weight loss within one month before the survey was investigated in the frontline and non-frontline nurses. The questionnaire for weight loss includes 4 levels; no weight loss; mild weight loss–body weight was decreased less than 5%; moderate weight loss–body weight was decreased 5–10%; severe weight loss–body weight was decreased more than 10%.

Headache

Headache was assessed in frontline and non-frontline nurses with 4 levels: no headache=never had headache; mild headache=little bit headache, can tolerant, and work/life was not affected by headache; moderate headache=headache affected work/life but can be tolerated; severe headache=can do nothing and have to stay on the bed.

Poor appetite

Poor appetite was examined in frontline and non-frontline nurses with 4 levels: normal appetite; mild poor appetite=poor appetite 1,2 time per week; moderate poor appetite=poor appetite 3–5 time per week; severe poor appetite=poor appetite every day.

2.3. Ethical approval

The study protocol was approved by the Ethics Committee of the First Hospital Affiliated to China Medical University (protocol approval No. [2020]194). All participants provided written informed consent. This study was conducted in accordance with the Declaration of Helsinki.

2.4. Data collection

The survey was conducted online for investing the impact of COVID-19 on psychological and somatic status in frontline and non-frontline nurses. The relevant information of the research purpose, anonymity and confidentiality and the above scales were uploaded to the "questionnaire star" website, and the QR code or URL of the shared questionnaire was sent to the frontline nurses during 2-week quarantine after finished their job in Wuhan. Data collected from the nurses who did not go to Wuhan and did not worked for COVID-19 patients (non-frontline nurses) served as controls.

2.5. Study outcomes

We evaluated the prevalence of psychological stress (PTSD and anxiety) and somatic symptoms reported by the frontline and non-frontline nurses. Additionally, we investigated the association between psychological stress and somatic symptoms.

2.6. Statistical analysis

Enter the survey data into Microsoft Excel (version 2010) and SPSS 22.0, and double-check the accuracy of the data. Counting data is expressed by frequency and percentage, and measurement data is expressed by mean and standard deviation. Comparison between the two groups was performed using independent sample t test and comparison between multiple groups was performed using one-way analysis of variance (ANOVA). Pearson correlation analysis was used to analyze the correlation among IES-R, SAS scores and risk factors. $p < 0.05$ was considered to be significant.

3. Results

3.1. Characteristics of participants

There was 31 (6.86%) and 44 (10.05%) male, and 421 (93.14%) and 394 (89.95%) female in non-frontline and frontline nurse group, respectively Table 1, $p = 0.087$). Average of age was 33.64 and 33.13 years in the non-frontline and frontline nurses, respectively ($p = 0.173$). Length of working was significantly short in the frontline nurses compared to non-frontline nurses (12.48 ± 8.23 vs. 11.23 ± 5.91 years, respectively, Table 1, $p = 0.01$). Employee status between frontline and non-frontline nurse were significantly different (Table 1, $p = 0.001$). In frontline nurses, 312 (71.23%) and 126 (28.77) were contract and regular employees, respectively.

In non-frontline nurses, there were 366 (80.97%) contract and 86 (19.03%) regular employees. The monthly income was significantly different between frontline and non-frontline nurses (Table 1, $p < 0.001$). There was no different on marital status ($p = 0.105$). In frontline nurses, 58.22% had children and 41.78% do not have children compared to 66.81% and 33.19% in the non-frontline nurses, respectively (Table 1, $p = 0.008$). There was no different on education between frontline and non-frontline nurses (Table 1, $p = 0.102$). Frontline nurse group included 11.87% junior nurses; 44.75% senior nurses; 35.39% nurses-in-charge and 7.99% vice-director nurse and above. While non-frontline nurse group included 17.04% junior nurses; 50.44% senior nurses; 29.20% nurses-in-charge and 3.32% vice-director nurse and above. Positions in the team in frontline and non-frontline nurses were significantly different. Frontline group included 11.42% principal nurses; 22.83% team leader; 58.68% team member and 7.08% administrative staffs. Whereas, non-frontline group included 4.42% principal nurses; 6.64% team leader; 60.18% team member and 28.76% administrative staffs (Table 1, $p < 0.001$).

