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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Original Article

Prevalence of and risk factors associated with sleep disturbances among HPCD exposed to COVID-19 in China

Guoli Yang [a, 1], Chunlin Li [b, 1], Xiao Zhu [c], Jin Yan [d], Jia Liu [c, e, *]

[a] Department of Pulmonary and Critical Care Medicine, The Third Xiangya Hospital of Central South University, Changsha, China
[b] Tongji Medical College of Huazhong University of Science & Technology, Wuhan, 430030, China
[c] Transplantation Center, The Third Xiangya Hospital of Central South University, Changsha, China
[d] The Nursing Department, The Third Xiangya Hospital of Central South University, Changsha, 410013, China
[e] The Nursing School of Central South University, Changsha, 410000, China

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ABSTRACT

Objective: To assess sleep disturbances and associated factors among front-line healthcare providers who have been called upon for, dispatched (HPCD) and exposed to COVID-19 in China.
Methods: This cross-sectional, survey-based, isolation area-stratified study collected demographic data, sleep status and emotional measurements from 1036 HPCD in nine medical institutions from March 5 to 9, 2020 in Wuhan, China, which was the epicenter of the epidemic. HPCD who worked in isolation areas with COVID-19 were eligible for inclusion. The severity of symptoms of sleep disorders, insomnia and emotional self-efficacy were assessed by the Chinese versions of the 10-item Self-rating sleeping situation scale, the seven-item Insomnia Severity Index and the 12-item Regulatory emotional self-efficacy questionnaire, respectively. Univariate analysis was performed to identify factors associated with sleep disturbances. A structural equation model (SEM) was constructed via AMOS to explore the relationship among the four components.
Results: A total of 1036 out of 1075 contacted individuals completed the survey, with a participation rate of 96.4%. A total of 925 (89.3%) were aged 20–39 years, and 755 (72.9%) were women. Among all participants, 874 (84.4%) were nurses, and 162 (15.6%) were physicians; 538 (51.9%) worked in intensive care isolation units; 843 (81.4%) worked in isolation areas for 4 h straight, and 395 (38.1%) perceived COVID-19 peer exposure. A considerable proportion of participants reported symptoms of sleep disorders (543, 52.4%). Exposure status and length of work were the main factors affecting sleep status, which had indirect effects on sleep status by mediating regulatory emotional self-efficacy.
Conclusions: In this survey of HPCD for patients with COVID-19 in China, participants reported experiencing sleep disturbance burdens, especially those having exposure experience and working long shifts. Regulatory emotional self-efficacy (RESE) is an important resource for alleviating sleep disturbances and improving sleep quality. These findings emphasize the importance of being prepared to support HPCD through psychological interventions.

1. Introduction

The outbreak of an unusual and contagious novel pneumonia caused by a novel coronavirus (SARS-CoV-2) incited considerable panic in the world because of its rapidity of transmission and high mortality rate [1]. In the early days of the pandemic, the most strongly affected area was Wuhan, China, which has experienced an unprecedented challenge to its health-care system. To address the epidemic effectively, more than 42,000 healthcare providers from all over the country were called upon and dispatched (HPCD) by the Chinese government to the metropolitan area of Wuhan city over a two-month period, the origin and center of the epidemic, where the medical system was overwhelmed [2]. This first large-scale mobilization of the greatest amount of medical resources in human history has been the focus of media coverage for months.

It has already been confirmed that COVID-19 has appeared to spread primarily by close person-to-person, family cluster and nosocomial transmission [3]. Frontline healthcare workers are at

* Corresponding author. Transplantation Center, The Third Xiangya Hospital of Central South University, Changsha, 410013, China.
E-mail address: chucklejl@163.com (J. Liu).
[1] Guoli Yang and Chunlin Li contributed equally and share the first authorship.

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risk because of the lack of forewarning that they might be in close contact with someone with COVID-19. Essential medical providers might be in direct contact with patient sputum, blood, and even stool, which are all reported as modes of transmission, and long working hours in isolation areas full of liquid droplets containing virus from patients' mouths, noses and mechanical ventilation expiratory ports [4]. HPCD have been at exceptionally high risk of stress because of exposure to traumatic events, such as death and dying, in an unfamiliar working environment while having to make highly challenging decisions, and thus they are particularly at risk of stress responses. Among the 84,404 confirmed cases in China, at this writing, there have been more than 3000 Chinese healthcare workers infected [5].

