

A cross-sectional study on the effect of bedtime smartphone usage on sleep quality, sleep duration and daytime sleepiness in medical students

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ABSTRACT

Background: Sleep is a physiological phenomenon. It is a condition of unawareness that the body regulates homeostatic. Sleep is essential because it plays a leading role in mental and physical function, removing toxins, preventing diseases, etc. Reduced sleep among young adults is becoming a significant health problem worldwide. Several factors have been shown to lead to poor sleep quality, but the reason smartphone use creates sleep disorders in young adults has attracted great curiosity for a few years. The study aimed to assess sleep quality, duration, and daytime sleep dysfunction among medical students who use their smartphones at bedtime.

Materials and methods: This cross-sectional study included 109 medical students. The data was collected using a pre-validated questionnaire about bedtime mobile phone usage and Pittsburgh sleep quality index (PSQI). The means were calculated, and the association was determined using statistical analysis.

Results: In the study, 60% of participants indicated poor sleep quality was due to prolonged bedtime smartphone usage. The average global PSQI score was 5.4 ± 2.5 .

Conclusion: This study concluded that participants had poor sleep quality measured by PSQI. In addition, prolonged smartphone usage during bedtime was strongly co-related to poor sleep latency.

Introduction

All human beings need good sleep for good health.¹ Sleep is a state of reversible consciousness where the body and mind are renewed, repaired, and evolved. One of the main cornerstones of adolescent development is good sleep.² Electronic gadgets have an undesirable influence on the sleep quality of most children and young adults.³ Due to the revolution in the technology field, most phone users currently possess smartphones that can be used for accessing the internet online, chatting on social networks,

playing games, and watching videos.⁴ Hence in the modern age, the use of smartphones has increased exponentially, especially among young students. The usage of smartphones has become a method of relieving academic stress and mental pressure.⁵ Late-night smartphone usage has become a norm among undergraduate students, leading to interrupted sleep and daytime sleepiness. Studies have revealed that sleep disturbances are hazardous for physical and mental problems, mainly during adolescence.⁶ The decrease in sleep quality is not only associated with health problems but also leads to the poor academic performance of students.⁷ Sleep deprivation among students isn't a new phenomenon. However, it has drawn more clinical and educational interest in the past few years. Many types of research have shown that impaired sleep quality is highly prevalent among medical students compared to students at other universities, which may be inferable to the vast academic load, several hours of clinical

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duties, and lifestyle choices. However, little research has been attempted to detect the presence of any correlation between the usage of smartphones at bedtime and the sleep quality of medical students. Hence this study aimed to study the existing research gap and establish the effect of late-night smartphone use on sleep quality, duration, and daytime sleepiness among medical students

Materials and methods

This cross-sectional study was conducted taking a batch of MBBS students consisting of 150 students from the 3rd year after obtaining the approval of the Institutional Ethical Committee (IEC).

Data collection

Data were collected by convenience sampling technique. All the students were invited to participate in the study. One hundred and nine out of 150 students completed the questionnaire, and the response rate was 72.6%. Informed consent was received from all volunteering participants. No pressure was exerted on the participants. Confidentiality was reassured and maintained. All the data were collected via a questionnaire. The data collected was analysed using SPSS 20. The quantitative variables were reported using the mean and the SD, whereas qualitative variables were reported as frequencies and percentages. Pearson's Chi-Square test was used to determine the associations between the qualitative variables. Group means were compared using ANOVA and t-tests wherever applicable. A *p*-value less than 0.05 was taken to be statistically significant.

Study tools

After obtaining the appropriate informed consent from the participants, an online questionnaire was generated using Google form and distributed to the participants via a WhatsApp group text. This online questionnaire was designed by the authors based on relevant required information extracted from a few previous studies.⁸⁻¹¹ All participants were given ample time to complete the questionnaire and also were allowed to complete it at their homes.

The questionnaire consisted of 4 main sections

1. Purpose of study and reassurance of maintaining the confidentiality
2. Demographic details
3. Smartphone usage
4. Pittsburgh sleep quality index (PSQI)

Pittsburgh sleep quality index (PSQI)

A standardised measure of sleep quality is PSQI.¹² There are 18 questions in the PSQI which has seven rated components. 1) sleep quality, 2) sleep latency, 3) habitual sleep efficiency, 4) sleep duration, 5) use of sleeping medication, 6) sleep disturbances, and 7) daytime dysfunction. Each question is allotted a score between 0 to 3. The scores of all the items are added together to obtain a final score that can range between 0 to 21. If the total score is more significant than equal to 5, it denotes poor sleep quality. If the score is below 5, it is considered good sleep quality.