Table 1
Characteristics of participants ($n = 890$).

Variables	Non-frontline ($n = 452$)	Frontline ($n = 438$)	p value
Gender			0.087
Male	31 (6.86%)	44 (10.05%)	
Female	421 (93.14%)	394 (89.95%)	
Age (year)	33.64 ± 6.01	33.13 ± 5.13	0.173
Years of working	12.48 ± 8.23	11.23 ± 5.91	0.010
Type of employment			0.001
Contract	366 (80.97%)	312 (71.23%)	
Regular	86 (19.03%)	126 (28.77%)	
Monthly income (Chinese Yuan)			< 0.001
2000~3000	45 (9.96%)	53 (12.10%)	
3000~5000	71 (15.71%)	113 (25.80%)	
5000~7000	76 (16.81%)	98 (22.37%)	
7000~10000	171 (37.83%)	137 (31.28%)	
10000 and above	89 (19.69%)	37 (8.45%)	
Marital status			0.105
Single	109 (24.12%)	133 (30.37%)	
Married	330 (73.01%)	295 (67.35%)	
Divorced	13 (2.88%)	10 (2.28%)	
Fertility status			0.008
Has children	302 (66.81%)	255 (58.22%)	
Do not *have children*	150 (33.19%)	183 (41.78%)	
Education			0.102
Certificate	9 (1.99%)	4 (0.91%)	
Diploma	64 (14.16%)	51 (11.64%)	
Bachelor	370 (81.86%)	365 (83.33%)	
Master and above	9 (1.99%)	18 (4.11%)	
Job title			0.001
Junior Nurse	77 (17.04%)	52 (11.87%)	
Senior nurse	228 (50.44%)	196 (44.75%)	
Nurse-in-charge	132 (29.20%)	155 (35.39%)	
Vice-director nurse and above	15 (3.32%)	35 (7.99%)	
Position in the team			< 0.001
Principal	20 (4.42%)	50 (11.42%)	
Team leader	30 (6.64%)	100 (22.83%)	
Team member	272 (60.18%)	257 (58.68%)	
Administrative staffs	130 (28.76%)	31 (7.08%)	

3.2. Prevalence and severity of PTSD was increased in the frontline nurses

The psychological impact of the COVID-19 pandemic was measured by Impact of Event Scale-Revised (IES-R) as described previously (Hao et al., 2020; Wang et al., 2020a,b). We found the average of IES-R score in the frontline nurses was significantly higher than that in the non-frontline nurses (39.85 ± 14.13 vs. 22.46 ± 14.70, $p < 0.01$). Previous study reported that IES-R score was greatly correlated with PTSD level ($r = 0.84$) (Creamer et al., 2003). PTSD level can be determined by the IES-R scores (Christianson and Marren, 2012; Creamer et al., 2003). We further examined the effects of COVID-19 on PTSD in the frontline nurses compared to the non-frontline nurses. We observed that more frontline nurses than non-frontline nurses suffered from different level of PTSD (100 vs. 79.42%, Table 2, $p < 0.001$). There were more nurses suffered from moderate PTSD (IES-R score = 26–43) in frontline nurse group compared to that in non-frontline nurse group (41.10% vs. 25.66%, respectively, Table 2, $p < 0.01$). Our study indicates that the COVID-19 pandemic impact on both IES-R score and PTSD level in the frontline nurses scores. Moreover, IES-R score may be a significant diagnosis marker of PTSD in frontline nurses of COVID-19.

Table 2
PTSD evaluated by IES-R scores in non-frontline and frontline nurses.