Recent studies have mentioned that the direct and indirect psychological and social effects of the COVID-19 pandemic are pervasive and could affect mental health now and in the future [6,7]. A recent position paper in the Lancet called for high-quality data about the mental health effects of the pandemic, especially for health care professionals [7]. A timely rapid systematic review and meta-analysis of 13 cross-sectional studies and a total of 33,062 participants provided early evidence that a high proportion of healthcare professionals experienced significant levels of anxiety, depression and insomnia during the COVID-19 pandemic [8]. However, a specific sleep evaluation in HPCD is still lacking, which is necessary for understanding how the state of their sleep during the pandemic can be supported to optimize coping strategies to improve symptoms of sleep disorders and to facilitate the implementation of preventive interventions in the future.

Therefore, the aim of this study was first to investigate and to analyze the actual sleep situation among HPCD exposed to COVID-19 in China. In addition, we explored the factors influencing HPCD-reported immediate sleep disturbance outcomes.

2. Methods

2.1. Design and procedures

The study was a cross-sectional survey. From March 5, to March 9, 2020, we distributed questionnaires to HPCD exposed to COVID-19 in Wuhan, China. By this time, the average dispatched and isolation area working time of HPCD were all over three weeks. To clarify the magnitude of sleep disturbances and associated factors among HPCD in China, samples were stratified by the isolation area (ie, Fangcang shelter hospitals, general isolation wards and intensive care isolation units). In total, nine medical institutions, including two Fangcang shelter hospitals and seven general hospitals staffed by HPCD from all over China, were involved.

Ethics approval was obtained from the Human Subjects Institutional Review Board at the Third Xiangya Hospital of Central South University in February 2020 (No: 2020-S333). Online informed consent was provided by all survey participants prior to their enrollment. Participants were allowed to terminate the survey at any time they desired. The survey was anonymous, and confidentiality of information was assured.

2.2. Participants

All HPCD who were working in isolation departments of the nine medical institutions in Wuhan were invited to participate in this study. The target sample size of participants was determined using the formula $N=U^2_{\alpha/2}\pi(1-\pi)/\delta^2$, where $\alpha = 0.05$ and $\delta = 0.07$. The proportion of HPCD with sleep disturbances was estimated to be over 40%, based on previous studies, including the China Sleep Quality Index 2016 and one early study in the COVID-2019 outbreak in China. To allow for subgroup analyses, we increased the sample size by 20% with a goal of at least 800 completed questionnaires from participants.

2.3. Outcomes and covariates

We focused on the magnitude of symptoms of sleep disturbances, insomnia and emotional self-efficacy for all participants using Chinese versions of validated measurement tools. Data were collected through an anonymous, self-rated questionnaire distributed to all HPCD over the internet (to which all HPCD had free access). Online consent was obtained before the data collection. Only one response to the questionnaire per person was permitted. The internet questionnaire consisted of four parts: basic demographic data with COVID-19 exposure experience, the self-rating sleeping situation scaling, the insomnia severity index, and regulatory emotional self-efficacy.

(1) Basic demographic data with COVID-19 exposure experience

Information about exposure to COVID-19 and working experience was collected, including evaluation of the nature and place of isolation area work and contact with and care of COVID-19 patients. In addition, items regarding the perception of risk and adverse experiences were reported.

(2) Self-rating sleeping situation scaling

The 10-item self-rating sleeping situation scaling (SRSS) was developed by Li Jian-ming in China [9]. In the SRSS, each item is estimated as 1 to 5 grades and as 10 to 50 scores representing the increasing severity of sleeping problems. According to Li's criteria, the cutoff score for detecting symptoms of a sleep disorder is 23, followed by 23–29 for a mild sleeping disorder, 30–39 for a moderate sleeping disorder, and 40–50 for a severe sleeping disorder. The SRSS has demonstrated extensive reliability and validity, and the Cronbach's alpha value and the correlation coefficient were 0.6418 and 0.5625, respectively. The SRSS is used frequently in sleep research and has also been used to assess sleep disturbances in emergency medical staff in China.

