The Impact of Risk Cognitive and Characteristics of Mobile Phone Using on the Sleep Quality of College Students in China during COVID-19

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Research

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Abstract

Objectives: This study aimed to assess the influence of risk cognitive and characteristics of mobile phones using on sleep quality during the COVID-19 epidemic.

Methods: We used the Pittsburgh Sleep Quality Index (PSQI), mobile phone use characteristics and a mobile phone use risk cognitive questionnaire, which was answered by 1207 college students. The data were statistically analyzed with SPSS 21.0 software.

Results: There were significant differences in the general and poor sleep quality groups (p=0.013 and 0.037, respectively) between before and during the COVID-19 period. In the PSQI scores there were significant differences of the participants between before and during COVID-19 period with respect to dimensions other than sleep quality. Generalized linear regression analysis showed that the “pros and cons” (p=0.007) of mobile phone use for the items “How often do you take a break during use time?” (p=0.003), “Will subjectively increase the distance between the screen and the eyes?” (p=0.003), “Daily accumulated use time (hours)” (p=0.003) and “use time before bed with the lights off (hours)” (p<0.001) were significantly correlated with sleep quality.

Conclusions: Risk cognitive and characteristics of mobile phone using influence sleep quality during the COVID-19 epidemic.

Contributions To The Literature

1. **Research has shown that using mobile phone with lights off take more influence than using mobile phone with lights on. For many public, risk cognitive subjective can be more relevant on sleep quality.**
2. **During COVID-19, isolation has caused changes in the way of communicating with the outside world, although mobile phone brought convenience, but the negative impact of mobile phone use on sleep cannot be ignored.**
3. **These findings contribute to recognized gaps in the literature, call on public uses mobile phones correctly and reasonably.**

Introduction

From the outbreak of the coronavirus disease 2019 (COVID-19) [1] epidemic in the central part of China in December 2019 to the end of March 2020, it spread throughout the country, becoming the largest public health incident since the founding of New China [2].

During periods of quarantine, almost everyone stays at home, and the only connection between people and the outside world is the Internet. People obtain external information and communicate with other people using electronic products such as mobile phones, tablets, laptops and computers. Workers and students have started working and learning at home using the Internet. A previous survey showed an average of 27 hours of mobile phone use per person per week in China [3] (China Daily, 2018) and an

average of 4.4 hours per day spent on mobile phones among college students [4] before the outbreak of COVID-19. Ahmad S Haider et al. showed that during the epidemic period, 51.2% of college students used digital tools to study for more than 6 hours [5]. Despite the convenience produced by electronic products and the Internet, the negative effects of using electronic products for a long time cannot be ignored.

Some previous studies have focused on human sleep quality during the COVID-19 epidemic, and the target population of these studies has mostly been frontline medical workers (FMW). Further research has confirmed that FMW experienced sleep symptoms during the COVID-19 epidemic [6–11], and most of these symptoms were related to work pressure, anxiety and other emotions. There are also a small number of studies focusing on human sleep quality in non-frontline medical workers (NFMWs). Shuai Yuan et al. found that during a two-week period, NFMW in Hubei Province became less anxious about the COVID-19 epidemic, but their sleep quality did not improve [12]. The results from Lili Yang et al. showed that under the influence of COVID-19, the sleep status of patients with chronic insomnia was affected by the epidemic [13]. Many previous studies have shown that there is a direct or indirect link between using mobile phones or other electronic products and sleep quality [14–24]. However, the influence of mobile phone characteristics on sleep quality during the COVID-19 epidemic has not been confirmed.

To assess the influence of mobile phone characteristics on sleep quality during the COVID-19 epidemic, the current study used a mobile phone use questionnaire, a mobile phone use risk cognitive questionnaire and the Pittsburgh Sleep Quality Index (PSQI) questionnaire to develop a survey of college students. In addition to the sleep quality of participants, the characteristics of mobile phone use and the pros and cons of mobile phones and the participants' interactions were considered.

