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Background: An outbreak of the 2019 novel coronavirus (COVID-19) has been ongoing in China since January 2020. The threat of infection affects the work and life of most of the population and may also damage sleep. This study aims to examine the subjective sleep status and mental health of the population during the peak of the COVID-19 epidemic.

Method: The data were collected through an online questionnaire with a sample of 5461 individuals in China from February 5, 2020, to February 23, 2020. Participants were divided into four groups based on their degree of threat from COVID-19: Group 1 was most closely associated with COVID-19, including inpatients diagnosed with COVID-19, first-line hospital workers and first-line management staff; Group 2 included outpatients diagnosed with COVID-19 and patients who developed a fever and visited the hospital; Group 3 included people related to Group 1 or 2, such as their colleagues, relatives, friends and rescuers; and Group 4 was the farthest removed from contact with COVID-19, covering the general public affected by COVID-19 prevention strategies. The Insomnia Severity Index (ISI), Patient Health Questionnaire (PHQ-9), Generalized Anxiety Disorder Scale (GAD-7) and Acute Stress Disorder Scale (ASDS) were used.

Results: Threat degree of COVID-19 (groups) had significant correlations with insomnia, depression, anxiety, and stress (p < 0.05, p < 0.01). Age, gender, and area (Hubei province or other provinces) had significant correlations with insomnia (p < 0.01). A total of 1380 (24.46%) participants were suspected of having major depression based on the PHQ-9. Additionally, 1042 (18.47%) participants were suspected of having generalized anxiety disorder based on the GAD-7. A total of 892 (15.8%) of the participants had Acute Stress Disorder (ASD) according to the ASDS. The prevalence of clinical insomnia during the outbreak was 20.05% (1131) according to the ISI. The factors of satisfaction with the current sleep pattern and how perceptible the symptoms of the current sleep pattern are to other people (p < 0.05) and the middle (difficulty staying asleep) and terminal (waking up too early) (p < 0.01) factors of the ISI were significantly different across groups. A total of 1129 (20.01%) participants spent more than one hour awake in bed.

Conclusion: The results indicated that insomnia is more severe in people who are female, young, living in the epicenter and experiencing a high degree of threat from COVID-19. As prevention and treatment efforts continue with regard to COVID-19, the general public has developed poor sleep hygiene habits, which deserve attention.

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1. Introduction

Cases of pneumonia of unknown cause started to occur in Wuhan, China, in December 2019 [1]; these cases were later confirmed to be due to infection with a novel coronavirus, SARS-CoV-2 (COVID-19) [2]. A viral outbreak occurred in Wuhan and other cities in Hubei Province in January 2020, spreading as the population migrated to most other provinces in China [3]. As of February 10, 2020, the number of diagnosed cases of COVID-19 nationwide had reached 42,708 (31,732 in Hubei), and there had been 1017 deaths [4]. The implementation of an emergency response was announced by the Centers for Disease Control (CDC), internal and external public traffic in Wuhan city was restricted, and other provinces simultaneously implemented the highest level of emergency response to an infectious disease. People were advised to stay at home, canteens and shopping centers were closed, and public transportation (eg, buses and subways) was reduced or even stopped [5]. These measures have been effective in preventing the spread of COVID-19. Then, 10–14 days after the implementation of these measures, the daily growth of new cases of COVID-19 in most provinces declined. After more than 10,000 health care workers moved to Hubei Province to support the treatment and prevention of the disease, the epidemic situation in Wuhan and other cities in Hubei Province stabilized [6]. With the implementation of epidemic prevention and control measures, the number of infections has declined gradually, and the epidemic situation in China has become relatively stable. Nevertheless, as reported on the world health organization (WHO) website, the number of infections continues to increase globally, with more than two million confirmed cases of COVID-19 worldwide at present. Given its high morbidity and mortality, people worldwide live under the influence of the epidemic of COVID-19.

The COVID-19 outbreak occurred during the Chinese Spring Festival (January 24, 2020, to January 30, 2020) in China, which is one of the most important and longest holidays in China. Almost every Chinese citizen was forced to change plans and had to face the problem of staying at home for a long time under strict control restrictions. At the same time, the outbreak of COVID-19 caused the shortage of almost all protective supplies and fresh food due to the disruption of logistics. People received news about the infections diagnosed around them, and possible contact with infected persons was difficult to avoid. As a result, people lived in fear of SARS-CoV-2 [7].