(3) Insomnia severity index

The seven-item Insomnia Severity Index (ISI) is a self-reported questionnaire assessing the nature, severity, and impact of insomnia. The usual recall period is the "last two weeks", and the specific items evaluate the severity of difficulties with sleep onset, sleep maintenance, and early morning awakening; sleep dissatisfaction; interference of sleep problems with daytime functioning; noticeability of sleep difficulties by others; and distress caused by sleep difficulties. A five-point Likert scale is used to rate each item (eg, 0 = no problem; 4 = very severe problem), yielding a total score ranging from 0 to 28. The total score is interpreted as follows: absence of insomnia (0–7); subthreshold insomnia (8–14); moderate insomnia (15–21); and severe insomnia (22–28). Previous studies have reported adequate psychometric properties for Chinese versions [10].

(4) Regulatory emotional self-efficacy

The 12-item Regulatory Emotional Self-efficacy Scale (RESE) was used to assess individuals' perceived ability (ie, self-efficacy) in emotion regulation [11]. This scale assessed self-efficacy in three aspects of emotion regulation: expressing positive emotions (POS;

four items; eg, “express joy when good things happen to you”), managing despondency-distress (DES; four items; eg, “keep from getting discouraged by strong criticism”), and managing anger-irritation (ANG; four items; eg, “avoid flying off the handle when you get angry”). Responses were made on a 5-point scale, ranging from 1 = not well at all to 5 = very well. The higher the score was, the stronger the self-efficacy of emotional regulation. The RESE has been reported to have great reliability and validity for Chinese versions [12]. The Cronbach's alpha values of the three subscales were 0.85, 0.79, and 0.77, respectively.

2.4. Statistical analysis

Data analysis was performed using SPSS statistical software version 20.0 (IBM Corp). Descriptive analysis was used to describe the general data. For count data, frequencies and percentages were used. T-tests and ANOVA were conducted to compare the differences between variables. A structural equation model (SEM) was constructed via AMOS to explore the relationship among the four components, namely, exposure, working days, SRSS and RESE. In SEM, several criteria, such as root mean square error of approximation (RMSEA) values < 0.08 and comparative fit index (CFI) and Tucker–Lewis index (TLI) values > 0.90, indicate acceptable models. P values < 0.05 indicated that a difference was significant.

3. Results

3.1. Demographic characteristics

Of over 2000 HPCD eligible for the study from nine medical institutions, only 1075 completed the questionnaire. Thirty-nine responses (3.6%) were excluded owing to incomplete answers. The successful respondents comprised 755 (72.9%) women and 281 (27.1%) men, with a mean age of 32.46 (s d. = 5.36) years (range 23–51 years). Of the participants, 682 (65.8%) had an undergraduate educational level, 551 (53.2%) had an intermediate technical title, 123 (11.9%) had a fertility plan in one year and 715 (69%) had children. The respondents were nurses (n = 874; 84.4%) and physicians (n = 162; 15.6%). The different types of isolation areas were Fangcang shelter hospitals (13.6%), general isolation wards (34.5%) and intensive isolation units (51.9%). A total of 844 (81.4%) participants had been dispatched to the epidemic center over 31 d; 4 h/d continuous working in isolation areas affected the majority (81.4%). Nearly all participants (97.3%) had no exposure history

Table 1
Demographic and exposure to COVID-19 responder characteristics.

