A Large Scale of Nurses Participated in Beating down COVID-19 in China: The Physical and Psychological Distress

Quan WANG[1†], Jun-yao FAN[1†], Hui-min ZHAO[1†], Yue-ting LIU[1], Xin-xue XI[2], Ling-lin KONG[1], Jie LI[1#], Jing MAO[1#]
[1]*School of Nursing, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430030, China*
[2]*Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430030, China*

Summary: The outbreak of coronavirus disease 2019 (COVID-19) posed an unprecedented threat to health care providers (HCPs) in Wuhan, China, especially for nurses who were frequently exposed to infected or suspected patients. Limited information was available about the working experience of nurses in fighting against the pandemic. To learn the physical and psychological responses of nurses during the pandemic and explore the potential determinants, we conducted a large-scale survey in Wuhan. This multicenter cross-sectional study enrolled 5521 nurses who worked in designated hospitals, mobile cabins, or shelters during the pandemic. A structured online questionnaire was distributed to assess the physical discomforts, emotional distress and cognitive reactions of nurses at work, and the log-binomial regression analysis was performed to explore potential determinants. A considerable proportion of nurses had symptoms of physical discomforts [3677 (66.6%)] and emotional distress [4721 (85.5%)]. Nurses who were directly involved in the care of patients (i.e., care for severe patients: RR, 2.35; 95% CI, 1.95–2.84), with irregular work schedules (RR, 2.36; 95% CI, 1.95–2.87), and working overtime (RR, 1.34; 95% CI, 1.08–1.65) were at a higher risk for physical discomforts. Nurses who were directly involved in the care of patients (i.e., care for severe patients: RR, 1.78; 95% CI, 1.40–2.29), with irregular work schedules (RR, 3.39; 95% CI, 2.43–4.73), and working overtime (RR, 1.51; 95% CI, 1.12–2.04) were at a higher risk for emotional distress. Therefore, formulating reasonable work schedules and improving workforce systems are necessary to alleviate the physical and emotional distress of nurses during the pandemic.
Key words: coronavirus disease 2019; pandemic; nurses; distress

As reported by the National Health Commission of China (NHC), up to August 11, 2020, more than 84 737 cases of coronavirus disease 2019 (COVID-19) had been confirmed in China, including more than 50 344 cases in Wuhan, Hubei Province[1]. Confronting with the unprecedented pandemic, the Chinese government mobilized multifaceted forces. On January 25, the first-level public health emergency response was initiated in Hubei Province, marking an arrival of the peak to fight the pandemic. Since January 28, at the request of NHC, a pre-diagnosis and registration system had been implemented across each community healthcare center, aiming to alleviate the stress of the hospitals. Meanwhile, 61 designated fever clinics were set up in Wuhan to diagnose the suspected cases, and 16 mobile square cabins were established to divert confirmed cases under mild conditions[2]. Additionally, 48 national designated hospitals, which possessed the most advanced medical resources, were dedicated to saving critical and severe patients. Despite numerous healthcare providers involved in the pandemic, the medical staff in Hubei Province were still insufficient to cope with the surging cases. It was estimated that the deficiency rate of doctors and nurses for critical patients had reached approximately 30% and 50% respectively[3]. To address the issue of health care providers (HCPs) shortage, as of March 1, 2020, 344 medical teams from 30 provinces were dispatched to Hubei Province. These reinforcements were comprised of 42 322 HCPs, including 11 416 doctors and 28 679 nurses[4].

With tremendous support and strict policy prohibitions, the pandemic was controlled effectively. At the early stage of COVID-19 pandemic, significant and sustained efforts have focused on mobilization of personal protective equipment, intensive care beds, and medical equipment, while substantially less attention

Quan WANG, E-mail: m201975570@hust.edu.cn; Jun-yao FAN, E-mail: fanjunyao@hust.edu.cn; Hui-min ZHAO, E-mail: zhaohuimin@hust.edu.cn
[†]These authors contributed equally to this work.
[#]Corresponding authors, Jie LI, E-mail: lijie@hust.edu.cn; Jing MAO, E-mail: Maojing@hust.edu.cn.