PTSD level	Non-frontline($n = 452$)	Frontline(n=438)	P value
Sub-clinical	93 (20.58%)	0	**< 0.001**
Mild	193 (42.70%)	82 (18.72%)	**< 0.001**
Moderate	116 (25.66%)	180 (41.10%)	**< 0.001**
Severe	50 (11.06%)	176 (40.18%)	**< 0.001**

There were also more nurses suffered from severe PTSD (IES-R score = 44–88) in frontline nurse group compared to that in non-frontline nurse group (40.18% vs. 11.06%, respectively, Table 2, $p < 0.001$). Moreover, we observed that IES-R score for each questionnaire was significantly increased in frontline nurses compared to non-frontline nurses (Table 3, $p < 0.001$). Our findings strongly indicate that frontline nurses had more negative psychological impact in response to COVID-19 pandemic compared to non-frontline nurses.

3.3. Prevalence of anxiety was increased in the frontline nurses

We evaluated anxiety by SAS score as described previously (Cheng et al., 2020). Although the average of SAS score was similar in frontline and non-frontline nurses (34.12 ± 8.68 vs. 34.31 ± 9.82, $p = 0.785$), we noticed that number of frontline nurses without anxiety in frontline nurses was significant less compared to non-frontline nurses (89.26 vs. 94.58%, Table 4, $p = 0.021$). Number of frontline nurses suffering from mild anxiety was significantly increased compared to non-frontline nurses (10.50 vs. 6.19%, Table 4, $p = 0.016$). Our findings indicate that COVID-19 has significant impact on anxiety in the nurses.

3.4. Job/social demographic factors were unrelated to IES-R and SAS score in both frontline and non-frontline nurses

As several job/social demographic factors were significant different between frontline and non-frontline nurses (Table 1), we next examined whether those factors impact on IES-R and SAS score. By correlation analysis, we found that although some of correlations were significantly different in both within frontline and non-frontline nurses, none of job/social demographic factors were strongly correlated to IES-R and SAS score (Supplementary Tables 3 and 4). Our findings indicate that the job/social demographic factors did not affect the IES-R and SAS score both in the COVID-19 frontline and non-frontline nurses in the setting of our subjects.

3.5. Prevalence of severe insomnia and weight loss was increased in the frontline nurses

The percentage of nurses having no insomnia or suffering from mild and moderate insomnia was similar between frontline and non-frontline nurses (Table 5, $p = 0.136$, $p = 0.477$ and $p = 0.729$, respectively). We noticed that there were more frontline nurses suffering from severe insomnia compared to non-frontline nurses (13.47 vs. 7.52%, Table 5, $p < 0.001$). We also found that less frontline nurses kept their body weight compared to non-frontline nurses within one month before the survey (21.46 vs. 53.10%, Table 5, $p < 0.001$). There were more frontline nurses lost 5–10% or more 10% body weight (28.31% vs. 7.97% and 19.86% vs. 2.43%, respectively, Table 5, $p < 0.001$). There were no different between frontline and non-frontline nurses on the evaluation of headache and poor appetite (Table 5).

Table 3
IES-R score from each questionnaire in non-frontline and frontline nurses.

