# Research on sleep status, body mass index, anxiety and depression of college students during the post-pandemic era in Wuhan, China

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## ARTICLE INFO

## ABSTRACT

*Objective:* Wuhan was the first Chinese city to be lockdown for the coronavirus disease 2019 (COVID-19) outbreak in springtime of 2020. The purpose of this study was to investigate the relationship between sleep status, body mass index, anxiety and depression in college students during the post-pandemic era in the universities of Wuhan, China.

*Methods:* A total of 1457 college students completed the online surveys from December 25, 2020 to January 16, 2021. Collected data included gender, age, school name, native place, grade, major, body mass index (BMI), the scores of self-assessment lists of sleep (SRSS), Zung self-rating anxiety scale (SAS) and Zung depression self-rating scale (SDS).

*Results:* 1445 valid questionnaires (99.18%) were received. Of all the respondents, the prevalence of insomnia, overweight and obesity, anxiety and depression were 32.73%, 19.45%, 15.43% and 62.91%, respectively. Female students were more likely to have insomnia and anxiety than male students. The rate of insomnia, overweight and obesity in postgraduates were higher than undergraduates. Non-medical students were more likely to be overweight and obese than medical students. In addition, insomnia severity was positively correlated to anxiety severity, and BMI was positively correlated to anxiety or depression severity. There was also a positive correlation between the severity of anxiety and depression.

*Conclusion:* During the post-pandemic era, insomnia and depression are common problems among college students in Wuhan, suggesting that we should strengthen the sleep education of college students to improve sleeping disorders and psychosomatic health.

## 1. Introduction

Viral diseases represent a serious threat to public health, with novel viruses continuing to emerge. Several viral respiratory epidemics have occurred in the past 20 years, such as severe acute respiratory syndrome (SARS) in 2003, the virus subtype H1N1 in 2009, Middle East respiratory syndrome (MERS) in 2012, Ebola virus disease in 2014, and the current COVID-19 (Ashour et al., 2020). Since December 2019, COVID-19 has been spread globally. COVID-19 has become a serious threat to public health through its wide infectivity and strong pathogenicity. The coronaviruses can cause illnesses ranging from the common cold to more severe diseases like SARS (Kisely et al., 2020). Due to

the lack of effective treatment measures (Majumder and Minko, 2021), many countries have to take strict steps, such as lockdown and quarantine, to cut off transmission routes effectively (Sideli et al., 2021). Lockdown and quarantine have forced people to change their original working and living habits. Although various vaccines have been developed and inoculation programs are progressively being launched in different countries (Izda et al., 2021), their effectiveness in achieving general population immunity and reducing viral transmission needs to be further evaluated (Peiris and Leung, 2020). Thus, it is difficult to completely restore the present situation to the pre-COVID-19 normal life in short time.

The fear of infection and the change of lifestyle had a severe impact

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on public psychosomatic health. A meta-analysis suggested that 38.9%, 23.2% and 22.8% medical workers during the COVID-19 suffered from insomnia, anxiety and depression, respectively (Pappa et al., 2020). Meanwhile, changes in people's mood, dietary and exercise habits during pandemic are also closely associated with weight gain (Pellegrini et al., 2020).

The novel virus, belonging to the coronavirus (CoV) family, emerged in Wuhan, the largest metropolitan area in Chinese Hubei province. At present, it has quickly brought the pandemic under control and entered the post-pandemic era in China. In September 2020, colleges and universities in Wuhan started their new term successively and various restrictions were taken to prevent the recurrence of the pandemic. These measures, such as restricting access to campus, travel limitations, wearing mask and keeping social distance, may affect students' study, daily life and psychosomatic health.

As is known, good sleep is essential for college students' psychosomatic health and social adaptation (Chen et al., 2021). One recent study showed that adolescents' high prevalence of mental health and sleep problems occurred when COVID-19 breakout (Li et al., 2021). In order to investigate the effect of the epidemic on sleep, body mass index (BMI), anxiety and depression of college students during the post-pandemic era, an online questionnaire aiming at college students in Wuhan was conducted. We hope to provide a basic analysis for physical and mental health intervention of students during the post-pandemic era.

## 2. Methods

### 2.1. Study design

An online questionnaire was designed with the purpose of assessing the mental health status of college students both quantitatively and qualitatively.

The questionnaire was divided into two parts. The quantitative part collected the basic information of the participants, including the participants' gender, age, school name, native place, grade, major, height and weight. Height and weight were converted into BMI for assessment. Using SRSS, SAS and SDS, the qualitative part investigated the participants' psychosomatic symptoms, including sleep conditions, anxiety and depression.