has focused on preserving the physical/psychological health of HCPs[5]. However, the impacts of working during the pandemic have been identified by a number of studies on HCPs around the world as being stressful, and even traumatic[6–10]. To conduct their duties successfully, the HCPs may be exposed to a miscellany of potentially disturbing sensory stimuli, as well as physical, emotional and cognitive experiences[5, 11]. A recent study indicated that approximately 71.5% of HCPs experienced emotional distress during the COVID-19 pandemic, and the frontline nurses were at a higher risk of depression, anxiety and insomnia[8]. Several studies conducted during the severe acute respiratory syndrome (SARS) outbreak suggested that the prevalence of emotional distress was highest in nursing staff, ranging from 45.1% to 89.0%[12–14], and about 73.0% had experienced SARS-related symptoms (i.e., chill, headaches, myalgia, cough, etc.)[14]. Numerous studies have attempted to explore variables that may increase the likelihood of a HCP experiencing distress during the pandemic. However, the conclusions of relevant studies are controversial. For example, most studies considered that the HCPs directly involved in the diagnosis, treatment, and care of patients were at a higher risk of suffering emotional distress[15–17], but a research conducted during the SARS pandemic proposed an opposite opinion: the experience in treating patients infected with SARS may be a mediating factor which could protect HCPs from emotional trouble[10]. Furthermore, previous studies indicated that individuals may have different cognitive reactions during the pandemic: some HCPs could feel an appreciation from the hospital management and society, and felt an improved self-confidence from the experience, while others did the opposite[7, 18, 19].

Learning the experience of HCPs in fighting against the COVID-19 pandemic may help us further understand the impacts of working during the pandemic and identify contributing factors, so that HCPs can be provided with the most favorable working conditions possible in times of extreme stress. For now, assessing the extent to which HCPs have been physically or psychologically affected is difficult because the Centers for Disease Control and Prevention (CDC), medical associations or unions of health professionals have not released worldwide data yet[19, 20]. Therefore, we conducted a large-scale survey among nurses in Wuhan to demonstrate their physical, emotional and cognitive responses to the pandemic, and explore the factors contributing to the above responses.

1 MATERIALS AND METHODS

1.1 Study Design

This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline. This was a cross-sectional, multi-center survey conducted in Wuhan, Hubei Province, the area that was most severely affected in this pandemic. The survey was conducted via convenience sampling from Mar. 9 to Mar. 25, 2020, the tail end of the pandemic, when all the healthcare institutions were still on high alert. Ten affiliated hospitals of Huazhong University of Science and Technology (HUST, China), which were all listed as designated hospitals by local government to treat COVID-19, were invited to participate in this study.

Ethics approval was obtained from the HUST Research Ethics Board before the initiation of this study. Verbal informed consent was provided by all survey participants prior to their enrollment. Participation was voluntary, and anonymity and confidentiality of information was assured.

1.2 Participants

The target sample size of participants was determined using the formula $N = Z_\alpha^2 P (1-P)/d^2$, in which $\alpha = 0.05$ and $Z_\alpha = 1.96$, and the estimated acceptable margin of error for proportion d was 0.1. The proportion of nurses with physical and emotional distress was estimated at 73.0% and 45.1% respectively, based on the previous studies of the SARS outbreak[13, 14]. Considering the potential bias caused by convenience sampling, we doubled the sample size with a goal of at least 1186 completed questionnaires from participants. Nursing staff were eligible for inclusion if they worked in the following institutions during the pandemic: designated hospitals, mobile cabins, or shelters/communities. We excluded those staff who did not participate in fighting against the pandemic based on preset items, including the job duties and workplaces.

1.3 Data Collection

A self-administered questionnaire was distributed online via WeChat between Mar. 9 and 25, 2020. To avoid duplicated questionnaires, each electronic device was permitted to access the interface for once. Data extraction and verification were performed by two investigators (Wang Q and Fan JY) independently with a customized data collection form.

1.4 Measurement

The self-report questionnaire consisted of a sociodemographic section to identify participants by age, gender, length of work experience, professional title, job position, job duties, workplaces, overtime work and work schedules. The questionnaire developed for this study contained 25 items in total, which were grouped into three domains: (1) nurses' physical discomforts; (2) emotional distress at work; (3) cognitive reactions in fighting against the pandemic. Participants were allowed to select at least one item, and the responses in these domains were dichotomized into positive and negative responses. For responses with one or more specific symptoms, we concerned

them as positive responses, and for responses that replied "none", we concerned them as negative responses. These domains were chosen based on the available literature on stress during the pandemic and the opinion of experts working on the frontline.

