



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.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



## Brief Communication

## The evaluation of sleep disturbances for Chinese frontline medical workers under the outbreak of COVID-19



Jing Qi<sup>a, b</sup>, Jing Xu<sup>b</sup>, Bo-Zhi Li<sup>b</sup>, Jin-Sha Huang<sup>c</sup>, Yuan Yang<sup>d</sup>, Zhen-Tao Zhang<sup>e</sup>, Dong-Ai Yao<sup>f</sup>, Qun-Hui Liu<sup>g</sup>, Min Jia<sup>g</sup>, Dao-Kai Gong<sup>h</sup>, Xiao-Hong Ni<sup>i</sup>, Qi-Mei Zhang<sup>j</sup>, Fu-Rong Shang<sup>k</sup>, Nian Xiong<sup>l</sup>, Chun-Li Zhu<sup>l</sup>, Tao Wang<sup>c, \*\*</sup>, Xi Zhang<sup>b, a, \*</sup>

<sup>a</sup> School of Medicine, Nankai University, Tianjin, 300071, China

<sup>b</sup> Department of Neurology, The Secondary Medical Center, Sleep Medicine Research Center, Chinese PLA General Hospital, Beijing, 100853, China

<sup>c</sup> Department of Neurology, Union Hospital, Tongji Medical College, Huazhong University of Science & Technology, Wuhan, Hubei, 430022, China

<sup>d</sup> Department of Neurology, Tongji Hospital, Tongji Medical College, Huazhong University of Science & Technology, Wuhan, Hubei, 430030, China

<sup>e</sup> Department of Neurology, Renmin Hospital of Wuhan University, Wuhan, Hubei, 430060, China

<sup>f</sup> Department of Neurology, Zhongnan Hospital of Wuhan University, Wuhan, Hubei, 430071, China

<sup>g</sup> Department of Neurology, The Central Hospital of Enshi Tujia and Miao Autonomous Prefecture, Enshi, Hubei, 445000, China

<sup>h</sup> Department of Neurology, Jingzhou Central Hospital, Jingzhou, Hubei, 434000, China

<sup>i</sup> Department of Neurology, Huanggang Central Hospital, Huanggang, Hubei, 438000, China

<sup>j</sup> Department of Neurology, People's Hospital of Yichang Central, Yichang, Hubei, 443003, China

<sup>k</sup> Department of Neurology, Xiangyang Central Hospital, Xiangyang, Hubei, 441021, China

<sup>l</sup> Department of Neurology, Red Cross Hospital of Wuhan, Wuhan, Hubei, 430015, China

## ARTICLE INFO

## Article history:

Received 28 April 2020

Received in revised form

11 May 2020

Accepted 13 May 2020

Available online 23 May 2020

## Keywords:

Sleep disturbances

COVID-19

Pressure

Medical workers

## ABSTRACT

**Objective:** To evaluate sleep disturbances of Chinese frontline medical workers (FMW) under the outbreak of coronavirus disease 2019 (COVID-19), and make a comparison with non-FMW.

**Methods:** The medical workers from multiple hospitals in Hubei Province, China, volunteered to participate in this cross-sectional study. An online questionnaire, including Pittsburgh Sleep Quality Index (PSQI), Athens Insomnia Scale (AIS) and Visual Analogue Scale (VAS), was used to evaluate sleep disturbances and mental status. Sleep disturbances were defined as PSQI > 6 points or/and AIS > 6 points. We compared the scores of PSQI, AIS, anxiety and depression VAS, as well as prevalence of sleep disturbances between FMW and non-FMW.