#### 2.1.1. Self-rating scale of sleep (SRSS)

The Self-rating scale of sleep was compiled by Jianming Li and is used for assessing the sleep status of the respondents in the last month. It consists of ten items and each item is rated on a scale of 5 (1–5). The total score ranges from 10 to 50 points. The higher the total score, the worse the sleep problems. In this study, a score below 22 is normal, 23–30 means mild insomnia, 31–40 reflects modern insomnia, and 41–50 indicates severe insomnia (Jiang et al., 2021).

#### 2.1.2. Body mass index (BMI)

Body mass index was calculated by dividing weight (kg) by height (m) squared. The standard was based on the weight of Chinese people recommended by the Group of China Obesity Task Force. 24 and 28 were used as cut-off points for overweight and obesity.

#### 2.1.3. Self-rating anxiety scale (SAS) and self-rating depression scale (SDS)

The Self-rating anxiety scale and self-rating depression scale were compiled by William W.K. Zung. This two-scale assessed anxiety and depression of the participants in the past one week, respectively. They both consist of twenty items and each item is scored on 4 (1–4). The scores of the twenty items are added up to get a rough score. The rough score is multiplied by 1.25 to round up to the standard score. The higher the total score, the greater the tendency to anxiety or depression. The standard scores of each scale can range from a minimum of 25 to a maximum of 100. A score of 50–59 indicates mild anxiety or depression,

60–69 moderate anxiety or moderate depression, and above 70 relatively severe anxiety and major depression (Zung, 1971).

### 2.2. Data collection

This survey was conducted among college students in Wuhan, Hubei Province, China, from December 25, 2020 to January 16, 2021. The survey used online questionnaires, which were administered through a web-based survey platform. We distributed questionnaires to the students from 23 universities in Wuhan through a WeChat QR code for cluster sampling. These questionnaires were completed once per interviewee.

### 2.3. Ethics

The research was approved by the Research Ethics Board at the Medical College of China Three Gorges University (2020FA002) and interviewee were informed of the purpose of the survey and informed consent principle.

### 2.4. Statistical analysis

GraphPad Prism and R language software were used for statistical analysis. The non-normal distribution was represented by the median, the 25th and 75th percentiles. In addition, Spearman correlation analysis was used for non-normal distribution samples. A Chi-square test was used for comparison between two groups, such as gender (male and female), grade (undergraduate and graduate students), professional nature (medical students and non-medical students), etc. $P < 0.05$ indicates a significant difference between the two groups. For significant $P < 0.05$, a positive value of correlation coefficient indicates positive correlation and a negative value indicates a negative correlation.

## 3. Results

### 3.1. Demographic characteristics of participants

Overall, 1457 participants answered the questionnaire. Among these participants, 12 questionnaires were invalid. The male proportion is 44.98% and the female is 55.02%. The response rate was 99.18% (1445/1457). All 1445 participants were from 23 colleges in Wuhan. Table 1 presents the general characteristic of college students.

### 3.2. The prevalence of sleep problems, anxiety and depression among college students

Among the investigated college students, the prevalence of sleep

**Table 1**
Participants socio-demographic characteristics ($N = 1445$).

| Variable($n = 1445$) | No. (%) |
|---|---|
| Gender | |
|   Male | 650(44.98%) |
|   Female | 795(55.02%) |
| Grade | |
|   Fresher | 212(14.67%) |
|   Sophomore | 364(25.19%) |
|   Junior | 398(27.54%) |
|   Senior(4th and 5th) | 129(8.93%) |
|   postgraduate | 342(23.67%) |
| Professional | |
|   Medical students | 717(49.62) |
|   Non-medical students | 728(50.38) |
| Age | |
|   Minimum | 15 |
|   Maximum | 46 |
|   Median(25%, 75%) | 20(19, 22) |

problems, anxiety and depression were 32.73%, 15.43% and 62.91%, respectively.

In terms of gender, 286 females had insomnia and 145 females had anxiety. There were 187 males with insomnia and 78 males with anxiety. The chi-square test showed a significant difference between the two groups ($P < 0.01$), indicating that females are more likely to suffer from insomnia and anxiety than males. The proportion of overweight and obese males were far more than females ($P<0.01$). However, there was no statistically difference of depressive status between genders in our study ($P = 0.38$).

Regarding to grade, 60 postgraduates were overweight and 131 postgraduates had insomnia while undergraduates were less likely to suffer from these problems. It indicated a significant difference between the two groups ($P < 0.05$). We did not find other significant differences among grades.

In relation to majors, the rate of overweight and obesity in the students of other majors were far above medico ($P < 0.01$). However, no significant difference was found in insomnia, anxiety and depression among different majors ($P = 0.87$, $P = 0.09$, $P = 0.13$).

Concerning native place, there was no significant difference in BMI between Hubei students and students of other origin. The result of insomnia, anxiety and depression in students from different native place were the same as before ($P = 0.06$, $P = 0.31$, $P = 0.06$). Table 2 presents the demographic variables and association with psychological impact.

