

Sleep disturbances among medical workers during the outbreak of COVID-2019

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Background	The outbreak of Corona Virus Disease-2019 (COVID-19) has posed unprecedented pressure and threats to healthcare workers in Wuhan and the entire country.
Aims	To assess the effect of the COVID-19 outbreak on the sleep quality of healthcare workers in a children's healthcare centre in Wuhan.
Methods	A cross-sectional, anonymized, self-reported questionnaire survey was conducted at the Children's Healthcare Centre of Renmin Hospital, Wuhan University, Wuhan, China. The questionnaire consisted of three parts, including socio-demographic characteristics and COVID-19 epidemic-related factors, the Pittsburgh sleep quality index (PSQI), and Zung's self-rating anxiety scale (SAS) and self-rating depression scale (SDS).
Results	In total, 47 out of 123 (38%) participants with PSQI scores > 7 were identified as having sleep disturbance. A logistic regression analysis showed that sleep disturbance was independently associated with being an only child (adjusted odds ratio (OR) and 95% confidence interval (CI) 3.40 (1.21–9.57), $P < 0.05$), exposure to COVID-19 patients (adjusted OR and 95% CI 2.97 (1.08–8.18), $P < 0.05$) and depression (adjusted OR and 95% CI 2.83 (1.10–7.27), $P < 0.05$).
Conclusions	We observed that, during the outbreak of COVID-19, sleep disturbance was highly prevalent among paediatric healthcare workers, and sleep disturbance was independently associated with being an only child, exposure to COVID-19 patients and depression. Therefore, more mental health services are required for front-line paediatric healthcare workers in Wuhan.
Key words	COVID-19; paediatric healthcare workers; sleep disturbance.

Introduction

In December 2019, an outbreak of novel coronavirus pneumonia originated in Wuhan, China, and subsequently spread rapidly all over China and to many other countries and regions [1], this outbreak has placed extraordinary demands upon healthcare systems worldwide [2]. On 11 February, the World Health Organization officially named the disease Corona Virus Disease-2019 (COVID-19). As of 11 February 2020, a total of 44 672 confirmed cases of COVID-19 were reported, including 1716 among healthcare workers, resulting in 1023 deaths, including at least five among healthcare workers [3].

COVID-19 is characterized by its efficient transmission, high risk of infection among healthcare workers and even fatal risk for healthcare workers [4]. The lack of protective materials for front-line healthcare workers further increases the risk of infection. In addition, with the rapid increase in the number of patients, healthcare workers are facing high work intensity, and most of them were not able to be reunited with their families for the Spring Festival, the most important traditional festival in China. There is no doubt that, in order to combat COVID-19, healthcare workers have been substantially burdened. Some healthcare staff may face sleep disturbance, or anxiety and depression, especially

Key learning points

What is already known about this subject:

- Healthcare workers in China have been substantially burdened by Corona Virus Disease-2019.
- Previous studies have found that sleep disturbance is common among healthcare workers in China.
- During the Severe Acute Respiratory Syndrome outbreak in 2003, studies found that healthcare staff had psychological stress, including post-traumatic stress disorder, anxiety and depression.

What this study adds:

- We found that 38% of paediatric healthcare workers were suffering from sleep disturbance, in addition, 7% and 25% of paediatric healthcare workers had anxiety and depression.
- Sleep disturbance in paediatric healthcare workers in Wuhan was independently associated with depression, being an only child and contact with Corona Virus Disease-2019 patients.

What impact this may have on practice or policy:

- More mental health services are required for paediatric healthcare workers in Wuhan, and a larger sample survey of front-line healthcare workers is urgently needed.

those who work in emergency, respiratory and critical care departments.