**Results:** A total of 1306 subjects (801 FMW and 505 non-FMW) were enrolled. Compared to non-FMW, FMW had significantly higher scores of PSQI ( $9.3 \pm 3.8$  vs  $7.5 \pm 3.7$ ;  $P < 0.001$ ; Cohen's  $d = 0.47$ ), AIS ( $6.9 \pm 4.3$  vs  $5.3 \pm 3.8$ ;  $P < 0.001$ ; Cohen's  $d = 0.38$ ), anxiety ( $4.9 \pm 2.7$  vs  $4.3 \pm 2.6$ ;  $P < 0.001$ ; Cohen's  $d = 0.22$ ) and depression ( $4.1 \pm 2.5$  vs  $3.6 \pm 2.4$ ;  $P = 0.001$ ; Cohen's  $d = 0.21$ ), as well as higher prevalence of sleep disturbances according to PSQI > 6 points (78.4% vs 61.0%; relative risk [RR] = 1.29;  $P < 0.001$ ) and AIS > 6 points (51.7% vs 35.6%; RR = 1.45;  $P < 0.001$ ).

**Conclusion:** FMW have higher prevalence of sleep disturbances and worse sleep quality than non-FMW. Further interventions should be administrated for FMW, aiming to maintain their healthy condition and guarantee their professional performance in the battle against COVID-19.

© 2020 Elsevier B.V. All rights reserved.

**Abbreviations:** COVID-19, Coronavirus disease 2019; FMW, Frontline medical workers; PSQI, Pittsburgh Sleep Quality Index; AIS, Athens Insomnia Scale; VAS, Visual Analogue Scale.

\* Corresponding author. Department of Neurology, The Secondary Medical Center, Sleep Medicine Research Center, Chinese PLA General Hospital, Beijing, 100853, China.

\*\* Corresponding author. Department of Neurology, Union Hospital, Tongji Medical College, Huazhong University of Science & Technology, Wuhan, Hubei, 430022, China.

E-mail addresses: [wangtaowh@hust.edu.cn](mailto:wangtaowh@hust.edu.cn) (T. Wang), [SMRC301@163.com](mailto:SMRC301@163.com) (X. Zhang).

## 1. Introduction

In December 2019, several pneumonia patients with cryptogenic etiology were reported in Wuhan, Hubei Province, China [1]. A novel coronavirus was identified and subsequently named as coronavirus disease 2019 (COVID-19) by the World Health Organization (WHO) [2,3]. More than 84,000 cases were confirmed with COVID-19 in China [4], conservatively including 3000 doctors and

nurses [5]. Frontline medical workers (FMW) are exposed to high chronic stress due to high risk of infection and long work hours. These constant stressors may negatively impact their sleep and mental health.

Medical workers generally experience high levels of stress, irregular work schedule, and frequent work shifts, which may lead to increased sleep disturbances [6]. In a meta-analysis, Qiu et al. [7], found that 39.2% of Chinese medical workers suffered from sleep disturbances, which indicated the prevalence was much higher than general population. The outbreak of COVID-19 in China remains to be a serious challenge for FMW. They are not only under high risk of being infected with the disease but also high mental stress, which may lead to acute sleep disturbances [8]. Therefore, we conducted a cross-sectional study to evaluate the sleep disturbances, anxiety, and depression of FMW in Hubei Province, and made a comparison with non-FMW. We hypothesized that FMW would report greater sleep disturbances, anxiety, and depression levels than non-FMW.

## 2. Methods

### 2.1. Study samples

This cross-sectional study included medical workers in Hubei Province, China. The Institutional Review Board of Chinese PLA General Hospital approved this study. All subjects provided informed consent. The survey was conducted anonymously. The inclusion criteria for this study were as follows: (a) age older than 18 years old; (b) medical workers in Hubei Province, including local medical workers and supportive medical workers from other Chinese regions, and (c) volunteered to participate in the survey. The exclusion criteria were listed as follows: (a) history of mental disorders; (b) sleep quality was affected by negative personal events; (c) taking sleep modulating medication (sedatives and hypnotics), and (d) incomplete data of the online questionnaire. Subjects were divided into FMW and non-FMW groups according to whether directly exposed to COVID-19 patients. FMW worked in departments specialized for the treatment of COVID-19 patients, while non-FMW worked in general departments.