Materials & Methods

Participants

A survey was conducted from March 2020 to April 2020. This study was approved by the Ethics Committee of China Medical University and all participants informed consent before fill out the questionnaire. A total of 1207 college students were selected to complete the questionnaires and 3 in all questionnaires missing data are mainly due to incomplete answers to the questionnaire items, for a response rate of 99.67%. Of the participants, 315 were male (26.16%) and 889 were female (73.84%). The ratio of male to female respondents was 1:2.82. Of the participants, 88.46% were of Han nationality, and approximately half of the participants' families had a household income of 1001–5000 yuan.

Questionnaire

The questionnaire used in this study was composed of a demographic survey, a mobile phone use questionnaire, a mobile phone use risk cognitive questionnaire and the Pittsburgh Sleep Quality Index (PSQI) questionnaire. The demographic survey data mainly included personal information (age, gender, nation and family income).

The mobile phone use questionnaire and mobile phone use risk cognitive questionnaire were self-designed. The former mainly included mobile phone use purposes (entertainment, work, information, study, other), posture (sitting, standing, lying down, lying prone), the distance between the eyes and the screen (10 ~ 30 cm, 31 ~ 50 cm, 51 ~ 70 cm and more than 71 cm), daily cumulative use time (0 hours, less than 5 hours, 5 ~ hours, 10 ~ hours, 15 ~ hours), use time before bed (0 hours, less than 1 hour, 1 ~ hour, 2 ~ hours, 3 ~ hours) and use time before bed with the lights on or off (0 hours, less than 0.5 hour, 0.5 ~ hour, 1 ~ hours, 2 ~ hours). The latter mainly included the impact on the human body (ocular, cervical spine, sleep, mental and mental state, others), channel acquisition (book, newspaper, magazine, Internet media, radio, mobile phone, TV, family, friend, doctor), pros and cons (pros = cons, pros□cons, pros□cons), how often breaks were taken during use time (never, rarely, sometimes, often, always), and whether the participant subjectively increased the distance between the screen and their eyes? (never, rarely, sometimes, often, always).

We used the PSQI to assess the sleep quality of the investigated subjects over the previous month, as described in a previous article [25–27]. In this study, a PSQI score ≤ 4 indicates good sleep quality, a PSQI score of 5–7 indicates general sleep quality, and a PSQI score ≥ 8 indicates poor sleep quality (Kim et al., 2000 & Kaneita et al., 2006).

Statistical analysis

Data analysis was performed using SPSS 21.0 statistical software. Count data are expressed as frequencies or percentages, and measurement data are expressed as the mean ± standard deviation (M ± SD). The t-test, chi-square test or Wilcoxon signed rank test was used to test for differences in measurement data. Multivariate analysis of the factors influencing sleep quality was conducted by generalized linear regression analysis. The test level was a = 0.05; that is, $P < 0.05$ was considered statistically significant. The standard for statistically significant differences is $P < 0.05$.

Results

Mobile phone use habits and risk cognition of students

In this study, 100% of the participants used mobile phones frequently. The descending order of mobile phone usage was 95.02% for studying, 93.94% for entertainment, 64.12% for obtaining information, 29.73% for work, and 15.95% for other purposes. Of the respondents, 89.87% and 72.84% used mobile phones in sitting and lying positions, respectively. A total of 62.96% and 33.47% of the participants had a distance between their eyes and the mobile phone screen of 10□30 cm and 31□50 cm, respectively. The descending order of the survey respondents' perceptions of physical damage caused by mobile phone use is ocular (99.34%), cervical spine (95.27%), sleep (86.38%) and mental and mental state (71.26%). More than 50% (84.55%, 82.72%, 61.05% and 51.66%) of the participants obtained information about the hazardous aspects of mobile phone use through mobile phone information, Internet media, reading books and family, respectively (Table S1).