To ensure the face validity of the questionnaire, the questionnaire was pretested in a pilot group with similar characteristics to the final sample. The assessment was answered pertinently, which revealed no difficulties in understanding the content of the statements, demonstrating that the subjects had a comprehension and understanding of the propositions. To assess the construct validity of the questionnaire, we applied an exploratory factor analysis of principal components with orthogonal varimax rotation. The result showed that the Kaiser-Meyer-Olkin value was 0.80 (χ^2=34 959, df=300, P<0.01), indicating that the adequacy of the model was high. The Cronbach alpha was calculated as a measure of internal consistency for the questionnaire; the total instrument was found to have high internal consistency, with an alpha coefficient of 0.83. And based on the items clustered in different categories, the Cronbach alpha was 0.75 for the physical discomforts subscale, 0.77 for the emotional distress subscale and 0.62 for the cognitive reactions subscale, indicating a good internal consistency for each subscale.

1.5 Statistical Analysis

Data analysis was performed using Stata statistical software version 14.0 (StataCorp), and the threshold for statistical significance was set at 2-sided P<0.05. Owing to forced choice responding, no missing case was found for the main study variables of interest. Descriptive statistics were presented for all variables, including sociodemographic variables and variables related to physical/psychological symptoms. We performed a log-binomial regression to model associations with the binary outcome of physical/psychological distress and potential indicators (sociodemographic measures being the variables of interest), as each of the variables of physical/psychological distress was not a rare outcome and therefore the odds ratio from logistic regression model would overestimate the RR to a meaningful degree[21]. The association between dependent and independent indicators was presented as RR and 95% CI after controlling for confounders, including age, gender, workplace, job duties, overtime work, and work schedules. We chose a categorical variable rather than a continuous variable of sociodemographic measures because of the nonlinear relationship between the dependent and independent indicators, and the greater ease of interpretation of relative rates.

2 RESULTS

2.1 Sociodemographic Characteristics

Totally, 5521 valid questionnaires returned for further analysis, accounting for 60.6% of the eligible participants (9110). The majority of the nurses were females [5166 (93.6%)], under 35 years of age [4158 (75.3%)], and worked less than 10 years in the clinic [3396 (61.5%)], indicating that the participants were mainly young women. Most nurses were directly engaged in the care for patients [4540 (82.2%)] during the pandemic. In terms of workload, 506 (9.2%) nurses reported that they worked overtime during the pandemic, and 761 (13.8%) stated that the work schedules were irregular in their workplaces (table 1).

2.2 Physical/Psychological/Cognitive Responses of Respondents

A considerable proportion of nurses had symptoms of physical discomforts [3677 (66.6%)], mainly involving muscle tension [1863 (33.7%)], headaches

Table 1 Sociodemographic characteristics of respondents

Variables	n (%)
Demographic characteristics	
Age, years	
<25	676 (12.2)
25–34	3482 (63.1)
35–44	1119 (20.3)
≥45	244 (4.4)
Gender	
Male	355 (6.4)
Female	5166 (93.6)
Length of work experience (years)	
<5	1516 (27.5)
5–9	1880 (34.0)
10–14	1085 (19.7)
≥15	1040 (18.8)
Professional title	
Junior	4370 (79.1)
Intermediate	1058 (19.2)
Senior	93 (1.7)
Job position	
Nurse	5233 (94.8)
Managerial position	288 (5.2)
Work-related characteristics	
Job duties during pandemic	
Care for mild or moderate patients	2236 (40.5)
Care for severe patients	1318 (23.9)
Care for critical patients	986 (17.8)
Medical supplies allocation or other duties	981 (17.8)
Workplace during the pandemic	
Designated hospitals	5205 (94.3)
Mobile cabin hospitals	225 (4.1)
Communities or shelters	91 (1.6)
Overtime work	
No	5015 (90.8)
Yes	506 (9.2)
Irregular work schedules	
No	4760 (86.2)
Yes	761 (13.8)
Cooperation with medical staff from outside Hubei	
No	1226/3444 (35.6)
Yes	814/2077 (39.2)

[1724 (31.2%)], and dizziness [1412 (25.6%)]. When it came to emotional experiences during the pandemic, most nurses [4721 (85.5%)] claimed that they were plagued by at least one negative emotion, with anxiety being the most common [4324 (78.3%)]. Interestingly, in terms of cognitive reactions, nurses who reported increased self-worth at work [2040 (36.9%)] were more than twice as likely to report decreased self-worth [965 (17.5%)] (table 2).