### 2.2. Data collection

The online survey was conducted in February 2020, with the contents encompassing basic information (age, gender, marriage, education level, etc.), epidemiological investigation, Pittsburgh Sleep Quality Index (PSQI), Athens Insomnia Scale (AIS) and Visual Analogue Scale (VAS). PSQI is a self-reported questionnaire which assesses subjective sleep quality within one month. A subject with a total score >6 points is defined as poor sleep quality. The higher the PSQI, the worse the sleep quality [9]. The AIS is a brief instrument to assess the severity of insomnia. It contains eight items with each item rated from 0 to 3 points [10]. A subject with a total score >6 points screens positive for insomnia. The higher the AIS, the more severe the insomnia [11]. In this study, we used the VAS to measure anxiety and depression. Furthermore, the VAS was presented as a horizontal graphic slider, which was divided into 10 segments from 1 (weakest) to 10 (strongest). Higher scores indicate stronger feeling of each mental status.

### 2.3. Statistical analysis

Categorical variables were described as percentages, and continuous variables were described as mean  $\pm$  SDs. Statistical analyses were performed using SPSS 23.0 for Windows. The scores of PSQI, AIS, and VAS were compared by ANCOVA. The demographic characteristics with significant differences between two groups

were described as covariates and joined in the process of ANCOVA. Comparisons of categorical variables were conducted by Chi-square test. P value < 0.05 was considered statistical significance.

## 3. Results

### 3.1. Subject demographic characteristics

A total of 1396 medical workers answered the questionnaire. There was no subject excluded due to exclusion criteria A, B, and C, while 90 questionnaires were excluded due to incomplete data. Therefore, 1306 subjects (801 FMW and 505 non-FMW) with age of ( $33.1 \pm 8.4$ ) years old were finally enrolled, comprising 256 (19.6%) males and 1050 (80.4%) females. There were 161 (20.1%) males and 640 (79.9%) females in FMW, while there were 95 (18.8%) males and 410 females (81.2%) in non-FMW. There were 534 (66.7%) subjects married in FMW, whereas there were 359 (71.1%) subjects married in non-FMW. Significant differences of age ( $[32.4 \pm 7.7]$  vs  $[34.1 \pm 9.3]$ ;  $P = 0.016$ ), education level ( $P = 0.002$ ), and rank ( $P = 0.001$ ) were found between FMW and non-FMW.

### 3.2. Comparison of scores and prevalence

The scores of PSQI, AIS, and VAS are presented in Table 1. Compared to non-FMW, FMW had significantly higher scores of PSQI ( $9.3 \pm 3.8$  vs  $7.5 \pm 3.7$ ;  $P < 0.001$ ; Cohen's  $d = 0.47$ ), AIS ( $6.9 \pm 4.3$  vs  $5.3 \pm 3.8$ ;  $P < 0.001$ ; Cohen's  $d = 0.38$ ), anxiety ( $4.9 \pm 2.7$  vs  $4.3 \pm 2.6$ ;  $P < 0.001$ ; Cohen's  $d = 0.22$ ), and depression ( $4.1 \pm 2.5$  vs  $3.6 \pm 2.4$ ;  $P = 0.001$ ; Cohen's  $d = 0.21$ ) (Fig. 1).