Questionnaire	Non-frontline	Frontline	*P* value
1	1.69 ± 0.96	2.41 ± 1.06	**< 0.001**
2	1.44 ± 1.07	2.50 ± 1.06	**< 0.001**
3	1.29 ± 0.88	2.20 ± 1.02	**< 0.001**
4	1.40 ± 0.99	1.89 ± 0.90	**< 0.001**
5	1.14 ± 0.93	1.77 ± 0.88	**< 0.001**
6	1.07 ± 0.91	1.82 ± 0.88	**< 0.001**
7	0.87 ± 0.92	1.69 ± 0.83	**< 0.001**
8	0.86 ± 0.89	1.53 ± 0.75	**< 0.001**
9	1.08 ± 0.88	2.03 ± ± 0.95	**< 0.001**
10	0.94 ± 0.92	1.63 ± 0.82	**< 0.001**
11	0.85 ± 0.89	1.55 ± 0.77	**< 0.001**
12	0.92 ± 0.89	1.75 ± 0.85	**< 0.001**
13	0.99 ± 0.91	1.58 ± 0.76	**< 0.001**
14	0.79 ± 0.85	1.66 ± 0.83	**< 0.001**
15	1.04 ± 1.01	2.20 ± 1.04	**< 0.001**
16	1.00 ± 0.86	1.89 ± 0.92	**< 0.001**
17	0.85 ± 0.94	1.52 ± 0.74	**< 0.001**
18	0.94 ± 0.92	1.74 ± 0.89	**< 0.001**
19	0.63 ± 0.82	1.45 ± 0.69	**< 0.001**
20	0.66 ± 0.83	1.62 ± 0.78	**< 0.001**
21	1.18 ± 1.06	1.84 ± 0.97	**< 0.001**
22	0.81 ± 0.89	1.58 ± 0.80	**< 0.001**

Table 4
Anxiety level evaluated by SAS scores in non-frontline and frontline nurses.

Anxiety level	Non-frontline nurses(n = 452)	Frontline nurses (n=438)	*P* value
None	423 (94.58%)	391 (89.26%)	**0.021**
Mild	28 (6.19%)	46 (10.50%)	**0.016**
Moderate	0 (0%)	1 (0.23%)	0.309
Severe	1 (0.22%)	0 (0%)	0.325

Table 5
Somatic symptom in non-frontline nurses and frontline nurses.

Somatic symptom	Non-frontline (n = 452)	Frontline (n=438)	*p* value
Insomnia			
None	167 (36.95%)	141 (32.19%)	0.136
Mild	142 (31.42%)	128 (29.22%)	0.477
Moderate	109 (24.12%)	110 (25.11%)	0.729
Severe	34 (7.52%)	59 (13.47%)	**< 0.001**
Weight loss			
None	240 (53.10%)	94 (21.46%)	**< 0.001**
Mild	165 (36.50%)	133 (30.37%)	0.052
Moderate	36 (7.96%)	124 (28.31%)	**< 0.001**
Severe	11 (2.43%)	87 (19.86%)	**< 0.001**
Headache			
None	211 (46.68%)	234 (53.42%)	**0.044**
Mild	165 (36.50%)	148 (33.79%)	0.397
Moderate	59 (13.05%)	44 (10.05%)	0.161
Severe	17 (3.76%)	12 (2.74%)	0.391
Poor appetite			
None	287 (63.50%)	273 (62.33%)	0.719
Mild	120 (26.55%)	122 (27.54%)	0.662
Moderate	37 (8.19%)	32 (7.31%)	0.624
Severe	8 (1.77%)	11 (2.51%)	0.444

3.6. Insomnia and weight loss were positively correlated to IES-R and SAS scores

It has been suggested that somatic symptoms may be more prevalent during periods of stress (Basant et al., 2014). To examine whether increased insomnia and weight loss was related to increased severity of PTSD and anxiety which was evaluated by scores of IES-R and SAS, we did correlation analysis. We observed that insomnia and weight loss was similarly positively correlated with IES-R scores in both frontline nurses and non-frontline nurses (Table 6). Insomnia and weight loss was also positively correlated with SAS scores in both frontline and non-frontline nurses. We also overserved that correlation coefficients (r value) between insomnia/weight loss and SAS scores in non-frontline nurses seemed to greater extent than that in the frontline nurses (0.545 vs. 0.460 and 0.645 vs. 0.403, respectively).