Characteristic	No.(%)					
	Total	Isolation areas			Occupation	
		Fangcang shelter hospitals	General Isolation ward	Intensive isolation unit	Physician	Nurse
Overall	1036 (100)	141 (13.6)	357 (34.5)	538 (51.9)	162 (15.6)	874 (84.4)
Gender						
Men	281 (27.1)	41 (29.1)	160 (44.8)	80 (14.9)	143 (88.3)	138 (15.8)
Women	755 (72.9)	100 (70.9)	197 (55.2)	458 (85.1)	19 (11.7)	736 (84.2)
Age group						
20-29	339 (32.7)	52 (36.9)	107 (30.0)	180 (33.5)	91 (56.2)	248 (28.4)
30-39	586 (56.6)	88 (62.4)	203 (56.9)	295 (54.8)	32 (19.8)	554 (63.4)
40-49	109 (10.5)	1 (0.7)	46 (12.9)	62 (11.5)	37 (22.8)	72 (8.2)
>50	2 (0.2)	0	1 (0.3)	1 (0.2)	2 (1.2)	0
Education level						
junior college	11 (1.1)	0	8 (2.2)	3 (0.6)	2 (1.2)	9 (1.0)
undergraduate	682 (65.8)	97 (68.8)	222 (62.2)	363 (67.5)	89 (54.9)	593 (67.8)
graduate	265 (25.6)	43 (30.5)	90 (25.2)	132 (24.5)	16 (9.9)	249 (28.5)
doctoral	18 (7.5)	1 (0.7)	37 (10.4)	40 (7.4)	55 (34.0)	23 (2.6)
Technical title						
Junior	387 (37.4)	62 (44.0)	96 (26.9)	229 (42.6)	110 (67.9)	277 (31.7)
Intermediate	551 (53.2)	77 (54.6)	215 (60.2)	259 (48.1)	14 (8.6)	537 (61.4)
Senior	98 (9.4)	2 (1.4)	46 (12.9)	50 (9.3)	38 (23.5)	60 (6.9)
Executive position						
Director	28 (2.7)	1 (0.7)	9 (2.5)	18 (3.3)	17 (10.5)	11 (1.3)
Head nurse	44 (4.3)	5 (3.5)	25 (7.0)	14 (2.6)	11 (6.8)	33 (3.8)
None	964 (93.1)	135 (95.7)	323 (90.5)	506 (94.1)	134 (82.7)	830 (95.0)
Marital status						
Unmarried	292 (28.2)	40 (28.4)	69 (19.3)	183 (34.0)	39 (24.1)	253 (28.9)
Married	684 (66.0)	101 (71.6)	267 (74.8)	316 (58.7)	123 (75.9)	561 (64.2)
Divorced	60 (5.8)	0	21 (5.9)	39 (7.2)	0	60 (6.9)
Children						
Yes	715 (69.0)	89 (63.1)	294 (82.4)	332 (61.7)	114 (70.4)	601 (68.8)
No	321 (31.0)	52 (36.9)	63 (17.6)	206 (38.3)	48 (29.6)	273 (31.2)
Fertility plan, in 1 year						
Yes	123 (11.9)	11 (7.8)	47 (13.2)	65 (12.1)	17 (10.5)	106 (12.1)
No	913 (88.1)	130 (92.9)	310 (86.8)	473 (87.9)	145 (89.5)	768 (87.9)
Days working in the epidemic center, day						
≤30	192 (18.5)	21 (14.9)	92 (25.8)	79 (14.7)	58 (35.8)	134 (15.3)
31-40	823 (79.4)	118 (83.7)	256 (71.7)	449 (83.5)	101 (62.3)	722 (82.6)
≥41	21 (2.0)	2 (1.4)	9 (2.5)	10 (1.9)	3 (1.9)	18 (2.1)
Frequency of working in an isolation area, time/week						
≦5	900 (86.9)	119 (84.4)	337 (94.4)	444 (82.5)	140 (86.4)	760 (87.0)
>5	136 (13.1)	22 (15.6)	20 (5.6)	94 (17.5)	22 (13.6)	114 (13.0)

Table 1 (*continued*)

