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Original Article

Sleep disturbances among Chinese residents during the Coronavirus Disease 2019 outbreak and associated factors

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A B S T R A C T

Objectives: Sleep status can affect the body’s immune status and mental health. This study aims to investigate the sleep status of Chinese residents during the outbreak of Coronavirus Disease 2019 (COVID-19) and to evaluate its related risk factors.

Methods: This research carried out a cross-sectional survey in February 2020 (during the COVID-19 outbreak) to investigate the sleep status of residents nationwide in the form of an online questionnaire. Of the 8151 respondents, 6437 were eventually included in the analysis. Logistic regression is applied to analyze the associated factors affecting residents’ sleep quality.

Results: During the COVID-19 outbreak, the incidence of sleep disturbances in residents was 17.65%. Increased risk of sleep disturbances was found to be associated with older age, female gender, and poor self-reported health status. Moreover, the odds ratios (ORs) were 1.42 (95% CI: 1.12–2.64), 1.35 (95% CI: 1.16–1.59), 5.59 (95% CI: 4.32–7.23), respectively. Those residents who believed COVID-19 had caused a high number of deaths or who thought COVID-19 was not easy to cure were more likely to experience sleep disorders, and the ORs were 1.73 (95% CI: 1.43–2.09), 1.57 (95% CI: 1.29–1.91), respectively. Regular exercise was a protective factor for sleep disturbances, OR = 0.77 (95% CI: 0.63–0.93).

Conclusions: During the outbreak of COVID-19, nearly one-fifth of participants had sleep disorders. It is necessary to pay more attention to people at high risk for sleep disturbances during the outbreak, adopt effective risk communication methods, enhance residents’ rational understanding of COVID-19, and develop practical indoor exercise programs for general public to improve sleep quality.

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1. Introduction

The 2019 novel Coronavirus Disease (COVID-19) pandemic poses a serious threat to global health [1,2]. To control the spread of the epidemic, countries around the world have adopted a series of effective measures, such as city lockdowns, home quarantine and production suspension [3,4]. These measures have achieved conspicuous results. However, these measures inevitably bring inconvenience to residents’ lives, which changes their lifestyles and further affects their health.

Sleep is an essential part of our daily life and a significant predictor of residents’ health [5]. Poor sleep status has a negative impact on residents’ physical and mental health, and good sleep quality can enhance the body’s immune defense [6]. Currently, many studies and surveys have confirmed that residents’ sleep quality can be affected during the outbreak of emergent epidemics.
For example, a study showed that an outbreak of the Middle East Respiratory Syndrome, which occurred in Korea in 2015, had a great impact on the sleep of medical staff [7]. In the same year, a cross-sectional study conducted in Nigeria found that the most common psychological distress experienced by survivors and their relatives during the Ebola outbreak was lack of sleep due to worrying about the epidemic (33.3%; 39/117) [8]. A longitudinal study, which was conducted during the SARS outbreak in Taiwan province, China, showed that nurses had poor sleep quality [9]. Based on the above research evidence, we have reason to speculate that the sleep condition of the public may also be affected during COVID-19 outbreak. Before the outbreak, studies had shown that sleep was related to physiological, psychological factors and lifestyle. For instance, a previous multi-center cross-sectional study from the World Health Organization focused on the prevalence of sleep problem across eight countries in the continents of Africa and Asia, which investigated 43,935 people, found that the incidence of sleep problems varies by age and gender [10]. Another study, which surveyed 6284 Chinese college students, found that perceived stress, alcohol consumption and lack of exercise had a negative impact on sleep quality [11]. However, in the context of the current global COVID-19 epidemic, little research has been conducted on the sleep status of general public. Existing studies mainly focused on medical staff, and the sample sizes were relatively small [12]. Research on screening for sleep disturbances among public and its risk factors is scarce. This study aims to conduct a cross-sectional survey to investigate the sleep status of Chinese residents during the outbreak of COVID-19, and determine the related risk factors, thereby providing scientific evidence for improving sleep quality of residents during the epidemic.

2. Methods

2.1. Ethical statement

This study was approved by the Medical Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology. All the respondents’ participation was voluntary and informed consent was obtained.