Overall, 936 (71.7%) subjects had poor sleep quality according to PSQI > 6 points, while 594 (45.5%) subjects had insomnia according to AIS > 6 points. There were 628 (78.4%) FMW and 308 (61.0%) non-FMW with PSQI > 6 points. Meanwhile, AIS > 6 points were observed in 414 (51.7%) FMW and 180 (35.6%) non-FMW. Compared to non-FMW, FMW had significantly higher prevalence of sleep disturbances, according to PSQI > 6 points (78.4% vs 61.0%;  $P < 0.001$ ) and AIS > 6 points (51.7% vs 35.6%;  $P < 0.001$ ). FMW were 29% more likely to endorse poor sleep quality relative to non-FMW (relative risk [RR]: 1.29), and had 45% increased risk of insomnia (RR: 1.45) (Table 1). Additionally, there were 670 (83.6%) FMW and 353 (69.9%) non-FMW with PSQI > 5 points, and 538 (67.2%) FMW and 241 (47.7%) non-FMW with PSQI > 7 points. In subgroup analysis, 516 (80.6%) female FMW and 112 (69.6%) male FMW had PSQI > 6 points. Compared to male FMW, female FMW had significantly higher prevalence of sleep disturbances (80.6% vs 69.6%;  $P = 0.002$ ) according to PSQI > 6 points.

## 4. Discussion

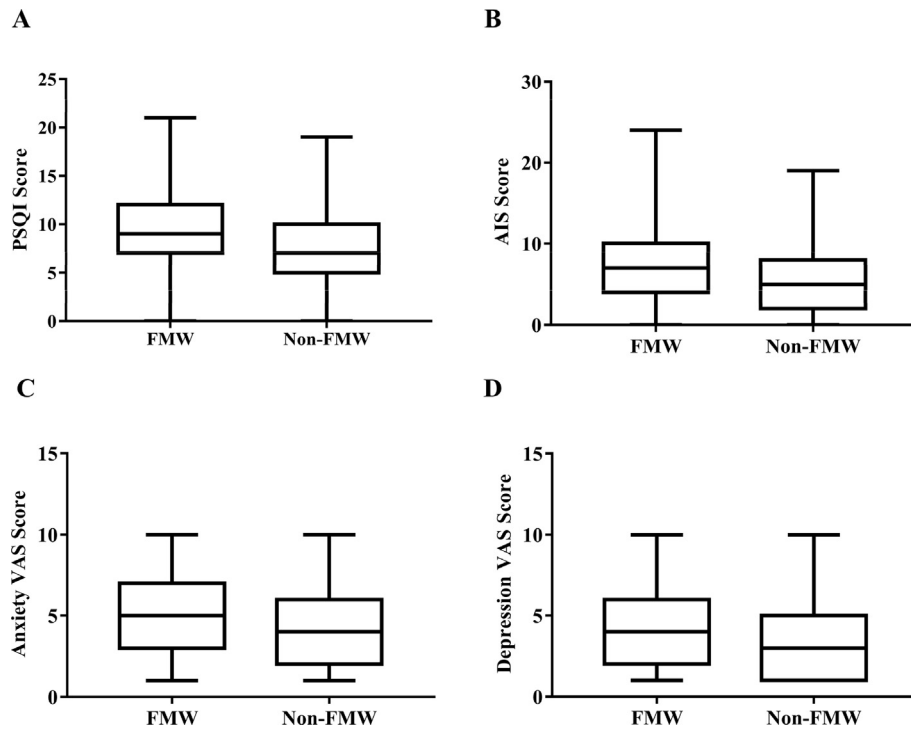
The rapid spread of the disease and inadequate early realization toward COVID-19 challenged the health institutions in many countries. In addition, the mortality of COVID-19 was 2.3%, and medical workers accounted for 3.8% of confirmed cases as reported by the latest epidemiological study [5]. Previous studies have indicated medical workers were vulnerable to sleep disturbances in ordinary times [6,7]. Therefore, we hypothesized that FMW under the outbreak of COVID-19 may be more susceptible to sleep disturbances. To the best of our knowledge, this is the first study to evaluate the sleep disturbances of FMW under the outbreak of COVID-19.