3.7. Insomnia and weight loss were slightly positively correlated to severity of anxiety in the non-frontline nurses but not in the frontline nurses

Because there were 89.26% frontline and 94.58% non-frontline nurses have very low SAS scores in the large number of sample size, this distribution of data may result in small r value. We next examined whether severity of anxiety and insomnia/weight loss is positively correlated in the frontline ($n = 47$) and non-frontline nurses ($n = 29$) with SAS score> 49 of anxiety. We observed that severity of anxiety was slightly correlated to insomnia/weight loss in the non-frontline nurses (0.319 and 0.388 for insomnia and weight loss, respectively) but not in

Table 6
Correlation between insomnia/weight loss and score of IES-R and SAS in non-frontline nurses and frontline nurses.

Somatic symptom	Non-frontline (n = 452)				Frontline (n=438)			
	IES-R		SAS		IES-R		SAS	
	r value	*p* value	*r* value	*p* value	*r* value	*p* value	*r* value	*p* value
Insomnia	0.699	< 0.001	0.545	< 0.001	0.693	< 0.001	0.460	< 0.001
Weight loss	0.706	< 0.001	0.645	< 0.001	0.621	< 0.001	0.403	< 0.001

the frontline nurses (0.08 and 0.029 for insomnia and weight loss, respectively, Supplementary Table 5).

4. Discussion

In the present study, we investigated psychological impacts of COVID-19 on frontline nurses by evaluating online questionnaire scores of IES-R and SAS as previously described (Christianson and Marren, 2012; Hao et al., 2020; Wang et al., 2020a,b; Zung, 1971). The major finding of this study are: 1, there were more frontline nurses suffering from different level of PTSD than non-frontline nurses (100 vs. 79.42%, $p < 0.001$); 2, Mild anxiety was significantly increased in frontline nurses compared to non-frontline nurses (10.50 vs. 6.19%, $p = 0.016$); and 3, insomnia and weight loss was positively correlated to PTSD and anxiety. Our study provides strong evidence that COVID-19 negatively impacted on the psychological and somatic status of frontline nurses.

PTSD is arguably the most common psychiatric disorder to arise after exposure to a traumatic event. Symptoms of PTSD may include nightmares, flashbacks, severe anxiety, as well as uncontrollable thoughts about the events. IES-R has been considered as the best tool for recent and specific traumatic events and extensively used for evaluation of PTSD (Weiss, 1997). In the present study, we evaluated PTSD in the frontline nurses who served patients with COVID-19 by IES-R score. We firstly found IES-R score in the frontline nurses was dramatically increased compared to non-frontline nurses (39.85 ± 14.13 vs. 22.46 ± 14.70, $p < 0.01$). We further evaluated PTSD levels by IES-R scores and found that there were more frontline nurses suffering from different level of PTSD (100 vs. 79.42%, $p < 0.001$). The PTSD in frontline nurse was also more severe compared to that in non-frontline nurse (moderate PTSD: 41.10 vs. 25.66%; severe PTSD: 40.18 vs. 11.06%, $p < 0.001$). Our study was in line with recent findings that PTSD morbidity and severity was increased in persons who were impacted by COVID-19 (Chew et al., 2020; Hao et al., 2020).

Many factors were suggested to be related to PTSD in response to pandemic, such as less experience in response to public emergencies, over workload, and worry about infection. In addition, PTSD also comes from frustration caused by unfamiliar work environment, sense of incapability of dependent decision-making in work, and pressure on patient's treatment effect. The stress of nurses working in a pandemic situation can also come from the objective environment and their own subjective perception (Li et al., 2020). In addition, loss of normality and balance of daily life and hard to relieve psychological pressure were suggested to be risk factors of PTSD (Lee et al., 2015). Prevention/therapeutics of PTSD remains unclear. It has been suggested that group virtual discussion about the deficiencies of the day's work and what needed to be improved will be helpful to relieve the loneliness and tension of living alone and to release pressure during pandemic (Rosen et al., 2020). Further investigations for understanding the risk factors of PTSD in frontline nurses of COVID-19 are needed which could provide novel avenues for prevention and therapeutics of PTSD.