Differences in sleep quality before and during the COVID-19 period

Table 1 shows the distribution and differences in different sleep quality levels of the participants between before and during the COVID-19 period. The descending order of the number of cases and percentage is 736 (61.13%) for good sleep quality, 375 (31.15%) for general sleep quality and 93 (7.72%) for poor sleep quality before the COVID-19 period and 761 (63.21%) for good sleep quality, 307 (25.50%) for general sleep quality and 136 (11.30%) for poor sleep quality during the COVID-19 period. There were significant differences of general sleep quality group (p = 0.013) and the poor sleep quality group (p = 0.037) between before and during the COVID-19 period.

Table 1 Difference of equal PSQI quality of students between before and during COVID-19

Quality of sleep	Period	Number of cases（n）	Percentage (%)	PSQI score (M±SD)	Z	P
Good (PSQI ≤ 4)	Before	736	61.13	2.26 ± 1.31	-1.179	0.239
Good (PSQI ≤ 4)	During	761	63.21	2.18 ± 1.31		
General (5 ≤ PSQI ≤7)	Before	375	31.15	5.93 ± 0.85	-2.484	**0.013**
General (5 ≤ PSQI ≤7)	During	307	25.50	5.76 ± 0.78		
Poor (PSQI ≥ 8)	Before	93	7.72	9.06 ± 1.55	-2.085	**0.037**
Poor (PSQI ≥ 8)	During	136	11.30	9.55 ± 1.90		

Note: PSQI – Pittsburgh Sleep Quality Index; M ± SD – mean ± standard deviation;

Before – before COVID-19 period; During – during COVID-19 period.

As shown in Table 2, there were significant differences in the PSQI scores of the participants between before COVID-19 and during COVID-19 with respect to dimensions other than sleep quality. Sleep efficiency (p = 0.017) and hypnotic drugs (P = 0.045), and the sleep latency, sleep persistence, sleep symptoms and sleep dysfunction between the two groups were statistically significant (P < 0.001).

Table 2 Difference of PSQI factors scores of students between before and during COVID-19

Species	Factor score (M±SD)		*t*	*p*
	Before	During		
Sleep quality	0.73 ± 0.70	0.76 ± 0.74	-1.813	0.070
Sleep latency	0.77 ± 0.70	0.87 ± 0.86	-5.322	**< 0.001**
Sleep persistence	0.43 ± 0.69	0.32 ± 0.64	5.153	**< 0.001**
Sleep efficiency	0.36 ± 0.72	0.31 ± 0.68	2.386	**0.017**
Sleep symptoms	0.62 ± 0.58	0.56 ± 0.59	4.517	**< 0.001**
Hypnotic drugs	0.04 ± 0.28	0.03 ± 0.24	2.002	**0.045**
Diurnal dysfunction	0.97 ± 0.90	1.07 ± 0.95	-5.411	**< 0.001**

Note: PSQI – Pittsburgh Sleep Quality Index; M ± SD – mean ± standard deviation;

Before – before COVID-19 period; During – during COVID-19 period.

Differences in PSQI scores among students before and during the COVID-19 period

As shown in Table 3, 63.95% of the participants stated that the benefits outweighed the disadvantages of mobile phone use; this number was obviously higher than the percentage of the other two groups (18.52% for pros cons group and 17.53% for pros = cons group). The descending percentages were 43.11%, 24.34%, 23.75%, 5.32% and 3.49% of the participants who sometimes, rarely, often, always and never took a break during mobile phone use, respectively. The descending percentages were 37.71%, 31.98%, 17.28%, 8.89% and 4.15% of the participants who sometimes, rarely, often, never and always increased the distance between the screen and their eyes, respectively.