With regard to events that may cause extreme psychological discomfort to humans, unlike natural disasters (eg, earthquakes [8–10] and floods [11]), accidents (eg, traffic accidents) [12] and major diseases (eg, tumors and acute myocardial infarction), the psychological impacts of human-to-human transmissible diseases such as Spanish influenza, severe acute respiratory syndrome (SARS) [13–16], acquired immunodeficiency syndrome (AIDS) [17,18], and Ebola [19] are long term, continuous and widespread. COVID-19 has a longer latency and is more contagious than SARS, another coronavirus-related disease [20,21]. Human-to-human transmission of SARS-CoV-2 is thought to occur mainly via respiratory droplets; the virus is released in the respiratory secretions when an infected person coughs, sneezes, or talk, which may be infectious [22–24]. SARS-CoV-2 has been reported to remain activated in aerosols for at least three hours [25], which makes it spread widely. It has been reported that asymptomatic carriers were found in several provinces in China, people can become ill 24 days after exposure, and asymptomatic carriers may also be infectious, which may increase the fear experienced by the public [4].

As defined in the DSM-V, traumatic events are actual or potential injuries that a person experiences and responds to with intense fear, helplessness or horror [26]. As a public health event, COVID-19 is a kind of traumatic event and may be an independent factor that affects sleep in the general public. Although complaints about insomnia are common, only 4%–22% of the public meet the diagnostic criteria for insomnia [27]. A meta-analysis indicated that the pooled prevalence of insomnia in China was 15.0% (95% confidence interval [CI]: 12.1%–18.5%) [28]. Sleep may therefore be a sensitive indicator of the stress status of the population. After psychological impacts such as earthquakes, wars, bombings, and attacks, the prevalence of insomnia ranges from 25 to 70% [29,30]. Trauma-induced insomnia patterns are associated with hyperarousal and more Stage 1 (N1 sleep), less slow wave sleep (N3 sleep) and increased rapid eye movement (REM) density in poly- somnography [31–33]. However, studies of the sensitivity of insomnia symptoms to the intense impact of public health emergencies of international concern (PHEIC) are rare. This topic is worthy of further research.

2. Methods

2.1. Design and participants

This survey was based on an online questionnaire delivered by WeChat, a Chinese social network, from February 5, 2020, to February 23, 2020, the peak period of the COVID-19 epidemic. The deadline for submitting the questionnaire was set to one month after the restriction of internal and external traffic in Wuhan, which was the beginning of the nationwide control of transportation and crowd gathering [4]. The questionnaire was self-reported and brief because research personnel could not interview the participants during this period. The link to the questionnaire was delivered to more than 1000 hospital workers (including doctors, nurses, and medical technicians) all over China, and a snowball sampling methodology was used. Participants were invited to deliver the questionnaire to their acquaintances who were potentially interested in this survey. Each WeChat ID could submit the questionnaire only once.

A total of 17,573 individuals opened the link, and 32.10% of them completed the questionnaire and submitted their answers. Data were collected from 5641 Chinese individuals, including 1685 (29.9%) males and 3956 (70.1%) females. Participants were in all provinces of China, and 482 (8.5%) of the participants were in Hubei Province, where the COVID-19 outbreak has been the most severe. Participants ranged across all ages: 76 (1.3%) were younger than 18 years, 3995 (70.8%) were between 18 and 44 years, 1444 (25.6%) were between 45 and 60 years, and 126 (2.2%) were older than 60 years. Most of the individuals (84.2%) had 13–16 years of schooling or more (associate’s, bachelor’s or master’s degree).

Because only anonymous data with no identifiable personal information were collected and used, prior signature of consent was waived for the participants, and we passed ethical review and were exempted by the Nanjing Hospital of Chinese Medicine from the need to obtain signature of informed consent.