2.3 Determinants of Physical Symptoms

To explore the potential determinants of physical symptoms, we used a stepwise selection procedure with a preset significant level of $P<0.10$ to select the model, and six variables remained in the final model. The regression analysis showed that, after controlling for confounders, nurses who were in older age group (i.e., 35–44 year-old age group: RR, 2.30; 95% CI, 1.87–2.82; $P<0.001$), directly involved in the care of patients (i.e., care for severe patients: RR, 2.35; 95% CI, 1.95–2.84; $P<0.001$), working overtime (RR, 1.34; 95% CI, 1.08–1.65; $P=0.007$), with irregular work schedules (RR, 2.36; 95% CI, 1.95–2.87; $P<0.001$) were at a higher risk for physical discomforts. Nurses worked outside the designated hospitals during the pandemic were at a lower risk for physical discomforts (RR, 0.71; 95% CI, 0.53–0.93; $P=0.01$) (table 3).

2.4 Determinants of Emotional Distress

Regression analysis showed nurses who were females (RR, 1.34, 95% CI, 1.00–1.79; $P=0.046$), in

Table 2 Physical/psychological/cognitive responses of respondents

Variables	n (%)
Physical discomforts	
Muscle tension	1863 (33.7)
Headache	1724 (31.2)
Dizziness	1412 (25.6)
Difficulty in breathing	1139 (20.6)
Stomachache	1104 (20.0)
Diarrhea	827 (15.0)
Nausea and vomiting	686 (12.4)
Cough	534 (9.7)
Fever	171 (3.1)
None	1844 (33.4)
Emotional distress	
Anxious	4324 (78.3)
Fear	2573 (46.6)
Grievance	1841 (33.3)
Disappointment	1539 (27.9)
Depression	1442 (26.1)
Anger	1093 (19.8)
None	800 (14.5)
Cognitive reactions	
Increased sense of self-value	2040 (36.9)
Slow thinking process	1195 (21.6)
Impaired concentration	1147 (20.8)
Decreased sense of self-value	965 (17.5)
Hesitate to make decision	562 (10.2)
Withdrawal	358 (6.7)
Cognitive distortions	214 (3.9)
None	1792 (32.5)

Table 3 Determinants of physical discomforts identified by regression analysis

Variables	No. of positive responses/ No. of total responses (%)	Adjusted RR (95% CI)[a]	P value[b] Category	P value[b] Overall
Physical discomforts				
Gender				
Male	217/355 (61.1)	1 [Reference]	NA	0.06
Female	3460/5166 (67.0)	1.25 (0.99–1.58)	0.06	
Age (years)				
<25	352/676 (52.1)	1 [Reference]	NA	
25–34	2364/3482 (67.9)	1.80 (1.51–2.13)	<0.001	<0.001
35–44	799/1119 (71.4)	2.30 (1.87–2.82)	<0.001	
≥45	162/244 (66.4)	2.41 (1.74–3.33)	<0.001	
Workplace				
Designated hospital	3520/5205 (67.6)	1 [Reference]	NA	
Mobile cabins	126/225 (56.0)	0.71 (0.53–0.93)	0.01	<0.001
Communities/Shelter	31/91 (34.1)	0.29 (0.19–0.46)	<0.001	
Job duties				
Medical supplies allocation	543/981 (55.4)	1 [Reference]	NA	
Care for mild/moderate patients	1430/2236 (64.0)	1.56 (1.33–1.84)	<0.001	<0.001
Care for severe patients	973/1318 (73.8)	2.35 (1.95–2.84)	<0.001	
Care for critical patients	731/986 (74.1)	2.32 (1.90–2.84)	<0.001	
Overtime work				
No	3319/5015 (66.2)	1 [Reference]	NA	0.007
Yes	358/506 (70.8)	1.34 (1.08–1.65)	0.007	
Irregular work schedules				
No	3057/4760 (64.2)	1 [Reference]	NA	<0.001
Yes	620/761 (81.5)	2.36 (1.95–2.87)	<0.001	