According to the early epidemiological data, cases of COVID-19 among children are rare [4,5]. However, with the progress of the epidemic, it has been confirmed that the entire population is generally susceptible, and the number of paediatric patients is gradually increasing [3,6]. Paediatric healthcare workers also experience great work pressure. Despite a large epidemiological literature on communicable diseases, there is little information available regarding the psychological impact on healthcare workers during the outbreak of COVID-19. This study attempted to measure the psychological impact of COVID-19 on the healthcare workers at a children's healthcare centre at a large teaching hospital in Wuhan; in particular, this study evaluated sleep quality.

Methods

A cross-sectional, anonymized, self-reported questionnaire survey was conducted at the Children's Healthcare Centre of Renmin Hospital of Wuhan University, Wuhan, China, from 30 January to 7 February 2020. At present, the centre has 246 healthcare staff, >200 open beds and receives ~200 000 paediatric patients annually. It is one of the largest children's healthcare centres in Wuhan. The questionnaire was completed by participants on their own smartphone and consisted of three parts, including socio-demographic characteristics and COVID-19 epidemic-related factors, the Pittsburgh sleep quality index (PSQI) for evaluating sleep quality, and Zung's self-rating anxiety scale (SAS) and self-rating depression scale (SDS) for evaluating psychological stress, which took ~10 min to complete. Before the survey, the researchers explained the purpose of the study to each participant. In 1 week, 129 people completed the survey (51% of all workers). However, six questionnaires that did not provide normative key information were eliminated. In total, 123 subjects were included. The

study protocol was approved by the Ethics Committee of Renmin Hospital of Wuhan University.

Socio-demographic data were gathered on sex, age, education level, marital status, birthplace, only child status and job title. In addition, we collected some epidemic-related factors, including their current location, contact with COVID-19 patients, quarantine status, current physical condition, relatives suffering from COVID-19 and family reunion during the Spring Festival (yes/no).

In our study, the PSQI was employed to evaluate sleep quality [7]. The PSQI is used to evaluate sleep quality in the previous month. It consists of 19 self-evaluation items and produces seven scores: sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, the use of sleeping medications and daytime dysfunction. The score ranges from 0 to 3 for each dimension, and the summed score of the seven dimensions is the global score (range: 0–21) for subjective sleep quality; the higher the score, the poorer the subjective sleep quality. Chinese researchers found that a PSQI score > 7 cut-off point, with a high sensitivity of 98% and specificity of 90% ($\kappa = 0.89$, $P < 0.01$), is suitable for Chinese people [8]. In this study, a PSQI score > 7 was also used to determine sleep disturbance.

In terms of psychological distress, SAS [9] (Cronbach's α coefficient 0.897, $P < 0.001$) and SDS [10] (Cronbach's α coefficient 0.920, $P < 0.001$) were used to evaluate anxiety and depression. The SAS and SDS were compiled by William W. K. Zung. The two scales have become one of the most common and convenient psychological measurement tools. The SAS is a self-rating scale with 20 questions. Questions 1–5 are used to evaluate the emotional symptoms of anxiety, while questions 6–20 are used to evaluate the physical symptoms of anxiety. The score for each question ranges from 1 to 4, and the total score of each item is raw scores, which is then multiplied by 1.25 to obtain the standard score; a standard score ≥ 50 indicates 'psychological anxiety'. The SDS is

a self-rating scale with 20 questions, including the four dimensions of mental-emotional, physical, psychomotor disorder and psychological disorder. The score for each question ranges from 1 to 4, and the total score of each item is the raw score, which is then multiplied by 1.25 to obtain the standard score. The cut-off standard score for depression is 50, and the higher the score, the more likely one is to be depressed.

Statistical analysis was performed using the Statistical Package for Social Science (SPSS Inc., version 20.0, IBM). Independent *t*-tests for continuous variables or chi-square tests for categorical variables were used to examine the differences between healthcare workers with and without sleep disturbance. Odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated to examine the association of sleep disturbance with socio-demographic characteristics, COVID-19

epidemic-related factors and psychological stress factors using multivariate logistic regression analysis with a full entry model. Initially, univariate analyses were calculated with sleep disturbance as the dependent variable and each of the potential explanatory variables as independent variables; $P < 0.05$ was considered statistically significant.