Characteristic	No.(%)					
	Total	Isolation areas			Occupation	
		Fangcang shelter hospitals	General Isolation ward	Intensive isolation unit	Physician	Nurse
Continuous working hours in an isolation area hours/day						
4 h	843 (81.4)	130 (92.2)	324 (90.8)	389 (72.3)	140 (86.4)	703 (80.4)
5 h	50 (4.8)	0	10 (2.8)	40 (7.4)	0	50 (5.7)
6 h	143 (13.8)	11 (7.8)	23 (6.4)	109 (20.3)	22 (13.6)	121 (13.8)
Exposed oneself						
Yes	28 (2.7)	0	4 (1.1)	24 (4.5)	0	28 (3.2)
No	1008 (97.3)	141 (100)	353 (98.9)	514 (95.5)	162 (100)	846 (96.8)
Exposure route of oneself						
No	1008 (97.3)	141 (100)	353 (98.9)	514 (95.5)	163 (100)	846 (96.8)
Blood fluids	3 (0.3)	0	1 (0.3)	2 (0.4)	0	3 (0.3)
Air-borne droplets	7 (0.7)	0	0	7 (1.3)	0	7 (0.8)
Suspected exposure	12 (1.2)	0	3 (0.8)	9 (1.7)	0	12 (1.4)
Others	6 (0.6)	0	0	6 (1.1)	0	6 (0.7)
Perceived peer exposed						
Yes	395 (38.1)	9 (6.4)	47 (13.2)	339 (63.0)	27 (16.7)	368 (42.1)
No	641 (61.9)	132 (93.6)	310 (86.8)	199 (37.0)	135 (83.3)	506 (57.9)
Exposure route of others						
No	641 (61.9)	92 (65.2)	251 (70.3)	298 (55.4)	103 (63.6)	538 (61.6)
Blood fluids	9 (0.9)	7 (5.0)	1 (0.3)	1 (0.2)	0	9 (1.0)
Air-borne droplets	108 (10.4)	20 (14.2)	28 (7.8)	60 (11.2)	8 (4.9)	100 (11.4)
Suspected exposure	111 (10.7)	12 (8.5)	19 (5.3)	80 (14.9)	18 (11.1)	93 (10.6)
Others	167 (16.1)	10 (7.1)	58 (16.2)	99 (18.4)	33 (20.4)	134 (15.3)
Perceived peer diagnosis						
Yes	206 (19.9)	9 (6.4)	17 (4.8)	180 (33.5)	14 (8.6)	192 (22.0)
No	830 (80.1)	132 (93.6)	340 (95.2)	358 (66.5)	148 (91.4)	682 (78.0)

themselves, but the rate of perceived peer exposure was as high as 395 (38.1%) (Table 1).

3.2. Severity of sleep disturbances

In Table 2, 543 (52.4%) participants reported sleep disturbances. A total of 191 (18.4%), 316 (30.5%) and 36 (3.5%) participants had mid, moderate and severe sleeping disorders, respectively. A considerable proportion (76.3%) of participants had symptoms of insomnia. The most commonly reported sleeping problems were lack of sleep (83.9%), followed by waking up and the inability to go to sleep (67.6%), waking up early (32.1%) and difficulty falling asleep (29.6%). See Table 3. Many participants had at least one sleeping problem (Fig. 1).

3.3. Demographic and exposure to CVOID-19 characteristics and SRSS

There were significant differences in SRSS by gender and education level. Female HPCD had higher SRSS scores than males. HPCD participants with higher education levels had higher levels of sleep disorders. There were significant differences in the SRSS scores among occupation and isolation areas. HPCD participants who work in the ICU have suffered more sleep disorders. Compared with doctors, nurses reported more sleep problems. Participants with longer working times in Wuhan or daily working hours had higher SRSS scores. Participants who were unmarried, had exposure experience and perceived peer exposure and diagnosis also had higher SRSS scores. The results are presented in Table 4.

Table 2
Self-rating sleep problems in HPCD.

	n	%
no	493	47.6
mild sleeping disorder	191	18.4
moderate sleeping disorder	316	30.5
severe sleeping disorder	36	3.5

Table 3
Common sleeping disturbance in HPCD.

	n	%
Lack of sleep	869	83.9
Waking up and cannot go to sleep	700	67.6
Waking up early	333	32.1
Difficulty falling asleep	307	29.6

3.4. Relation between SRSS and RESE

The SRSS score was significantly negatively related to the RESE score and its three dimensions (Table 5).