[a]Adjusted for gender, age, workplace, job duties, overtime work, and work schedules, when appropriate; [b]Category refers to the P value for each category vs. the reference, while overall refers to the results of the regression analysis. NA: not available

older age group (i.e., 35–44 year-old age group: RR, 1.56; 95% CI, 1.20–2.04; *P*=0.001), directly involved in the care of patients (i.e., care for severe patients: RR, 1.78, 95% CI, 1.40–2.29; *P*<0.001), working overtime (RR, 1.51; 95% CI, 1.12–2.04; *P*=0.01), with irregular work schedules (RR, 3.39; 95% CI, 2.43–4.73; *P*<0.001) were at a higher risk for emotional distress. Nurses who worked outside designated hospitals (i.e., mobile cabins: RR, 0.56; 95% CI, 0.41–0.78; *P*=0.001) were at a lower risk for emotional distress (table 4).

2.5 Determinants of Increased and Decreased Self-value

To further explore whether physical discomforts and emotional distress would affect the self-value of nurses during the pandemic, the measures of physical discomforts and emotional distress, along with sociodemographic characteristics were submitted to the stepwise regression model. The regression analysis showed nurses who were directly involved in the care of patients (i.e., care for severe patients: RR, 1.52; 95% CI, 1.27–1.81; *P*<0.001), and collaborated with medical staff from outside Hubei (RR, 1.13; 95% CI, 1.02–1.28; *P*=0.03) were more likely to feel an increased self-value at work. Nurses who were females (RR, 0.76; 95% CI, 0.61–0.95; *P*=0.02), with irregular work schedules (RR, 0.79; 95% CI, 0.67–0.93; *P*=0.004) were less likely to feel an increased self-value (table 5). And nurses who were in older

age group (i.e., 35–44 year-old age group: RR, 1.90; 95% CI, 1.44–2.51; *P*<0.001), working overtime (RR, 1.30; 95% CI, 1.03–1.64; *P*=0.03), with irregular work schedules (RR, 2.57; 95% CI, 2.16–3.06; *P*<0.001), exposure to physical discomforts (RR, 1.74; 95% CI, 1.45–2.07; *P*<0.001) and emotional distress (RR, 8.86; 95% CI, 5.43–14.48; *P*<0.001) were more likely to feel a decreased self-value at work. Nurses who were females (RR, 0.58; 95% CI, 0.44–0.76; *P*<0.001), and collaborated with medical staff from outside Hubei (RR, 0.78; 95% CI, 0.68–0.92; *P*=0.002) were less likely to feel a decreased self-value (table 6).

3 DISCUSSION

This cross-sectional study enrolled 5211 nurses and specifically demonstrated the physical, psychological and cognitive experience of nurses working during the COVID-19 pandemic. Previous studies had identified occupation as an independent risk factor for emotional distress during pandemic, with the prevalence of emotional distress being highest among nursing staff, ranging from 45.1% to 89.0%[12–14], and the reporting rate of SARS-related symptoms was significantly higher among nurses who were directly exposed to SARS suspected or SARS patients[14]. In this study, we reached similar conclusions: the prevalence of emotional distress and physical discomforts among