Results

A total of 123 healthcare workers were included in the study, including 22 (10%) male and 111 (90%) female healthcare workers, with an average age of 33.75 ± 8.41 years. Table 1 compares the differences in the socio-demographic characteristics and COVID-19 epidemic-related factors between the research subjects with and without sleep disturbance. The results suggest that sleep

Table 1. Demographics and the COVID-19 epidemic-related factors of the participants

Factors	PSQI > 7 (<i>n</i> = 47)	PSQI ≤ 7 (<i>n</i> = 76)	χ ² -value
Socio-demographic characteristics			
Female, <i>n</i> (%)	41 (87)	70 (92)	0.783
Age, <i>n</i> (%)			1.055
20–35	33 (70)	55 (72)	
36–50	12 (26)	15 (20)	
>50	2 (4)	6 (8)	
Education level, <i>n</i> (%)			4.864
Junior college or below	1 (2)	5 (7)	
Bachelor	21 (44)	45 (59)	
Master or above	25 (53)	26 (34)	
Job title			6.460*
Doctor	29 (62)	19 (25)	
Nurse	18 (38)	57 (75)	
Only child, <i>n</i> (%)	17 (36)	9 (12)	10.311**
Marital status, <i>n</i> (%)			2.442
Married	18 (38)	19 (25)	
Unmarried	29 (62)	57 (75)	
Birth place, <i>n</i> (%)			1.929
Rural	27 (57)	53 (70)	
Urban	20 (43)	23 (30)	
Epidemic-related factors			
Contact with COVID-19 cases, <i>n</i> (%)	38 (81)	39 (51)	10.821***
Quarantine, <i>n</i> (%)	3 (6)	5 (7)	0.002
Current physical condition, <i>n</i> (%)			3.516
Health	39 (83)	66 (87)	
Suspected or confirmed COVID-19	5 (11)	2 (26)	
Healthcare observation	4 (8)	8 (13)	
Family reunion during the Spring Festival, <i>n</i> (%)	16 (34)	27 (36)	0.028
Relatives suffer from COVID-19, <i>n</i> (%)	3 (6)	2 (3)	1.048
Current location			2.461
Wuhan	35 (75)	64 (84)	
Except Wuhan, Hubei Province	5 (11)	7 (9)	
Outside the province	7 (15)	5 (7)	

Values are *n* (%). Percentages may not add up to 100 due to rounding.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

disturbance was statistically related to job title, being an only child and contact with COVID-19 patients ($P < 0.05$) but not to sex, age, education level, marital status, quarantine status, current health status, family reunion during the Spring Festival or having relatives who suffer from COVID-19.

The average PSQI score of all research subjects was 7.22 ± 2.62 ; 47 (38%) participants had scores >7 and were identified as sleep disturbance. The total score of the PSQI and its component scores of sleep quality, sleep latency, sleep duration, sleep efficiency and sleep disturbance in the research subjects with sleep disturbance were significantly higher than those among the subjects without sleep disturbance ($P < 0.05$), but there was no significant difference in the component scores of sleep disturbance or the use of sleeping medication ($P > 0.05$). In terms of psychological stress, the average SAS score of all research subjects was 34.44 ± 7.21 , and nine subjects (7%) had SAS scores ≥ 50 , while the average SDS score was 45.67 ± 8.67 , and 31 subjects (25%) had SDS scores ≥ 50 . These results suggest that sleep disturbance was associated with anxiety and depression ($P < 0.05$) (Table 2).