2.2. Self-reported variables

We used several self-reported scales to measure our variables of interest. The Insomnia Severity Index (ISI) is a 7-item scale that measures the self-reported level of sleep quality and insomnia [34]. We used the ISI to measure the participants’ nighttime and daytime insomnia components in the previous two weeks (ISI-post) and their sleep status between October and December (the last quarter) in 2019 according to their memory of it (ISI-pre) [35,36]. We used a cutoff score of 10 to judge whether a participant had clinical insomnia [37].
To measure self-reported depression and anxiety, the Patient Health Questionnaire (PHQ-9) and Generalized Anxiety Disorder Scale (GAD-7) were used. We used cutoff points of 5, 10, 15 and 20 to represent minimal, mild, moderate, moderately severe and severe levels of depression based on PHQ-9 scores [38,39]. GAD-7 cutoff scores of 5, 10 and 15 represented mild, moderate, and severe levels of anxiety, respectively. We used a cutoff score of 10 to determine whether a participant had major depression and a cutoff score of 10 to determine whether a participant had generalized anxiety disorder [40,41].

To measure self-reported stress, we also used the Acute Stress Disorder Scale (ASDS) [42,43]. This 19-item self-reported scale can be adapted to assess and determine acute stress disorder (ASD). This questionnaire contains 4 subscales: (1) disassociation (Questions 1–5), (2) reexperience (Questions 6–9), (3) avoidance (Questions 10–13), and (4) arousal (Questions 14–19). We determined that a participant had ASD when the score for disassociation (subscale 1) was no less than 5 and the total score on the ASDS was no less than 28 [43].

In addition, we conducted a survey on the sleep habits of the individuals, including sleep latency (choices were less than 15 min, 15–30 min, 30–60 min, more than 60 min and need hypnotic drugs), time in bed (choices were less than 5 h, 5–6 h, 6–7 h, 7–8 h, 8–9 h, 9–10 h and more than 10 h) and sleep duration (choices were less than 5 h, 5–6 h, 6–7 h, 7–8 h, 8–9 h, 9–10 h and more than 10 h) each day in the past two weeks.

2.3. Procedure

Individuals who expressed an interest in participating in the study were provided with a link through WeChat and asked to complete the online survey at their leisure. Participants were informed before they provided any information that all data collected were completely anonymous and that there would be no way to trace their responses. Participants were asked for demographic information (age, sex, degree of threat from COVID-19, etc.), and they were asked to indicate how many minutes they spent falling asleep, how many hours they spent lying in bed and how many hours they stayed asleep on average in the previous two weeks. All participants were asked to complete the ISI, PHQ-9, GAD-7, and ASDS. Participants were asked to complete the ISI a second time based on their memory of their sleep patterns between the second time based on their memory of their sleep patterns between October and December 2019. The participants received brief feedback about their degree of depression, anxiety, stress and insomnia immediately upon submitting their questionnaires according to their answers to the PHQ-9, GAD-7 ASDS and ISI-post.

2.4. Statistical analysis

We stratified the participant groups according to the government standards regarding the threat of COVID-19. People affected by COVID-19 were divided into four groups: (a) Group 1 was most closely associated with COVID-19, including inpatients diagnosed with COVID-19, first-line hospital workers (doctors, nurses, medical technicians, etc.) and first-line management staff; (b) Group 2 included outpatients diagnosed with COVID-19 and patients who developed a fever and visited the hospital (who may not have been diagnosed with COVID-19); (c) Group 3 included people related to Group 1 or 2, such as their colleagues, relatives, friends and rescuers; and (d) Group 4 was the farthest removed from contact with COVID-19, covering the general public affected by COVID-19 prevention strategies.

Kruskal–Wallis nonparametric analyses were conducted to determine whether several independent groups had differences in each item on the ISI and the total ISI, PHQ-9, GAD-7, and ASDS scores. Spearman’s coefficients were calculated to examine the correlations between variables [44,45]. Hierarchical regression analysis was used to measure the effects of the related factors on insomnia severity (ISI score) [46]. Analyses were conducted using SPSS version 19. The significance level was set at $p < 0.05$.

3. Results

3.1. Socio-demographics of individuals

Of the 5641 individuals, 837 (14.8%) were first-line hospital workers or first-line management staff (Group 1), 57 (1.0%) were outpatients diagnosed with COVID-19 or patients who had a fever and visited the hospital (Group 2), 660 (11.7%) individuals were colleagues, relatives, friends or rescuers related to Group 1 or 2, and 4087 (72.5%) were members of the general public affected by COVID-19 prevention strategies. The prevalence of demographic characteristics is presented in Table 1.