2.2. Research design

This research was a web-based cross-sectional study. From February 4 to February 18, 2020 (during the outbreak of COVID-19), 80 undergraduates were recruited as investigators to conduct online questionnaire survey in the communities where their family lived. The target respondents were Chinese residents over 18 years old. The questionnaire link was sent to community residents through social networks, who submitted the questionnaire online anonymously after completing it. The survey content included questions on general demographic characteristics, perception of COVID-19, self-reported health status and sleep quality. Each investigator was recommended to cover 100 residents. The total number of respondents was 8151. The number of respondents in Hubei (the epidemic area) and other regions were 2109 and 6,042, respectively.

2.3. Measurement indicators

The Pittsburgh Sleep Quality Index (PSQI) was used in the present study to evaluate the sleep status. This scale consists of seven dimensions and 18 items. It evaluates multiple dimensions of sleep over a one-month period. Eighteen self-evaluation questions generate seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. Each component is scored according to the levels 0–3. The accumulative score of each component is the total score of the PSQI. Total scores thus ranged from 0 to 21, where the higher the score, the worse the sleep quality. This study set seven points as the critical score to calculate the incidence of sleep disturbances [13].

In our study, self-reported economic status was surveyed using a question, “What do you think of your current financial situation?” with four response options, “very bad”, “bad”, “fair”, and “good”. The self-perceived physical health was measured using a single question, “What do you think of your current status of health?” with three response options, “good”, “fair”, and “bad”. The exercise status of residents during the COVID-19 outbreak was assessed by the question, “How often do you exercise per week? (more than 30 min at a time, eg, yoga, aerobic dance, etc.)” with three response options, “basically no or very little exercise”, “once or twice a week”, and “three times or more per week”.

The following two questions were set to investigate the residents’ perception of COVID-19. This research evaluated residents’ perception of COVID-19’s fatality risk by the question, “What do you think of the death toll of COVID-19?” with two response options, “High” and “Low,” and residents’ perception of COVID-19’s treatment difficulty was evaluated by the question, “How do you rate the treatment difficulty of COVID-19?” with four options, Easy, Neither easy nor difficult, Moderately difficult, and Very difficult.

2.4. Statistical analysis

Statistical analysis was performed using SAS version 9.2. Descriptive statistical analyses were reported as frequencies and percentages. Chi-square tests were conducted to compare the incidence of sleep disturbances between groups. Multivariable logistic regression analysis was used to analyze the associated factors of sleep disorder. Adjusted odd ratios (ORs) and 95% confidence intervals (CIs) for each variable were calculated. For all comparisons, differences were tested using two-tailed tests and p-values less than 0.05 were considered statistically significant.

3. Results

Table 1 presents participants’ characteristics. Of the 8151 completed questionnaires, 1714 were discarded because of too many missing data, irregularly filling or obvious logical errors. Finally, 6437 eligible questionnaires remained, and the effective rate of the questionnaire was 79.0%. The mean age of the 6437 residents was 31.40 (SD = 13.49). More than half of the participants were female (56.13%) and 55.85% of the participants had a bachelor’s or higher degree. There were 55.48% of the participants reported good health. Of the 6437 participants, 17.23% considered perceived deaths of COVID-19 to be high, and 15.01% and 5.83% of the participants thought that the treatment of COVID-19 was difficult and very difficult, respectively.

The average PSQI score was 4.85 ± 3.11, including 1136 participants with a PSQI >7, accounting for 17.65%. Table 1 shows that sleep disturbances were statistically related to age, education level, marital status, self-reported economic status, self-perceived physical health, exercise, perceived death of COVID-19 and perceived difficulty of COVID-19 treatment (P < 0.05). There were no significant differences in sleep disturbances among participants in terms of region and gender. The main symptoms of the 1136 residents with sleep disturbances were “cannot get to sleep within 30 min” (1026, 90.32%) and “wake up in the middle of the night or early morning” (848, 74.65%) (Table 3).

Table 2 demonstrates the factors contributing to the occurrence of 6437 residents’ sleep disturbances surveyed in 2020. The result
of a multifactor logistic regression analysis showed that those participants who were older (OR = 1.42, 95% CI: 1.1–2.64), who were female (OR = 1.16–1.59); who reported fair health, who believed COVID-19 had caused a high number of deaths (OR = 1.73, 95% CI: 1.43–2.09), who thought COVID-19 was not easy to cure (Easy, OR = 1.32, 95% CI: 1.1–1.57; Difficult, OR = 1.57, 95% CI: 1.29–1.91; Very difficult, OR = 1.34, 95% CI: 1.01–1.79) were more likely to experience sleep disorders. In addition, compared with those who do little or no exercise, people who exercised regularly every week were less likely to experience sleep disturbances (OR = 0.77, 95% CI: 0.63–0.93).