The factors related to sleep quality, including job title, being an only child, contact with COVID-19 patients, anxiety and depression, shown in Tables 1 and 2, were included in the logistic regression analysis. The results showed that being an only child (adjusted OR and 95% CI 3.40 (1.21–9.57), $P < 0.05$), contact with COVID-19 patients (adjusted OR and 95% CI 2.97 (1.08–8.18), $P < 0.05$) and depression (adjusted OR and 95% CI 2.83 (1.10–7.27), $P < 0.05$) were independently associated with sleep disturbance in healthcare workers (Table 3).

Discussion

We observed that during the outbreak of COVID-19, 38% of paediatric healthcare workers were suffering from

sleep disturbance, in addition, 7% and 25% of paediatric healthcare workers had anxiety and depression. In addition, we found that the sleep disturbance in healthcare workers was independently associated with depression, being an only child and contact with COVID-19 patients.

To the best of our knowledge, this is the first study concerning the sleep quality of paediatric healthcare workers in Wuhan, which is at the centre of the COVID-19 epidemic. Our results showed that 38% of the paediatric healthcare workers participating in this study suffered from sleep disturbance, which was significantly higher than in the general population or in other professional occupations, consistent with the previous research [11–14]. A study in Tehran found that 43% of healthcare workers had sleep disturbance [13]. A large sample ($n = 5012$) study found that, in China, the proportion of healthcare workers with sleep disturbance was as high as 64% [12]. The results of the above two studies are significantly higher than those of this study. We speculate that the reason for the difference may be that PSQI > 7 was selected as the cut-off point in our study. In addition, our study found that some healthcare workers had obvious anxiety and depression, which is also consistent with previous studies. During the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003, studies in Beijing [15], Taiwan [16], Hong Kong [17], Singapore [18] and Canada [19] found that healthcare staff had obvious psychological stress, including post-traumatic stress disorder, anxiety, depression, etc. In 2014, during the Ebola epidemic in Africa, researchers found that Chinese healthcare workers who assisted the healthcare workers in Africa also faced psychological pressure [20]. In fact, the psychological pressure on healthcare staff caused by public health emergencies is substantial, so the results are not unexpected.

The results of the logistic regression analysis demonstrated that being an only child, contact with the COVID-19 patients and depression were independently

Table 2. Sleep quality and the psychological distress of the participants

Variables	Total n ($n = 123$)	PSQI > 7 ($n = 47$)	PSQI ≤ 7 ($n = 76$)	t/χ^2 -value
Global PSQI score (mean \pm SD)	7.22 ± 2.62	9.87 ± 1.98	5.58 ± 1.26	13.274***
Sleep quality	1.04 ± 0.66	1.47 ± 0.65	0.78 ± 0.51	6.192***
Sleep latency	1.37 ± 0.85	1.85 ± 0.98	1.08 ± 0.61	4.868***
sleep duration	1.03 ± 0.79	1.47 ± 0.83	0.76 ± 0.63	5.000***
Sleep efficiency	0.59 ± 0.77	0.96 ± 0.86	0.37 ± 0.61	4.449***
Sleep disturbance	0.88 ± 0.57	1.09 ± 0.58	0.75 ± 0.52	3.315**
Use of sleeping medication	0.03 ± 0.18	0.06 ± 0.247	0.01 ± 0.12	1.321
Daytime dysfunction	1.16 ± 1.07	1.34 ± 1.19	1.05 ± 0.98	1.397
SAS (mean \pm SD)	34.44 ± 7.21	38.83 ± 9.02	34.97 ± 5.37	2.65**
SDS (mean \pm SD)	45.67 ± 8.67	49.93 ± 10.57	43.03 ± 5.94	4.09***
Anxiety (SAS standard score ≥ 50), n (%)		8 (17.0)	1 (1.3)	10.563**
Depression (SDS standard score ≥ 50), n (%)		21 (44.7)	10 (13.2)	15.308***

Mean \pm SD, mean and standard deviation.