### 3.3. Correlation analysis of sleep problem, BMI, anxiety and depression in college students

The correlation among the above 4 variables, SRSS, BMI, SAS and SDS, was analyzed respectively in 1445 participants. The results showed that there was no significant correlation between SRSS and BMI ($r = -0.03$, $P = 0.23$) which was the same as SRSS and SDS ($r = -0.03$, $P = 0.21$). But there was a positive correlation between SRSS and SAS ($r = 0.36$, $P < 0.01$), suggesting that sleep status was significantly correlated with anxiety rather than BMI and depression. Furthermore, the positive correlation was found between BMI and SAS ($r = 0.06$, $P < 0.05$). This consequence was consistent with the correlation between BMI and SDS ($r = 0.08$, $P < 0.01$). It indicated that BMI was correlated with anxiety and depression. However, the correlation coefficient was very low, suggesting a weak association. Additionally, SAS was distinctly correlated with SDS ($r = 0.33$, $P<0.01$) which means anxiety and depression had a prominent correlation.

## 4. Discussion

Since December 2019, the world has been adversely affected by COVID-19 pandemic, caused by severe acute respiratory syndrome coronavirus 2(SARS-CoV-2) (Tai et al., 2021).Wuhan was the center of the epidemic as the first affected city when COVID-19 breakout in China. This study is the first report on the correlation between sleep status and anxiety and depression of college students in Wuhan after resuming classes in autumn of 2020.

In this survey, up to 473 students (32.73%) developed insomnia, 281 students (19.45%) were overweight or obese, 223 students (15.43%) had anxiety, and 909 students (62.91%) were depressed. However, the results were significantly different from those of college students in home quarantine during the outbreak in spring of 2020. It has been reported that in the early stage of the pandemic outbreak, the sleep status of college students in 31 cities in China were evaluated by SRSS during home quarantine. And only 13.5% of them suffered from insomnia (Wang et al., 2020). It was also different from abroad. A study in the United States, with Pittsburgh sleep quality index, compared the sleep status of 1222 college students in the spring of 2019 during the non-pandemic period and the first half year of 2020 during the pandemic. The rate of poor sleep status was 64%, 65% and 66.5%, respectively, which indicated no significant difference. But the proportion of students taking sleeping pills and having poor sleep efficiency increased as the sleep latency increased during the pandemic (Benham, 2021).

In the present study, female students are more likely to suffer from insomnia and anxiety than male students, which is significantly different from the gender difference in the sleep quality of college students during the non-epidemic period reported in China (YF et al., 2012).Epidemiological studies have shown that women have a higher incidence rate than men in mental disorders such as anxiety and post-traumatic stress disorder, which may be related to the changes in gonadal hormone levels under stress and gender differences in brain regions (Maeng and Milad, 2015). In addition, the survey also found that postgraduates were more likely to suffer from insomnia than undergraduates. This result may be the social environment pressure, the pressure of academic and career development, as well as the financial pressure of life (Guan and Zhou, 2020).

We also found that insomnia was correlated with anxiety, suggesting that insomnia and anxiety may be mutually causative. The reason may be the inconvenient life caused by the control measures or the fear of the pandemic rebound. Additionally, students have been in the reduced space and scope of collective life for a long time, possibly leading to anxiety and insomnia. The two cause and effect each other, forming a