The pooled prevalence of sleep disturbances for Chinese healthcare professionals is 39.2% [7]. In comparison, the present study demonstrated that medical workers under COVID-19 outbreak suffered from elevated sleep disturbances, especially for FMW. Our study showed that 78.4% of FMW had poor sleep quality and 51.7% of them had insomnia. The high prevalence of sleep

**Table 1**  
Comparison of PSQI, AIS, VAS, and sleep disturbances prevalence.

	Overall (n = 1306)	FMW (n = 801)	Non-FMW (n = 505)	Effect size	P value
Scores				Cohen's <i>d</i>	
PSQI	8.6 ± 3.9	9.3 ± 3.8	7.5 ± 3.7	0.47	<0.001
AIS	6.3 ± 4.2	6.9 ± 4.3	5.3 ± 3.8	0.38	<0.001
Anxiety VAS	4.7 ± 2.7	4.9 ± 2.7	4.3 ± 2.6	0.22	<0.001
Depression VAS	3.9 ± 2.4	4.1 ± 2.5	3.6 ± 2.4	0.21	0.001
Prevalence				RR	
PSQI>6	936 (71.7%)	628 (78.4%)	308 (61.0%)	1.29	<0.001
AIS>6	594 (45.5%)	414 (51.7%)	180 (35.6%)	1.45	<0.001

FMW = frontline medical workers, PSQI= Pittsburgh Sleep Quality Index, AIS = Athens Insomnia Scale, VAS= Visual Analogue Scale, RR = relative risk.



**Fig. 1.** The boxplots for PSQI, AIS, Anxiety and Depression VAS scores of FMW and non-FMW (A) The FMW had significantly higher scores of PSQI ( $P < 0.001$ ) than non-FMW. (B) The FMW had significantly higher scores of AIS ( $P < 0.001$ ) than non-FMW. (C) The FMW had significantly higher scores of anxiety VAS ( $P < 0.001$ ) than non-FMW. (D) The FMW had significantly higher scores of depression VAS ( $P = 0.001$ ) than non-FMW. FMW = frontline medical workers, PSQI= Pittsburgh Sleep Quality Index, AIS = Athens Insomnia Scale, VAS= Visual Analogue Scale.

disturbances for FMW should be put much emphasize, since sleep disturbances influence not only medical workers' health but also their professional performance [12]. The study also demonstrated FMW had significantly higher prevalence of sleep disturbances than non-FMW. Change of work environment may underpin the more severe sleep disturbances of FMW. With the direct contact with COVID-19 patients, FMW are inclined to emerge anxiety and worries of being infected. The rapid spread of COVID-19 boomed the medical demands, aggravated the shortage of medical resources, and increased work stress for FMW, especially for those with continuous work and frequent day–night shifts. By comparison, non-FMW work in a relatively mild environment and have less possibility of being infected, thus having fewer sleep disturbances. Our study also found female FMW had worse sleep quality than male FMW. Zhang et al. [13], calculated a hazard ratio of 1.41 for female versus male toward insomnia. In general, females have inferior symptom bearing and greater bodily vigilance [14], which potentially exaggerates the severity and prevalence of sleep disturbances.

The study has several limitations that should be noted. First, this is a cross-sectional study. All subjects volunteered to participate in

the survey, so there may be subject selection bias. Second, we did not measure COVID-19 exposure, infection, or attitudes in subjects, which could influence sleep quality. Third, our questionnaires did not contain sufficient items to explore the potential risk factors for sleep disturbances. Finally, our study lacked of follow-ups, which may show the following changes of sleep disturbances for FMW.

## 5. Conclusion

In conclusion, FMW have higher prevalence of sleep disturbances and worse sleep quality than non-FMW. And female FMW report more sleep disturbances than male FMW. Further interventions should be administrated for FMW, aiming to maintain their healthy condition and guarantee their professional performance in the battle against COVID-19.