** $P < 0.01$; *** $P < 0.001$.

Table 3. Logistic regression analysis of multiple factors influencing sleep disturbance

Variables	B	SE	OR	95% CI for OR	
				Lower	Upper
Job title (0 = doctor, 1 = nurse)	0.805	0.433	2.24	0.96	5.23
Only child status (0 = no, 1 = yes)	1.223	0.528	3.40*	1.21	9.57
Contact with COVID-19 cases (0 = no, 1 = yes)	1.086	0.518	2.97*	1.08	8.18
Anxiety (0 = no, 1 = yes)	1.266	1.167	3.55	0.36	34.97
Depression (0 = no, 1 = yes)	1.038	0.482	2.83*	1.10	7.27

SE, standard error. Model is logistic regression with enter model. Variables include job title, only child, contact with COVID-19 cases, anxiety and depression. The independent variable is sleep disturbance (no, PSQI \leq 7; yes, PSQI $>$ 7). Model is logistic regression with enter model.

* $P < 0.05$.

associated with sleep disturbance. Although there was more anxiety reported among the healthcare workers with sleep disturbance than among those without sleep disturbance, the logistic regression analysis results showed that anxiety was not significantly associated with sleep disturbance in healthcare workers. However, although the difference was not statistically significant, doctors were more likely to have sleep disturbance than nurses. In China, due to the one-child policy, only children are a group with special characteristics [21]. At present, the research shows that only children have more psychological problems than non-only children. Only children are more stubborn, more self-centred, lonelier, more dependent on the family and parents, less able to adapt to the social environment, and more likely to be pessimistic and have badly behaved [16, 22, 23]. Not surprisingly, the only child group has suffered greater psychological distress and is more likely to develop sleep disturbance. COVID-19 is highly infectious; it is mainly transmitted by respiratory droplets and close person-to-person contact and may be transmitted in the form of aerosols in a specific environment. At present, thousands of healthcare workers have been infected and some have died [3]. Therefore, healthcare workers who are in contact with COVID-19 patients have greater psychological distress, including depression, anxiety, sleep disturbance, etc.

In addition, in the treatment and care of COVID-19 patients, to avoid infection, healthcare workers need to adhere to very strict protective measures. To reduce the consumption of protective materials, they often cannot eat, drink or defecate while they are in their protective clothing, with high temperatures and negative pressure during long working hours, and the workers are physically and mentally tired, which will undoubtedly increase the risk of psychological distress in these healthcare workers. Depression is prone to persistent sleep disorders, which are manifested as insomnia, difficulty falling asleep, early waking, sleep rhythm disorder and other forms. Sleep time and quality are difficult to guarantee [22]. A study in Taiwan found that depression, but not anxiety, was associated with sleep disturbance in local health workers, which is consistent with the results of this study [16].

These findings provide valuable information for policymakers and mental health professionals worldwide regarding the psychological impact of an infectious disease outbreak. According to a study of healthcare workers in Beijing who participated in the SARS epidemic in 2003 [15], this effect still exists for a long time after the end of the epidemic. Therefore, it is necessary to provide mental health services to these healthcare workers who are on the front line providing anti-epidemic therapy.

There are some limitations to this study. Firstly, with a cross-sectional study design and self-reported measures, our findings cannot be used to draw conclusions regarding causal relationships. The research subjects in this study were limited to a children's healthcare centre at one hospital, which may not reflect the sleep quality of all healthcare workers in Wuhan, so further evidence through multicentre and large sample size research is required. In addition, the use of the SAS and SDS to measure anxiety and depression symptoms cannot diagnose depression and anxiety disorders.

In conclusion, we observed that, during the outbreak of COVID-19, sleep disturbance was highly prevalent among paediatric healthcare workers, and sleep disturbance was independently associated with being an only child, exposure to COVID-19 patients and depression. Therefore, it is necessary to provide more mental health services to front-line paediatric healthcare workers in Wuhan, and a larger sample survey of all front-line healthcare workers is urgently needed.