**Table 2**
Demographic variables and association with psychological impact (No.%).

| | Gender | | Grade | | Major | | Native place | |
|---|---|---|---|---|---|---|---|---|
| | Male% | Female% | Undergraduate% | Postgraduate% | Medico% | Other% | Hubei% | Other% |
| N | 650 | 795 | 1103 | 342 | 717 | 728 | 643 | 802 |
| Insomnia | 187(28.77) | 286(35.97)** | 342(31.01) | 131(38.30)* | 233(32.50) | 240(32.97) | 193(30.02) | 280(34.91) |
| Mild | 157(24.15) | 247(31.07) | 295(26.75) | 109(11.57) | 207(28.87) | 197(27.06) | 165(25.67) | 239(29.80) |
| Moderate | 26(4.00) | 37(4.65) | 44(3.99) | 19(5.56) | 25(3.49) | 38(5.22) | 24(3.73) | 39(4.86) |
| Severe | 4(0.62) | 2(0.25) | 3(0.27) | 3(0.88) | 1(0.14) | 5(0.69) | 4(0.62) | 2(2.49) |
| BMI | 177(27.23) | 59(7.42) | 167(15.14) | 69(20.18) | 86(11.99) | 150(20.60) | 112(17.42) | 124(15.46) |
| Overweight | 140(21.54)** | 51(6.42) | 131(11.88) | 60(17.54)* | 75(10.46) | 116(15.93)** | 93(14.46) | 98(12.22) |
| Obesity | 37(5.69)** | 8(1.01) | 36(3.26) | 9(2.63) | 11(1.53) | 34(4.67)** | 19(2.95) | 26(3.24) |
| Anxiety | 78(12.00) | 145(18.24)** | 163(14.78) | 60(17.54) | 99(13.81) | 124(17.03) | 92(14.31) | 131(16.33) |
| Mild | 62(9.54) | 130(16.35) | 145(13.15) | 47(13.74) | 89(12.41) | 103(14.15) | 78(12.13) | 114(14.21) |
| Moderate | 11(1.69) | 12(1.51) | 13(1.18) | 10(2.92) | 8(1.12) | 15(2.06) | 11(1.71) | 12(1.50) |
| Severe | 5(0.77) | 3(0.38) | 5(0.45) | 3(0.88) | 2(0.28) | 6(0.82) | 3(0.47) | 5(0.62) |
| Depression | 417(64.15) | 492(61.89) | 683(61.92) | 226(66.08) | 437(60.95) | 472(64.84) | 387(60.19) | 522(65.09) |
| Mild | 337(51.85) | 389(48.93) | 534(48.41) | 192(56.14) | 340(47.42) | 386(53.02) | 311(48.37) | 415(51.75) |
| Moderate | 79(12.15) | 100(12.58) | 146(13.24) | 33(9.65) | 94((13.11) | 85(11.68) | 75(11.67) | 104(12.97) |
| Severe | 1(0.15) | 3(0.38) | 3(0.27) | 1(0.29) | 3(0.42) | 1(0.14) | 1(0.16) | 3(0.37) |

\* $P < 0.05$.
\*\* $P < 0.01$.

vicious circle.

One recent meta-analysis reported that the pooled prevalence of increased weight in obesity was 52% and the pooled prevalence of symptomatic deterioration in eating disorders was 65% when the time of lockdown in COVID-19 (Sideli et al., 2021). Previous studies also showed that people with insomnia have an increased risk of obesity. Insomnia may activate a central reward circuit in the brain center which makes people more inclined to eat a high-sugar, high-fat diet and increase their food intake (St-Onge, 2017). The loss of stamina in daytime associated with insomnia makes people more inclined to exercise less, resulting in decreased energy expenditure. Both factors are closely related to sleep deprivation and obesity (Patel and Hu, 2008). Nevertheless, this study did not find any correlation between insomnia and body weight in college students. Since the students' eating and exercise conditions were not recorded, the specific reasons need to be further studied. This survey also found that 19.45% students were overweight or obese, with higher rate in male and postgraduates. Compared with medical students, non-medical students might be less prone to overweight and obesity. This may be on account of that medical students pay more attention to their physical health and a balanced diet than non-medical students.

Furthermore, it is worth paying attention that the survey found 62.91% of the 1445 subjects suffering from depression. And depression was positively correlated with anxiety. But unfortunately, no other reason was found for the high rate of depression. It may be related to the factor that universities in Wuhan have strengthened the control of personnel entering and leaving campus in order to prevent the pandemic rebound. Meanwhile, most of our participants came from highly standard universities. The academic competition among them was fierce. Besides, by the end of 2020, there was a certain rebound of the pandemic across China which made students to worry about their health while balancing academic. The above aspects were likely to have an impact on students' physical and mental health.

The survey recorded the origin place of students, however no correlation was found between the place of origin and the above four variables. According to a study, college students from a university in Zhejiang province quarantined at home in February 2020. The study found that students from severely affected areas as Hubei Province slept less during pandemic (JQ and J, 2020).

However, there were also some limitations in our study. This cross-sectional study only reflected the situation at that time, and there was no comparison with the previous (pre-pandemic) situation of Wuhan universities. We also did not conduct parallel comparison with universities in other Chinese cities. Cohort or case-control studies might be more revealing. Furthermore, the questionnaire has included fifty-eight items so we did not collect any information about the causes of insomnia, anxiety and depression of the interviewees.

## 5. Conclusion

To conclude, during the post-pandemic era of COVID-19, college students in Wuhan generally suffered from insomnia and depression. Overweight, obesity and anxiety also accounted for a certain proportion. In addition, insomnia was correlated to anxiety. There were gender differences and grade difference between above variables. It indicated that the sleep education of college students should be strengthened, the weight problem should be paid attention to, and the students with insomnia and anxiety should be given psychological counseling so as to improve sleep disorder and psychosomatic health.

## Financial disclosure

None

## Author statement

We declare that we have participated sufficiently in the research. Furthermore, we take public responsibility for the appropriateness of the experimental design and method, and the collection, analysis, and interpretation of the data. This paper is an original unpublished work and it has not been submitted to any other journal.

## Declaration of Competing Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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