3.2. Depression, anxiety, stress and insomnia outcomes

The average PHQ-9 score of all participants was $6.10 \pm 5.97$. A total of 1380 (24.46%) participants were suspected of having major depression. The GAD-7 was used to evaluate anxiety, with an average score of $4.97 \pm 5.25$ points. A total of 1042 (18.47%) participants were suspected of having generalized anxiety disorder. A total of 892 (15.8%) of the participants had ASD according to the ASDS, with an average score of $5.88 \pm 10.79$. Among the ASDS subscales, the arousal score was the highest, with an average score of $10.00 \pm 4.29$, followed by disassociation ($6.80 \pm 2.93$), avoidance ($5.61 \pm 2.90$) and reexperience ($5.53 \pm 2.33$) (Table 2, Table 3). The average ISI-post score of all participants was $5.93 \pm 5.88$, and the prevalence of clinical insomnia was $20.05\%$ (1131) according to ISI-post. However, the ISI-pre indicated that only $14.64\%$ (826) of individuals had clinical insomnia during the last quarter of 2019 (Table 2, Table 4).

There was a significant difference in the PHQ-9, GAD-7, and ASDS scores (disassociation, reexperiencing, avoidance, arousal and total) across groups with different degrees of threat from COVID-19. Differences between the groups are presented in Table 3. People who were farthest from the epidemic of COVID-19 (Group 4) had
Table 2
Depression, anxiety, ASD and insomnia severity of individuals.

| Variables       | Level           | N   | %   |
|-----------------|-----------------|-----|-----|
| PHQ-9           | Minimal (0–4)   | 2813| 49.9|
|                 | Mild (5–9)      | 1448| 25.7|
|                 | Moderate (10–14)| 770 | 13.7|
|                 | Moderately severe (15–19)| 395 | 7.0 |
|                 | Severe (20–27)  | 215 | 3.8 |
| GAD-7           | Minimal (0–4)   | 3310| 58.7|
|                 | Mild (5–9)      | 1289| 22.9|
|                 | Moderate (10–14)| 521 | 9.2 |
|                 | Severe (15–21)  | 521 | 9.2 |
| ASD-Non ASD     |                | 4749| 84.2|
| SDS             |                | 892 | 15.8|
| ISI-post        | No clinically significant insomnia (0–7)| 3971| 70.4|
|                 | Subthreshold insomnia (8–14) | 1161| 20.6|
|                 | Clinical insomnia (moderate) (15–21) | 359 | 6.4 |
|                 | Clinical insomnia (severe) (22–28) | 150 | 2.7 |
| ISI-pre         | No clinically significant insomnia (0–7)| 4295| 76.1|
|                 | Subthreshold insomnia (8–14) | 1026| 18.2|
|                 | Clinical insomnia (moderate) (15–21) | 229 | 4.1 |
|                 | Clinical insomnia (severe) (22–28) | 91  | 1.6 |

generally lower scores for each variable compared with the other three groups.

The ISI was used to compare individuals’ sleep status before and after the COVID-19 outbreak. Before the event, there was no significant difference in the factor scores and total scores on the ISI among the four groups (p > 0.05). During the event, there was no significant difference in the factors of initial insomnia (difficulty falling asleep), interference with daily functioning or distress about current sleep problems among the four groups (p > 0.05). The factors of satisfaction with the current sleep pattern and how perceptible the symptoms of the current sleep pattern are to other people (p < 0.05), the factors of middle (difficulty staying asleep) and terminal (waking up too early) insomnia, and the total score (p < 0.01) were significantly different between the four groups. The outcomes and comparison of the groups are shown in Table 4.

The composition of individuals with different insomnia severities is summarized in Table 5. There were significant differences in insomnia severity by gender, age, area, threat of COVID-19 (groups), and time awake in bed. The time awake in bed was set as the difference between sleep duration and time in bed of each individual. A total of 20.01% of the participants spent more than two grades (more than one hour) awake in bed each day; for example, they spent 8–9 h in bed but slept for 6–7 h a day.