3.5. Role of demographics, exposure and RESE in influencing SRSS

A structural equation model (SEM) was constructed via AMOS to explore the relationship among the four components, namely, exposure, working days, SRSS and RESE. First, exposure is a risk factor for sleeping disorders, including exposure history, perceived peer exposure and peer diagnosis. Second, is the participant's degree of emotional self-efficacy. Third, a sleeping disorder defined by the scores. The fourth area was working conditions, including working days in Wuhan, working hours per day in an isolation area, frequency of time spent in a medical area, time/week. There was collinearity between perceived peer exposure and peer diagnosis. We deleted the variable of perceived peer exposure in the analysis. The chi-square test of model fit yielded a value of 29.5, with 10 degrees of freedom, P value = 0.001 RMSEA = 0.043, CFI = 0.983, and TLI = 0.964, indicating a good fit. The results showed that the exposure status and length of work affected sleep status, and they had indirect effects on sleep status by mediating regulatory emotional self-efficacy (Fig. 2).

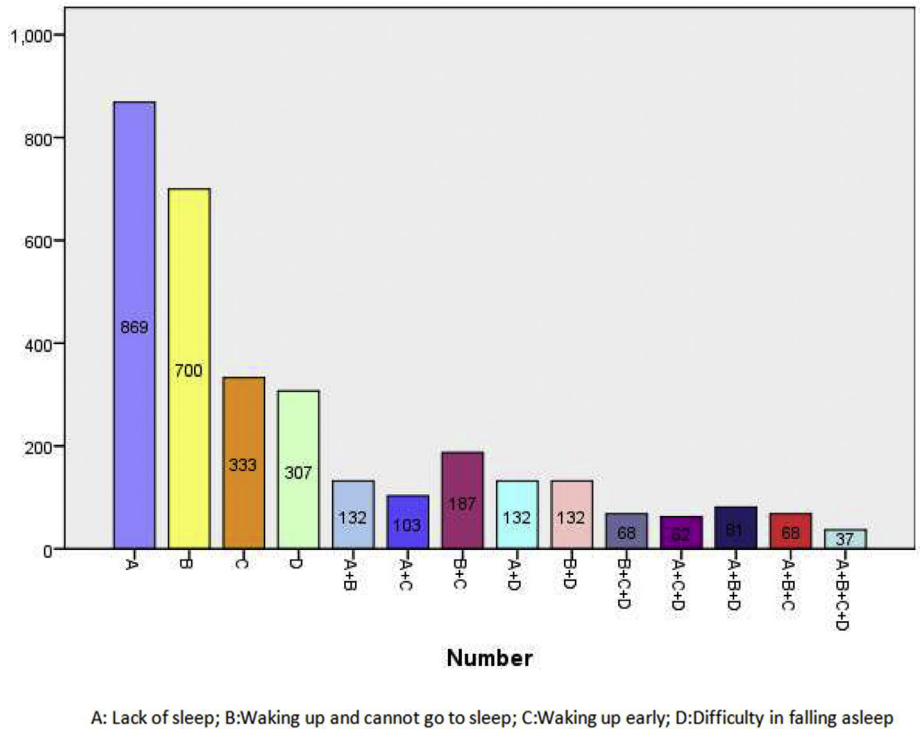

Fig. 1. Frequencies of HPCD with sleep disorders.

4. Discussion

The COVID-19 epidemic is affecting health, economics and society globally. Sleep problems appeared during the COVID-19 outbreak. There have been many reports around the world about the impact of COVID-19 on the public's sleep, including the impact on children's sleep at home [13].

Healthcare providers largely contribute to controlling this devastating disease, and they are at higher risk of infection. As estimated, 10–20% of COVID-19 patients are medical staff in some nations [14]. Healthcare providers suffer more sleep disorders than the general population [15,16]. In a previous study, the pooled prevalence of sleep disturbances for Chinese healthcare professionals was 39.2% [17]. The prevalence of poor sleep quality in healthcare workers fighting COVID-19 ranged from 18.2% to 61.0% [15,16,18,19]. In our study, nearly 60% of HPCD reported sleep disorders. Changes in the work environment, high-intensity work, and direct contact with COVID-19 patients could all increase the risk of sleep disturbances.