Table 3
Differ of PSQI scores with different mobile phone using risk cognitive between before and during COVID-19

	Number of cases(n)	Percentage (%)	PSQI score (M ± SD)		t	P
Factors			**Before**	**During**		
Pros and cons						
Pros cons	770	63.95	3.83 ± 2.518	3.74 ± 2.779	1.129	0.259
Pros cons	223	18.52	4.28 ± 2.376	4.51 ± 2.785	-1.634	0.104
Pros = cons	211	17.53	3.93 ± 2.744	3.99 ± 2.974	-0.385	0.701
Will I take a break during using time?						
Never	42	3.49	3.79 ± 3.51	4.79 ± 3.854	-3.183	**0.003**
Rarely	293	24.34	4.42 ± 2.515	4.47 ± 2.818	-0.404	0.686
Sometimes	519	43.11	3.95 ± 2.35	4.02 ± 2.725	-0.834	0.405
Often	286	23.75	3.52 ± 2.629	3.28 ± 2.755	2.026	**0.044**
Always	64	5.32	3.45 ± 2.618	3.08 ± 2.503	1.79	0.078
Will subjectively increase the distance between the screen and the eyes?						
Never	107	8.89	4.01 ± 2.967	4.36 ± 3.435	-1.836	0.069
Rarely	385	31.98	4.22 ± 2.429	4.26 ± 2.682	-0.373	0.709
Sometimes	454	37.71	4.05 ± 2.501	4.03 ± 2.862	0.21	0.834
Often	208	17.28	3.37 ± 2.491	3.22 ± 2.572	1.031	0.304
Always	50	4.15	2.82 ± 2.318	2.56 ± 2.331	1.113	0.271

Note: PSQI – Pittsburgh Sleep Quality Index; M ± SD – mean ± standard deviation;

Before – before COVID-19 period; During – during COVID-19 period.

The the groups of never and often of “Will I take a break during using time”? (p = 0.003 and 0.044, respectively) (Table 3). There were significant differences in sleep quality among the three mobile phone using risk cognitive groups both before and during the COVID-19 period. (Table S2).

As shown in Table 4, for daily accumulated use time (hours), the percentages are almost the same for the groups = 0 hours and 5 ~ hours. The ≤5 hours, 10 ~ hours and 15 ~ hours groups were significantly different before and during COVID-19. The percentage of participants before COVID-19 in the ≤5 hours group was 2.33 times higher than during the COVID-19 period. Among the 10 ~ hours and 15 ~ hours groups, the percentages during the COVID-19 period were 2.36 and 2.38 times higher than before the COVID-19 period, respectively.

For use time before bed (hours), among the ≤1 and 1 ~ hour groups, the percentages before COVID-19 were 1.31 and 1.16 times higher than during the COVID-19 period, respectively. Among the = 0, 2 ~ and 3 ~ hours groups, the percentages during the COVID-19 period were 1.79, 1.35 and 1.38 times higher than before the COVID-19 period, respectively.

For use time before bed with the lights on (hours), the percentages are almost the same for the group = 0, ≤0.5 and 1 ~ hour groups. The percentages before COVID-19 were 1.24 times higher than during the COVID-19 period.in the 0.5 ~ hour group. Among the 2 ~ hours group, the percentages during the COVID-19 period was 1.24 times higher than before the COVID-19 period, respectively.

For use time before bed with the lights off (hours), the percentages are almost the same for the group = 0. Among the ≤0.5 and 0.5 ~ hour groups, the percentage before COVID-19 was 1.13 and 1.14 times higher for both compared to the COVID-19 period. Among the 1 ~ and 2 ~ hour groups, the percentages during COVID-19 were 1.13 and 1.24 times higher than before the COVID-19 period, respectively.

There were significantly differences in the sample number of differ groups of four different mobile phone use time between before and during the COVID-19 period (Table S3). The groups with ≤5 and 5 ~ hours of daily accumulated use time (hours) (p = 0.02 and 0.023, respectively), 1 ~ hours of use time before bed (hours) (p = 0.04), and ≤0.5 hours of use time before bed with the lights off (hours) (p = 0.026) differed significantly in the PSQI test scores of the participants before and during the COVID-19 period (Table 4). There were significant differences in sleep quality among the three different mobile phone use time of Use time before bed (hours), Use time before bed with the lights on (hours) and Use time before bed with the lights off (hours) both before and during the COVID-19 period, and the the group of Daily accumulated use time (hours) during the COVID-19 period. (Table S4).