4. Discussion

To the best of our knowledge, this study is the first large-scale investigation to explore the prevalence and associated factors of sleep disorders in Chinese residents during the epidemic of COVID-19. The results of this study showed that during the outbreak of COVID-19, 17.7% of the Chinese residents had poor sleep quality. Residents who reported poor physical health, who believed that current situation of the epidemic was serious had a higher risk of experiencing sleep disturbances. Regular exercise was a protective factor of sleep quality. The results of this study provide data support for knowing the potential factors of sleep disorders among residents during the outbreak of COVID-19, and for helping to implement targeted interventions.

In this study, nearly one-fifth of participants had sleep disorders (17.7%). Prior to the COVID-19 outbreak, many studies on sleep quality of Chinese residents have been reported. For example, an epidemiological survey conducted in Tianjin in 2019 showed that 13.2% of adult residents had sleep disorders [14]. Surveys conducted in Xuzhou City and Liaoning Province in 2013 showed that the incidence of sleep disturbances was 8.96% and 11.59%, respectively [15,16]. Although the incidence of sleep disorders in this study is higher than that reported in the above studies, it is difficult to directly compare with the above results due to the changes in the study population. To some extent, this result indicates that emergent infectious diseases have a negative impact on sleep quality of Chinese residents. Previous studies demonstrated that emergency public health incidents could increase anxiety, depression and stress levels in general population and these negative emotions would have an influence on sleep quality [17–21].

Table 1
Descriptive statistics for the characteristics and associations with sleep disturbances of the participants.

| Variables                        | All Participants | Participants with PSQI >7 |
|----------------------------------|-----------------|--------------------------|
|                                  | n               | %                        | n              | %                        |
| Total                            | 6437            | 100.00                   | 1136           | 17.65                    |
| Region                           |                 |                          |                |                          |
| Other regions                    | 4791            | 74.43                    | 828            | 17.28                    |
| Hubei province                   | 1646            | 25.57                    | 308            | 18.71                    |
| Age                              |                 |                          |                |                          |
| <30                              | 3550            | 55.15                    | 556            | 15.66                    |
| 30–39                            | 1040            | 16.16                    | 193            | 18.56                    |
| 40–49                            | 1066            | 16.56                    | 197            | 18.48                    |
| ≥50                              | 781             | 12.13                    | 190            | 24.33                    |
| Gender                           |                 |                          |                |                          |
| Male                             | 2824            | 43.87                    | 497            | 17.60                    |
| Female                           | 3613            | 56.13                    | 639            | 17.69                    |
| Education level                  |                 |                          |                |                          |
| Junior middle school or below    | 832             | 12.93                    | 174            | 20.91                    |
| Senior middle school             | 941             | 14.62                    | 190            | 20.19                    |
| Associate degree                 | 1069            | 16.61                    | 214            | 20.02                    |
| Bachelor degree or higher        | 3595            | 55.85                    | 558            | 15.52                    |
| Marital status                   |                 |                          |                |                          |
| Unmarried/divorced/separated     | 3927            | 60.11                    | 630            | 16.04                    |
| Married/cohabitation             | 2510            | 38.99                    | 506            | 20.16                    |
| Self-reported economic status    |                 |                          |                |                          |
| Very bad                         | 475             | 7.38                     | 107            | 22.53                    |
| Bad                              | 883             | 13.72                    | 193            | 21.86                    |
| Fair                             | 3873            | 60.17                    | 645            | 16.65                    |
| Good                             | 1206            | 18.74                    | 191            | 15.84                    |
| Self-perceived physical health   |                 |                          |                |                          |
| Good                             | 3571            | 55.48                    | 405            | 11.34                    |
| Fair                             | 2535            | 39.38                    | 581            | 22.92                    |
| Bad                              | 331             | 5.14                     | 150            | 45.32                    |
| Physical exercise                |                 |                          |                |                          |
| No                               | 3020            | 46.92                    | 604            | 20.00                    |
| 1–2 times/week                   | 2077            | 32.27                    | 335            | 16.13                    |
| 3 times or more/week             | 1340            | 20.82                    | 197            | 14.70                    |
| Perceived death of COVID-19      |                 |                          |                |                          |
| Low                              | 5328            | 82.77                    | 839            | 15.75                    |
| High                             | 1109            | 17.23                    | 297            | 26.78                    |
| Perceived difficulty of treatment|                 |                          |                |                          |
| Easy                             | 3606            | 56.02                    | 545            | 15.11                    |
| Fair                             | 1490            | 23.15                    | 282            | 18.93                    |
| Difficult                        | 966             | 15.01                    | 224            | 23.19                    |
| Very difficult                   | 375             | 5.83                     | 85             | 22.67                    |