Bedtime smartphone usage:

The smartphone is "a cell phone with additional software functions (as email or Internet browser)", and bedtime has been defined as "the time at which you usually get into your bed to sleep".^{13,14} All participants were subjected to 5 questions. The first question was whether they use smartphones or not, the second question asked was, did they use them at bedtime and the third question put to them was, how frequently did they use the smartphone during bedtime: one to three times per month, once per week, several times per week, or every day. The fourth question asked to them was the purpose they used it for, such as internet surfing, calling, social networking, text messaging, video games, or watching videos like series, shows, movies, etc. The fifth question put to them was on the amount of time they spent using a smartphone at bedtime, and on the same basis, they were divided into five groups: less than 15 minutes, 15-30 minutes, 30-45 minutes, 45-60 minutes, and more than 60 minutes. During the analysis, for simplicity purposes, the study population was divided into three groups: group A: less than 30 minutes, group B: 30-60 minutes, and group C: more than 60 minutes

Results

Our study obtained results from 109 participants from a batch of 150 medical students. The average age of the study group was 22.14 ± 1.03 years. The age of the participants was between 20 years to 26 years. It was found that more females (57.8%) participated in this study than males (42.2%) (Figure 1). Pittsburgh sleep quality index was calculated for everyone by adding the scores of all seven components. The average global score was 5.4 ± 2.5 . The minimum score received was one, and the maximum score attained was 14. Table 1 indicates that the average PSQI score for both genders, the males had a score of 5.43 ± 2.4 , while the females had a score of 5.38 ± 2.5 , their association remained insignificant (*p*-value: 0.912). Forty individuals reported surfing the web before sleeping, thirty participants reported listening to podcasts, music, or audiobooks, twenty-eight reported texting before sleep, and twelve used their smartphones before sleeping. Ten reported playing video games before going to bed (Figure 2). Number of individuals having good sleep quality (i.e., PSQI score < 5) was 42 (38.5%), and those were having decreased sleep quality (i.e., PSQI score ≥ 5) was 67 (61.5%) (Figure 3). Table 2 depicts PSQI score and its association with its components we found out that there was a significant correlation between people having poor sleep quality and subjective sleep quality (*p*=0.002), sleep latency (*p*=0.000), sleep duration (*p*=0.000), habitual sleep efficiency (*p*=0.000), sleep disturbances (*p*=0.012), and daytime sleep dysfunction (*p*=0.001). However, we found out from our study that poor sleep quality was not related to the use of sleep medication (*p*=0.35). Table 3 shows the association between components of PSQI and duration of smartphone usage at bedtime; it was seen that only sleep latency was associated with increased duration of smartphone usage at bedtime (*p*=0.000). All the other components of PSQI compared with duration of smartphone usage at bedtime was found not to have any relationship, subjective sleep

quality ($p=0.486$), sleep duration ($p=0.614$), habitual sleep efficiency ($p=0.51$), sleep disturbances($p=0.332$), using of sleep medication ($p=0.754$), and daytime dysfunction ($p=0.981$). It was found that the maximum number is sixty-four of them watching videos and browsing social media.

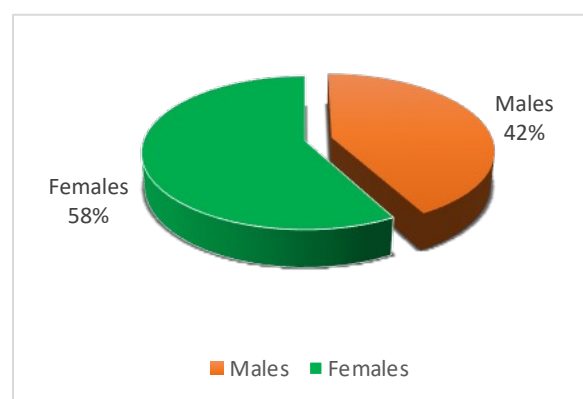


Figure 1 Gender distribution of the participants.