Table 3
Statistical analysis of PHQ-9, GAD-7, ASD and ISI in groups.

| Variables       | G1(N – 837)   | G2(N – 57)   | G3(N – 660) | G4(N – 4087) | Total | H   | Difference between groups |
|-----------------|---------------|-------------|-------------|-------------|-------|-----|--------------------------|
| PHQ-9           | 6.52 ± 6.14   | 7.84 ± 7.04 | 6.49 ± 6.02 | 5.92 ± 5.90 | 6.10 ± 5.97 | 20.520** | –2.352 –0.147 2.637 2.277 3.165** 2.568 |
| GAD-7           | 5.49 ± 5.37   | 5.71 ± 6.89 | 5.44 ± 5.39 | 4.75 ± 5.15 | 4.97 ± 5.25 | 31.126** | –1.798 0.147 3.981* 1.839 2.978* 3.418** |
| ASD-Disassociation | 6.96 ± 3.16 | 8.33 ± 4.11 | 6.89 ± 2.92 | 7.63 ± 2.86 | 6.80 ± 2.93 | 14.481** | –2.868 –0.542 1.250 2.657* 3.317** 1.803 |
| ASD-Experiencing | 5.79 ± 2.51   | 6.54 ± 3.37 | 5.30 ± 2.46 | 5.42 ± 2.23 | 5.53 ± 2.33 | 48.556** | –1.628 –0.496 4.815** 1.428 3.041** 4.970** |
| ASD-Avoidance   | 5.75 ± 3.10   | 7.42 ± 4.31 | 5.84 ± 2.93 | 5.51 ± 2.81 | 5.61 ± 2.90 | 25.270** | –3.177 –1.465 1.695 2.598 3.742** 3.350** |
| ASD-Arousal     | 10.79 ± 4.73  | 12.16 ± 5.47| 10.51 ± 4.59| 9.73 ± 4.09 | 10.00 ± 4.29 | 59.897** | –1.949 1.100 4.202** 2.348 3.752** 6.156** |
| ASDS            | 25.29 ± 11.83 | 34.46 ± 14.75| 29.05 ± 11.12| 27.39 ± 10.38| 27.94 ± 10.79 | 50.386** | –2.893 –0.024 4.681** 2.860* 4.301** 4.264** |

G1 = Group 1, G2 = Group 2, G3 = Group 3, G4 = Group 4, H, adjusted p-values (Kruskal–Wallis H Analysis) and mean ± SE for Patient Health Questionnaire (PHQ-9), Generalized Anxiety Disorder Scale (GAD-7), Acute Stress Disorder Scale (ASDS) factor scores across groups; p < 0.05 is indicated by *, p < 0.01 is indicated by **.

Table 4
Statistical analysis of insomnia severity index (ISI) factors in groups.

| Variables       | G1(N – 837)   | G2(N – 57)   | G3(N – 660) | G4(N – 4087) | Total | H   | Difference between groups |
|-----------------|---------------|-------------|-------------|-------------|-------|-----|--------------------------|
| Pre-post        |               |             |             |             |       |     |                          |
| Minimal         | 0.50 ± 0.79   | 0.56 ± 0.95 | 0.45 ± 0.70 | 0.51 ± 0.79 | 0.50 ± 0.78 | 2.513 |
| Mild            | 0.63 ± 0.88   | 0.82 ± 1.02 | 0.64 ± 0.89 | 0.60 ± 0.88 | 0.61 ± 0.88 | 5.601 |
| Moderate        | 0.57 ± 0.82   | 0.65 ± 0.94 | 0.49 ± 0.77 | 0.56 ± 0.82 | 0.55 ± 0.82 | 5.726 |
| Severe          | 0.80 ± 1.00   | 0.89 ± 1.06 | 0.66 ± 0.91 | 0.65 ± 0.91 | 0.67 ± 0.93 | 21.360** |
| Pre-post        |               |             |             |             |       |     |                          |
| Satisfaction    | 0.53 ± 0.79   | 0.65 ± 1.01 | 0.47 ± 0.71 | 0.51 ± 0.78 | 0.51 ± 0.77 | 2.027 |
| Pre-post        |               |             |             |             |       |     |                          |
| Interference    | 1.42 ± 0.87   | 1.51 ± 0.89 | 1.37 ± 0.89 | 1.41 ± 0.90 | 1.41 ± 0.90 | 5.641 |
| Pre-post        |               |             |             |             |       |     |                          |
| Noticeability   | 1.70 ± 1.15   | 1.07 ± 1.15 | 0.73 ± 0.94 | 0.77 ± 0.98 | 0.76 ± 0.97 | 7.023 |
| Pre-post        |               |             |             |             |       |     |                          |
| Distress        | 1.42 ± 1.12   | 1.25 ± 1.12 | 1.03 ± 1.09 | 1.01 ± 1.13 | 1.02 ± 1.12 | 5.643 |
| Pre-post        |               |             |             |             |       |     |                          |
| Total           | 4.94 ± 5.32   | 6.09 ± 5.67 | 4.63 ± 4.75 | 5.00 ± 5.28 | 4.96 ± 5.24 | 2.743 |