Exposure and length of work were the main factors affecting sleep quality. A recent study showed that the prevalence of COVID-19 antibodies in healthcare personnel in the New York City area was 13.7%, and high levels of HCP-reported suspicion of virus exposure were most strongly associated with seropositivity [20]. In our study, 28 people reported exposure history, and 206 peers had been diagnosed with COVID-19. Fear of infection may directly lead to sleep disorders. The risk of infection increased with longer working time. Therefore, a longer time in Wuhan may lead to more sleep problems. Other variables, such as gender (female), occupation (nurse), working place (intensive isolation unit), and marital status (unmarried), were related to sleep disorders. These predictors were mostly consistent with previous research. For example, in the Qi study, compared to male front-line medical workers (FMW), female FMW had significantly higher prevalence of sleep disturbances (80.6% vs 69.6%) according to PSQI (Pittsburgh sleep quality index) > 6 points [21]. HPCD working in the intensive isolation unit had a significantly higher prevalence of sleep disturbances than in general isolation wards and Fangcang shelter hospitals. The explanation was clear: work-related stress, risk of infection and work intensity were higher in the intensive isolation unit. Fifty percent of HPCD working in intensive isolation units, which can also explain the high prevalence of sleep disorders in our study.

Mental health problems in general population occurred during the COVID-19 outbreak. The overall prevalence of anxiety and depressive symptoms was 35.1% and 20.1%, respectively [15]. Health care providers experienced more mental disorders. Depressive symptoms are reported in 27.5–50.7% and severe anxiety symptoms in 45% [22]. These negative emotions can increase the sleep latency of individuals to a certain extent, which makes it difficult to fall asleep, even to wake up during the night, to wake up early and to have more dreams. As a result, sleep efficiency was reduced, and sleep symptoms such as sleep structure symptoms occurred [16]. Healthcare providers dispatched by the government had more responsibility dealing with the COVID-19 epidemic. HPCD were in daily contact with critically ill patients, working for long hours, resting in designated hotels, and with an uncertain time for returning back home, which led to lack of communication with family and friends and social support. HPCD faced more stress and more easily had mental health issues. Individual perceptions and evaluation of emotional regulating ability may play a key role in efforts to self-regulate emotions among HPCD. RESE refers to the assessment of self-efficacy in managing negative emotions, such as the perceived capability to ameliorate negative emotions in response to stressful or adverse events and to avoid being submerged by emotions [23]. According to our novel findings, exposure history had an indirect effect on sleep status by mediating regulatory emotional self-efficacy. Exposure history and peer diagnosis could have psychological impacts, such as infection-related worries, anxiety and depression. Individuals with low RESE tend to perceive themselves as incapable of managing their

Table 4
SRSS differences in demographic and exposure to CVOID-19 characteristics.

Characteristic		$\bar{x}\pm s$	t/F	p
Gender			−11.797	<0.001
Men	281	20.23 ± 6.05		
Women	755	26.95 ± 8.80		
Age group			0.828	0.437
20-29	339	25.01 ± 9.10		
30-39	586	25.01 ± 8.21		
>40	111	26.13 ± 9.26		
Education level			2.907	0.034
junior college	11	17.81 ± 5.09		
Undergraduate	682	25.11 ± 8.599		
Graduate	265	25.23 ± 8.84		
Doctoral	18	26.02 ± 8.86		
Technical title			2.560	0.078
Junior	387	25.91 ± 9.19		
Intermediate	551	24.63 ± 8.13		
Senior	98	24.86 ± 9.40		
Occupation			84.140	<0.001
Physician	162	19.60 ± 6.58		
Nurse	864	26.15 ± 8.60		
Working place			255.87	<0.001
Fangcang shelter hospitals	141	18.68 ± 4.42		
General Isolation ward	357	20.48 ± 6.44		
Intensive isolation unit	538	29.90 ± 8.03		
Marital status			9.662	<0.001
Unmarried	292	26.98 ± 8.94		
Married	684	24.32 ± 8.58		
Divorced	60	25.83 ± 7.04		
Children			6.608	0.100
Yes	715	24.66 ± 8.83		
No	321	26.16 ± 8.25		
Fertility plan, in 1 year			2.895	0.089
Yes	123	26.38 ± 8.64		
No	913	24,96 ± 8.67		
Days Working in the epidemic center, day			7.254	0.001
≤30	192	23.69 ± 7.23		
31-40	823	25.32 ± 8.92		
≥41	21	30.71 ± 8.37		
Frequency of working in an isolation area, time/week			0.059	0.808
≦ 5	900	25.10 ± 8.84		
>5	136	25.30 ± 7.55		
Continuous working hours in an isolation area, hours/day			81.70	<0.001
4 h	843	23.59 ± 8.45		
5 h	50	31.96 ± 5.46		
6 h	143	31.79 ± 6.35		
Exposed oneself			91.81	<0.001
Yes	28	40.00 ± 3.42		
No	1008	24.72 ± 8.41		
Perceived peer exposed			1573.31	<0.001
Yes	395	33.71 ± 4.84		
No	641	19.84 ± 5.84		
Perceived peer diagnosis			290.664	<0.001
Yes	206	33.29 ± 7.21		
No	830	23.10 ± 7.78		