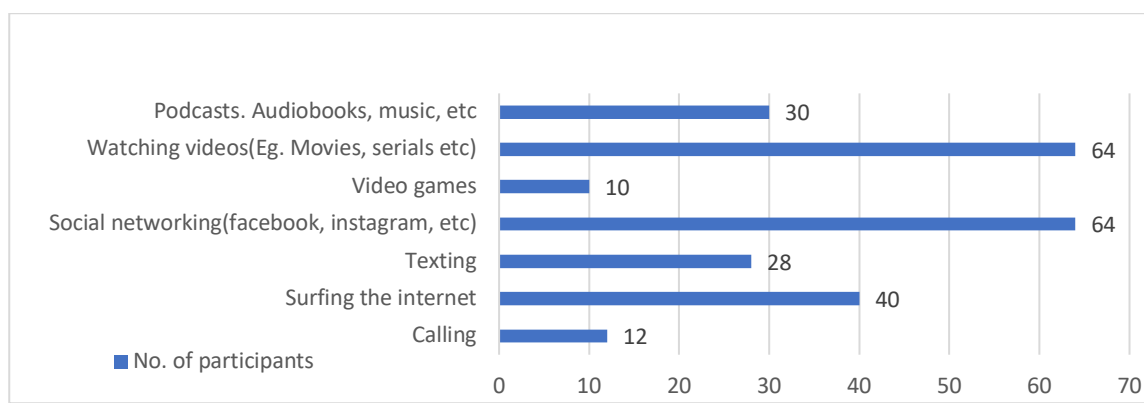


Figure 2 Distribution of participants based on different usage of smartphones at bedtime.

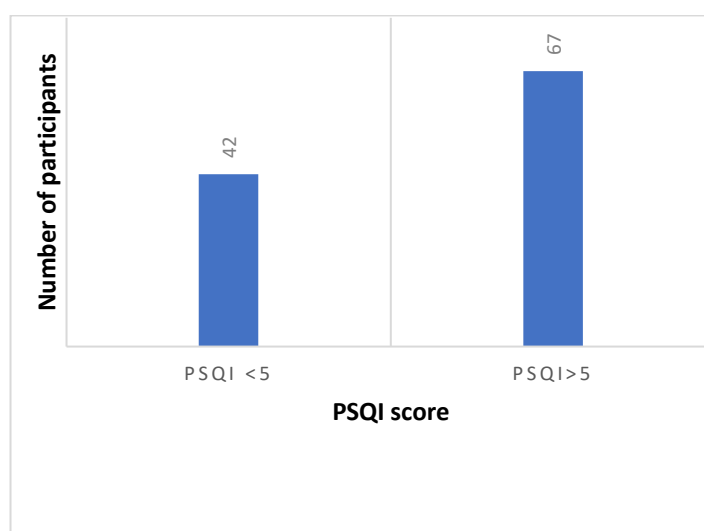


Figure 3 Distribution of participants into good and poor sleep quality based on PSQI Score.

Table 1 PSQI Global score as per gender.

Gender	PSQI Global Score	<i>p</i> *
Males	5.43±2.5	0.912
Females	5.38±2.5	

Note: **p*<0.05 is considered significant using an independent T-test.

Table 2 Association between global PSQI scores and the components of PSQI.

Components of PSQI	Classification	PSQI Score		<i>p</i>
		<5	≥5	
Subjective sleep quality	Very good	17	8	0.002*
	Fairly good	24	53	
	Fairly bad	1	6	
	Very bad	0	0	
Sleep latency	No problem at all	15	8	0.000*
	Only a very slight problem	24	29	
	Somewhat of a problem	2	22	
	A very big problem	1	8	
Sleep duration	No problem at all	26	11	0.000*
	Only a very slight problem	11	22	
	Somewhat of a problem	5	24	
	A very big problem	0	10	
Habitual sleep efficiency	No problem at all	42	42	0.000*
	Only a very slight problem	0	15	
	Somewhat of a problem	0	8	
	A very big problem	0	2	
Sleep disturbances	No problem at all	7	9	0.012*
	Only a very slight problem	35	43	
	Somewhat of a problem	0	13	
	A very big problem	0	2	
Use of sleep medication	No problem at all	42	62	0.35
	Only a very slight problem	0	1	
	Somewhat of a problem	0	2	
	A very big problem	0	2	
Daytime dysfunction	No problem at all	26	22	0.001*
	Only a very slight problem	16	28	
	Somewhat of a problem	0	14	
	A very big problem	0	3	

Note: *p*<0.05 is considered significant, * significant value set at 0.05 using chi-square test.

Table 3 Association between components of PSQI and duration of smartphone usage before sleep (n=109).

Bedtime smartphone usage		Group A	Group B	Group C	p*
PSQI Components					
Subjective sleep quality	Very good	13	9	2	0.486
	Fairly Good	39	29	3	
	Fairly bad	2	5	9	
	Very bad	0	0	0	
	Total	52	38	14	
Sleep latency	<15 min	15	5	3	0.000*
	15-30 min	33	15	5	
	31-60 min	4	19	1	
	>60 min	2	4	3	
	Total	54	43	12	
Sleep duration	>7 hr	15	16	6	0.614
	6-7 hr	19	12	2	
	5-6 hr	16	11	2	
	<5 hr	4	4	2	
	Total	54	43	12	
Habitual sleep efficiency	>85%	44	29	11	0.51
	74-84%	6	9	0	
	65-74%	3	4	1	
	<65%	1	1	0	
	Total	54	43	12	
Sleep disturbances	No problem at all	10	5	1	0.332
	Only a very slight problem	37	31	10	
	Somewhat of a problem	7	6	0	
	A very big problem	0	1	1	
	Total	54	43	12	
Use of sleep medication	No problem at all	50	42	12	0.754
	Only a very slight problem	1	0	0	
	Somewhat of a problem	1	1	0	
	A very big problem	2	0	0	
	Total	54	43	12	
Daytime dysfunction	No problem at all	23	20	5	0.981
	Only a very slight problem	23	16	5	
	Somewhat of a problem	6	6	2	
	A very big problem	2	1	0	
	Total	54	43	12	