Table 4 Differ of PSQI scores with different mobile phone use time between before and during COVID-19

	Number of cases（n）		Percentage (%)		PSQI score (M ± SD)		Z	P
Factors	Before	During	Before	During	Before	During		
Daily accumulated use time (hours)								
= 0	7	12	0.58	1.00	4.14 ± 2.91	5.42 ± 3.66	-0.641	0.522
≤5	468	201	38.87	16.69	3.70 ± 2.29	3.38 ± 2.63	-2.329	**0.02**
5 ~	562	596	46.68	49.50	3.99 ± 2.59	3.69 ± 2.66	-2.277	**0.023**
10 ~	125	295	10.38	24.50	4.42 ± 3.05	4.31 ± 2.89	-0.238	0.812
15 ~	42	100	3.49	8.31	4.24 ± 2.53	5.13 ± 3.37	-1.108	0.268
Use time before bed (hours)								
= 0	15	27	1.25	2.24	3.27 ± 2.60	3.30 ± 2.18	-0.146	0.884
≤1	234	179	19.44	14.87	3.50 ± 2.47	3.51 ± 2.76	-0.322	0.747
1 ~	608	524	50.50	43.52	3.86 ± 2.45	3.64 ± 2.61	-2.055	**0.04**
2 ~	154	208	12.79	17.28	3.99 ± 2.39	4.04 ± 2.59	-0.119	0.905
3 ~	193	266	16.03	22.09	4.68 ± 2.84	4.76 ± 3.31	-0.378	0.705
Use time before bed with the lights on (hours)								
= 0	42	43	3.49	3.57	3.33 ± 2.52	3.16 ± 2.18	-0.146	0.968
≤0.5	144	133	11.96	11.05	3.84 ± 2.49	3.45 ± 2.52	-1.45	0.147
0.5 ~	374	302	31.06	25.08	3.67 ± 2.47	3.56 ± 2.68	-0.994	0.32
1 ~	353	364	29.32	30.23	4.02 ± 2.40	3.88 ± 2.68	-1.217	0.224
2 ~	291	362	24.17	30.07	4.28 ± 2.77	4.55 ± 3.15	-0.404	0.686
Use time before bed with the lights off (hours)								
= 0	170	185	14.12	15.37	3.26 ± 2.39	3.43 ± 2.63	-0.325	0.745
≤0.5	337	299	27.99	24.83	3.73 ± 2.36	3.4 ± 2.55	-2.23	**0.026**
0.5 ~	339	297	28.16	24.67	3.84 ± 2.44	3.7 ± 2.62	-0.987	0.324
1 ~	188	213	15.61	17.69	4.26 ± 2.47	4.15 ± 2.66	-0.828	0.408
2 ~	170	210	14.12	17.44	4.8 ± 3.00	5.22 ± 3.37	-0.971	0.332

Note: PSQI – Pittsburgh Sleep Quality Index; M ± SD – mean ± standard deviation;

Before – before COVID-19 period; During – during COVID-19 period.

Generalized linear regression analysis of different influencing factors and sleep quality

As shown in Tables 5, with regard to the pros and cons (p = 0.007) of mobile phone use, how often breaks were taken during use time (p = 0.003) and Will subjectively increase the distance between the screen and the eyes? (p = 0.003)were significantly correlated with sleep quality. Pros cons and Pros = cons of mobile phone using risk cognitive was negative factors for sleep quality. More frequent of take breaks during mobile phone use time and subjectively increase the distance between the screen and the eyes were protective factors for sleep quality.