Anxiety is a normal and often healthy emotion. However, when a person regularly feels disproportionate levels of anxiety, it might become a medical disorder. Anxiety disorder occurs when a person regularly feels disproportionate level of distress, worry, or fear over an emotional trigger. A wide variety of factors can contribute to anxiety disorders. According to previous studies from SARS and Ebola pandemic, the onset of a sudden /immediately life-threatening illness could lead to extraordinary amount of pressure on healthcare workers (Liu et al., 2012). SAS score which was developed by professor Zung (1971) has been extensively used as a simple tool for evaluating level of anxiety in clinics due to its good reliability and validity (Cheng et al., 2020; Cui et al., 2021; Li et al., 2021; Mo et al., 2021). Recently, many studies evaluated the impact of COVID-19 on development of anxiety in the frontline nurses. Using SAS scores, we analyzed prevalence of anxiety in the frontline nurses. We observed that there were 89.26% frontline nurses developed anxiety symptoms. Our findings are in good accordance with recent meta-analysis studies showing 93.85% (sample size= 1304) (Salari et al., 2020) and 75.94% (12 studies) (Pappa et al., 2020) frontline nurses developed anxiety.

In consistent with recent studies showing that 10.5 to 13.2% of frontline nurses of COVID-19 developed mild anxiety (Cheng et al., 2020; Li et al., 2021; Mo et al., 2021), here we also provided strong evidence that COVID-19 markedly increased mild anxiety in frontline nurses (10.50 vs. 6.19%, $p = 0.016$). Many factors have been suggested to be related to sudden/immediately life-threatening illness-induced anxiety, including increased workload, physical exhaustion, inadequate personal equipment, nosocomial transmission, and the need to make ethically difficult decisions (LeMay and Wilson, 2008). In addition, their resilience can be further compromised by lack of social support, isolation, fear of infections as well as drastic and often unsettling changes working environment (Lung et al., 2009; Pappa et al., 2020; Wu et al., 2009). The different in the incidence of anxiety in COVID-19 frontline nurses reported in different studies may be due to job/social demographic factors of nurses and work-related factors. Further studies to compare anxiety severity in COVID-19 frontline nurses in different working environments/hospitals thus find out the anxiety risk factors are required.

In the present study, the effect of COVID-19 on anxiety was slighter than that on PTSD in the frontline nurses. Both anxiety and PTSD are symptoms of psychological stress. In general, PTSD symptoms are considered to be intrusive and often interrupt daily life. And some symptoms of PTSD can be similar to anxiety. It has been suggested that less anxiety in response to acute infection may be protective from excessive stress response (Cai et al., 2020). Factors related to less anxiety in response to infection potentially include: prior experiences (Ni et al., 2020), inoculation hypothesis (Boals et al., 2012) and adaptive coping ability (Knight et al., 2000). Further studies to investigate factors related to less anxiety compared to PTSD in response to COVID-19 in the frontline nurses are needed.

Previous studies demonstrated that somatic symptoms may be more prevalent during periods of stress (Basant et al., 2014). In the present study, we found that number of frontline nurses suffered severe insomnia was significantly increased compared to non-frontline nurses (13.47 vs. 7.52%, $p < 0.001$). In addition, there were more frontline nurses lost 5–10% or more than 10% body weight than non-frontline nurses (48.17 vs. 10.40%, $p < 0.001$). Most importantly, we provided strong evidence that increased insomnia and weight loss is positively correlated to severity of PTSD and anxiety in both frontline and non-frontline nurses (Table 6). Our findings strongly support the notion that COVID-19-related excessive negative emotions can lead to somatic symptoms that in turn cause significant physical and mental discomfort (Liu et al., 2020). Noteworthily, the positive correlation between insomnia and body weight loss with severity of anxiety (evaluated by SAS score) seemed more powerful in non-frontline nurses compared to