Note: *Significant value set at 0.05 using chi-square test.

Discussion

Our study found that all medical students owned a smartphone, and nearly 98 (90%) of them use their smartphones at bedtime for various activities. Of the 98 participants who used their smartphones at bedtime, 60 (61.2%) had poor sleep quality. The sleep quality of all the participants was determined using the PSQI questionnaire, from which we found that 67 (61.5%) had poor sleep quality. We found that there was no significant relationship between quality of sleep and gender. Our finding was consistent with a Moroccan study which revealed that there were no gender differences between male and female medical students concerning poor quality of sleep.¹⁵ Fobian et al. told that using media at bedtime and remaining awakened by the use of smartphone were related to lowering of the efficiency of sleep in adolescents.¹⁶ Lemola *et al.* found a correlation between using electronic media during the night and sleep disturbance and concluded it to be a potential mediator for depressive symptoms.¹⁷ Similar cross-sectional study taking 3,139 adolescents from America revealed that smartphone use at bedtime was related to sleeplessness and daytime sleepiness.¹⁸ Our study confirmed that the prolonged usage of smartphones at bedtime was associated with poor sleep quality, daytime dysfunction, and prolonged sleep latency. Further research must be done to ascertain the causal relationship between poor sleep quality and smartphone usage. Few recently conducted studies have concluded that mobile phone screens emitted blue light, which is the main factor responsible for the poor sleep quality in people using mobile phones late at night. Mostly the screens of mobile phone release blue light of wavelengths ranging from 400-495 nm, which is capable of causing a phase-shifting in the circadian rhythm of humans or hampering the biological clock by reducing melatonin production.^{19,20} Decrease in melatonin levels has further been responsible for increased sleep latency and disturbances.²¹ Further, prolonged exposure to blue light enhances the alertness of our brain, and the cognitive functions are stimulated, resulting in poor sleep quality.^{22, 23} The findings of our study also supported the facts mentioned above. As per our observation, the participants who used their smartphones for 30 minutes or more after getting into bed had prolonged sleep latency, reduced sleep duration, and daytime dysfunction. Additionally, the effects of blue light on the mobile phone screen while using the mobile phone before bedtime for searching the web, playing video games, watching Facebook for a prolonged period, or reading a negative email, may also lead to hyperexcitability both physical and mental, contributing to hyperarousal condition and poor sleep quality.^{24,25} Some studies have indicated that putting a smartphone near or under the pillow during sleep can cause prolonged latency of sleep, sleep disturbances, and daytime sleep dysfunction. The factors that contribute to these effects may be attributed to an irresistible desire to go through notifications received and the updates being displayed on the mobile phone, disturbances that are produced by the vibrating phone while receiving new notifications and recent messages, the heat produced by charging phones, and RF-EMF (radiofrequency and electromagnetic fields) exposure from the smartphone.²⁵ The reasons mentioned

above are suspected to be the underlying cause of sleep problems like excessive daytime sleepiness, sleep disturbances, and increased sleep latency, observed in our study participants. Our study confirmed that prolonged usage of smartphones at bedtime was strongly associated with poor sleep quality, daytime dysfunction, and prolonged sleep latency. Further research must be done to ascertain the causal relationship between poor sleep quality and smartphone usage.

Conclusion

From this study, we conclude the following points. We observed a significant association between prolonged (>60 minutes) bedtime smartphone usage and the sleep latency component of the PSQI (p -value=0). Most medical students (61.5%) had poor sleep quality (i.e. PSQI score ≥ 5). Lastly, there was no significant relationship between sleep duration and daytime sleepiness, but there was a significant correlation between poor sleep quality and all the components of PSQI. Therefore, the main implication of this study is that, through this study, the authors urge young adults to restrict the use of smartphones during bedtime, thereby preventing subsequent health hazards.

The limitations of this study were the short duration of two months and a smaller number of participants consisting of MBBS students of a single batch. Further research can be done by taking a more significant number of participants in multicentred studies to assess the sleep quality among medical students.

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Conflicts of interest

Nil.

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