G1 = Group 1, G2 = Group 2, G3 = Group 3, G4 = Group 4, H, adjusted p-values (Kruskal–Wallis H Analysis) and mean ± SE for pre- and post-ISI factors across groups; p < 0.05 is indicated by *, p < 0.01 is indicated by **.
4. Discussion

As a PHEIC, COVID-19 has an impact on both the physiology and psychology of humans [47]. However, due to differences in educational backgrounds, occupations and regions, individuals experience different levels of threat from COVID-19, which causes people to experience varying degrees of stress and levels of severity of insomnia. In our study, groups 1 and 2 were in direct and close contact with the virus, and groups 3 and 4 were more likely to obtain information related to the epidemic of COVID-19 from the media, social networks, friends and family members.

Obviously, acute stress anxiety and depression in individuals were directly affected by the spread of COVID-19 and changes in lifestyle. People who were more affected by the epidemic had higher ASDS, GAD-7 and PHQ-9 scores. However, the difference in anxiety and depression between groups 1, 2 and 3 was not significant, which may be related to the fact that groups 1 and 3 were mainly composed of healthcare workers. Healthcare workers have more professional knowledge of diseases, which may reduce the degree of their emotional-physical stress. At the same time, they face the psychological pressure of on-site treatment, which may increase their emotional-physical stress. At the same time, they face the psychological pressure of on-site treatment, which may increase their emotional-physical stress.

The number of people with insomnia has increased significantly after experiencing acute stress, resulting in abnormal behavioral changes. Although most people respond actively to stress, abnormal behaviors associated with anxiety and depression often pose a potential risk to individuals and their communities. Stress, anxiety and depression associated with the COVID-19 outbreak certainly cause disruptions to normal sleep patterns. The number of people with insomnia has increased significantly, and people may develop or experience relapses or worsening of frequent wakefulness during sleep, early awakening (related to hyperarousal) and even nightmares or other sleep disorders [30].

With the gradual discharge of patients treated in compartment hospitals and the lifting of restrictions in Wuhan, the national economy, transportation, and education have gradually returned to normal in China. People have generally returned to work; however, we found that many patients with short-term or relapsed insomnia come to the clinic for help. The sleep status of the participants was indirectly affected by changes caused by epidemic control measures. The sleep statuses of groups 1, 2, and 3 were strongly affected by the epidemic situation, and the factors of satisfaction with the current sleep pattern, how perceptible the symptoms are to other people, difficulty staying asleep and problems waking up too early are more sensitive indicators that require more attention.

Notably, the COVID-19 outbreak has had a substantial impact on individuals’ subjective sleep quality. The experience of living through the epidemic may lead to acute insomnia in some people and may worsen symptoms in those who already have insomnia. From the perspective of the ‘3 P model of insomnia’ [48], although this event is only a precipitating factor [49,50], whether it affects sleep is also based on the basic sleep quality and susceptibility of patients. Insomnia has a large impact on human quality of life, and early intervention is therefore needed. In addition, according to our survey, the amount of time spent in bed may be prolonged due to long stays at home; people find long periods of watching television boring, and they may read inconclusive news intended to shock readers on social media at night. A total of 20.01% of the participants suffered from more than one hour of spare time in bed. Participants in groups 2 and 4 tended to spend a much longer time in bed due to not going to work (some people work at home) and staying at home; however, groups 1 and 3 were mainly composed of healthcare workers, who had to go to work during this period and spent relatively less time in bed. From the perspective of the sleep stimulation control theory, spending spare time in bed is not conducive to healthy sleep [51,52]. There is a hidden danger of the transformation of acute insomnia into chronic insomnia, and insomnia symptoms can worsen [53]. It is necessary to disseminate sleep health education and sleep hygiene behavior interventions to the population in a timely manner. Telemedicine may be an innovative and efficient way to benefit patients with insomnia and other sleep disorders.