## CRedit authorship contribution statement

**Jing Qi:** Conceptualization, Investigation, Data curation, Formal analysis, Methodology, Software, Writing - original draft. **Jing Xu:** Conceptualization, Investigation, Data curation, Formal analysis,

Methodology, Software. **Bo-Zhi Li:** Investigation, Data curation, Formal analysis, Methodology, Software. **Jin-Sha Huang:** Investigation, Resources, Data curation. **Yuan Yang:** Investigation, Resources, Data curation. **Zhen-Tao Zhang:** Investigation, Resources, Data curation. **Dong-Ai Yao:** Investigation, Resources, Data curation. **Qun-Hui Liu:** Investigation, Resources, Data curation. **Min Jia:** Investigation, Resources, Data curation. **Dao-Kai Gong:** Investigation, Resources, Data curation. **Xiao-Hong Ni:** Investigation, Resources, Data curation. **Qj-Mei Zhang:** Investigation, Resources, Data curation. **Fu-Rong Shang:** Investigation, Resources, Data curation. **Nian Xiong:** Investigation, Resources, Data curation. **Chun-Li Zhu:** Investigation, Resources, Data curation. **Tao Wang:** Conceptualization, Investigation, Resources, Data curation, Methodology, Writing - review & editing. **Xi Zhang:** Conceptualization, Data curation, Funding acquisition, Methodology, Project administration, Supervision, Writing - review & editing.

### Acknowledgements

This study was supported by National Military Science Foundation of China [grant number AWS14J011]. The funding agency did not take part in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript.

### Conflict of interest

None.

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.2020.05.023>.

### References

- [1] Lu H, Stratton CW, Tang YW. Outbreak of pneumonia of unknown etiology in Wuhan, China: the mystery and the miracle. *J Med Virol* 2020;92:401–2.
- [2] Chan JF, Yuan S, Kok KH, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *LANCET (N AM ED)* 2020;395:514–23.
- [3] WHO. Coronavirus disease (COVID-19) pandemic. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>. [Accessed 23 February 2020].
- [4] WHO. Coronavirus disease 2019 (COVID-19) Situation Report-98. [https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200427-sitrep-98-covid-19.pdf?sfvrsn=90323472\\_4](https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200427-sitrep-98-covid-19.pdf?sfvrsn=90323472_4). [Accessed 28 April 2020].
- [5] Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese center for disease control and prevention. *J Am Med Assoc* 2020;323:1239–42.
- [6] Kaneita Y, Ohida T. Association of current work and sleep situations with excessive daytime sleepiness and medical incidents among Japanese physicians. *J Clin Sleep Med* 2011;7:512–22.
- [7] Qiu D, Yu Y, Li RQ, et al. Prevalence of sleep disturbances in Chinese healthcare professionals: a systematic review and meta-analysis. *Sleep Med* 2020;67:258–66.
- [8] Kalmbach DA, Anderson JR, Drake CL. The impact of stress on sleep: pathogenic sleep reactivity as a vulnerability to insomnia and circadian disorders. *J Sleep Res* 2018;27:e12710.
- [9] Tsai PS, Wang SY, Wang MY, et al. Psychometric evaluation of the Chinese version of the Pittsburgh Sleep Quality Index (CPSQI) in primary insomnia and control subjects. *Qual Life Res* 2005;14:1943–52.
- [10] Soldatos CR, Dikeos DG, Paparrigopoulos TJ. Athens Insomnia Scale: validation of an instrument based on ICD-10 criteria. *J Psychosom Res* 2000;48:555–60.
- [11] Chung K, Kan KK, Yeung W. Assessing insomnia in adolescents: comparison of insomnia severity Index, Athens insomnia Scale and sleep quality Index. *Sleep Med* 2011;12:463–70.
- [12] Piskovsky O, Oron M, Shiyovich A, et al. The impact of sleep deprivation on sleepiness, risk factors and professional performance in medical residents. *Isr Med Assoc J* 2013;15:739–44.
- [13] Zhang B, Wing YK. Sex differences in insomnia: a meta-analysis. *Sleep* 2006;29:85–93.
- [14] Barsky AJ, Peekna HM, Borus JF. Somatic symptom reporting in women and men. *J Gen Intern Med* 2001;16:266–75.