that in frontline nurses ($r = 0.545$ vs. 0.46 for insomnia; $r = 0.645$ vs. 0.403 for body weight loss, respectively). In the present study, since 89.26% frontline and 94.58% non-frontline nurses had very low SAS scores in the large number of sample size, this abnormal distribute data may result in low correlations. Therefore we examined correlations between SAS score of anxiety (> 49) and insomnia/weight loss in the frontline and non-frontline nurses. We found that the small positive correlation between SAS scores and insomnia/body weight loss (Table 6) was further decreased in the non-frontline nurses (0.319 and 0.388 for insomnia and weight loss, respectively) and frontline nurses (0.08 and 0.029 for insomnia and weight loss). As incidence of insomnia and body weight loss was significantly increased in the frontline nurses, our findings suggest that anxiety may not be the important factor for the increased incidence of insomnia and body weight loss in the frontline nurses. As incidence of PTSD was significantly increased in the COVID-19 frontline nurses, the similar correlation coefficient (r value) between insomnia and body weight loss with severity of PTSD (IES-R score) in the frontline and non-frontline nurses strongly implied that PTSD may be a critical risk factor for insomnia and body loss in response to COVID-19 in the frontline nurses. We demonstrate that rather than anxiety, PTSD may be the most reliable and valid criteria for evaluating psychological and somatic status for frontline nurses of COVID-19.

The true association of somatic symptoms and psychological stress in the frontline nurses of COVID-19 is indeed challenging to determine. Previous studies suggested that somatic symptoms may be more prevalent and represent a way of communicating emotion during periods of stress (Basant et al., 2014). Our study is in line with recent study that the increased prevalence of self-reported somatic symptoms is likely due to psychological impact of the outbreak (Chew et al., 2020). Another possible factor which affects physical symptoms of the frontline nurses was suggested to be the social stigma associate with mental health issues, which may have resulted in individuals having a higher tendency to express their psychological distress via physical symptoms instead (Yang, 2007).

5. Strengths and limitations

There are several strengths and key limitations in this study: The strength of this study is that: 1, the questionnaires were administered online, and the recruitment of participants for the two groups were processed according to the basal criteria we set in the Methods thus results are solid; 2, the present study adopted a cross-sectional survey design with self-administered online questionnaires which avoids interaction between interviewers and respondents.

The limitation of this study is that the results only represented psychological status and somatic symptom on one time point thus the development of psychological stress and somatic symptom if stress during pandemic of COVID-19 in the frontline nurses were missing. In addition, as a self-assessment questionnaire survey, it is possible that objectivity and reliability was lack. And there may be some deviations in the results. Moreover, in the present study, since working for COVID-19 patients and in Wuhan where was surrounded with COVID-19-induced stress were two important factors which existed in the frontline nurses but not in the non-frontline nurses, the impact of COVID-19–induced stressful atmosphere surrounded in Wuhan on psychological and somatic status of frontline nurses compared to non-frontline nurses who also worked in Wuhan remains unclear which warrants further investigation.

6. Conclusions

Our findings indicate that prevalence of PTSD and anxiety, as well as somatic symptoms was significantly increased in the frontline nurses of COVID-19. PTSD may be the most reliability and validity criteria for evaluating psychological and somatic status for frontline nurses of COVID-19. Our study provided strong evidence that COVID-19 negatively impacts on psychological status and increases somatic symptoms in the frontline nurses.

Author statement

As corresponding author of this paper entitled “COVID-19 negatively impacts on psychological and somatic status in frontline nurses”, I have made substantial contributions to the conception or design of the work, the acquisition, analysis, and interpretation of data for the work.

I agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriate investigated and resolved.

All persons who have made substantial contributions to the work were reported in the manuscript.

Declaration of Competing Interest

None.

We declare that we have no financial and personal relationships with other people or organizations that can inappropriately influence our work, there is no professional or other personal interest of any nature or kind in any product, service and/or company that could be construed as influencing the position presented in, or the review of, the manuscript entitled “COVID-19 negatively impacts on psychological and somatic status in frontline nurses”.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2021.07.031.

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