Because of the specific characteristics of diseases with human-to-human transmission, strict epidemic prevention and control

### Table 5

Socio-demographics and sleep habits among insomnia severities.

| Non-insomnia | Subthreshold | Moderate | Severe | Total | Chi 2 |
|--------------|--------------|----------|--------|-------|-------|
| N            | 3971 (70.4)  | 1161 (20.58) | 359 (6.36) | 150 (2.66) | 5641 |
| Gender       |              |          |        |       |       |
| Male         | 1247 (31.40) | 313 (26.96) | 90 (25.07) | 35 (21.33) | 1685 (29.87) | 16.156** |
| Female       | 2724 (68.60) | 848 (73.04) | 269 (74.93) | 115 (76.67) | 3956 (70.13) |
| Age          |              |          |        |       |       |
| < 18         | 52 (1.31)    | 11 (0.95) | 5 (1.39) | 8 (5.31) | 76 (1.35) | 53.779** |
| 18-44        | 2730 (68.75) | 876 (75.45) | 275 (76.60) | 114 (76.00) | 3995 (70.82) |
| > 60         | 99 (2.49)    | 21 (1.81) | 2 (0.56) | 4 (2.67) | 126 (2.23) |
| Education    |              |          |        |       |       |
| Less than high school | 207 (5.21) | 64 (5.51) | 25 (6.96) | 11 (7.33) | 307 (5.44) | 11.147 |
| High school or occupational certificate | 410 (10.32) | 115 (9.91) | 36 (10.03) | 20 (13.33) | 581 (10.30) |
| Bachelor’s or associate’s degree | 2377 (59.86) | 724 (62.36) | 275 (76.60) | 114 (76.00) | 3995 (70.82) |
| Master’s degree or above | 977 (24.60) | 258 (22.22) | 82 (22.64) | 25 (16.67) | 1342 (23.79) |
| Area         |              |          |        |       |       |
| Hubei Province | 3675 (92.55) | 1051 (90.53) | 308 (85.79) | 125 (83.33) | 5159 (91.46) | 34.716** |
| Other        | 296 (7.45)   | 110 (9.47) | 51 (14.21) | 25 (16.67) | 482 (8.54) |
| Threat from COVID-19 |              |          |        |       |       |
| Group 1      | 555 (13.98)  | 193 (16.62) | 59 (16.43) | 30 (20.00) | 837 (14.84) | 26.396** |
| Group 2      | 35 (0.88)    | 10 (0.86) | 10 (2.79) | 2 (1.33) | 57 (1.01) |
| Group 3      | 459 (11.56)  | 135 (11.63) | 52 (14.48) | 14 (9.33) | 660 (11.70) |
| Group 4      | 2922 (73.58) | 823 (70.89) | 238 (66.30) | 104 (69.33) | 4087 (72.45) |
| Awake in bed |              |          |        |       |       |
| Others       | 3406 (85.77) | 806 (69.42) | 212 (59.05) | 88 (58.67) | 4512 (79.99) | 304.816** |

Non-insomnia — no clinically significant insomnia (0–7), Subthreshold — subthreshold insomnia (8–14), Moderate — clinical insomnia (moderate) (15–21), Severe — clinical insomnia (severe) (22–28). Pearson chi 2, p-values and N (%) for socio-demographics and sleep habits across groups (p < 0.05 is indicated by *, p < 0.01 is indicated by **).
are needed. It is recommended that the general population reduce all outside and social activities, which affects exercise and eating habits. Many people choose to take naps during the day or watch television and play games on their phones in bed; they lack regular exposure to sunlight, which affects their biological rhythms. Therefore, we recommend that people open their windows and ventilate their rooms, ensure moderate exposure to sunlight, and engage in appropriate indoor exercise during the COVID-19 epidemic [54–56]. It is suggested that e-aid cognitive behavioral therapy (e-CBT) may be a good way to improve the public’s sleep health during the event [57–59].

The survey has several limitations. First, we used the ISI to evaluate symptoms of insomnia before and after the event, which may have resulted in recall bias on the ISI-pre. Second, according to the standards we used, the occupations of the participants were not considered. As a result, Group 1 was composed of mostly first-line health care workers because severely ill inpatients may not have completed the questionnaire; however, we could not separate them clearly for analysis. Finally, due to the difference in the population characteristics in the groups, the number of Group 2 participants was small, which may have affected the results.

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Conflict of interest
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.2020.05.018.

Appendix A. Supplementary data
Supplementary data to this article can be found online at https://doi.org/10.1016/j.sleep.2020.05.018.

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