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Competing interests

The authors declared no conflict and interest related to this article.

References

1. Munster VJ, Koopmans M, van Doremalen N, van Riel D, de Wit E. A novel coronavirus emerging in China—key questions for impact assessment. *N Engl J Med* 2020;**382**:692–694.
2. Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. *Lancet* 2020;**395**:470–473.
3. [An update on the epidemiological characteristics of novel coronavirus pneumonia COVID-19]. *Zhonghua Liu Xing Bing Xue Za Zhi* 2020;**41**:139–144.
4. Wang D, Hu B, Hu C *et al*. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *J Am Med Assoc* 2020.
5. Chen N, Zhou M, Dong X *et al*. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet* 2020;**395**:507–513.
6. Shen KL, Yang YH. Diagnosis and treatment of 2019 novel coronavirus infection in children: a pressing issue. *World J Pediatr* 2020.
7. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res* 1989;**28**:193–213.
8. Liu ZC, Tang MQ, Hu LEI *et al*. Reliability and validity of the Pittsburgh sleep quality index. *Zhonghua Jing Shen Ke Za Zhi* 1996;**29**:103–107.
9. Zung WW. A rating instrument for anxiety disorders. *Psychosomatics* 1971;**12**:371–379.
10. Zung WW. A Self-rating depression scale. *Arch Gen Psychiatry* 1965;**12**:63–70.
11. Ford DE, Kamerow DB. Epidemiologic study of sleep disturbances and psychiatric disorders. An opportunity for prevention? *J Am Med Assoc* 1989;**262**:1479–1484.
12. Dong H, Zhang Q, Sun Z, Sang F, Xu Y. Sleep disturbances among Chinese clinical nurses in general hospitals and its influencing factors. *BMC Psychiatry* 2017;**17**:241.
13. Ghalichi L, Pournik O, Ghaffari M, Vingard E. Sleep quality among health care workers. *Arch Iran Med* 2013;**16**:100–103.
14. Li RH, Wing YK, Ho SC, Fong SY. Gender differences in insomnia—a study in the Hong Kong Chinese population. *J Psychosom Res* 2002;**53**:601–609.
15. Liu X, Kakade M, Fuller CJ *et al*. Depression after exposure to stressful events: lessons learned from the severe acute respiratory syndrome epidemic. *Compr Psychiatry* 2012;**53**:15–23.
16. Chen CS, Wu HY, Yang P, Yen CF. Psychological distress of nurses in Taiwan who worked during the outbreak of SARS. *Psychiatr Serv* 2005;**56**:76–79.
17. Tam CWC, Pang EPF, Lam LCW, Chiu HFK. Severe acute respiratory syndrome (SARS) in Hong Kong in 2003: stress and psychological impact among frontline healthcare workers. *Psychol Med* 2004;**34**:1197–1204.
18. Chan AO, Huak CY. Psychological impact of the 2003 severe acute respiratory syndrome outbreak on health care workers in a medium size regional general hospital in Singapore. *Occup Med (Lond)* 2004;**54**:190–196.
19. Maunder RG, Lancee WJ, Rourke S *et al*. Factors associated with the psychological impact of severe acute respiratory syndrome on nurses and other hospital workers in Toronto. *Psychosom Med* 2004;**66**:938–942.
20. Li L, Wan C, Ding R *et al*. Mental distress among Liberian medical staff working at the China Ebola Treatment Unit: a cross sectional study. *Health Qual Life Outcomes* 2015;**13**:156.
21. King M. China's infamous one-child policy. *Lancet* 2005;**365**:215–216.
22. Riemann D, Krone LB, Wulff K, Nissen C. Sleep, insomnia, and depression. *Neuropsychopharmacology* 2020;**45**:74–89.
23. Wang Q, Leichtman MD, White SH. Childhood memory and self-description in young Chinese adults: the impact of growing up an only child. *Cognition* 1998;**69**:73–103.