Table 5
Generalized linear regression analysis of different mobile phone using risk cognitive and sleep quality during COVID-19

Factors	B	SE	Wald	df	P	OR (95% CI)
Pros and cons			9.787	2	**0.007**	
Pros □cons[a]						
Pros ▯ cons	0.659	0.211	9.755	1	0.002	1.933(1.278,2.923)
Pros = cons	0.188	0.2148	0.762	1	0.383	1.206(0.792,1.838)
How often take a break during using time?			16.066	4	**0.003**	
Never[a]						
Rarely	-0.256	0.4714	0.295	1	0.587	0.774(0.307,1.95)
Sometimes	-0.615	0.46	1.787	1	0.181	0.541(0.219,1.332)
Often	-1.131	0.4761	5.639	1	0.018	0.323(0.127,0.821)
Always	-1.09	0.577	3.568	1	0.059	0.336(0.109,1.042)
Will subjectively increase the distance between the screen and the eyes?			16.068	4	**0.003**	
Never[a]						
Rarely	-0.028	0.3127	0.008	1	0.929	0.973(0.527,1.795)
Sometimes	-0.123	0.3084	0.158	1	0.691	0.885(0.483,1.619)
Often	-0.763	0.3434	4.937	1	0.026	0.466(0.238,0.914)
Always	-1.292	0.5008	6.653	1	0.010	0.275(0.103,0.733)
Constant	4.668	0.4576	104.074	1	**▯0.001**	106.504(43.438,261.137)
Note: [a]: control group.						

Table 6 have shown that Daily accumulated use time (hours) ($p = 0.003$) and use time before bed with the lights off (hours) ($p < 0.001$) were significantly correlated with sleep quality. The longer the daily accumulated use time and the use time before bed with the lights off, the worse the sleep quality was.

Table 6 Generalized linear regression analysis of different mobile phone use time and sleep quality during COVID-19

Factors	B	SE	Wald	df	P	OR (95% CI)
Daily accumulated use time (hours)			16.061	4	**0.003**	
= 0[a]						
5	-2.268	0.8255	7.545	1	0.006	0.104(0.021,0.522)
5 ~	-2.079	0.8141	6.522	1	0.011	0.125(0.025,0.617)
10 ~	-1.71	0.8237	4.308	1	0.038	0.181(0.036,0.909)
15 ~	-1.271	0.8592	2.187	1	0.139	0.281(0.052,1.512)
Use time before bed (hours)			1.511	4	0.825	
= 0[a]						
1	0.415	0.5955	0.485	1	0.486	1.514(0.471,4.865)
1 ~	0.201	0.5786	0.121	1	0.728	1.223(0.394,3.802)
2 ~	0.251	0.6041	0.172	1	0.678	1.285(0.393,4.199)
3 ~	0.428	0.6112	0.489	1	0.484	1.534(0.463,5.081)
Use time before bed with the lights on (hours)			4.089	4	0.394	
= 0[a]						
0.5	0.623	0.5122	1.477	1	0.224	1.864(0.683,5.086)
0.5 ~	0.712	0.4783	2.219	1	0.136	2.039(0.799,5.206)
1 ~	0.892	0.4756	3.52	1	0.061	2.441(0.961,6.2)
2 ~	0.891	0.4891	3.322	1	0.068	2.439(0.935,6.361)
Use time before bed with the lights off (hours)			30.042	4	**<0.001** 0	
= 0[a]						
0.5	-0.027	0.2619	0.01	1	0.919	0.974(0.583,1.627)
0.5 ~	0.297	0.2621	1.287	1	0.257	1.346(0.805,2.25)
1 ~	0.598	0.2814	4.515	1	0.034	1.818(1.047,3.156)
2 ~	1.41	0.3062	21.192	1	<0.001	4.095(2.247,7.462)
Constant	4.37	0.9107	23.025	1	<0.001	79.029(13.262,470.929)

Note: [a]: control group.

Discussion

During the COVID-19 epidemic, adjusting to life at home during quarantine may have contributed to increasing mobile phone use time. Previous research has shown that there is a direct or indirect link between using mobile phones and other electronic products and sleep quality [14–24]. To study the influence of mobile phone characteristics on sleep quality during the COVID-19 epidemic, this study used the Pittsburgh Sleep Quality Index (PSQI), mobile phone use characteristics and a mobile phones use risk cognitive questionnaire to obtain information on mobile phone use characteristics and sleep quality before and during the COVID-19 epidemic through a questionnaire answered by 1204 college students integrally. Related findings in this study showed that the occurrence of more than 5 hours of daily cumulative mobile phone use time during the COVID-19 epidemic was significantly higher than before the epidemic (Table 4). This result is expected as workers and students have started working and learning at home via the Internet during the COVID-19 epidemic.