Note: P values are associated with Chi-square tests.
PSQI – The Pittsburgh Sleep Quality Index.
COVID-19 – Coronavirus Disease 2019.
This study found that the elderly or female residents were more likely to experience sleep disorders. These findings are consistent with previous extensive epidemiological studies, which have shown that the incidence of sleep disorders increased with age [10,22], and women had worse sleep quality than men [10,23,24]. In addition, this study found that self-perceived health condition was an important factor affecting residents’ sleep quality during the COVID-19 outbreak. Residents with self-perceived poor health had worse sleep quality than men [10,23,24].

Additionally, this study found that residents’ awareness of severity of the epidemic was associated with their sleep quality. Residents who perceive a high death risk and treatment difficulty of the COVID-19 have an increased risk of experiencing sleep disorders, which is consistent with earlier study results. Moldofsky et al. [30], confirmed that sleep disorders experienced by SARS survivors were caused by factors such as worry and uncertainty about the epidemic situation. It suggests that government should provide accurate epidemic information during the outbreak to reduce negative effects of rumors, and to alleviate residents’ worries about difficulties of controlling the epidemic. It is supposed to adopt appropriate risk communication methods, and use various forms of publicity and education channels, such as establishment of epidemic expert forums and consulting platforms, which could publicize and explain the disease hazards to the public, emphasize the curiosity, improve public knowledge about the disease, help the public to understand the situation of COVID-19 rationally, and guide residents to take effective prevention and control measures, thereby reducing panic and anxiety caused by residents’ uncertainty and lack of knowledge.

There are several limitations in this study. First, this study is a cross-sectional study, thus we cannot establish a causal relationship between sleep disorders and related risk factors. Second, due to the influence of the epidemic, it is not appropriate to conduct face-to-face investigations. Therefore, an online questionnaire was used to conduct the survey, resulting in more young people and highly educated people who were better at using mobile phones among the respondents, which may underestimate the incidence of sleep disorders. In addition to the factors investigated in this study, there are other related factors that may affect sleep (eg, caffeine intake [31], obesity [32], chronic diseases [33] etc.). Considering the patience of residents in filling in questionnaires and the richness of questionnaire contents, we did not investigate too many related influencing factors in order to ensure the highest quality of questionnaire filling, which led to the shortcoming of this study.

5. Conclusion

This research provided scientific evidence for knowing the sleep quality of Chinese residents during the COVID-19 outbreak and its associated factors by administering a nationwide cross-sectional survey. This study showed that nearly one-fifth of participants...
had poor sleep quality during COVID-19 outbreak. It is thus necessary to pay more attention to the elderly and people with poor health conditions. Practical indoor exercise programs should be designed for general public, which could improve their sleep quality. Moreover, during an epidemic outbreak, the government should adopt appropriate risk communication methods, expand publicity and education, and enhance residents’ rational understanding of COVID-19, so as to relieve psychological pressure and alleviate residents’ sleep problems.

Data statement

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

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CRediT authorship contribution statement

Jing Wang: Conceptualization, Methodology, Investigation, Software, Formal analysis, Writing - original draft. Yanhong Gong: Conceptualization, Methodology, Software, Formal analysis, Data curation, Writing - review & editing. Zhenyuan Chen: Methodology, Investigation, Software, Formal analysis. Jianxiong Wu: Software, Investigation, Data curation. Jie Feng: Software, Investigation, Data curation. Shijiao Yan: Investigation, Data curation. Chuanzhu Lv: Investigation, Data curation. Zuxun Lu: Investigation, Data curation. Ketao Mu: Conceptualization, Writing - review & editing, Visualization. Xiaoxi Yin: Conceptualization, Data curation, Writing - review & editing, Visualization, Supervision, Funding acquisition.

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Conflict of interest

All authors have no competing interests to declare.

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.2020.08.002.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sleep.2020.08.002.

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