Table 4 Determinants of emotional distress identified by regression analysis

Variables	No. of positive responses/No. of total responses (%)	Adjusted RR (95% CI)[a]	*P* value[b]	
			Category	Overall
Emotional distress				
Gender				
Male	291/355 (82.0)	1 [Reference]	NA	0.046
Female	4430/5166 (85.8)	1.34 (1.00–1.79)	0.046	
Age (years)				
<25	545/676 (80.6)	1 [Reference]	NA	
25–34	3001/3482 (86.2)	1.38 (1.11–1.72)	0.004	
35–44	976/1119 (87.2)	1.56 (1.20–2.04)	0.001	0.05
≥45	199/244 (81.6)	1.19 (0.80–1.77)	0.38	
Workplace				
Designated hospital	4481/5205 (86.1)	1 [Reference]	NA	
Mobile cabins	171/225 (76.0)	0.56 (0.41–0.78)	0.001	0.001
Communities/Shelter	69/91 (75.8)	0.59 (0.36–0.97)	0.04	
Job duties				
Medical supplies allocation	793/981 (80.8)	1 [Reference]	NA	
Care for mild/moderate patients	1889/2236 (84.5)	1.28 (1.05–1.58)	0.02	
Care for severe patients	1172/1318 (88.9)	1.78 (1.40–2.29)	<0.001	<0.001
Care for critical patients	867/986 (87.9)	1.62 (1.25–2.10)	<0.001	
Overtime work				
No	4271/5015 (85.2)	1 [Reference]	NA	0.01
Yes	450/506 (88.9)	1.51 (1.12–2.04)	0.01	
Irregular work schedules				
No	3999/4760 (84.0)	1 [Reference]	NA	<0.001
Yes	722/761 (94.9)	3.39 (2.43–4.73)	<0.001	

[a]Adjusted for gender, age, workplace, job duties, overtime work, and work schedules, when appropriate; [b]Category refers to the *P* value for each category *vs.* the reference, while overall refers to the results of the regression analysis. NA: not available

Table 5 Determinants of increased self-value identified by regression analysis

Variables	No. of positive responses/ No. of total responses (%)	Adjusted RR (95% CI)[a]	P value[b] Category	Overall
Increased self-value				
Gender				
Male	154/355 (43.4)	1 [Reference]	NA	0.02
Female	1886/5166 (36.5)	0.76 (0.61–0.95)	0.02	
Job duties				
Medical supplies allocation	295/981 (30.1)	1 [Reference]	NA	
Care for mild/moderate patients	813/2236 (36.4)	1.38 (1.18–1.63)	<0.001	<0.001
Care for severe patients	527/1318 (40.0)	1.52 (1.27–1.81)	<0.001	
Care for critical patients	405/986 (41.1)	1.62 (1.34–1.95)	<0.001	
Irregular work schedules				
No	1793/4760 (37.7)	1 [Reference]	NA	0.004
Yes	247/761 (32.5)	0.79 (0.67-0.93)	0.004	
Collaborate with medical staff from outside Hubei				
No	1226/3444 (35.6)	1 [Reference]	NA	0.03
Yes	814/2077 (39.2)	1.13 (1.02–1.28)	0.03	

[a]Adjusted for gender, age, workplace, job duties, overtime work, and work schedules, when appropriate; [b]Category refers to the P value for each category *vs.* the reference, while overall refers to the results of the regression analysis. NA: not available

Table 6 Determinants of decreased self-value identified by regression analysis

Variables	No. of positive responses/ No. of total responses (%)	Adjusted RR (95% CI)[a]	P value[b] Category	Overall
Decreased self-value				
Gender				
Male	86/355 (24.2)	1 [Reference]	NA	<0.001
Female	879/5166 (17.0)	0.58 (0.44–0.76)	<0.001	
Age (years)				
<25	78/676 (11.5)	1 [Reference]	NA	
25–34	629/3482 (18.1)	1.69 (1.31–2.17)	<0.001	<0.001
35–44	222/1119 (19.8)	1.90 (1.44–2.51)	<0.001	
≥45	36/244 (14.8)	1.33 (0.87–2.03)	0.19	
Job duties				
Medical supplies allocation	179/981 (18.2)	1 [Reference]	NA	
Care for mild/moderate patients	265/2236 (11.9)	0.75 (0.61–0.93)	0.008	0.10
Care for severe patients	316/1318 (24.0)	0.69 (0.54–0.87)	0.002	
Care for critical patients	205/986 (20.8)	0.91 (0.71–1.15)	0.43	
Overtime work				
No	852/5015 (17.0)	1 [Reference]	NA	0.03
Yes	113/506 (22.3)	1.30 (1.03–1.64)	0.03	
Irregular work schedules				
No	720/4760 (15.1)	1 [Reference]	NA	<0.001
Yes	245/761 (32.2)	2.57 (2.16–3.06)	<0.001	
Collaborate with medical staff from outside Hubei				
No	652/3444 (18.9)	1 [Reference]	NA	0.002
Yes	313/2077 (15.1)	0.78 (0.68–0.92)	0.002	
Physical discomforts				
No	189/1844 (10.2)	1 [Reference]	NA	<0.001
Yes	776/3677 (21.1)	1.74 (1.45–2.07)	<0.001	
Emotional distress				
No	17/800 (2.1)	1 [Reference]	NA	<0.001
Yes	948/4721 (20.1)	8.86 (5.43–14.48)	<0.001	