Among the respondents, 61.13% and 63.21%, 31.15% and 25.50%, 7.72% and 11.30% had good sleep quality, general sleep quality and poor sleep quality corresponding to before and during the COVID-19 period, respectively. Although there was little difference in the percentage composition of different sleep qualities, there were significant differences in the PSQI for the general sleep quality group ($p = 0.013$) and the poor sleep quality group ($p = 0.037$) before the COVID-19 period and during the COVID-19 period (Table 1). This result suggests that the COVID-19 epidemic has had a greater impact on the general and poor sleep quality groups. There were significant differences in the PSQI scores of the participants before COVID-19 and during COVID-19 with respect to dimensions other than sleep quality. Previous studies have shown that excessive mobile phone use time (including daily accumulated use time and bedtime lights-off use time) may reduce the sleep quality of college students [21], and blue light emitted by smartphone screens can affect the sleep quality of people who use these devices at night through the suppression of melatonin [28, 29]. Therefore, the results of this study might be closely related to cumulative ocular exposure to blue light from mobile phones. On the other hand, it is possible that when people feel that their life is in danger, a series of internal psychological reactions, including cognitive, emotional, and behavioural changes, may occur [30]. It is difficult to adjust to life at home during periods of quarantine, which may have contributed to the deterioration in the mood of students and service personnel [31]. The influence of anxiety and stress on sleep quality has been clearly confirmed [32–38].

Public awareness of the dangers of mobile phone use has a certain control and preventive effect on avoiding the negative effects of mobile phones. Based on the results of the generalized linear regression analysis (Tables 5 and 6), this study shows that the “pros and cons” ($p = 0.007$) of mobile phone use for the items “How often do you take a break during use time?” ($p = 0.003$), “Will subjectively increase the distance between the screen and the eyes?” ($p = 0.003$), “Daily accumulated use time (hours)” ($p = 0.003$) and use time before bed with the lights off (hours) ($p < 0.001$) were significantly correlated with sleep quality. The more agree with the negative effects of mobile phone use, the more frequent of take breaks

and increase the distance between the screen and the eyes during mobile phone use, the shorter the daily accumulated use time and the use time before bed with the lights off, the better the sleep quality was. This study recommends increasing the frequency of breaks from mobile phone use and reducing the use time of mobile phones especially with lights off before bed.

As with all studies, this study has some limitations. This study required the participants to recall sleep quality information from approximately 2 months earlier, which produced a certain degree of bias. There may be other factors, such as anxiety, stress, and fear, that could lead to poor sleep quality in college students, so further cohort studies are needed to clarify the causal relationship. However, the results of this study could be used to enhance public awareness regarding the risk of sleep quality decline caused by mobile phone use and to inform effective professional health education and guidance.

Conclusions

The risk cognition and characteristics of mobile phone use influenced sleep quality between before and during the COVID-19 outbreak.

Abbreviations

COVID-19
Coronavirus disease 2019
FMW
Frontline Medical Workers
NFMWs
Non-Frontline Medical Workers
PSQI
Pittsburgh Sleep Quality Index
M ± SD
Mean ± Standard Deviation

Declarations

Ethics approval and consent to participate

Approval to conduct the study was gained from the China Medical University.

Consent for publication

All our authors have contributed to this project, have read the manuscript, and agreed to submit this paper to this journal.

Availability of data and materials

“Not applicable”

Competing interests

All our authors declare that there are no conflict of interest.

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Authors' contributions

YW X involved in the design of the study, data analysis and interpretation, and wrote the manuscript. J L, Q G, C C, J M, LN F and J L involved in the questionnaire and data analysis. F W led the design and provide funding support of this study.

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