Table 5
Relationship between RESE and SRSS.

	SRSS
expressing positive emotions	−0.309**
managing despondency-distress	−0.418**
managing anger-irritation	−0.555**
Total score of RESE	−0.519**

emotions effectively, which means they would not be able to manage their emotions effectively and would more easily immerse themselves in negative emotions [24]. Previous studies have shown that negative emotions play a critical role in developing worse sleep quality. We did not measure mental health status, but the model can also explain why emotional self-efficacy plays a role in mediating sleep quality.

Many reports have already been published dealing with sleep problems (predominantly insomnia) in COVID-19 workers and the public [17,18,21,22]. Before this research, we assumed that HPCD could have more sleep problems than other COVID-19 health workers because of exposure to unfamiliar working environments, unfamiliar work partners and a higher risk of infection. The findings in our study were consistent with previously reported results about COVID-19 workers. This outcome might mean that HPCD are similar to other COVID-19 healthcare workers in psychological and sleep situations. On the upside, this model of dispatching health workers to respond to public health emergencies in China is feasible. Health workers know where they are placed can make a great difference. Large-scale dispatch could not increase the risk of sleep disorders or even mental disorders. It can provide guidance both in domestic aid and

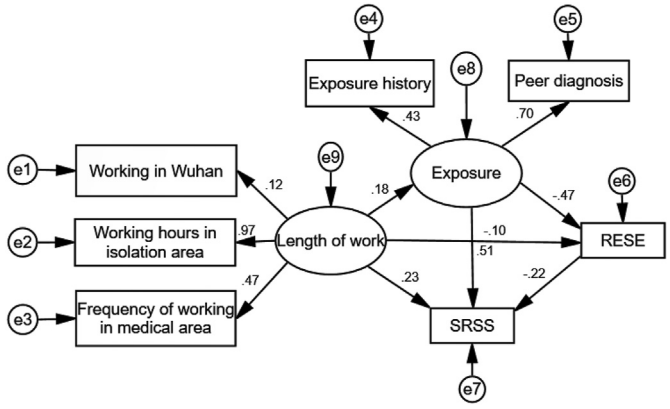

Fig. 2. SEM of the role of demographics, exposure and RESE in influencing SRSS.

international medical aid. It is worth considering that psychological experts should be team members to provide care for either patients or health workers.

There were some limitations in this study. First, this is a cross-sectional study, and we did not follow up to analyze changes in sleep over time. Second, all HPCD volunteered to participate in the survey, which may be subject to selection bias. Finally, our questionnaires did not contain sufficient items to explore all the potential risk factors for sleep disturbances.

5. Conclusions

In summary, this study was the first to examine sleep quality for HPCD. This group has a higher prevalence of sleep disturbances. The longer the length of work and exposure history to COVID-19 patients is, the greater the risk that HPCD will suffer from sleep disorders is. RESE was a mediator for reducing sleep disorders, suggesting that proper psychiatric intervention is needed.

CRediT authorship contribution statement

Guoli Yang: Investigation, Data curation, Writing - original draft. **Chunlin Li:** Software, Investigation, Resources. **Xiao Zhu:** Writing - review & editing, Visualization. **Jin Yan:** Software, Methodology. **Jia Liu:** Conceptualization, Supervision, Methodology.

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Conflict of interest

None declared.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: https://doi.org/10.1016/j.sleep.2020.12.034.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sleep.2020.12.034.

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