[a]Adjusted for gender, age, workplace, job duties, overtime work, and work schedules, when appropriate; [b]Category refers to the P value for each category *vs.* the reference, while overall refers to the results of the regression analysis. NA: not available

nurses was 85.5% and 66.6% respectively during the COVID-19 pandemic, and the reporting rate of above symptoms was higher among nurses who were engaged in the care of patients and worked in designated hospitals. These may be explained by the fact that exposing to a highly contagious circumstance

was inherently challenging[8], let alone providing high-quality nursing care for infected or suspected patients consecutively.

Interestingly, we noticed that although nurses who are involved in the care of patient were more likely to feel the physical and emotional distress, they were also more likely to feel an increased self-value at work. This finding is similar to previous studies conducted during the SARS epidemic and H1NI outbreak, the frontline staff depicted their working experience as a journey from self-doubt to self-strengthening, where they could advance professional skills, increase self-confidence, foster personal growth, and discover the meaning of life, all of which benefit to the value related to professional nursing[16, 22, 23]. Therefore, it seems like that the close exposure to patients may have a complicated influence on HCPs, involving positive and negative aspects at the same time.

In terms of the negative effects of work-related experience during the pandemic, our study revealed that working overtime and irregular work schedules could significantly contribute to the presence of physical discomforts, emotional distress and a decreased self-value at work. Actually, a study conducted among Philippine nurses and midwives in normal circumstances had suggested that working mandatory overtime was associated with work-related injury, work-related illness and missing more than 2 days of work because of a work-related injury or illness[24]. Another survey also showed that nurses' overtime work and irregular work schedules would be negatively associated with their job satisfaction[25]. Due to the multifaceted impacts of work-related stress on nurses, it is crucially important to formulate reasonable work schedules and improve human resource systems to maintain the physical/mental health of nurses during the pandemic. Fortunately, at the early stage of pandemic, Chinese government quickly responded to the issue of HCPs shortage, and promptly dispatched 344 medical teams from 30 provinces to Hubei Province, thereby alleviating the heavy workload of local HCPs.

Besides, our study found that nurses who collaborated with HCPs from outside Hubei Province seemed to be more likely to feel an increased self-value at work. Two recent studies also put forward similar perspectives, demonstrating that the peer-support-model could play an important role in alleviating mental stress of frontline staff during the pandemic, especially before the formal mental support was available[5, 26]. Therefore, the significance of the medical assistance team may include, but not limited to, reduce the physical pressure of local employees.

Meanwhile, our study also elucidated the association between nurses' health and their occupational attitudes during the pandemic. As proposed by Perry and colleagues, the poor general health of nurses and midwives could hinder their career intention in the next 12 months[27]. Our study revealed that exposure to physical/emotional distress was both independent risk factors for a decreased self-value of nurses at work, after controlling for sociodemographic variables. Based on the impacts of nurses' health on their occupational attitudes, it is urgent for nursing managers and policy makers to formulate strategies to mitigate health risks for this workforce in this ongoing worldwide crisis.

Some limitations are inherent in this study. First, this survey was conducted via convenience sampling, and we only included nurses of ten designated hospitals in Wuhan, indicating that generalization of the results to other populations might be limited. To address the potential bias caused by convenience sampling, we amplified the sample size by 100% and control the confounders related to sociodemographic characteristics in statistical analysis. Second, this cross-sectional study may be unable to distinguish the new symptoms from preexisting physical/emotional distress, so cohort studies focusing on the physical/emotional distress of this population are needed. Last but not least, although the self-administered questionnaire in this study was developed based on available literature on stress during the pandemic and the opinion of experts working on the frontline, it may still not be able to comprehensively reflect the impact of work-related stress on nurses during the pandemic. Therefore, developing instruments with good reliability and validity in the context of pandemic will be necessary to assess the complicated impacts of pandemic on HCPs.

Conflict of Interest Statement

All authors declare no competing interest exists.

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